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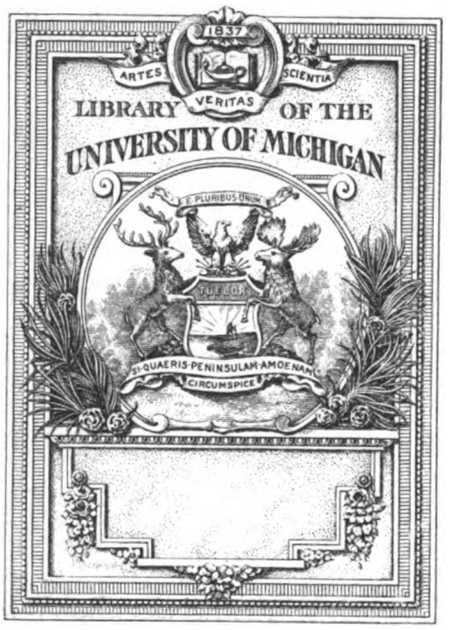

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THE

ELECTRICAL REVIEW.

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A SUB-DEPARTMENT OF STATE.

THE members of the deputation from the Eastern and Eastern Extension Telegraph Companies which, on Thursday last week, waited on the Chancellor of the Exchequer and the Secretary of State for the Colonies, must have left the Treasury at the conclusion of the interview sadder and wiser men. The object of this deputation was to point out to the Government the unrighteousness of interference with the very profitable monopoly which has so long been peacefully enjoyed by the Eastern group of companies and their allies. It is indeed hard to be "wounded in the house of a friend," and a touching reference was made by the Marquis of Tweeddale (the chairman of both companies) to the fact that the companies had done the State some service, on several critical occasions, and that hitherto the cable companies represented had been treated by Her Majesty's Government very much as if they were a sub-department in the administration of the affairs of the Empire. To a great extent this doubtless has been the case, and the position, so profitable to the interests of the companies thus favoured, has been maintained by extremely judicious management in this connection. It must be, therefore, doubly disappointing to find the claims of an old friendship so coldly received. As regards the services afforded the State by the companies on critical occasions, we may rest quite content in the knowledge that the companies have been repaid for them, both in meal and in malt, and Mr. Chamberlain, in his remarks, while cordially recognising the general excellence of the services rendered, said that he had observed that hardly any critical situation arose at the Cape, but one or more of the cables were broken down!

Among other things, Lord Tweeddale denied the imputation that the allied companies were either monopolists, or that they charged exorbitant rates. Mr. Chamberlain, however, pointed out that instead of applying their very large earnings to the reduction of rates, the amount which might have been so used was devoted to strengthening their monopoly, which although not a statutory monopoly, is none the less a practical one. It is only owing to the rejection of the proposals which the Eastern group of companies made to the Chancellor of the Exchequer two years ago that the Government are now free to unite with the Colonies in the establishment of the Pacific cable. In March, 1897, the companies were applying not only for various subsidies but also for "an undertaking by the Governments concerned, that for a fixed period, they will not subsidise any opposition line connecting any of the places served at present by the associated companies." Had this proposition been agreed to, the competition of even a State guaranteed Pacific line would have been impossible. Instead of reducing the rates, these companies have spent very large sums out of revenue in renewals and extensions

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of their cables. The Eastern Extension Company alone has paid away £1,500,000 for repairs and renewals, and the reserve funds of the Eastern and Eastern Extension Companies now stand at £2,137,000, at the lowest computation. It is a striking exhibition of the irony of events to find these companies gravely lecturing the Government on the wickedness of assisting the Pacific cable financially, or by guarantee, while they themselves, when recently advocating an "all-British" cable, *viâ* the Cape to Australia, and with a branch to Ceylon, asked for Government assistance amounting to £101,400 annually, besides a Government capital expenditure of about £50,000 for an English land-line. This scheme having collapsed, these companies are, as pointed out by Sir M. Hicks-Beach, now asking for £20,000 per annum towards another cable to South Africa.

The inefficient service to the Cape undoubtedly calls for such a cable, which, however, might well be laid without Government assistance out of the very large profits which have resulted from the existing cables to Cape Colony, which are already heavily subsidised. The amount of these profits may be guessed at, when we are told that, although the late Sir John Pender considered a gross annual receipt of £180,000, in respect of the traffic circulating by the eastern and western routes to the Cape, a fairly paying revenue, this amount, in the year 1896, was exceeded by £120,000. Besides the claim mentioned by the Chancellor of the Exchequer, the Eastern group, in the very deputation under consideration, ask the Government for a guarantee for their proposed British Imperial Telegraph Company. This group, including other companies in which they themselves are largely interested, has received in subsidies and from guarantees a total sum very largely exceeding £3,000,000, the greater portion of which has been paid to them by the Governments of England, Cape Colony, and Australasia. This assistance obviously places these associates above the risk of competition from any other unaided source, and it is owing to this position that their practical monopoly has been established and gradually extended in its scope. As regards the manner in which the companies deal with the rates, these, as Mr. Chamberlain pointed out, are the subject of very great and justifiable complaint. We know that in the case of Australia the rate was reduced from 9s. 4d. to 4s. 9d. per word, only under the pressure due to the impending rivalry of the Pacific cable scheme. We also know that the reduction was only agreed to after the Australian Colonies had promised to share in the financial loss which might arise. We pointed out last week that in the case of Indian rates, to which attention was recently called in Parliament, these companies do nothing to meet public convenience, although very well able to do so, for we gather from figures provided by the Marquis of Tweeddale, that on a message in transit from Australia to England only 1s. 4½d. per word is charged for carriage from Bombay to London, while for an Indian message the exorbitant rate of 4s. per word is charged for transmission between the same two places, although it requires only the same amount of attention. We submit that it is much more to the advantage of the English public that the excess profits of the Eastern Company should be applied to the reduction of such high rates, than to laying cables from Emden to the Azores for the benefit of Germany, and in doing unproductive work in foreign waters.

As regards the attitude of general benevolence claimed for these companies, the suggestions which we have here made might seem to be out of place were they not called for by the claims which these companies profess to have on public gratitude. We cannot find that this assumption of benevolence is at all borne out by the past history of the relations between the complaining companies and the Colonial Governments. When in February, 1886, the subsidy paid to the Eastern Extension Company by the New Zealand Government expired, and the latter hesitated to renew what they considered to be an unnecessary subsidy, the company in question, while professing willingness to give a tariff of 5s. per 10 words from New Zealand to Australia if the subsidy was continued, threatened to raise the rate to 10s. per 10 words, and 1s. for every extra word should the subsidy not be forthcoming. This, Sir Julius Vogel, for New Zealand, refused to assent to, on the grounds that the renewal of subsidy would tend to perpetuate monopoly and prevent the laying of a new line. The rates were accordingly raised and maintained until an agreement was arrived at. In the case of Queensland, which Colony for many years declined to join the remainder of Australia in paying subsidies to these companies, the rate from London to Queensland was kept at 9s. 5d. per word; although telegrams to the neighbouring Colony of New South Wales only cost 4s. 11d. per word. When, however, on July 1st, 1897, Queensland consented to join the other Colonies in assisting the companies, the rate to Queensland was at once reduced to 5s. 1d.

With all the above information before us, we can only conclude that, however much these companies may strive to obscure the issue, this cable combination can only be described as a carefully constructed and very profitable monopoly, the success of which has hitherto been due to extremely conservative management and to the absence of healthy competition.

Fire-Resisting Material.—A novel fire-resisting material is described in the *Times*. This is known as Rous's, and is said to consist of hay chaff mixed with lime, alum, tungstate of soda, and other salts of alkaline earths. It is claimed to possess a very low specific gravity, and to be adherent to iron and capable of ordinary use as plaster. Probably the porosity due to the chaff renders it a poor conductor of heat, while the resistant properties of plaster remain. The alum and soda salts no doubt produce toughness. Alum has a well-known hardening effect on both carbonate and sulphate of lime, and is used for this purpose in Keene's and other cements. Experiments are described which seem to show that the new material has considerable protective effects on timber. Would it not be desirable to try the material upon wrought-iron and cast-iron columns in a fierce fire, with heavy compressive stresses on the columns? These are the materials which are used for columns, and it is the failure of columns and beams when hot which destroys fireproof buildings. Rather softer than Keene's cements, this and other cements are recommended as a coating upon Rous's, which is stated to be effective in preventing the passage of heat through coke breeze concrete floors; these are stated by Mr. Rous to be good floors, but permeable to heat. It is also advised as a material for covering boilers and steam pipes, for which purpose it is cheaper than many substances now employed for the purpose. It is suggested that the material would form excellent linings on steam ships, to prevent the passage of heat from galleys and other working places to other parts. One cwt. of Rous's composition will cover 30 square feet to a thickness of ¾ inch, and the material will cost about 18s. per cwt., or at the rate of nearly 6d. per square foot, apart from labour, which does not appear to us to be so very cheap.

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ELECTRIC TRAMWAYS IN LONDON.

One of the most extensive, and at the same time interesting schemes of electric tramways in London, is that projected by the London United Tramways Company. Many of our readers may remember that some months ago we set forth the various lines owned and controlled by this company, as well as the extensions and changes which were proposed. The ambitious nature of the proposals will be shown from the fact that if Parliamentary and local sanction is obtained, the tramways will comprise one vast system amounting to over 39 miles of road line, and 75 miles of track. There are already either working or under construction some 27 miles of route, and the remaining 13½ miles are being promoted at the present moment. Mr. J. Clifton Robinson, the well-known managing director of the London United Tramways, quite recently gave some interesting details of the electric system which will be employed on the West London lines; and it will be useful to refer to the principal features of the scheme. It is interesting to mention, as showing the advantage of a vigorous policy in all tramway matters, that in 1894 the system of tramways, some 8 miles in length, was known as the West Metropolitan Tramways; the company owning these lines had fallen upon evil days, and in the year mentioned the concern was practically in a bankrupt condition. It was taken in hand by a small syndicate composed of experienced directors of tramways, among whom were Mr. Clifton Robinson and Mr. George White, both of whom had acquired distinction in connection with Bristol tramways, and the extensive systems owned by the Imperial Tramways Company. Even as a horse tramway, the West Metropolitan system was completely re-organised, but the aim of the directors, and one which was never lost sight of, was to convert the whole system into electric tramways. The battle which has been fought in West London, in the cause of electric traction, is one familiar to most of us; and in fighting the vested interests of property owners, and the more or less public rights of the district councils, magnificent service has been rendered to the cause of electricity. When the lines were first acquired by the syndicate alluded to, it was re-named the London United Tramways Company, and at the commencement of the operations there were four lines. One from Hammersmith through Chiswick to Kew Bridge, which was 3 miles and 3 furlongs in length; the second from Shepherd's Bush to Acton, 2 miles and 5 furlongs in length; the third a junction line on the Goldhawk Road, connecting the two before-mentioned lines together, 1 mile and 4 furlongs in length; the fourth from Kew Bridge to Richmond, 1 mile and 5 furlongs in length, the whole system compriaing a little over 9 miles in length. In seeking powers to convert these lines for electrical working the company sought at the same time to strike out into new directions. They sought powers to construct electric lines from Kew Bridge to Brentford and Hounslow, which was to be 3 miles and 5 furlongs in length; another line from Acton through Ealing and Hounslow, which was to be 2 miles and 7 furlongs in length; and a third line from Brentford northwards to connect up with Hounslow, which was to be 2 miles and 3 furlongs in length. It is sufficient to indicate the soundness of the scheme when it is mentioned that Parliament looked so favourably upon the project as to grant the necessary powers with the solitary exception of the Ealing connecting line, and that was refused merely because the District Council withheld their consent. These lines were not sufficient to exhaust the demands of the London United Tramways Company, for permission was sought and obtained from the Light Railway Commissioners to construct an electric trolley line extending from the terminus at Hanwell through Southall, Hayes, Hillingdon, and Uxbridge, a distance of some 7 miles. It was to some extent unfortunate for the company that some portion of their system lay within the jurisdiction of the London County Council, and we need hardly say that until recent times this august body has been strenuously opposing the overhead trolley system, but the opposition of the County Council only spurred the London United Tramways to fresh efforts, and by Parliamentary consent and an important light railway order they were at last able to wring permission from the County Council to convert this small portion of the tramways which entered the area governed by the County Council. It was not, however, a complete victory, for the County Council insisted that some portion of the line should be laid down as a conduit line, practically for the purpose of providing the County Council with information as to the working of this particular system of electric traction. The system when completed will provide more than an interesting example of the conduit line through a populous district, for the electrical arrangements of the trolley line itself will be unique as far as this country is concerned. It will be remembered that Prof. Rücker and other eminent scientific men offered some opposition to the West London Tramway's scheme, on the grounds that they might interfere with the very important work carried on at the Kew Observatory. It is to the credit of the promoters of the West London Tramway's scheme that they recognised the claims of the Kew authorities to be protected against the influence of earth currents, and they propose to meet the necessities of the case by boldly adopting a double trolley system throughout, and so avoiding the necessity of using the rails as a return. Obviously a double trolley system means not only considerable increase in the use of copper, but, moreover, gives some little inconvenience in that each car is compelled to use two trolley poles instead of one. At the same time, where excessive speed is not required, care in handling the cars will minimise any little inconvenience arising from this cause. It is hardly necessary to say that double trolley systems are rare; at Cincinnati a double trolley system has been used in order to avoid as far as possible any interference with the telephone circuits. While on this subject it may be interesting to quote Mr. Philip Dawson, who in his work on "Electric Railways and Tramways," says of the Cincinnati lines that "the principal difficulties encountered were in preventing short circuits at the crossing of positive and negative wires. At turn-outs a second set of wires have been provided for one track, and the conductors on entering some of the curves have to transfer the trolley poles to a different set of wires. The cars pass the dead points in the branches by momentum, the current being carried past these points by insulating cables above the frogs. This system works satisfactorily, but it necessitates an enormous and most objectionable increase in the number of aerial wires. It also seems impossible to insulate the line properly. If one of the trolleys be taken off the line and connected to the rails, sufficient current would flow to light up all the lamps in the car, although not sufficient to move the car."

The many difficulties enumerated in the foregoing remarks are not likely to be experienced on the London United system, for though there will be practically throughout the system two tracks, which will necessitate four overhead wires, they will be connected up on the three-wire system. The two central wires will form the neutral, and the outside wires the positive and negative side. The neutral wire will be grounded at the station and at this point only. The three-wire system has been, of course, employed with considerable success in the United States, more particularly in Bangor, Me., St. Louis, and other places; and as far as one can learn, the balancing of these systems has been generally achieved without much trouble.

There is one distinct advantage gained by operating electric tramways on the three-wire system; that is, that as the motors are entirely independent of a good earth connection, the system can be employed in a better operating condition through the winter. Turning now to some of the electrical details which are adumbrated in Mr. Robinson's paper*, we find that the main generating station is at the present car depôt of the company in Chiswick. At this point considerable ground space is at the disposal of the company, and it is assumed that the present accommodation necessary for horses will give ample car storage and space for a large power house containing engines capable of developing 5,000 H.P. The building was designed to be a one-storey one, 154 feet long and 106 feet wide. It will be divided into an engine and boiler room, and the most modern arrangements are to be adopted both in the steam raising and electrical sections of the power house. Following the practice introduced of late years from America, the chimney shaft is to be built up of steel plates, lap-welded and riveted, tapering upwards, and finished with an ornamental cap. It is designed to be self-supporting, and is to be lined inside with fireproof

* Paper read before the Cleveland Institution of Engineers.

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bricks. A similar type of smoke stack has been adopted at the new power house, which is being erected by the Dublin United Tramways Company. The first equipment of the boiler room will be eight horizontal water-tube boilers, which will develop steam at a pressure of 160 lbs., each boiler having a capacity of evaporating 8,250 lbs. of water per hour. Mechanical stokers will be adopted, the coal being fed into the stokers from bunkers located above the boilers. Between the coal store and the stokers will be placed weighing hoppers, which will record the amount of coal passed through to the furnaces, a similar system to that which we recently noted in use at the Bankside works of the City of London Electric Lighting Company.

In an important power house of this character it always pays to adopt elaborate arrangements for dealing with the fuel. It is proposed to carry coal from the ground level outside the building to the coal bunkers above the boilers by a gravity bucket type of conveyer, which is reported to have a capacity of handling 40 tons of fuel per hour. This conveyer will also be employed for removing ashes, dumping them into a special ashbin through which they can be rapidly removed. Another feature of interest in connection with the coal supply is a coal store of 2,000 tons capacity, which will be erected near the boiler room. The coal will be taken direct to these stores, from the North and South-Western coal depôt some 700 feet distant from the boiler room by means of a gravity bucket conveyer. Alongside the coal siding, and entirely below the surface, will be placed a receiving hopper with the necessary apparatus for the delivery of coal to the conveyer, thus enabling coal to be handled automatically direct from the railway trucks and to and from the company's coal stores and to the stoker hoppers.

The auxiliary plant possesses some interesting features. Two water towers are to be provided for cooling the condensing water, and these will be somewhat similar to those which we illustrated when describing the Barcelona tramways. They are of the twin type, arranged in two sections, having a capacity to deal with plant of 4,000 H.P.; the dimensions of the towers are 40 feet × 15 feet, and 38 feet high. The mats composing the cooling surface will be of galvanised iron wire netting. For each section of the tower there will be provided two air propellers, driven by electric motors.

Obviously the most notable features are in the power house, where the generating plant will consist of three-phase and continuous current generators. The latter will predominate, the three-phase machinery being utilised for supplying electricity to the extreme end of the system. The engines are to be of the vertical type, which, in itself, is somewhat of a departure from what we have been accustomed to in some of the later traction systems. They will be cross-compound condensing, and four of them will each develop 750 H.P. These will run at 90 revolutions, and will have cylinders 22 inches, 44 inches, and 42 stroke. Three of them will each drive two continuous current generators, while the fourth engine will run at 94 revolutions, and be direct coupled to a 500-kw. three-phase 5,000-volt generator, having a frequency of 25. The lighting necessary for the works will be provided by two 75-kw. 500-volt generators, each direct coupled to a two-crank tandem compound engine. A useful plant will be a motor generator set, consisting of one three-phase synchronous motor, having a capacity of 500 kw. at 5,000 volts; this will be direct connected to two 250-kw. 500-volt generators. The function of this plant will be to convert from direct to alternating or *vice versâ*, and will be of considerable use at times of light load, and will, moreover, serve as a spare generating unit. The switching arrangements will be, in many respects, similar to those in use on the Middlesbrough and Stockton lines*.

Near the extreme end of the system the three-phase current will be converted by means of four rotary converters. The sub-station is to be fed by duplicate three-core lead-covered paper cables, the current being transmitted at 5,000 volts. Air blast static transformers to the number of seven will be located here, and will transform down from 5,000 volts to 350. The rotary converters will each have a capacity of 200 kw., and are to be of the six-pole type running at 500 revolutions and delivering current into the line at 550 volts. These machines are also intended to act as balancers on the two sides of the system.

The rolling stock will be chiefly notable for the use of eight-wheel bogie cars, that type of car being the one so successfully used on the Middlesbrough lines.

* Electrical Review, August 12th, 1898.

THE REPORT OF THE PACIFIC CABLE COMMITTEE.

(*Continued from Vol. 44, page* 1054.)

Admiral Wharton, in speaking of the Fanning Island-Fiji section, pointed out that there were no soundings along two-thirds of this portion, and estimated an average depth of 2,700 fathoms varied by possible deep holes and rises in the bottom; which he characterised as very irregular. Since this evidence was given the route has been surveyed by the Hydrographical Department, and, with the exception of some inequalities in the vicinity of the Fiji Islands, the bottom has been found to be quite regular with an average depth of about 2,800 fathoms. Admiral Wharton also refers to the volcanic nature of this region, and points out that along the line from Fanning Island to the Phœnix Island group (one of which is the Canton Island of the route mentioned by Sir W. H. Preece) there are "a very large number of shallow banks, and also a depth as great as 3,400 fathoms."

The Hydrographer also points out that owing to the extreme steepness of the slope of the Phœnix Islands he doubted very much whether the cable could be laid there without a great deal of expense; this evidence bears strongly against the selection of Canton Island as a landing place. As regards the steepness of the slope of the islands along the selected route, the only one regarding which such a question arises is Fanning Island, and which has not yet been surveyed; but it should be borne in mind that experience of this class of landing place is by no means of rare occurrence in cable-laying. Bermuda, Turk's Island, Porto Rico, St. Jago de Cuba and St. Thomas, are all instances of very steep slopes in the Atlantic, some of them being coral fringed, and the cables landed on these islands have given no exceptional trouble. Mauritius is another instance. Excepting on the Fanning Island-Fiji section, Admiral Wharton's opinion of the selected route, although advanced with some caution, may be summarised as not at all unfavourable as far as the depth and the nature of the bottom is concerned. It is perhaps hardly worth while referring to the opinion expressed by Mr. Hesse, that all that portion of the route between Vancouver and Fanning Island is highly volcanic, as this opinion is neither supported by any known facts, nor does general knowledge of this zone in any way bear out such an assertion. We have gone into these points in some detail as they are all of importance in considering the route to be preferred. One of the advantages of a cable laid along the route chosen, is that the cable would land in the heart of the business district of Australia, thus avoiding the long land-lines which are a necessary adjunct to the present cable service and are a source of weakness. In going over the evidence relating to this portion of the subject, we have been much struck by the difference in the measurement of distance between similar landing places as given by the various witnesses, but on this, as on other points of the division of the report we are now considering, we are quite in agreement with the report as expressed by the Committee.

III.—What will be the Cost (*a*) of Laying, (*b*) of Maintaining the Cable, and (*c*) of the Annual Working Expenses?

(*a*) In regard to this subject we will limit ourselves simply to the only route which has met with acceptance, viz., that which runs from Vancouver to Fiji, touching at Fanning Island, and continuing on from Fiji to Norfolk Island, whence it bifurcates to New Zealand and to Australia. The tenders put in at Ottawa in reply to the invitation of the Canadian Government, which had been entrusted with this work by the members of the Colonial Conference held in Ottawa in June, 1894, were as follows:—

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The India-Rubber, Gutta-Percha, and Telegraph Works Company	£1,517,000
W. T. Henley's Telegraph Works Company ...	1,826,000
Siemens Bros. & Co.	2,170,000
Fowler-Waring Cable Co.	2,350,000

These tenders are based on the general conditions prescribed; they include in each case the manufacture and laying of cables, which shall have for each section a calculated speed of not less than 12 words per minute, the providing of station buildings and instruments for the use of the staff, likewise the maintenance and repair of the entire length of the line for a period of three years after the whole line shall have been completed and put in operation. The condition being, that the cables are to be owned and controlled by Government, and to be worked under Government authority. Besides these tenders, a letter was received from the late Sir John Pender discouraging the project, and pointing out that a cable laid as intended would be quite useless, and would prove a commercial failure; but the writer wound up by stating that, if offered sufficient inducements, his company (the Eastern Extension Telegraph Company) could "undertake the work on better terms than could be offered by any other company." The chairman of the Telegraph Construction and Maintenance Company, after raising objections to each of the eight alternative routes for which tenders were asked by the Canadian Government, proposes a new route from Vancouver, taking in Honolulu and Samoa, and going to New Zealand only; trusting to the existing cables (the property of the Eastern Extension Company) for the communication between New Zealand and Australia. This cable he offered to lay for £1,870,000, which, however, does not include maintenance for three years, nor, indeed, for any period. The route here proposed would make the Pacific cable to a great extent a feeder for the system of the Eastern Extension Telegraph Company, who charge 3s. per message of 10 words, with 5d. for each additional word between New Zealand and Australia. Sir W. H. Preece gave the estimated cost of the cable which he had "sketched out" to meet the specification as £2,924,000; adding to this £159,900, the estimated cost of a cable from New Zealand to Australia, omitted in the above, and, also to make it comparable with the tenders, adding £180,000, the minimum amount estimated by Sir W. H. Preece to cover maintenance for three years, we have a total of £3,264,000. The extraordinary total of this estimate is mainly due, to those responsible for it, having in the case of the Vancouver Island-Fanning Island section taken too great an overground distance; to this excessive distance 20 per cent. of slack has been added, and on the erroneous length so obtained it has, for some obscure reason, seemed fitting to those who "sketched out" this estimate, to adopt a core weighing 940 lbs. of copper and 940 lbs. of gutta-percha per knot—a distribution of material inexcusable on either practical or economical grounds. In explaining away this estimate before the Committee, Sir W. H. Preece pointed out that for the sheathing, steel wire costing £45 per ton had been adopted in this estimate (dated 1893), whereas steel of strength and quality amply sufficient for the purpose could be got for £12 per ton (in 1896), which item alone meant a reduction of £400,000 or £500,000 on this Post Office estimate!

In relation to the core, a diminution to 750 lbs. of copper and 600 lbs. of gutta-percha is suggested, and so the "revised" Post Office estimate of cost is arrived at, as being not much over £2,000,000. Even this revision is a very different story from that given in Mr. J. C. Lamb's letter of July 5th, 1893, which, as coming from the technical advisers of Her Majesty's Government, was circulated among the Colonial Governments by the Colonial Office, and thus three months after it was written, it turned up at the Antipodes in time to act as a damper on the mission of the delegates sent by the Canadian Government to Australia, to try to come to an arrangement with the Australasian Governments concerning the Pacific cable, among other things.

The representatives of the Eastern Extension Telegraph Company estimated the cost of laying a cable along the selected route at "something like £1,650,000" for the making and laying of the cable, erecting the stations, and supplying apparatus, but exclusive of maintenance. Mr. J. C. Lamb estimated the capital cost at £2,000,000, to which he applied £154,860 annually for interest at 8 per cent., maintenance and working, and sinking fund. Even this figure is just £72,304 less of an annual charge than that which Mr. Lamb gave in July, 1893. We may look on this also as a "revised" Post Office estimate. The same witness calls attention to the fluctuation in the price of material. In speaking of the estimate put in by his firm, Mr. Alexander Siemens pointed out that (just as was the case with the Post Office authorities) he had estimated for wire at £50 per ton, of which, as he showed, it would have taken about 20 years for the makers to supply the necessary 11,000 tons turned out at the usual rate, but by adopting the usual deep-sea wire, giving 96 tons breaking strain per square inch, a reduction of some £500,000 could be made in his tender. As, however, Mr. Siemens says that when he sent in his tender, he did not look on it as a firm offer, but "only to give the Governments an idea what the thing might cost," it is not surprising that he did not go into the figures so closely as Her Majesty's technical advisers, not being influenced by commercial strategy, might reasonably have been expected to do. The India-Rubber, Gutta-Percha Telegraph Company also submitted tenders for cables along the selected route, capable of giving a speed greater than 12 words. These figures were, for a 15-word per minute cable, £1,672,000, and for an 18-word per minute cable £1,880,000. We must bear in mind that the figures given in the actual tenders were submitted to the Canadian Government in October, 1894, and that the price of material, as pointed out in Mr. Chamberlain's letter of April 28th last, has since that date altered considerably, not enough, however, in the natural condition of the markets to entail any very large increase.

THE VOLTA CENTENARY.

Exhibition at Como.

[from our special commissioner.]

The exhibition now in progress at Como claims to be international for electrical appliances and machinery and national for the silk industry. In view of the importance of such an event as the Volta Centenary, and the well-known characteristic of the Italians to wax enthusiastic over their great men, we were expectant of some striking exhibits. But several visits to the galleries failed to impress us with any sense of importance or novelty. Whatever was lacking in energy and enthusiasm in the exhibition was amply compensated for by the wonderful demonstrations which centred round the International Congress of Telegraphists held in the same town as the exhibition. Readers of the Electrical Review cannot afford to remain ignorant of these events.

First, however, as to the exhibition. The site chosen for the buildings is picturesque in the extreme. Nestled down in the south-east corner of the beautiful lake, and facing the steep face of Brunate, the exhibition is well situated for easy communication by rail, water, or road. The erection is not very large, but is very pretty. The front consists of a crescent-shaped gallery with façade, measuring about 130 metres from end to end. The extremities are surmounted by two towers constructed in imitation of the well-known Voltaic Pile. From the back or eastern side of this gallery open out three extensive galleries, the centre one terminating in a large circular building which is devoted mainly to the entertainment section of the exhibition. Running parallel with the face of the building and intersecting the central circular gallery are the two galleries devoted to the electrical exhibits. From another point in the central hall opens a small gallery devoted to motors. The *Salle d'entrée* was occupied by telegraphic apparatus employed in the telegraphic competition which continued for a week during the festivities, the extensive Salle being roped off for the purpose.

Brioschi Finzi & Co., of Milan, have a very extensive exhibit of electrical machinery for driving printing machines. Notable among their exhibits is a large lithograph press constructed by the Leipziger Schnellpressenfabrik Vorm Schmiers Werner and Stein, Leipzig. With a comparatively small motor the huge machine was being effectively driven, and was turning out first class work. Norberto Arbizzoni, of

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Monza, exhibits a small handy motor which can be readily applied to treadle machines without removing the treadles. The same firm exhibits a large flat press driven by a motor of the same form constructed by Ditta G. Gadda & Co., of Milan. Several forms of bicycle motor are exhibited. The best we saw was a rather cumbersome, heavy machine, for which it was claimed that it could be applied to any type of bicycle or tricycle without alteration of the wheels. This was constructed by Carlano, Milan, and exhibited by the agents, Oreste Rossi, Via Dante 14, Milano. An electric motor tricycle of an exceptionally cumbersome description is exhibited by Prenetto & Stucchi, but the absence of any attendant precluded us from discovering what virtues were claimed for it. An exhibit, for which a very important claim was made, next came under our notice. This was no less than a "Perfected Edison Phonograph," which was called "Bettini's Micro-Phonograph." The inventor, who hails from Milan, was very reticent concerning his apparatus, which appeared to give the same results as a well-adjusted phonograph. Werth, of Milan, has an extensive plating exhibit, about which we saw nothing new either in method or construction. The Naples Electric Light Company have a very large show of switches. One of the largest exhibits is that of Ellictt Bros. Improved forms of electrical machines occupy the first part of the stand, and the direct reading potentiometer has chief place. They have also a large display of coast signalling apparatus.

A very large show of ingenious electrical domestic appliances is made by the Italian Commerce Company. We were surprised to find that in nearly every instance an inspection proved these appliances to be of American manufacture. There is room for English competition in this field, which appears to be a growing one. This practically completes the electrical exhibition, which, it will be seen, is of little or no importance.

At the southern end of the electrical galleries is a good sized room devoted to the exhibition of relics of Volta and Galvani, and the collection appears to be a tolerably complete one. In the wall cases are exhibited Volta's diplomas and patents of nobility, those from the Great Napoleon being undoubtedly of the greatest interest. In a large case, prominently placed, is a collection of the apparatus used by him in his physical researches. Chief among these is the original pile, which it is claimed is actually the original as constructed by Volta. A condenser, an electrophorus, a eudiometer, a crown of cups, and a number of objects used by Volta in his researches into the nature of gases complete a most interesting collection. In each case the objects are stated to be actually the originals, as used by the great discoverer. A very realistic model of the skull of Volta surmounts the case.

In the same hall there are also some very interesting relics in the shape of physical apparatus employed by Galvani, and a large number of diplomas and original editions of his works. This section of the exhibition seems deservedly to be the most popular and attractive.

(*To be continued.*)

CONDENSERS FOR ELECTRIC LIGHT AND POWER STATIONS.

This paper, read by Mr. J. F. C. Snell before the Municipal Electrical Association at Bristol, we shall publish in full. To the ordinary steam engineer accustomed to regard the consumption of coal from a serious point of view, the practice of electrical engineers is simply astonishing. Mr. Snell calls it wholesale reduction of efficiency—and very correctly. Unsound financially, it is equally unsound engineering. Thus an engine with a pressure of 135 lbs. absolute has a back pressure of, perhaps, 6 lbs. (21 lbs. abs.). If condensing, its back pressure is only 3 lbs. abs. The ratio is 114 : 132 as regards pressure, but the temperature ranges are 350 to 231, and 350 to 127, and one engine would thus have an efficiency of 1 87 times that of the other on the basis of

$$\frac{T - T_1}{T - T_2}.$$

In any case there are the further advantages of abolishing the greasy rain from the exhaust pipe, there is less boiler cleaning. The type of condenser is affected by locality, and, broadly, condensers are divided into surface and jet variety. Mr. Snell is properly in favour of surface condensers, because of the freedom from impurities in the water produced, and the freedom from scale which is secured, though there is always the lubricating oil to be considered—it must be got rid of. At Sunderland, the author has decided to employ artificial water cooling and self-contained surface condensers to each of a pair of 500-H P. dynamo sets, with a cooling tower and fan draught. With water of 25° hardness this seems wise. The condensing plant is estimated to cost 45s. per E.H.P.

He recommends separate condensers for large engines, even if the pumps are separately driven—that is, he would not have a condensing plant common to two or more large engines. It is an advantage, he considers, to have the condenser near to the L.P. cylinder, and below it also, to secure good drainage from the cylinder. For small sets the condenser may be common to several engines with advantage, though, of course, this introduces the risk of every set being suddenly and simultaneously deprived of vacuum, whereby the whole service may be impaired. But we need not follow the author further as we intend reprinting the whole paper. We desire, however, to emphasise his arguments. There is rarely occasion to employ non-condensing engines on permanent work. The argument of short water supply should now be exploded, for, by special cooling, less water is necessary by several per cent. when condensing than when non-condensing. Yet many electrical engineers have put down considerable powers with neither condensers, nor flue feed-heaters, nor have they even provided means to heat feed water by means of exhaust steam, but have simply blown away the steam to the atmosphere, and bought water to replace it. The author's remarks on evaporative condensers may be read with profit. Given tube enough, a condenser may be run without any cooling water. The air is sufficient.

We hear a good deal about high speed engines consuming but little oil. The author refers to graphite lubrication. Engine makers do not seem to take to any system of lubrication which is not exceedingly wasteful of oil. The old idea of an occasional drop or two of oil seems to have given way to very wasteful usage. Engines are made to use very little steam, but the oil consumption is becoming important. In place of steam tests a few oil consumption tests might, with advantage, be published. We are convinced that much lubricant is being wasted in some of the engines now made for electrical purposes.

PARLIAMENTARY COMMITTEES.

Great Northern and Strand Railway Bill.

This Bill came before a House of Lords Committee last Friday. Mr. Balfour Browne, Q.C., who appeared for the promoters, explained that the Bill had already been before a House of Commons Committee, and had been agreed to. The only opposition now came from the London County Council in respect of Section 4 of the railway, which would run from Holborn to the Strand under the new street which the London County Council were proposing to make. The line, as proposed, would run from Wood Green to the Strand, and would be 6 miles 2 furlongs and 7 chains from end to end. It would be constructed in two tunnels, and would cost £2,287,903. It would, from Wood Green to King's Cross, run under the Great Northern Railway, and from King's Cross to Holborn under private property, while, as he had stated, from Holborn to the Strand, the line would be under the County Council's new street. The line was not being promoted by the Great Northern Railway, but as a separate undertaking. The tunnels would be small tunnels, and would not be capable of taking the rolling stock of the Great Northern Railway, nor could they be used for any traffic except passenger. The only petitioner against the Bill was the London County Council, and he thought it would be found that theirs was really not a hostile opposition. In fact, he believed that the London County Council must see, as everybody saw, what an enormous improvement it would be to London. In their petition they referred to the promoters wishing to have the use of the soil without payment. The petitioners were purchasing the whole of the property involved in the new street, and they would have no use for the layer underground.

Counsel proceeded to deal with the London County Council's petition against the proposal. Sir Henry Oakley was called, and gave evidence of the grave difficulty the Great Northern Company had in dealing with its enormously developed

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suburban traffic, and after mature consideration it was felt that a line worked by electricity as proposed was the best means of dealing with the traffic. The number of suburban passengers on the Great Northern Railway was increasing at the rate of one million a year. The cost of equipment would be between £300,000 and £500,000. They would make the railway as light and as airy as possible to attract passengers to use it. Their Holborn platform would be alongside the platform of the Central London Railway, so that a man could come from Wood Green and get to Shepherd's Bush or Cricklewood without coming to the surface. It was expected that it would take four years to construct. Cross-examined by Mr. Freeman, Q.C. (for the London County Council) Witness said there was certainly no case for the company paying anything to the London County Council. The engineer of the Council and the engineer of the company could easily agree as to the exact line for the railway. He knew that as a matter of fact in the three electrical schemes which had been before Parliament that session cheap train clauses had been inserted, but, in his opinion, they were bad for the railway and for the workmen. He knew that the new clause suggested was that workmen should be allowed to travel by any train up to 8 o'clock at a certain fare, and to return by any train, but at a penny fare it was impossible to make it pay.

Further evidence was called, but Mr. Freeman said all his desire was that the scheme should not spoil the great scheme of the London County Council.

The Right Hon. G. J. Shaw Lefevre, the chairman of the Improvements Committee of the London County Council, was called by Mr. Freeman.

Mr. Fitzgerald (for the promoters) said there was no scheme whatever in the air of any other company coming and asking to go under the street, and even if there was, it would be easy to lay their tunnels on one side of the street. What, however, underlaid all the opposition of the London County Council was that they wanted a contribution from the company towards the cost of the new street.

The Committee decided to consider the London Improvement Bill of the London County Council dealing with the Holborn to Strand new street before giving a decision, and, after hearing part of the case for that Bill, the Committee decided that the Bill should proceed, and refused to insert clauses suggested by the London County Council as to any payment for wayleaves or for further provision for workmen's trains, holding that the matter was sufficiently dealt with by the general law.

Baker Street and Waterloo Railway.

Before the Committee on Thursday last week this Bill was considered. Mr. E. Page and Mr. J. Shaw appeared for the promoters, and Mr. Lewis Coward was for the Brompton and Piccadilly Railway Company, who were the only petitioners. Mr. Shaw said the Bill was to extend the period for the construction of the authorised line for three years from 1901, when the authorised time expired, and to make the station under Trafalgar Square in place of Cockspur Street, and make public subways at Charing Cross. As the Committee knew the Bill had already been before a Committee of the House of Commons which had, however, struck out those portions which related to branch lines to Paddington and Euston stations by which it had been intended to give facilities to passengers using the Great Western and the London and North-Western Railways. The clause for the proposed generating station at Paddington had also been struck out. The only opponents to the Bill now were the Brompton and Piccadilly Railway, who asked that the promoters should be bound to make their railway at a certain depth where they proposed to cross the proposed line of that company. He contended, however, that the petitioners had no *locus standi*, inasmuch as they were not owners or occupiers, and had not yet got their Bill. Mr. Coward said the petitioners had been negotiating for property, and he only asked for a protective clause. After consideration, the Committee decided that the Brompton and Piccadilly Railway Company had no *locus standi*. The Committee then went through the clauses of the Bill as amended by the Commons, and ordered that it should be reported for third reading.

Newcastle Tramways and Electricity.

The Select Committee of the House of Commons met on Wednesday last week, under the chairmanship of Sir Stafford Northcote, to consider a Bill promoted by the Corporation of Newcastle-on-Tyne, by which they sought additional powers for general purposes, including the running of the tramways in the borough by electricity. Mr. Pember, Q.C., and Mr. Moon represented the promoters of the Bill; Mr. Pembroke Stephens, Q.C., and Mr. T. Dickinson appeared for the Newcastle-on-Tyne Electric Supply Company, Limited, and Mr. Edwin Short represented the Newcastle and District Electric Lighting Companies in opposition to the Bill. Mr. Moon, in opening the case for the promoters, said that the main object of the Bill was to construct and re-construct a large number of tramways in Newcastle, and to work them by electrical energy. By Section 7 of the Bill the Corporation proposed to construct or re-construct 20 miles of tramways, and to work them by electricity, and Clause 26 provided that they might use certain lands for the purpose of constructing a station for the generation of electrical energy. Those clauses were not opposed by the two companies appearing in opposition—the real opposition arose upon Clause 99, which would enable the Corporation to employ the electric energy for the purpose of lighting the public streets and public buildings, the quay, market, or other property of the Corporation for the time being of the Corporation in the borough. The use of the electric power for the cranes on the quay was a most important matter, but the two electric supply companies opposed the granting of such power on the ground that it would lead to unfair competition with them. In the present case the competition would not be at all a serious matter, but even if it were he (Mr. Moon) maintained that such competition was perfectly legitimate, and had been recognised by Parliament to be so. As regarded the street lighting, at present the two companies who were opposing only lighted 24 lamps between them, and with regard to supplying electricity as motive power, the companies could not supply it economically because they both worked on the alternating system. Therefore, the Corporation were not competing with those companies, because the objects to which they sought to apply and utilise electricity were not objects which the electric companies were now carrying out, or could successfully carry out. In conclusion, the learned counsel pointed out that, by the Act of 1888, Parliament had recognised the right of local authorities to enter into competition where a Committee of the House were of opinion that such competition was justifiable.

Mr. Hill Motum, the town clerk of Newcastle, having given evidence in favour of the Bill, Mr. C. Hopkinson, C.E., said that the same electric plant that supplied the power to the tramways could be used for other purposes. In his opinion, it was a matter of importance that the general supply should be under one control.

Mr. Dickinson (for the Newcastle Electric Supply Company) called Mr. J. T. Merts, a director of the company, who stated that he had held that position since the formation of the company in 1889. The company was incorporated with a capital of £50,000, which had since been increased to £100,000. At the start they adopted the alternating system, but they would shortly be in a position to supply direct current. They had 850 consumers, and supplied many of the public buildings. They could supply electricity for public purposes quite as cheaply as the Corporation.—Mr. J. S. Watson, assistant engineer to the Electric Supply Company, said that Clauses 15 and 23 of the Corporation's Bill could be prejudicial to the company unless an undertaking were given by the Corporation that they would make compensation for any disturbance of the company's wires, and that the Corporation should give a proviso that outside authorities should not supply inside Newcastle.

The Chairman pointed out that the Corporation only asked for power to supply their own buildings, and there was no question of setting up a hostile company.

Mr. Pembroke Stephens, Q.C., addressed the Committee for the company, and contended that as the company could not have obtained its provisional order without the consent of the Corporation, the company were there with the consent of the local authority; but now the local authority asked Parliament to give them powers in derogation to their grant. There was really no use making bargains between companies and corporations and getting the sanction of the Local Government Board if all was to be reduced to a sham.

The Committee decided to pass the Bill.

Charing Cross and Strand Electricity Supply Corporation's Bill.

On Monday a Select Committee of the House of Commons, under the chairmanship of Col. Gunter, sat to consider the Provisional Order Confirmation Bill of the Charing Cross and Strand Electricity Supply Corporation, Limited, giving them power to supply electricity within the area of the City of London. Mr. Pember, Q.C., and Mr. Shiress Will and the Hon. Sydney Holland appeared for the promoters. The petitioners were the City of London Electric Lighting Company, represented by Mr. Pope, Q.C., Mr. Balfour Browne, Q.C., Mr. Freeman, Q.C., and Mr. Rokell, and the City of London Corporation, represented by Mr. Littler, Q.C., Lord Robert Cecil, Q.C., and Mr. A. D. Walter.

Mr. Pember, Q.C., in opening the case for the promoters, said this was the City of London Electric Lighting Order for the lighting of the City of London, given to the Charing Cross and Strand Electricity Supply Corporation. The order had been granted by the Board of Trade, and he thought the principle of competition in electric lighting was now thoroughly established. There was hardly a part of London where competition had not been sanctioned. The City of London Company had always used the alternating current principle, but the Charing Cross Company had always used the direct current in their existing districts, and they intended to use it in the City if the order was confirmed. In all probability there would have been competition in the City of London itself long ago had it not been that in the early days of electric lighting the Corporation made certain agreements with the existing company, which, however, were quite invalid and could not bind Parliament. The Corporation had been advised that the agreements were invalid, but he understood the question would be eventually tried in the Courts of Law. However, he had nothing to do with those agreements, because they could not override the law. For some time dissatisfaction had existed in the City with regard to the electric lighting, and the matter had often been considered in the Common Council. At last the Charing Cross Company, one of the most successful and one of the best conducted companies in London, came forward and applied for an order, feeling that there was ample scope for them in such a rich area as the City of London. Their example was followed by the Metropolitan Electric Lighting Company and the Smithfield Electric Lighting Company, and all three applications were heard before Sir Courtenay Boyle, and his company produced a petition in their favour with 5,000 signatures, while the Smithfield Company produced a petition with 10,000 signatures. Having thoroughly inquired into the matter, Sir Courtenay Boyle decided to grant a competitive order, and he selected the Charing Cross Company to have the order. In doing this he dispensed with the consent of the City Corporation, who considered their hands tied by the agreements referred to. He should call evidence to show that the present supply was inefficient and expen-

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sive, but in view of the great amount of evidence which was called before Sir Courtenay Boyle on this point, he would not trouble the Committee more than he could help. There had been certain personal matters in the matter which he would not go into.

Mr. Pope, Q.C., said he had better go into them because there was no charge against the City of London Company.

Lord Robert Cecil said there was no charge against the gentlemen concerned. It was simply said that he was a member of the Corporation and also a shareholder of the company which promoted the City of London Company.

Mr. Pember said he made no charge against anyone. He only referred to the matter because it was brought into the Board of Trade inquiry. His position was that whatever agreements there were they were perfectly null and void. The Charing Cross Company was registered in 1889, and its capital powers were 250,000 ordinary shares, of which 150,000 had been issued, and 100,000 preference shares, of which the whole had been issued. Their shares were now being issued at 100 per cent. premium. They proposed to increase the capital of the company by £800,000 for the City undertaking, and to supply consumers in the City for lighting at 5d. a unit, to be reduced, according to consumption, to 4d. per unit, and for motive power at 3d., with a sliding scale to 2d. These charges were below those at present of the City of London Company. Sir C. Boyle recommended that the order be granted to the company, on the condition that the City Corporation should have the opportunity of purchasing at a reasonable date from the time of the order, to be agreed upon hereafter, and that time had now been agreed upon. In 1914 the Corporation would have the option of buying up the existing company if they chose to exercise it, and in the same year, and any time thereafter, they might, if they liked, buy up the City undertaking of the Charing Cross and Strand Company.

Mr. Edward Wilmot Seale, secretary of the Charing Cross and Strand Company, said the company first supplied in the St. Martin's District in competition with the Metropolitan Company and the London Electric Lighting Company, and afterwards they got competing powers with the Metropolitan Company in the Strand and St. Giles and Holborn. The order for the last two districts was granted last year, and they had already laid 18 miles of mains in those districts. In the Strand and St. Martin's districts they had hung what was equivalent to more than 157,000 8-candle-power lamps, the company last year standing fifth on the list of metropolitan companies in regard to supply. They supplied the new Admiralty buildings, Somerset House, the Constitutional Club, the National Liberal Club, the County Council offices, the Lyceum Theatre, Drury Lane Theatre, Covent Garden Theatre, the Hotel Metropole, the Hotel Cecil, the Grand Hotel, and many other large buildings. He attributed the success of the company to the lowness of their charges and to the freedom of failures. His company's average price was the lowest charged by any private metropolitan company, and was lower than the price charged by three of the four metropolitan local authorities who supplied themselves. The City of London Company were charging about 42 per cent. more than they did. His company would supply light in the City at from 5d. to 4d. per Board of Trade unit, and motive power at from 3d. to 2d. per unit. He thought that if their district was extended some of the large newspapers would take motive power.

Evidence was then given by Mr. Edwards, of the Canadian Pacific Company, Mr. G. E. Mead, of the Sun Fire Office, and others, as to the present insufficient supply of the City of London Company.

The Committee then adjourned.

At the resumed sitting of the Select Committee on Tuesday, Mr. Seale was recalled for cross-examination, and said that the company's charge for motive power was 3½d. if 15 hours' power per week was taken, and if over 15 hours' power was taken the charge was 2½d. per unit. They had 15 or 20 customers who took motive power.

By Mr. Roskell: The Board of Trade dispensed with the consent of the Strand local authority. There had been no complaints as to their taking up the streets in the Holborn district. There had been complaints in the St. Giles's district, where they had to leave open a trench quite unavoidably. He did not say that complaint was unfair, but the St. Giles Board of Works had treated them severely.

The Chairman: In parts of London I notice that the electrical mains appear to run under the footways. Is it necessary to take up the streets?—Sometimes not. It depends entirely on the question of the mains.

In Grosvenor Place and about there they are putting down mains under the pavement, and do not interfere with the street at all. Is it necessary to take up the streets?—It is only necessary to lay them in the streets where there is no room under the pavements. The County Council and the local authorities are making it a standing order, wherever possible, to lay the mains under the pavement where it can be done.

Mr. Roskell: And in St. Giles you lay mains both under the pavements and the streets?—Yes, the same as all other electric lighting companies.

Further examined by Mr. Roskell, Witness said he was not aware that the City of London Company were under statutory obligations to lay aside a considerable sum to depreciation account, or that £119,000 was so invested by that company in Consols. The Charing Cross Company invested their reserve fund more profitably in their own business. He would say that the actual reserve of their company was £30,000, and that £100,000 would stand to share premium account. The share capital to which the premium would apply was being subscribed at the present time. He should say that the restaurants and luncheon bars in the City would use as much light as those of the West End. He did not say under present conditions that was so. At present he admitted that the demand in the City was shorter in duration per day than in the Strand. He suggested that there was a wide field for the employment of electric energy wholly untouched in the City at the present time. The charge they proposed for public lighting was the same that the City of London Company charged at present.

By Mr. Shiress Will: Whatever might be the demand in the City for electric lighting, his company were perfectly prepared to take the risk, and two other companies were also willing to take the risk.

Mr. W. H. Patchell, the engineer of the Charing Cross and Strand Electricity Supply Corporation, said he had held that position for six years. Having explained the difference between direct and alternating current, witness said that for arc lighting the alternating current was not satisfactory. For motive purposes the direct system was the most satisfactory. For the last six years the whole of the laying of mains had been done under his direction, and in districts where there were competing companies. He had found no difficulty in laying mains that could not be got over. Competing companies did not use the same trenches. The case mentioned by Mr. Seale was the only case in which they had had any trouble with the local authorities. They had fogs just the same as they had in the City, and their load was liable to jump up on such days. They provided against that by having spare plant and also battery power. They were increasing their batteries at the present time. Batteries could not be used with an alternating current. There was no way of storing alternating current to make it commercially successful. With a reduced price they looked for an increased consumption of energy in the City, because that had been the experience of all companies. In 1893 the average price obtained by their company per unit was 5·29d., and the units sold were 28·07, while in 1896 the price was 4·70d., and the units sold 32·4. The dividends of his company were 4½ per cent. in 1893 and 1894; 5 per cent. in 1895; 6 per cent. in 1896; 7 per cent. in 1897; and 8 per cent. in 1898. If they supplied light at 5d. per unit in the City, they anticipated a larger demand than two hours per day for five days in the week. With regard to the Board of Trade schedule price in respect to the order, a private person in the City would pay for one hour per day 5d.; for 1½ hours 4·66d. and for two hours 4·5d. That was the average price. The reduction took place after one hour's daily use of the maximum. The maximum would be the amount of lamps which he asked for and which he could use.

Mr. Balfour Browne, Q.C.: And he might have 50 lamps to burn occasionally and never get any reduction at all.

Continuing, Witness said the price of the City of London Company was 7d. per unit for the first six units per quarter per 8-candle-power lamp; 6d. for the next four units per quarter; 5d. for the next two units; and 4d. all over that. A customer would have to consume electricity for two hours before he got a reduction, and it was this state of affairs which, in his opinion, retarded the use of electricity in the City, as the charges ran so high. Under their schedule, if authorised, a consumer would have to consume electricity for motor purposes for 2½ hours of his maximum demand, and would get the reduction from 3d. to 2d. At present, his company had on their mains 1,136 consumers.

Witness having been cross-examined by Lord Robert Cecil as to the company agreeing to insert certain clauses with respect to the charge for motive power, it was intimated that the promoters case was closed, and a discussion then ensued as to whether the Corporation or the City of London should be heard next.

Mr. Pope, Q.C., charged the Corporation with having sat on the fence all along, and said the City of London Company were entitled to know on which side of the fence they meant to come down before he went into his case.

Lord Robert Cecil said the Corporation had no commercial interest in the matter, and their attitude might depend on whether the company could or could not answer the allegations of the promoters.

The Chairman said the Committee would prefer to hear the company first, and

Mr. J. C. Bull, manager and secretary of the City of London Electric Lighting Company, was called, and said the prospectus of the company was issued on July 14th, 1891, 40,000 ordinary shares being offered for subscription, but only applications for 2,410 were received from the public. The directors and their friends, with the issuing houses took 30,152 shares, and the remaining 9,848 shares were offered for subscription in January, 1892, but only 6,258 were taken up, and the remainder were placed by the Electric and General Company. The capital of the company now consisted of 40,000 £10 preference shares, 60,000 £10 ordinary shares, and £400,000 of 5 per cent. debentures, or £1,400,000 in all. The expenditure upon capital account had been nearly £1,600,000 up to the present date, and the net revenue in 1898 was £97,842. The public lighting for the year ended 1892 resulted in a loss of £706, while the profit for the year ended 1898 was £662 12s. 8d. No dividends were paid from 1891 to 1893, but in 1894 2½ per cent. was paid; in 1895, 5 per cent.; in 1896, 7 per cent.; in 1897, 10 per cent.; and in 1898, 6 per cent. The number of private customers had increased from 242 at the end of 1892 to 7,414 at the end of 1898, while on June 21st last the total was 7,876, and this notwithstanding the alleged high prices. In 1895 the average price obtained per unit was 7·56d., and in 1898, 6·22d. Several customers had discontinued generating their own energy, and had taken their light from the company. It was not correct to say that the arrangements being made for a continuous current were only made in consequence of the threatened opposition of the Charing Cross Company. As far back as 1895, Mr. Bailey, the engineer, was instructed to give attention to the introduction of that system of supply, and he had been working at it ever since. The company now possessed plant for the supply of continuous current to the extent of 200 kilowatts, and by November next would be able to supply 3,000 kilowatts.

The Committee adjourned.

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The Telephone Bill.

The Standing Committee on Trade met on Monday last to consider the Telephone Bill of the Government.

The first clause, viz, a grant of £200,000 for the purpose of the Telegraph Acts, was agreed to without discussion. On Clause 2, which empowers the payment of expenses under a telephone license, Mr. Hanbury, who is in charge of the Bill, moved to leave out the word "county" in the phrase "where the council of a county borough are licensed by the Postmaster-General." He said that as the purpose of the Bill was to enable licenses to be granted to urban districts the word "county" was not necessary.

Mr. Tomlinson said he understood the original idea to be that the authorities to which licenses should be granted were large bodies. He understood further that they were to have, with respect to telephones beyond their borders, similar powers to those which they possessed with regard to gas and water. Was that so?

Mr. Hanbury replied in the affirmative. If the Postmaster-General considered that the proper working of a telephone system in a borough or an urbrn district required its extension outside—that was, between the suburban dwellings of business men and their urban works or offices—the urban authority would receive permission to make the extension if they could obtain the consent of the outside authority, but the Postmaster-General's license in such a case would not give them compulsory wayleaves in a jurisdiction not their own.

The amendment was adopted.

Col. Long proposed that the Postmaster-General should only issue telephone licenses by means of a provisional order confirmed by Parliament.

Mr. Hanbury remarked that the real object of his hon. friend was to kill the Bill. At any rate, the amendment would weaken the hands of the Post Office. So far as ground licenses in municipalities were concerned, there was no need for the clause. The necessity for it arose from the fact that even if a telephone license were granted by the Postmaster-General, the local authorities had not at present power to borrow or spend money for the purpose of putting it in operation. Should the amendment be passed, the Local Government Board would be enabled to intervene quite unnecessarily, and the Parliamentary proceedings might cause useless delay, expense, and annoyance.

Sir J. Joicey supported the amendment, and said it was very natural that Mr. Hanbury should be angry with anyone who would interfere with the Post Office, but it was equally natural that some people should look with distrust on a project permitting local authorities to spend any amount of money on telephones. Those persons who might object to the exercise of such a power ought, at least, to have the right of appealing to Parliament.

Mr. Cawley, in speaking against the amendment, said that municipalities had the right to control gas, water, and electricity, and he did not see why they should be hampered in respect to telephones.

Mr. Cohen supported the amendment because, he said, he wanted to check the growth of municipal enterprise outside proper municipal limits.

Sir J. Woodhouse said that to give all kinds of people power to come to Parliament and oppose the granting of telephone licenses would defeat the object of the Bill. Were the minority in a borough or urban district council to be allowed, after they had been defeated on a proposal that a telephone license should be applied for, to put the ratepayers to great expense in order to carry their opposition further? He thought not. The Postmaster-General ought to be left to decide whether he would issue a license or not.

The amendment was negatived by 30 votes to 9.

Mr. C. McArthur said that he would move the omission of the clause as a protest against the principle of municipalisation. There were many objections to the proposal. In the first place, it involved the multiplication of systems within the same area, and the question arose how these different systems were to be brought together. There must either be some arrangement between the various authorities for laying junction wires, or the Post Office trunk wires must be extended so as to connect the various systems; and that would involve great expense. There was also the objection that, according to the decision just taken, any one of these authorities might, with the consent of the Postmaster-General, impose a telephone system on the ratepayers without first obtaining the consent of Parliament. Then their licenses were to be extended for 25 years.

Mr. Hanbury pointed out that that was entirely in the discretion of the Postmaster-General.

Mr. McArthur said that it was, at any rate, permissible, and therefore, in fairness, the same facilities ought to be given to the National Telephone Company, whose license expired in 1911.

A division was then taken, and the clause, as amended, was approved by 35 votes to 7.

Mr. Hanbury then proposed the following new clause, which embodies the concessions made by the Government to the National Telephone Company and other opponents of the Bill:—"1. Where an existing company have, before the passing of this Act, under a license from the Postmaster-General, provided a system of telephonic communication in any area, and it is proposed to grant a new license to a local authority or to another company to provide telephonic communication in the same area, then if the existing company consent to it being made a condition of their license (*a*) that they will not give favour or preference to any person whomsoever within the area in question, and will not, as a condition of giving a service, require from any person the grant of any facility, except for the purpose of supplying telephonic communication to that person, and (*b*) that their charges shall not, within the area in question, exceed or fall below those authorised in that behalf by the Postmaster-General within that area, it shall be a condition precedent to the grant of a new license that where it is proved to the satisfaction of the Postmaster-General that the existing company have incurred, or contracted to incur, material expenditure in laying down underground wires, and have acquired a wayleave from a local authority for that purpose, the wayleave shall, within the area in question, continue for the period for which the new license is granted, but on the same terms and conditions, except only as to such continuation as those upon which the wayleave was granted, unless varied by agreement with the local authority. (2) An existing company shall not, without the consent of the Postmaster-General given after the passing of this Act, in each case open an exchange in any area included in their license in which they had not, before the passing of this Act, established an effective exchange. (3) Where a local authority or new company under a license from the Postmaster-General provides a system of telephonic communication in any area in competition with an existing company licensed by the Postmaster-General before the passing of this Act; then, if the existing company consent to it being made a condition of their license (*a*) that they will not give favour or preference to any person whomsoever within the area in question, and will not, as a condition of giving a service, require from any person the grant of any facility except for the purpose of supplying telephonic communication to that person, and (*b*) that their charges shall not within the area in question exceed (and where the local authority grants underground wayleaves, shall not fall below) those authorised in that behalf by the Postmaster-General within that area the license of the existing company shall within the area in question be extended and continue for the period for which the license of the local authority or new company is granted, but except as varied by this Act, the provisions of the license of the existing company shall remain in force."

Mr. Stuart regarded the proposed clause as a departure from the conclusions of the Select Committee. That body was convinced that the license of the National Telephone Company should not be extended beyond 1911. This clause provided for the granting of licenses to new companies, and the prolongation of the National Company's license as long as the new licenses should last. The authorization of new telephone companies was an even wider departure from the conclusions of the Committee than the one he had just named. The Post Office had not been a very effective competitor with the National Telephone Company. It had gone down like a house of cards before that body, and there was no guarantee that it would be firmer with new companies. Besides, how did anybody know that in a short time the National Telephone Company would not buy out all new competitors, and so become greater and stronger that ever?

Sir C. Cameron said he thought the clause was an immense improvement on the Bill, because it would ensure telephonic competition.

Mr. Cohen supported the clause.

Sir J. Woodhouse said the clause was a very complicated one, and had only been published two or three days ago, and he had received numerous communications from municipalities asking for time to study it and frame recommendations upon it. He hoped that the Committee would not be asked to decide upon it before Thursday, and therefore he moved the adjournment of the debate.

Mr. Hanbury said he did not ask that the clause should be added to the Bill at this sitting, but only that it should be read a second time. If that were done, he would undertake to communicate before Thursday with Sir J. Woodhouse, and if possible with the municipalities, to see whether they could not come to some arrangement which would be fair to both the National Telephone Company and the municipalities. He thought it possible to conclude some arrangement which would satisfy the latter.

Mr. Seton Karr complained that under the new clause the Postmaster-General would be absolutely autocratic as to the prices for telephonic communication. If so, where did competition come in? That was a point for consideration.

The motion for the adjournment having been withdrawn,

Mr. Hanbury explained the effect of the clause at some length. With regard to the prohibition of preferences, he said the National Telephone Company had, in the past, drawn customers from the Post Office by preferential rates. The prohibition of such proceedings would be a great advantage to municipalities who established telephone exchanges. There was another point. Hitherto the National Company had been able to say to a tradesman: "Although your rival has telephonic communication, you shall not have it unless you allow us to put a pole and wires on the top of your house, with leave to us to enter your premises and look after the pole and wires." The Government wanted to prevent that kind of thing. They would not allow either municipalities or new companies, or the present company, to give preferences of any kind. With regard to prices, they meant to fix a maximum and a minimum for all competitors in the same area. The minimum in the case of a municipal enterprise would prevent the rates being unduly drawn upon, and would, in all cases, probably save the Post Office from taking the telephones at unremunerative rates, if nationalisation came, as it might do, in 25 years, the period for which new licenses would be granted. It was to the interest of the municipalities that a minimum should be insisted upon, because a municipality competing with the National Telephone Company would have only one area, while the company would have many. The minimum rate would be subject to periodical revision, accounts would be submitted annually to the Postmaster-General, who would vary the rates if necessary. As to the new companies, there would be a great difference between them and those which had hitherto existed. The latter had general licenses, and the National Telephone Company in buying them up had only one operation to perform in each case. The Government would issue no more general licenses, and would guard against the danger of telephone companies being purchasable at all. The Treasury minute with regard to municipalities carried out this view, and another Treasury minute would apply it to new companies. Again, new companies would differ from their predecessors in being under Government control, as he wished the National Telephone Company was. In addition, they would

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be practically under the control of municipalities, for the Post Office would not grant a license if there was no efficie service, and there could not be an efficient service without underground wayleaves, the granting or the withholding of which was in municipal hands. Coming to the question of the extension of the National Telephone Company's licenses, he admitted that a Committee of the House of Commons recommended in 1892 that the licenses of existing telephone companies should not extend beyond 1911. The general license of the National Company would cease to exist after that year. That was not all. Its other licenses would end at the same time wherever there was no competition. If the municipalities were averse to the presence of the National Company in their area, and yet wanted to establish telephone systems, they would simply have to ask for licenses which would expire in 1911. They would be able to obtain renewals, but the National Company would not. The company's licenses would terminate for good and all either in 1911 or in the year when the first competing licenses expired. The Government wanted not only the authorities of large towns where the National Telephone Company was already established to create telephone systems of their own, but they also wanted the smaller authorities to do the same. That was why they laid it down that the National Company should not work where they had not already got an exchange. But for this provision the company might prevent the small authorities from laying down telephones by threatening competition. The only other question with which he had to deal was that of intercommunication between rival systems. He was as anxious as anybody that there should be intercommunication between the telephone exchanges in one area, but he feared he should not be able to get the National Company to agree, especially as he had obtained very fair concessions from them already. It would not be fair to insist on free intercommunication where the local authority, for instance, had a small exchange and the company a large one, but it would be reasonable if fair payment were made for terminals. The Government had promised that when the National Company worked in communication with new competitors, such as the Glasgow Corporation or the new Manchester Company, the former's new plant (constructed under the eye of the Postmaster-General) should be purchased by the State on the termination of the license.

Sir J. Joicey said he objected to the clause, because he desired the nationalisation of the telephone.

The second reading was agreed to by 28 votes to 5.

The Committee adjourned till Thursday.

The *Times* says that, thanks to the excellent progress made on Monday, there is every probability that the Standing Committee on Trade will finish their examination of the Telephone Bill at the next sitting.

LEGAL.

Hyde Corporation *v.* Oldham, Ashton, and Hyde Electric Tramways Company.

The case of the Mayor and Corporation of Hyde *v.* the Oldham, Ashton-under-Lyme, and Hyde Electric Tramways Company was heard on July 3rd before Mr. Justice Grantham, sitting without a jury in the Queen's Bench Division of the High Court. Mr. Macmorran, Q.C., and Mr. Sutton appeared for the plaintiffs, and Mr. Cripps, Q.C., and Mr. Bartley Dennis for the defendants.

Mr. Macmorran said this was an application for an injunction to prevent the defendants breaking up the footpaths in Hyde for the purpose of laying electric cables for the electric traction of a tramway in that town. The facts were admitted, and he now contended that the Corporation were within their rights under the provisional order in interfering. This order provided that the carriages used on this tramway might, with the permission of the Board of Trade, be moved by electric traction. The Tramway Act of 1870 was incorporated with that order, and that Act provided that the term "road" should mean any carriageway being a public highway and the carriageway of any bridge forming part of or leading to the same. The power to break up the roads was given by Section 56:—"The promoters may, from time to time, for the purpose of making and laying down, and for the maintenance and renewing of any tramway, open and break any road, subject to the following regulations." Then followed the regulations. Having the power to break up the road was given to any "road," and the term "road" was defined to be the carriageway of the road. He submitted that whatever power the company might have to break open any road in the borough was limited to the carriageways, and that under the section there was now power to break up the footpaths. In July, 1898, the company gave notice that they intended to break up the footpaths in order to lay electric cables to feed the overhead wires with power to work the trams. Negotiations followed, and eventually the Corporation decided that the work should be allowed to go on if the company would contribute a further £500 towards the expenses of certain road improvements, in addition to £500 which had already been promised.

Mr. Cripps, Q.C., said the Corporation seemed to have been ready to give their consent if the company paid a second sum of £500, and the company having paid one sum of £500 thought that was sufficient. His first point was that the company had got the power under the order to break up the footways, and his second was that, even if they had not that power, under the Battersea case, which had just been decided by the House of Lords, no injunction could be granted, because the company were not trespassers, being underneath the footway, and the rights of the Corporation only extended to the surface. He also contended that there was no damage done by the company. All the Corporation could do was to bring an action against the company for damages; but as no damage was done, that would be fruitless. Some time ago the Board of Trade, after consultation with a committee of experts, laid down certain regulations with regard to the method to be adopted with regard to these tramways. An interview was held with Major Cardew, of the Board of Trade. He made certain requirements, which were complied with, and the system was now in operation.

Mr. Justice Grantham: To come here now seems rather like locking the door after the steed is stolen.

Mr. Cripps said so far as the injunction was concerned, it was quite an impossible suggestion.

Mr. Macmorran: We protested all through.

Mr. Cripps: No; only to a certain point.

Mr. Justice Grantham said if it was wanted to stop what was done, application could have been made in Chambers. He supposed what they were really discussing was the £500.

Mr. Cripps said it was too late for that now. He contended there was no limitation of the word "carriageway" in the Act, and that it did not exclude footpaths.

Mr. Macmorran, for the Corporation, said it was not at first intended to lay cables under the paths. Even assuming that the company had power to lay the cables, he was prepared to show that they could be properly laid under the roads. He also contended that great damage had been done to the footpaths, and that it had cost some £100 to properly flag the streets which had been taken up by the company.

Mr. Joseph Mitchell, the borough surveyor of Hyde, said the company's original plan did not show any wires under the paths. The company had done damage to the extent of £100 to the footpaths, and had also taken up the space that the Corporation required to put wires for their own electric supply to the town.

Cross-examined: When he went round with the Board of Trade inspector in May last, he did not say a word of his objection to having the wires under the footpath. He denied that the whole object of the Corporation in raising the question of underground mains was to obtain money for the town's improvements.

Mr. Charles Hopkinson, a consulting engineer and electrical expert, said the cables could have been laid in the carriageways quite as well as under the footways, and it would not affect the system at all.

Mr. W. Hedderstedt, who was in charge of the work when the cables were laid below the pathway, said after it was carried out the paving was infinitely better than it was before. The chance was very remote that it would require repaving again for 10 or 12 years. It was not true that some of the flagging was not yet replaced.

Mr. E. Malen, who was in charge of the electrical work for the contractors, said he replaced by sound stones all stones broken in removing the pavement. The part that was relaid was better than before. It was not true that there had been any subsidence in the flagging.

Mr. Justice Grantham said the case raised a very important point. The question was whether an electrical company could, under the old tramway powers of the Act of 1870, arrange with the Board of Trade to break up the footpath as well as the carriageway for the purpose of their electrical plant. In his judgment they could not. It was clear that when the Act of 1870 was passed no one dreamt of electric tramways, and it was equally clear that no such wide powers as those claimed were intended by the Act. He did not think the case came under the Battersea case which had been quoted, and he thought under the circumstances he must give judgment for the plaintiffs for an injunction and for £100 damages. Execution would be stayed for six months to enable the parties to come to an understanding.

Blackwell *v.* Greenwood & Batley, Limited.

Mr. Justice Bruce gave judgment in the Queen's Bench Division on Monday (July 3rd) in the case of Blackwell *v.* Greenwood and Batley, Limited, which was recently tried at length before his Lordship. It was an action brought by Mr. Robert Winthrop Blackwell against Messrs. Greenwood & Batley, engineers, carrying on business at Leeds, to recover £605 for electric standards and other appliances supplied to the defendants in connection with the construction of electric tramways at Leeds. The defendants counterclaimed for £525 damages paid to three passengers who were injured by the breaking of one of the standards.

Mr. A. Cohen, Q.C., and Mr. Manisty appeared for the plaintiff, and Mr. Robson, Q.C., and Mr. Muir Mackenzie for the defendants.

In 1896 the defendants entered into a contract with the Corporation of Leeds to construct a new electric tramway in that town, and they obtained their electrical standards and other appliances from the plaintiff. In August, 1897, one of the standards broke, and an accident occurred, injuring three passengers, who brought actions against the Corporation and recovered damages. The Corporation subsequently obtained repayment of the damages and costs, amounting in all to £525 from Messrs. Greenwood & Batley, who in the present action counterclaimed to recover that amount from the plaintiff on the ground that the standard which caused the accident was defective. The plaintiff denied that there was any defect. His lordship said the evidence given on behalf of the plaintiff had failed to satisfy him that the designs for the working of the tramway was a bad or faulty design. The trolley standard which was broken on August 16th was not to be found, and they had not been told as to the circumstances under which it was broken. There was no evidence as to its being defective, and, in fact, the evidence tended to prove that it was of good quality and without flaw, and that there was no defect in the casting. It was probable that the standard

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was broken by reason of some unfair strain or violence. The defendants bound themselves to be answerable for all accidents unless they could satisfy the engineers or the Corporation that the accidents arose from other than defective workmanship or material, but the plaintiff did not bind himself to serve the Corporation on any such terms. The onus of proof was against the defendants to establish their case against the plaintiff, and that they had, in his opinion, failed to do. There would be judgment for plaintiff, with costs on the claim and on the counterclaim.

CORRESPONDENCE.

Remarks on Extracts from a Contemporary re Competitive Telephony and Non-Competitive Winchester House Telegraphy.

To the casual reader, the following extracts from one of your contemporaries for June 30th, 1899, seem to be scarcely compatible. Thus, in its first note, on the Winchester House visit to the Chancellor of the Exchequer and to the Secretary of State for the Colonies, we find—

The Marquis of Tweeddale . . . . *was able to show convincingly that* the objects sought by some of the colonies, viz, *a reduction of rates* and an alternative Pacific or other cable, *could be much more efficiently and economically attained by private enterprise.*

Again—

And we wonder that the Press do not see that a *State-owned Pacific cable would lead to a veritable monopoly, which it is not at all in their interests to bring about.* In some cases competition is good; in others, lower rates and better service can often be best secured without competition.

On turning over a few pages, we come to an article on "Competitive Telephony." I again quote two passages—

Those who have studied the problem presented by the state of telephony in this country have realised that the system will only be *at its best when it is controlled and also managed by a State department.* . . . .

We have frequently expressed our views in favour of a *telephone monopoly, worked either by the Post Office or an allied Government department.*

The italics are my own. How consistent! How disinterested!! There is plainly some function governing the ratio of alterations advisable in the control of the telephone systems differing vastly from that applicable to telegraph systems. Assuming that function to be in the shape of prospective benefits or the reverse to the country at large, the problem can be expressed thus:—

"From the ratio of proposed indefinitely large changes in two somewhat similar monopolies of magnitude, to ascertain the functions which will govern the changes."

I accept the fact, that the functions are diametrically opposite—that the problem is mixed and ridiculous; but put in this light it gives a fairly clear representation of Winchester House argument as applying firstly to themselves, secondly to their competitors.

H. B. F.

Cologne, *July 1st*, 1899.

Wholesale v. Retail.

Your correspondent, "A Disgusted Retailer," opens up a question which, as a purely commercial one, is, I consider, of vital importance to the electrical trade. Whilst sympathising with him on a subject which frequently hits me, and no doubt many others similarly situated, very hard, I cannot help feeling that the wholesale trade is placed by circumstances in a very difficult position. It is, however, in the interests of the latter to protect those of the retailer, but as "Manufacturer and Designer" points out how are they to distinguish where "the Trade" commences and where it ends? It is notorious of our countrymen that we are good at grumbling but slow in adopting measures to remove the cause of our complaints. Now, why not something practical?

Without taking up your space with detailed suggestions, I would submit that it is possible for the wholesale trade, by concerted action, to institute a system whereby all those who are justly entitled to trade discounts should be registered by some specially constituted body, whose duty it should be to inquire into the *bonâ fides* of those whose line of business it is to supply the public with any particular class of electrical goods. If then, the wholesale trade, by common consent, were to refuse to allow discount except to such registered retailers, it would obviate the cause of our very reasonable complaints.

It will no doubt be objected at first that the suggestion of concerted action is too empirical to meet with success, but let it once be realised that the present evil militates as much against the wholesale as the retail trade, and I venture to think that something could be done for our mutual protection.

Let me put just one illustration of what is constantly coming under my notice. A is a chemist, for example, who sells the necessary materials for charging electric batteries, and, as admitted by "Manufacturer and Designer," is entitled to trade discount on electrical requisites. One day he comes to the conclusion that he will have electric light in his shop instead of gas, or perhaps he requires a telephone installation. He immediately proceeds to obtain the necessary fittings and materials of the wholesale dealers B or C, who allow him the same discount as any of their legitimate customers who stock electrical goods. Then all he has to do is to find a fitter at so much an hour to do the rest. I submit, sir, that he has no more right to that discount than his next door neighbour the butcher, but if B will not allow it C will. This is how the wholesale traders are gradually killing the geese that lay the golden eggs.

One of the Geese.

Replying to "Manufacturer and Designer," the firm of dynamo manufacturers were advised in this particular case that their machine had been recommended and quoted for, and I therefore claim, and am grateful for the sympathy of "Manufacturer and Designer." At the same time it should not be necessary to advise wholesale houses or manufacturers of probable business; the advisability of so doing being to my mind very doubtful.

I quite agree that the question is a difficult one to deal with, and would like to ask "Manufacturer and Designer" the following questions:—Does he get, say, his plumbing, gas fitting, decorating done at trade prices; or furniture, medical supplies, &c., with trade discount? I anticipate not! I fail to see why wholesale houses, to whom the business must eventually come, should, in their anxiety to secure orders, thus allow the efforts of those who have large establishment expenses to be undermined to those whose interests are not strictly electrical.

A Disgusted Retailer.

Controllers for Traction Work.

Can you, or any of your readers inform me through the medium of the Review, wherein lies the patent, if such is the case, regarding the controllers now commonly used for street railway work? Is it in the general construction or in the magnetic blow-out attachment?

J. C.

BUSINESS NOTICES, &c.

Accumulators in Belgium.—A company has just been formed in Brussels with a capital of £20,000, to be known as La Société de l'Accumulateur Tobiansky.

Artesian Wells for Electricity Works.—Following the lead of many large establishments in London the directors of the London Electric Supply Corporation have determined to procure water at their Deptford works from the practically inexhaustible supply in the chalk, for boiler feeding purposes, and it is shown that a very large saving in expense will be effected by thus dispensing with the water company's service. The well, which is being commenced by Merryweather & Sons, will be lined with cast-iron cylinders to exclude surface water, and an artesian boring will be carried into the chalk from the bottom of the sinking. It is somewhat surprising that the number of private wells in London is not greater than it is—particularly in those districts served by water companies whose supplies are liable to curtailment in the dry season.

Bankruptcy Proceedings.—The case of John E. Liardet, engineer, Old Mill Works, Cowley, and 16, Hyde Park Gate, W., came before Mr. Registrar Brougham, last Friday, at the London

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Bankruptcy Court. The Official Receiver reported that the debtor had lodged an application for the Court's approval to a scheme of arrangement providing for the payment of a composition of 7s. 6d. in the pound to the creditors. The liabilities amounted to £13,254, and the sum required for the composition and expenses, about £5,000, had not yet been paid into Court. Mr. Ringwood, on the debtor's behalf, applied for an adjournment. Some delay had occurred in obtaining the money, but it would be in hand very shortly. It was proposed to form a syndicate to take over one of the inventions of the debtor and it had to be examined by an expert, but there would be no difficulty in lodging the money before the next adjournment. His Honour ordered the application to stand over for a month. The debtor has been experimenting in marine, electrical, and hydraulic patents at the Old Mill Works, and he attributes the failure to his inability to realise the patents to advantage.

The first meeting will be held on July 10th, and the public examination on August 3rd, both at Bankruptcy Buildings, W.C., in the case of J. G. M. Hilton, electrician, Bow Common Lane, London.

July 11th and 13th are the dates for holding similar proceedings at Victoria Street, Liverpool, in the case of B. Wild & J. H. Clarke (Wild, Rothwell and Co., general and electrical engineers, Virginia Street, Southport).

In the Edinburgh Bankruptcy Court last week, Stothert McLaren, electrical engineer, appeared for examination. Examined by Mr. George Cowan, S.S.C., the trustee, the bankrupt said he began business in August, 1897, as an electrical engineer. Previous to that he had been in the employment of the Corporation Electric Lighting Department. He also took on an ironmongery stock in addition to his electrical goods. At that time he had practically no capital, but borrowed £275. He had paid back nothing of that money. He first found himself in difficulties about two months ago, while a contract with the Corporation was going on. He attributed his deficiency of £805 to losses on contracts with the Corporation: on the Tollcross power station, £165, and on the City Chambers, £30. To his dealings with ironmongery, £45; to domestic trouble, £35; and to depreciation in the value of his stock, £100. He only kept 30s. a week for himself in order that the business might pay. The value of his contracts while in business would be over £3,000. The state of affairs showed the assets to be £553 and the liabilities £1,358.

At the Bradford Bankruptcy Court on 4th inst., a receiving order was made against the estate of Arthur Blackburn and Arthur Walker, carrying on business at Upper Lane Mills, Cleckheaton, as electricians and mechanical engineers, under the style of Blackburn, Walker & Co.

Liquidations, Dissolutions, &c.—Messrs. W. A. Gent and J. S. Richardson (Gent & Richardson, patentees and electrical engineers, Suffolk Street, Birmingham), have dissolved partnership.

Creditors of the Electrical Time Recording Company, Limited, are required to send particulars of their debts and the usual information to the liquidator, Mr. A. B. Clifton, 31, Bedford Row, W.C., by August 18th.

Creditors of the Fowler-Waring Cables Company must send particulars as to debts, &c., to Mr. J. A. Blackwood, liquidator, 110, Fenchurch Street, E.C., by August 4th.

Blackman Ventilators.—At the Royal Show, Maidstone, last week, the Blackman Ventilating Company, Limited, exhibited a Blackman air warmer and fan, an electric Blackman fan and motor combined, a Blackman fan driven by steam, and a hop kiln in operation (Blackman system).

Clean Boilers—The advantages of a really good preparation for neutralising the scale-forming salts found in most feed waters cannot be overrated, and there are few engineers who would not readily adopt such a remedy if they could be persuaded of its efficacy. From what we learn of "Dejecoline," it certainly appears to be prepared on thoroughly well-known scientific principles; and the manufacturers, who have the great advantage of being analytical chemists, and, therefore, should know their business, make a careful examination of each feed water submitted to them for treatment. On ascertaining the quantity and quality of scale-forming salts existing in the water, they modify their "Dejecoline" boiler fluid to neutralise same. This method, on the face of it, is in accordance with common sense and practical experience, and this specially prepared "Dejecoline" has been found a great success at a number of electric lighting stations in this country. Its increasing popularity is claimed as a proof of its efficacy for the purpose for which it is intended, viz., the removal and prevention of incrustation in boilers and steam pipes.

Coast Defence.—It is stated in the *South Wales Daily News* that the Government is erecting an electrical station and search light at Lower Penarth, for the defence of the Bristol Channel. It will be used by the Severn Submarine Miners. The station is being erected on the highest point of the cliff, which is about half a mile on the Penarth side of Lavernock Point.

An Electric Launch.—No doubt the reason why electric launches have not increased in numbers more than they have has been due to the fact that up to quite recently the various types of batteries available gave only a relatively small output compared with their heavy weight and did not last very long in addition. The following particulars of the recently built electric launch *Magic*, belonging to the Dee River Boating Company, Chester, will no doubt be interesting. It is built to carry 25 people, is 28 feet long, 6 feet broad, and 2½ feet deep, and has a displacement of 3 tons. With a full complement of passengers it has a maximum speed of 8 miles an hour. The battery consists of 26 Headland storage cells made by the Headland Electric Storage Battery Company, London. It has a capacity of 350 ampere-hours and weighs complete only 15 cwt. The normal current discharge rate is 30 amperes at half speed, and 50 amperes at full speed. The greatest distance travelled so far with one charge is about 50 miles at 8 miles an hour, while the battery has already run the launch upwards of 500 miles. The electro-motor is a 3½ H.P. L type "Taunton," taking 50 amperes at 50 volts and 600 revolutions per minute, corresponding to 8 miles an hour. There are two speeds, "half" and "full," and by means of a reversing switch which interchanges the terminals of the field magnet coils, the launch is able to proceed at either of these two speeds ahead or astern as the case requires. In order to obtain the above two speeds the battery is sub-divided, and for starting or half speed the controlling switch puts the battery in two parallels direct on to the motor, while for full speed all the cells are in series and direct on to motor, no resistances being used. The battery is placed in the centre of the launch under the raised floor. The *Magic* is noted for being the fastest electrically-driven launch on the picturesque Dee and has undergone severe trials as regards speed and capacity of the battery, both of which we learn are considered highly satisfactory.

The Institution of Junior Engineers.—The special London district excursion of this Institution took place on Saturday, July 1st, the destination being Hatfield. At Hatfield House a deputation of the party was received by Lord Hugh Cecil, M.P. On the estate are some interesting examples of the application of electric energy for pumping, farm purposes, &c. Visits are to be paid in July to Messrs. Simpson's engine works at Pimlico, and to the Shepherd's Bush electric generating station of the Central London Railway. The summer meeting, occupying a week, commences on August 11th, when Portsmouth and Southampton are to be visited, the president this year being Sir William H. White, K.C.B., F.R.S., Director of Naval Construction and Assistant-Controller of the Navy.

Labour Prosecution.—Messrs. Ashton & Frost, of Blackburn, have just prosecuted 40 men who absented themselves from work at their foundry because of intense heat, the works being stopped for two days in consequence of the action. The magistrates gave a verdict for the employers in the majority of the cases, with nominal damages amounting to 2s.

The Lizard Lights.—In the House of Commons on Tuesday in reply to Mr. Field, Mr. Ritchie said he was informed that for navigation reasons the Lizard lights have been so constructed as to be practically obscured from the adjoining coast, but in any case he did not think that the inquiries suggested by the hon. member as to electric light could lead to any useful result. He believed it to be true that in certain circumstances oil light did to some extent penetrate further than electric light.

Municipal Trading.—In the House of Commons on Monday Mr. B. L. Cohen, L.C.C., asked the First Lord of the Treasury whether, seeing that it had been found impossible this session to appoint the Joint Committee on Municipal Trading, he could give an assurance that the Government would appoint the Joint Committee in question early next session. In reply, Mr. Balfour said he hoped the committee would be appointed as desired.

Nalder & Hilton, Limited (in liquidation).—As will be seen from an advertisement in this issue the debenture holders of the above company are offering the business for sale as a going concern.

Provisional Orders.—The Camborne Electricity Supply Company's Provisional Order Bill, and the Clontarf Council's Bill, were last week certified for second reading; also the East Retford and Swinton Orders.

The Bermondsey Order Bill was read a third time, and passed in the House of Lords, last week. The Grimsby Street Tramways Bill was sent for third reading in the Commons.

The Electric Lighting Provisional Order (No. 5) Bill, which relates to Alloa, Montrose, Kilmarnock, and Inverness, was read a third time and passed.

The Shipley Council's Provisional Order has passed through the House of Lords, and has reached the first stage in the House of Commons.

The Kensington and Notting Hill Electric Lighting Bill has been read a third time and passed in the House of Lords.

The Liverpool Overhead Railway Bill with regard to the running of electric trams throughout the Waterloo district has passed the committee stage and was awaiting the third reading, and will probably receive the Royal assent in the middle of July.

The Kirkcaldy Electric Lighting Bill is to come before the House of Commons as an unopposed measure. A deputation has been in London in connection with the scheme.

Testing.—We have received a neatly arranged and well illustrated booklet showing Atkinsons' Testing Works, Cardiff. The owners of the works are Messrs. L. B. and Claude W. Atkinson, who have opened laboratories for mechanical, electrical, and chemical testing. Pictures are given of the offices and various laboratories and workshops.

Trade Announcements.—Mr. John Meek has been appointed district superintendent at the Edison & Swan United Electric Light Company's West End branch, 53, Parliament Street, S.W., and will represent the company in the S.W. district.

Mr. John Legg, Nelson Street, Swansea, has, it is announced,

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taken his two sons, Messrs. C. and W. Stanley Legg into partnership. Mr. Stanley Legg will undertake electric lighting and general engineering work.

Messrs. A. & W. Hopkins notify that they have taken Mr. Sydney S. Galsworthy into partnership, and that the business having been amalgamated with that of the London Electrical Fittings Company, and registered as a private company, will in future be carried on under the name of "The London Electrical Fittings Company, Limited" under the same management as at present.

Messrs. Barnett & Jones have opened premises at 30, Kingsland Road, N.E., as electrical engineers.

Messrs. Hurst, Nelson & Co., Limited, builders of tramway and light railway rolling stock, &c., intimate that their London office is now at 14, Leadenhall Street, E.C.

ELECTRIC LIGHTING NOTES.

Ashton-under-Lyne.—A trial was made of the public arc lamps on June 29th. The contract has been in hand nearly two years, but was delayed by the strike.

Barnard Castle.—A Newcastle Syndicate proposes to apply for a provisional order for supplying this district. The company will be called the Northern Counties Electricity Supply Company. The utilisation of water-power and some disused woollen mills, is suggested.

Barnsley.—In consequence of the number of applications received for electric light, an additional 250 I.H.P. electric light plant is to be provided at an estimated cost of £2,000; and tenders are to be obtained for enlarging the buildings.

Bermondsey.—The Electric Lighting Committee reported to the Vestry, at the meeting on Monday, that the London Electric Supply Corporation had withdrawn their petition in the House of Lords against the Bill to confirm the Vestry's provisional order, and that the Bill had been read a third time and passed by the Lords. The committee stated that they had referred to a sub-committee the question of inquiring for a site for the erection of a generating station and refuse destructor.

Birmingham.—An electric light installation has been fitted in the Central Free Libraries, with marked advantage to both the readers and the books.

Blackburn.—The General Purposes Committee of the Blackburn Corporation on June 26th advanced the salary of Mr. Giles, the electrical engineer and tramways manager, by £100, to be further increased by a similar amount next year.

Bournemouth.—The electric light installation of the pier and pleasure gardens was formally inaugurated on June 28th. The installation comprises 24 arc lamps and about 100 incandescents. It is probable that the public lighting of the town will shortly come under consideration; the Corporation obtained a license in 1893.

Brazil.—The contract for the electric lighting of the city of Juiz de Fora, Brazil, has been given to Messrs. James Mitchell and Co., of Rio de Janeiro, agents for the General Electric Company of America. The contract includes 50 street arcs and 100 16-C.P. incandescent lights, and also plant for a private lighting capacity of 4,000 16-C.P. lamps. The power will be derived from the Caraudahy Falls, 10 kilometres from the city. It is expected that the service will be inaugurated on January 1st, 1900. We believe that Messrs. Johnson & Phillips and the Brush Company were the only British firms to quote for this work.

Brechin.—Some time ago a company was formed in Brechin and Montrose (under the registered title of the Angus Electric Light and Power Company, Limited) to introduce electric lighting into these towns, and to carry on the business of electrical engineers, electricians, &c. The company has now secured premises in Brechin, and will probably start operations without delay.

Bridgend.—The draft transfer of the Electric Lighting Order to the English Industrials, Limited, has been submitted to the Bridgend District Council. It was considered in committee, but it is understood that it was decided to lay it before counsel for an opinion on it.

Buxton.—The District Council has decided, on the recommendation of the Electric Lighting Committee, to establish an electric wiring department. Two members protested against the injury to private tradesmen that would result.

Chelmsford.—The Electric Lighting Company has declined the offer of the Corporation to purchase the undertaking for £24,000, and has withdrawn the offer to sell. The price asked by the company in the first instance was £42,000.

Cheltenham.—At the last Council meeting the mayor mentioned that, as illustrating the progress of electricity, the number of electric light customers was now 313, taking 20,000 8-C.P. lamps, against 250 customers taking 16,000 lamps last year.

Chorley.—At a meeting of the Chorley Town Council on June 29th, it was decided that a site in Bengal Street, which is the property of the Corporation, was in every way suitable for the proposed refuse destructor house and electric lighting station.

Dartmouth.—The Corporation has referred to committee two proposals relative to the electric lighting of the borough.

Dorking.—The Urban District Council, having entered into a five years' agreement with the gas company, has decided to postpone the installation of electric lighting for that period, and has declined to sell the provisional order to an electrical company.

Drumcondra.—At a meeting of the Urban District Council last week a letter was read stating the terms on which the Dublin District Electricity Corporation, Limited, was prepared to supply electrical energy, viz., 4d. per unit for public and 5d. per unit for private lighting. It was resolved that the Local Government Board be asked that the Council be empowered to enter into such arrangements as they may deem most advantageous with the Dublin District Electricity Corporation, Limited, or others, as they may be advised.

Dublin.—The Carmelite Church, Clarendon Street, has been fitted with a very complete electric light installation, including a 17-H.P. gas engine and dynamo, and a battery of accumulators. The fittings are of a highly ornamental character, and 90 lamps are used, varying from 16 to 200-C.P., making 3,440 C.P. in all. The work was designed and carried out by Messrs. Cummins & Sons, of Dublin.

Edinburgh.—The Electric Lighting Committee, on June 27th, recommended the acceptance of estimates for the extension of the boiler house at Dewar Place station, amounting to a little over £2,000, and estimates for the formation of a siding at M'Donald Road station, amounting to somewhat over £1,000.

Electric Lighting (Clauses) Bill.—On Tuesday this Bill passed through Committee and was reported to the House.

Electric Lighting of St. Paul's Cathedral.—In connection with the offer of a wealthy American (Mr. Pierpoint Morgan) to light the interior of St. Paul's Cathedral with electricity, the *City Press* says that experiments in lighting the vast building have been made. These have proved most satisfactory, and arrangements are in progress to equip the cathedral with the most complete installation of electricity.

Epsom.—Last week the District Council considered in committee the report of Mr. Hawtayne on the electric lighting tenders.

Felling.—The District Council has received notice from the Electric Power Distribution Company intimating that they intend to seek powers to supply electricity in the district.

Gorton.—Mr. Thomas Wright, a London electrical engineer, has been engaged by the Urban District Council to report upon the advisability, or otherwise, of the Council exercising its powers with respect to the supply of electricity to the district.

Heathfield.—A small company has been formed for supplying the district with electricity. It has a capital of £5,000 in £5 shares, and a prospectus has been issued locally.

Henley.—The question of the electric lighting of the borough was brought up at a recent meeting of the Town Council, and it was resolved to make inquiries into the matter.

Kendal.—The results of the recent plebiscite show 183 answers in favour of electric lighting, and applications for 1,584 lamps. It is probable that the matter will now be pushed forward.

Kirkwall.—At a recent meeting of the Town Council, notice was given of the following motion:—That it be remitted to a committee to inquire and report whether it be advisable for the Corporation to introduce into the burgh lighting by electricity.

Lancaster.—Compared with the year 1897-8, there was an increased output last year at the Corporation electricity works; the total being 209,947, against 150,519 units. The expenditure amounted to £1,682, against £1,355, or 1·92d. per unit, against 2·11d. The income was £4,007 4s. 3d., against £2,901 18s. 7d.

Leeds.—Some time ago a sub-committee was appointed by the Electric Lighting Committee of the Leeds Corporation to negotiate the purchase of the Britannia Mills Estate, Whitehall Road, and take into consideration the general question of electrical development in the city. They have decided to instruct Messrs. Hopkinson and Talbot, consulting electrical engineers to the Corporation, to report upon the whole subject, but with special reference to the extension of electric lighting and power to the suburbs—a work rendered difficult on account of the scattered character of the districts

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concerned, and the fact that the present installation, put down by the House-to-House Electricity Company, is not commercially available for power to any great extent. Messrs. Hopkinson & Talbot are to be paid a fee of 200 guineas for their work.

Leek.—The Electric Lighting Committee of the Urban District Council considered returns which had been received from various towns where electric lighting had been adopted, and recommended that Messrs. Morton, Goodwin and Ingham, with the clerk and surveyor, visit two of the following places for the purpose of obtaining further information:—Nelson, Shoreditch, Stafford, or Llandudno. After discussion, the recommendation was agreed to.

Llandudno.—Mr. A. H. Preece's report on proposed extensions came before the Council last Monday. He said that the time had arrived when it was necessary not only to consider the new plant required for the light railway, but also further plant for meeting the large demand for electricity for lighting. The capacity of the works as designed was to meet a demand from 7,000 lamps. There were already nearly 8,000 lamps. He recommended the Council to order at once one boiler, one engine and dynamo. The cost of this would be £3,000, but the additional plant would enable them to supply 12,000 lamps of 8 candle-power. The acceptance of the terms by the Light Railway Company for supplying them with electricity rendered it necessary to be in a position to supply them. The railway was to be ready next season, and the supply of electricity must be ready at the same time. The cost of the plant needed for the railway would be £8,250. The details of the total additions would involve an expenditure of £11,250. The Council has resolved that application be made to the Local Government Board for sanction to borrow for the provision of plant for supplying current to the Light Railway Company, £8,250; and for extension of plant for lighting purposes, £3,000.

London, E.C.—At the Court of Common Council on Thursday last week, Mr Algar, chairman of the Streets Committee, brought up a report relative to proceedings commenced by the City of London Electric Lighting Company against the Corporation in the Chancery Division of the High Court for a declaration that the electric lighting agreements are valid and existing. The committee asked power to defend the action unless the company were prepared to make such terms as regarded efficiency and cost as would confer greater benefits on the consumers and ratepayers, and thereby enable any invalidity of such contracts to be removed, if necessary, by a fresh agreement. Mr. C. T. Harris hoped, for the honour of the Corporation, that the report would not be adopted. The Corporation had hitherto declined to take the step of obtaining the declaration that the contracts were null and void. Mr. Wallace thought the time had come when the whole subject should be dealt with by a special committee. After a long discussion, the report was carried.

The London County Council has decided to approve the plans submitted by Mr. F. Bailey on behalf of the City of London Electric Lighting Company for the construction of an additional boiler house at the company's generating station, 64, Bankside, Southwark.

Malton.—At a meeting of the Urban District Council a letter from the secretary of the Northern Counties Electric Supply Company, announcing their intention of forming a syndicate for the supply of the electric light in the district, was read, and the clerk was directed to acknowledge receipt of same.

Manchester.—The Electricity Committee of the Corporation presented its annual report to the Council on July 5th. For the year ended March 31st there was an increase of 44 per cent. in the output, amounting to 5,633,534 units. The number of consumers on March 31st, 1899, was 2,570, there being an increase of 515 during the year. The total length of mains now laid is 130,457 yards, or 74 miles 217 yards of mains, an increase of 28 miles 1,075 yards during the year. The accounts show that the financial results of the year have been satisfactory. The net profits, after defraying all charges for cost of production, &c., providing for renewals, sinking fund, and interest on loans, amounts to £17,188 8s. 7d. The committee proposes at an early date to ask the consent of the City Council to further reduce the charges for electricity, provision for such reduction having been made in the current year's estimates. The report continues:—"To meet the ever-increasing demand for supply of electricity, new mains are being laid in various parts of the city, and in the districts of Moss Side, Levenshulme, and Withington. It has further been decided to equip a new generating station on the Bloom Street site, which adjoins the present works, and an order has recently been placed with the Westinghouse Electric Company, Limited, for the supply and erection of four 1,800-kilowatt generators. The necessary buildings, boilers, pumps, pipes, &c., will be put in hand forthwith, and it is expected that the whole of this plant will be available for use by the autumn of 1900. In order to carry out various extensions further borrowing powers will be required, and in accordance with a resolution of the City Council application has been made to the Local Government Board for sanction to raise an additional sum of £500,000. The Board of Trade having notified its consent to an extra high pressure supply of electrical energy on the three-phase system being given by the Corporation under the Manchester Electric Lighting Orders, 1890 and 1896, the Levenshulme Electric Lighting Order, 1897, the Moss Side Electric Lighting Order, 1897, and the Withington Order, 1897, your committee will now be enabled to complete arrangements for the supply of electricity to the several out-districts. Agreements have recently been entered into with the Urban District Councils of Denton, Droylsden, and Heaton Norris for the supply of electricity in their respective districts."

Marylebone.—Prof. Kennedy is to be asked by the Vestry to advise them on terms to be proposed for the protection of the Vestry in the dispute with the Metropolitan Electric Supply Company relating to the breaking up of Edgware Road and Queen Street for laying mains from the Willesden station through Marylebone.

Montrose.—In connection with the Angus Electric Light and Power Company, Limited, it is understood that Messrs. Edmundsons' Electricity Corporation has acquired a site at Blackfriars Street, and operations will shortly commence.

Morecambe.—The District Council is standing in its own light, or rather that of the ratepayers, by making the price of energy prohibitive in the case of some of the public entertainment resorts. The Council charges 7d. per unit to companies which do not use the current all the year round, and amongst these are the West End Pier and the Electric Launch Company. The former has reintroduced gas where possible, instead of paying the extra 2d. per unit, while the Electric Launch Company is going to generate its own current. The ratepayers think the Council would be wiser to sell all it can without making the price exorbitant.

Newport, N.B.—Steps are being taken to form an electric lighting company in Newport. The proposal is receiving considerable support from prominent residents.

Nuneaton.—At a meeting of the Nuneaton District Council on June 29th, the Electrical Committee reported that the electric company offered to sell at the amount of the capital expended, plus £500, which practically meant £5,500, and it further appeared that it would be most likely necessary for the Council to obtain another provisional order. The Committee recommended that, in the event of the Council deciding to purchase, the price should be a sum not exceeding £5,000, but, before agreeing to this, a town's meeting should be called to consider the matter. It was resolved that the sum named by the Committee be offered to the company, and if they refused the matter should drop for a time, but if they accepted a town's meeting should be called.

Peterborough.—A special meeting of the Town Council in committee was held on June 23rd to consider an objection raised by Peterborough Trades and Labour Council to the tender of Edwin Danks, Limited, of Oldbury, Staffordshire, for supplying boilers, on the ground that the firm did not pay the standard rate of wages recognised by the trade society in that district. After some discussion the matter was adjourned.

Portsmouth.—A meeting of the Town Council was held on June 27th to consider the annual report of the Electric Lighting Committee, of which an abstract has appeared in our columns. The chairman of the committee stated that after setting aside £5,340, a profit of 3 per cent. remained; the reserve fund amounted to £14,767. In the course of the discussion objection was taken to the recommendation that £1,000 be paid to the Urban Fund in relief of the rates, but in the end the report was adopted *nem. con.*

Rugby.—At a recent meeting of the Urban District Council it was announced that the Rugby Electric Lighting Bill had received the Royal assent. The Act gives the Council sole rights for two years, but it is said that so few applications for supply have been received that further action is not justified as yet.

St. Helens.—With the building of the new electrical generating station in connection with the refuse destructors at Boundary Road, at the opposite side of the town, the Committee had under consideration the demolition of the Warrington Road station. It is now announced that they have decided to keep the old station working, and are recommending the Council to lay mains from it through the principal streets and roads of the Parr and Sutton districts at a cost of £2,000. The consumers at present connected are to be changed over to the new system as soon as possible after the Cropper's Hill power station is completed and ready for supply, at an estimated cost of £850; and a motor generator, with switch gear, is to be erected at the Warrington Road station at an estimated cost of £750. The town clerk is to apply to the Local Government Board for sanction to the borrowing of the sum of £3,600, the total estimated cost of carrying out the works.

Shoreditch.—Mr. N. Moss, chairman of the Lighting Committee, moved the adoption of the Committee's report at Tuesday's Vestry meeting. The Committee stated that they had considered a report from Mr. Newton Russell on the present practice of switching off the arc lamps at 12·45 a.m., and of lighting the incandescent lamps, which was done with the object of saving expense. The chief electrical engineer suggested that as the advantage would be considerable, and the cost only slightly greater, the arc lamps should be maintained alight throughout the night, and the Committee recommended that the suggestion should be adopted. Mr. H. E. Kershaw, as an amendment, proposed that the consideration of the question should be adjourned for six months, until the financial statement relating to the undertaking had been prepared by the accountant. He had just consulted Mr. C. H. Doughty, the lighting engineer, who thought that the additional expenditure likely to be incurred by the adoption of the proposal would amount to £1,320 per annum, but in the opinion of the speaker the expense would be considerably higher, and would mean an increase of ½d. in the rate. Mr. Steel having seconded the amendment, the chairman of the Committee said that Mr. Kershaw's statements came as a complete surprise to him. The chief electrical engineer had advised the Committee that

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the shutting off of the incandescent lamps and the keeping of the arc lamps alight all night would only cost an additional sum of £185 per annum. There was not only the 12s. 6d. as the cost of the incandescent lamps to be considered, but also the £7 12s. 6d. as the price of the automatic switch. The incandescent lamps, of which complaints had been made by the police, might as well be out as alight. Mr. Winkler said the committee were informed on the best authority that the automatic switches did not work properly, and he contended that it was absurd for the glow lamps to be alight in the daytime and extinguished during the night. Mr. Howlett expressed sorrow that Mr. Kershaw was going against the very principle which he had advocated of having more light for the parish. After further discussion the amendment was put to the vote; there were four in favour and the remainder against. The recommendation of the committee was then carried. On the recommendation of the committee an expenditure of £1,140 was sanctioned for the purchase of an additional supply of meters. It was decided to approve the action of the Housing Committee in arranging for the wiring of the staircases of certain model dwellings, so as to enable tenants, if desired, to obtain a supply of electrical energy for a two-roomed tenement at a charge of 8d. per week, and for a three-roomed tenement at 10d. per week.

Southampton.—At a meeting of the Electric Lighting Committee of the Borough County Council last week it was decided, after a lively discussion, that the salaries of the electrical staff should be as follows:—First assistant engineer, increased from £104 to £130, with annual increments of £10 to a maximum of £150; second assistant, increased from £78 to £100, with annual rise of £10 to a maximum of £120; third assistant, increased from £78 to £90, with annual increments of £7 10s. to a maximum of £105. The wages of the drivers, stokers, and switchboard attendants were also raised. The electrical engineer reported that he had communicated with various supply stations where free wiring was in operation, and the replies submitted were, without exception, favourable to the system. The general opinion was that many customers had been obtained who would never have been reached by the ordinary wiring contractor, and that these were usually of the most remunerative kind, being small shopkeepers who used nearly all their Lamps until late in the evening. A letter from the National Free Wiring Company, Limited, stated that it was fully prepared, and would prefer, to make arrangements with local firms to carry out the wiring. The consideration of this matter was deferred.

Southport.—A Local Government Board inquiry was held by Mr. C. Perrin, M Inst.C.E., at Southport, on June 30th, with regard to an application made by the Town Council for power to borrow £55,000 for the purpose of electric lighting. The town clerk (Dr. J. D. Williams) stated that the greater portion of the money for which they now sought borrowing powers was for the extension of their electricity plant for lighting purposes. This would account for about £43,000, and the remaining £12,000 was to provide power for working the tramways in the borough. They had applied for powers to construct new tramlines in the borough, and although they had not actually obtained the Parliamentary sanction, they expected to do so within a few weeks. It was necessary to apply a long time ahead, because there was such a congestion in the electrical world that the lines would be ready before the plant could be supplied by the manufacturers. The Corporation had purchased the lines of the Southport Tramways Company so far as they lay within the borough, and leased them back to the company. That company could not use mechanical traction for the working of their lines without the consent of the Corporation, and the Corporation hoped by supplying electricity at a reasonable rate to secure in the company a regular customer for electricity as a motive power. As for the new lines which the Corporation proposed to lay down, they intended to work them by electricity as a Corporation department. There was another company running in the borough, and the Corporation had the power to buy their lines in two years. Mr. C. D. Taite, the electrical engineer, gave evidence as to the nature of the proposed works, and stated that they had plant now of a capacity of 1,275 kilowatts. They proposed to dispose of three small machines, forming the original installation, of a capacity of 125 kilowatts, and in their place put down one large 600-kilowatt alternator. The net profit in the year ending March, 1898, was £640, and in the year ending March, 1899, £2,027. The maximum load last year increased by 187 kilowatts, and as the applications were coming in at a more rapid rate, they expected a still further increase in the coming year. For the purposes of electric traction, they propose to put down two 200-kilowatt alternators.—Mr. R. P. Hirst, borough surveyor, produced the plans of the proposed extensions of the buildings. There was no opposition to the application, but Mr. Alfred Peck, Rawlinson Road, pointed out that it had not been the practice to seal the meters or indicators, and it was open to any dishonest customer to cook his account.—Mr. Taite stated that the strictest orders had been given that all meters and indicators should be sealed.—The inquiry then terminated, and the inspector afterwards visited the works at Crowlands.

Stoke-on-Trent.—The consideration of the surveyor's report upon an installation of electric lighting for Bucknall has been further adjourned, pending a public meeting of the ratepayers of the township with reference to the proposal.

Sunderland.—A meeting of the Lighting Committee was held on June 30th to consider a report by Mr. Snell, the electrical engineer, with regard to extensions. Mr. Snell recommended that the Dunning Street works be enlarged at an outlay of £34,760, made up as follows:—Buildings, £7,000; four 400-H.P. steam dynamos, £12,000; spare armature, £350; condensers and cooling tower, £3,200; traction switchboard, £1,000; five Lancashire boilers, £32,500; two economisers, motor, feed pumps, hot well, &c., £1,000; steam and feed piping, £2,000; coal elevator and conveyor, £1,200; five mechanical stokers, £600; contingencies (10 per cent.), £3,160. The committee adopted the report, and decided to recommend that the extensions be begun at once, that £40,000 be borrowed, and steps taken to secure a site for a second station.

Swansea.—The Ratepayers' Association has, by a majority of five, passed a resolution in favour of the electric lighting of the borough being left to private enterprise.

Taunton.—At the Council meeting last week the Electric Lighting Committee presented the following report:—

After the resolution of the Council on April 25th last, authorising application to be made to the Local Government Board for their consent to a loan of £10,000 for condensing plant, accumulators, and extensions, your Committee considered it advisable to consult Messrs. Kincaid, Waller & Manville, the engineers acting for the Council in laying down the new arc lighting plant, &c., upon some of the items set out in the borough electrician's estimate produced at the before-mentioned meeting. Messrs. Kincaid & Co., made some valuable suggestions, and at your Committee's request, drew up a report with revised estimate. It will be seen from Messrs. Kincaid & Co.'s estimate that, in addition to the condensers, they provide for other plant which will effect a further saving in working expenses, as well as for accumulators and the extensions contained in the estimate of the borough electrician; but the amount of the loan required, namely, £10,000, is not increased. Your Committee recommend the Council to act under the report and advice now given by Messrs. Kincaid & Co., and to accept and pass their estimate in lieu of the estimate passed at the meeting of the Council on April 25th last; and so far as may be necessary, your Committee recommend the rescindment of the resolution passed at that meeting adopting the estimate then produced; and they recommend that application be made to the Local Government Board for sanction to borrow the sum of £10,000, repayable in 30 years by means of a sinking fund, for the works comprised in Messrs. Kincaid and Co.'s estimate. The Council are also asked to sanction your Committee at once obtaining tenders for the condenser and other plant mentioned in the estimate.

Messrs. Kincaid, Waller & Manville's report was of a lengthy character. In relation to the extensions of the station itself, it stated that "to produce the maximum possible efficiency in working, we consider that further economies can be obtained in two directions—(1) by installing a condensing plant in connection with the existing engines; and (2) by installing an economiser to decrease the amount of coal burnt to attain a given result."

Todmorden.—The Town Council has appointed a committee to inquire into the question of electric lighting and traction, but as the gasworks, acquired a few years ago, have just begun to pay, it is somewhat doubtful whether anything will be done in the matter. Todmorden has suffered severely from gas and water monopolies, and is now very jealous of private companies.

Uckfield.—The Rural District Council has received formal notice from Messrs. Verrall & Borlace, solicitors of Brighton, of an application which is to be made to the Board of Trade for a provisional order to supply electricity throughout the parishes of Rotherfield, Buxted and Withyham.

Wellingborough.—The Council has received a letter from the Electric Power Distribution Company urging that the electric lighting matter should be advanced at as early a date as possible. A special meeting of the whole Council in committee was to be held last Monday.

Worksop.—The clerk to the Urban District Council reported that the Worksop Electric Light and Power Bill had received the Royal assent, and was now in operation.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—At a meeting of the Tramways Committee on June 29th it was decided to lay additional cable ducts from the electric works to Market Street, with a view to further extensions, after the opening of the Woodside track. At a meeting on June 30th it was agreed to give Mr. Bell, the electrical engineer, £50 per annum for his work in connection with the tramways, and the Lighting Committee resolved to increase his salary from £225 to £250 per annum.

Bangor.—At a meeting of the Committee of the Privy Council held on June 30th at Dublin Castle, an application on behalf of the Drake & Gorham Electric Power and Traction Company, Limited, was made, praying for an Order in Council authorising the construction of a tramway in the town of Bangor, and from Bangor to Donaghadee. The Right Hon. the Lord Chancellor, and subsequently Lord Justice Fitzgibbon, presided. The routes of the tramways, six in all, were described in detail; the total length of tramways is 10½ miles, and the engineer's estimate of cost is £92,000, including lands, buildings, rolling stock and electrical equipment. The maximum limits of speed proposed are 8 miles per hour through towns and villages, 12 miles per hour along roads where the outside rail is less than 30 feet from the centre of the road, and 25 miles per hour where the tramway is securely fenced off or enclosed.—Sergeant Dodd, Q.C., in making the application on behalf of the promoters, said the scheme had been approved by the County Down Grand Jury, the Bangor District Council, the county surveyor and the Board of Works. There was little or no opposition, objections having been met by alterations in the draft order. Some minor amendments were accepted, and the Council passed the order as amended.

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Bradford.—At a meeting of the Tramways Committee on June 28th, the returns showing the results of the working of the electric tramways for the fortnight ended June 25th, 1899, were presented. On the Bolton section 4,720 miles have been run, and the receipts amount to £251 12s. 11d., which is equal to 12·79d. per car mile. The total receipts from April 1st amount to £1,535 11s. 3d., or 12 28d. per car mile. On the Horton section, during the past fortnight, 10,077 miles were run, and the receipts were £684 10s. 4d., which is equal to 16·3d. per car mile. The total receipts from April 1st amount to £3,134 19s. 3d., which is equal to 13 68 per car mile.

Brazil.—An electric railway 15 miles in length will shortly be opened at Manaos. The company carrying out the work is incorporated under the laws of the State of New York, and, as may be guessed, all the machinery, cars, rails, &c., is being supplied by firms in the United States. Manaos is a rising city, and in the exportation of rubber alone will, in a year or two, surpass that of Para, which city, up to 1897, had the bulk of the trade.

Cheltenham.—A public inquiry having been held at Cheltenham by the Light Railway Commissioners into an application for an order to authorise a light railway to be laid through the town of Cheltenham and the village of Prestbury up to the top of Cleeve Hill, the Commissioners have decided to authorise that portion of the railway from Cheltenham to Cleeve Hill, rejecting the greater part of the line within the town of Cheltenham.

Douglas—Ramsey.—The first car to pass over the completed line from Douglas to Ramsey ran on Monday night. In a few days there will be a regular service of cars between Douglas and Ramsey, doing the journey in little over an hour, opening up entirely new scenery to visitors.

Dudley and Stourbridge. — Pending the visit of the Board of Trade official to inspect the line from Dudley to Stourbridge, which has now been electrically equipped, electric cars have been running almost daily for the instruction of the motor men.

Eccles.—The sub-committee appointed by the General Purposes Committee have presented their report to the Council upon the proposal of a syndicate to connect Whitefield, Radcliffe, Little Lever, Farnworth, Worsley, Eccles and the Ship Canal by means of an electrically equipped system of tramways. It has been agreed to support the scheme, and also the action of the Swinton Council with regard to their tramways.

Electric Power for Kalgoorlie Mines.—The financial papers have just given particulars of a scheme which is now in progress for giving a supply of electric current to the leading mines. Prof. Geo. Forbes and Messrs. Belshaw & Co., electrical engineers, have been consulted in regard to the scheme, and a site has been chosen for generating works to the north of and adjoining Boulder City. It is estimated that there would be a saving of nearly £250,000 per annum to the mining industry on a consumption of only 5,000 horse-power, as it would be possible to retail the motive power to the mines at under 4s. per horse-power per day. The revenue to the General Power Company is set down at over £90,000 a year. The lighting of Boulder City, the running of trains for the Government, and the lighting of Kalgoorlie itself are to the proposal incidentals of considerable value.

Glasgow.—The detailed statement of the revenue and expenditure of the Corporation Tramways, for the year from June 1st, 1898, to May 31st, 1899, has been issued. The result of the year's working shows that the revenue amounted to £439,224 1s. 8d., and the working expenses to £318,105 18s. 1d., thus leaving a gross balance of £121,118 3s. 7d. The horse traction receipts amounted to £416,184, and the working expenses to £307,542, while the receipts from the electric cars amounted to £23,039 and the expenses to £10,563. To obtain these results the enormous number of 118,775,668 passengers were carried. The cars run each day averaged 305 85, and the mileage covered was 9,071,640, against 8,483,012 the previous year, at an average rate of 11·46d. per mile, against 11·01d. in 1897-98. At May 31st last, 35 electric cars had been built in the car works, and arrangements have been made for building 60 additional during the current year. As the accommodation in the car works is limited, it has been resolved to give some orders to outside car builders, so that the department may have a sufficient number of electric cars by the time the first considerable section is opened for electric traction. With regard to the conversion of the whole of the tramways to the overhead electric system, the report states that the conversion of the track is now being proceeded with in sections, and increased accommodation is also being provided at several of the depôts, as well as at the Coplawhill car works. The erection of the main generating station at Port Dundas is being proceeded with; and the scheme approved by the Corporation for numerous important extensions, both inside and outside the city, measuring in all 19 miles of double track, includes extensions to Shettleton, Tollcross, Rutherglen, Cathcart, Pollokshaws, Paisley, &c. Satisfactory agreements have been entered into with the authorities concerned.

Halifax.—The electrical engineer to the Halifax Corporation (Mr. H. F. Street) has presented to the Council a lengthy and exhaustive report in regard to the future requirements of the municipality under the altered conditions since the construction of the tramways. He points out that with an extended tramway scheme, sub-stations several miles out of Halifax will be required, and these must be supplied with power by means of polyphase distribution. At present, he says, electricity for lighting is generated at high pressure —2,000 volts—at Foundry Street, and is, by means of transformers fixed at suitable points, transformed to a low pressure—200 volts—which lights the lamps. He suggests that the area thus supplied should be lighted by the direct current, and this would result in all the large transformers being released for other work in distant parts of the town. He asks the Electricity Committee to discuss the following suggestions:—(1) To convert the two 600-H.P. alternators, at an estimated cost of £1,000, into tramway power generators, and to put down new plant for lighting the centre of the town; (2) to change the standard pressure from 100 to 200 volts, thereby doubling (*sic*) the capacity of the low tension network; and (3) to relay the cables in bitumen, thereby more than doubling their life. He points out that if the system were changed, and new direct current machines obtained, these could be used either for tramway or lighting work.

The Tramways Sub-committee having viewed the various routes, has agreed to recommend to the Town Council the construction of the following new lines:—To Elland; from King Cross, along Burnley Road, to Hebden Bridge; to West Vale and Holywell Green; and in Parkinson Lane in the borough.

Lanark.—The County Council has received a letter from the town clerk of Hamilton as to a conference on promoting a scheme of electric or other traction in connection with the more populous districts in the Middle Ward. The letter has been referred to the Committee engaged in dealing with the matter, as it affects Hamilton, Motherwell, and Wishaw.

Leeds—Rodley.—The movement having for its object the extension of the Leeds tramways to the city boundary at Rodley is taking concrete form. A petition for presentation to the chairman and members of the Tramways Committee of the Leeds City Council has been drawn up, and is being numerously signed by the ratepayers and residents of Rodley. The petition points out that the object of the petitioners is to induce the Committee to extend the city tramway system to the borough boundary at Rodley. The hon. secretary of the movement has made arrangements for the deputation appointed at a public meeting to wait upon the Leeds Tramways Committee on the 10th inst.

Leeds—Guiseley.—A deputation from Messrs. Greenwood & Batley attended a joint meeting of the Yeadon and Rawdon District Councils on June 29th, to explain their proposed scheme of tramways from Leeds to Guiseley. The deputation stated that the maximum fare would be 1d. per mile, with certain cars daily at ½d. per mile. The local authorities could purchase the concern at the end of 42 years at its then value. A plan was presented showing the route of the proposed tramway, with branches to Horsforth, Woodside, and Yeadon. It was stated that the Corporation of Leeds would probably extend their system from the present terminus at Kirkstall Abbey to the city boundary to join the new line. After the deputation had retired, the Yeadon Council passed a resolution in favour of the company's scheme; the Rawdon and Horsforth Councils are also favourable to the project, so that it is expected that the three authorities will shortly grant permission to Messrs. Greenwood & Batley to obtain a provisional order.

Liverpool.—An official inspection was made on Tuesday of the electric tramways on the Smithdown Road route by the Lord Mayor and the members of the Tramways Committee of the Corporation. Among those accompanying his lordship were Councillor W. W. Rutherford, chairman of the Tramways Committee, Alderman Fred Smith, deputy chairman, Mr. J. A. Brodie, city engineer, Mr. Holmes, electrical engineer, Mr. Bellamy, tramways manager, Mr. Forbes Higginson, representative of Messrs. Blackwell & Co., and the representatives of Messrs. Dick, Kerr & Co. The lines inspected start at the junction of Upper Parliament Street with St. James Place, and pass along Upper Parliament Street and Smithdown Road to the new car shed on the Richmond Lodge Estate, near the junction of Penny Lane with Smithdown Road. The total length of single track is about 4⅔ miles, which, together with the lines already opened in the city, make a total length of 14½ miles now being worked by electric traction. The electric equipment is of the overhead trolley type throughout the route. The power for working the line is obtained from the Smithdown Road destructor. The cars for working the lines are now in course of being built, viz, ten by Messrs. Dick, Kerr and Co., Limited, five by the Westinghouse Electric Company, Limited, and five by the Brush Electrical Engineering Company, Limited. Of this number of cars only four have up to the present time been delivered. The Liverpool Corporation, by their own workmen at the Lambeth Road carriage works, are also constructing six cars, the trucks, motors, and electrical equipment being supplied by Messrs. Dick, Kerr & Co., Limited. The permanent way consists of girder rails weighing 95 lbs. per lineal yard, double-bonded at each joint, and laid on Portland cement concrete. The paving, where new, has been executed with Welsh granite setts, with the exception of a length adjoining the workhouse hospital, which has been laid with West Australian hardwood. The paving of the remainder of the line has been taken up and relaid, new material being added as required. The company left St. George's Church at noon in two special cars, the one in which the Lord Mayor travelled having been built at the Lambeth Road carriage works by Corporation workmen. It was much admired, both as to construction and design, and it was stated to be 4½ cwt. lighter than the electric cars now in use. Reversible seats are provided on the top, and there is accommodation for about 60 passengers, inside and outside. The line is to be opened for traffic next Monday. The trial run was in every way most successful. The party afterwards proceeded to Heathfield, the residence of Councillor Rutherford, and were hospitably entertained by that gentleman and Mrs. Rutherford.—Councillor Rutherford said it would be a fatal mistake to suppose that they could judge from horse traction what were going to be the developments of electrical traction. Nobody could judge in advance what would be the outcome of cheap, rapid, and commodious locomotion for the public. He believed that their estimate of 600 cars for Liverpool would eventually reach 1,200, that their idea of 85 miles of tramway lines would end in 150 miles, and

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that the number of passengers would be at least double what they now anticipated. Electric tramways commended themselves to the common sense of the major portion of the community, and the sooner a general system was completed in Liverpool the better for everybody. In submitting the toast of "The Engineers and Contractors, Messrs. R. W. Blackwell & Co., and Messrs. Dick, Kerr & Co.," he declared that at the present rate of progress it would take 12½ years to equip the whole of Liverpool with electric traction. His suggestion was that five or six young engineers should be employed to take charge of different sections of the route. The Corporation themselves might purchase rails, cement, and all materials, and let the whole construction out on mile tenders. By that means the work would be completed within two years.

London, Walthamstow and Epping Forest Railway.—The Great Eastern Railway held a special meeting on 3rd inst., to consider the above railway scheme, which will have connection with the Great Eastern Railway at certain points. Two of the G.E.R. directors will be on the board of the Walthamstow Company. The meeting decided to approve the Bill. It was stated that it was proposed to work the line wholly or in part by electricity.

Lowestoft.—The Light Railway Commissioners have sanctioned the scheme of electric tramways from the harbour to Kessingland, about 5 miles through the southern portion of the borough. A similar scheme for North Lowestoft has been rejected.

Manchester.—It would seem that, after all, Manchester is to carry out the overhead trolley system which has already been authorised by the Corporation. At a special meeting of the Tramways Committee of the City Council, on July 4th, a motion was brought forward in favour of a sub-committee being appointed to visit New York and Washington and inspect the conduit system in those cities, with a view to reporting on its suitability for the central portion of the City of Manchester. After a lengthy discussion the resolution was rejected by seven votes to two. At a meeting of the Council on the following day the action of the committee was confirmed.

Some time ago the Waterworks Committee requested Prof. Kennedy to report on the practicability of utilising the power of the compensation water from the Longdendale Valley. The report has now been issued; after going very fully into details, Prof. Kennedy shows that the capital charges would be so heavy that the cost of production would be nearly double the cost of generation with steam plant. The matter will therefore, no doubt, be dropped.

Mirfield.—At a meeting of the Urban District Council on June 28th notice was given of a motion to approach the Huddersfield Corporation with a view to inducing the latter to extend its tramway system from Bradley through Mirfield to Ravensthorpe.

Newcastle-on-Tyne.—Following his visit to America, Prof. Kennedy has now reported to the New Tramways Committee of the Newcastle Corporation. His advice was asked in regard to the possibility of avoiding overhead wires in the busy centre of the city by the substitution of the conduit system. It is understood that he states that there is no difficulty whatever in working the overhead and conduit systems in conjunction with each other; but as to the advisability of doing so he does not give any definite recommendation. At the same time, he takes occasion to point out that the conduit system is not desirable for any gradients, and is more for the perfectly flat situations of Continental towns. Even the gradient in Grainger Street between the Central Station and the Bigg Market, he seems to think would be a trial for the conduit service.

Nice.—A commencement was made last year towards utilising the considerable water-power of the Nice district for electrical purposes. A company was formed, which at once took in hand the Var, at the point called "La Mescla," where it is confined in a narrow gorge. We read in the *Engineer* that a tunnel was pierced through the solid rock of some 600 metres in length into the Vallon de Fenouillet, where a large reservoir has been formed, and whence the considerable fall thus obtained is about to be utilised by the Electric Tramways Company, which is literally taking possession of the whole littoral, to the great disgust of this aristocratic neighbourhood, and more especially of Cannes, where but one road exists to join the east and west portions of the place, and that a narrow one at the best. Protests, says a consular report, are rife, but have proved useless so far, as far as Cannes is concerned, and at Nice a great effort is being made to save the beautiful boulevards, shaded by fine trees, and bordered by handsome houses, from this invasion.

Peterborough.—Mr. S. Sellon and Mr. Parris, of the British Electric Traction Company, waited on the Peterborough Corporation on June 30th with regard to the widening of Narrow Street, and pointed out the necessity of settling the preamble of the Bill. The company proposed to omit all reference to Narrow Street for the present, in order to get on with the rest of the scheme. Eventually the matter was left over.

Pontypridd.—The District Council has, it is stated, decided to oppose the electric tramway scheme on the ground that having regard to the congested condition of the streets it is inadequate.

Portsmouth.—At a Council meeting on June 27th the Tramways Committee recommended the employment of an expert at an inclusive fee, and of a person to superintend the work in connection with the transfer of the tramways to the Corporation and the introduction of electric traction. As the report of the committee was issued some time ago, and changes had taken place in the meantime, it was decided that it should be withdrawn and a new report presented.

A Record Mote.—It is stated that a motor car belonging to the Electrical Undertakings, Limited, with Leitner accumulators and motors, ran from Westminster to Brighton on one charge at an average speed of 12 miles per hour. This is a record, and is the more remarkable seeing that the battery had already run over 500 miles; the run was superintended by two experts.

St. Helens.—The electric tramway is now approaching completion, and an unofficial trial run was made on June 30th at 11 p.m. The trial was perfectly successful, and a steep gradient was overcome without difficulty. The car was in charge of Mr. Highfield, the electrical engineer, and Mr. Isaac Cutler, secretary and manager. Power was supplied from the new electricity works at Boundary Road. Large numbers of people were present at the trial, in spite of the lateness of the hour and heavy rain; and great satisfaction was expressed at the admirable behaviour of the car and machinery.

Spen Valley.—The agreement between the Cleckheaton and Heckmondwike District Councils and the Dewsbury Town Council with reference to the proposed joint electric tramway was on June 27th ratified by the Cleckheaton General Purposes Committee. The agreement pledges the authorities to oppose the scheme of the British Electric Traction Company, Limited, and to promote the joint undertaking by an application to the Light Railway Commissioners in November; and it provides that the undertaking shall be worked by a joint committee of 12, six representing Dewsbury and three each Heckmondwike and Cleckheaton, and that the cost shall be apportioned on the basis of population. The system proposed is the overhead trolley system, and the electrical energy is to be supplied up to the Heckmondwike boundary by the Dewsbury Corporation, and for the remainder by Heckmondwike and Cleckheaton, as may be arranged. Provision is made for local extensions by each authority within its own district, and any matter of difference or dispute is to be referred to the Board of Trade.

Sunderland.—At a meeting of the Tramways Committee on June 26th, it was decided to engage counsel and send witnesses in view of the opposition of the Southwick Urban Council and the North-Eastern Railway Company to the Sunderland Tramways Bill in the House of Commons. The electrical engineer suggested that there should be a shed for cars on each side of the river, and that they should be placed as near as possible to where electric energy is stored for lighting purposes, so that one set of men can look after both lighting and tram locomotion. The consideration of this matter was held over to a future date.

Surrey.—A meeting of a committee constituted to represent the various local authorities in the northern part of the county of Surrey took place at Kingston on Saturday, to further consider the question of providing light railways or tramways in the county. The chairman disclaimed any desire on the part of the Council to control the local authorities in the matter, or to establish lines for its own profit, but pointed out that local lines such as it is suggested to construct in the borough of Kingston and elsewhere would be of little use comparatively unless they were connected, and in regard to this the County Council could render valuable assistance. While desiring to work in amity with the London County Council for mutual advantage, he thought they would all agree that Surrey was quite rich enough and clever enough to establish and manage its own tramways. It was unanimously resolved:—"That, in the opinion of this conference, it is desirable that the Surrey County Council should prepare a general plan and scheme for tramways or light railways for the county, or such parts thereof as it may be deemed expedient to provide with this means of communication, and that the local authorities should be invited to supply the County Council with the particulars of their views and proposals in relation thereto."

TELEGRAPH AND TELEPHONE NOTES.

Telegraphic Interruptions and Repairs:—

CABLES.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa ...	April 4th, 1898 ...	...
Bonny-Cameroun	May 29th, 1899 ...	...
Latakia-Cyprus	June 21st, 1899 ...	...
Para-Maranham	April 10th, 1899 ...	...
LANDLINES.		
Communication between Salonika and Monastir	March 16th, 1899 ...	...
Port au Prince-Jeremie	June 14th, 1899 ...	June 29th, 1899

The Telephones Bill.—The following members were added to the Standing Committee on Trade for the purpose of considering the Telephones Bill:—Mr. Bartley, Mr. Bigg, Mr. Griffith Boscawen, Sir C. Cameron, Mr. Cawley, Mr. T. Curran, Mr. Fry, Mr. Hanbury, Mr. Lough, Mr. C. M'Arthur, Mr. Nicol, Mr. J. Redmond, Mr. Strutt, Mr. A. Thomas, and Sir J. Woodhouse.

(*Continued on page* 24)

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THE HULL ELECTRICAL TRAMWAYS.

On Wednesday last the Hull electrical tramways were officially opened, the Board of Trade inspectors having provisionally passed the lines on the two previous days. The following was the programme of the inaugural proceedings:—

The members of the Corporation and others were to assemble at the power station, Osborne Street, at 2.30 p.m., and on the request of Alderman Larard (chairman of the Works Committee) the Mayor (Councillor W. A. Gelder) was to open the power station, and Alderman Wilde (deputy chairman of the Works Committee) start the first engine. On behalf of the Corporation the Mayor was to make a presentation to Mrs. Larard in commemoration of the opening of the electric tramways and as an acknowledgment of the able and devoted services of Alderman Larard in promoting the establishment of a system of electric traction for the city.

From the power station the party was to proceed by way of Waterhouse Lane to St. John Street, where Alderman Larard, on the request of the Mayor, was to start the first electric car. The party was then to be conveyed in tramcars over the Anlaby Road and Hessle Road tramway routes, and visit the car shed, Liverpool Street, where refreshments would be partaken of on the invitation of the Mayor. The party was then to return to the city in the tramcars.

Prior to the year 1895 the tramways in the city, with the exception of those on one road which are worked by steam power, were worked by horses and owned by a private company. In 1889 the company was wound up, and an official liquidator appointed by the Court of Chancery. Owing to the dilapidated and extremely defective condition of the tramways, complaints by the inhabitants were made to the Board of Trade, and eventually the official liquidator approached the Corporation with the object of purchase by them. After considerable negotiation the undertaking was purchased by the Corporation in 1895, for the sum of £12,500, which amount included the tramways and depôts but not the rolling stock. The Corporation thereupon decided to apply for powers to construct double lines of tramways in the streets in which the old tramways were laid, and accordingly they obtained a provisional order in the year 1896. This order confirmed the agreement for the purchase of the undertaking from the company, and also enabled the Corporation to work the tramways when reconstructed. Pending the reconstruction of the tramways, they were let to a local contractor at a rental of £100 per annum, the understanding being that, upon the Corporation requiring any section or road, the trams thereon should cease running, to enable the work of reconstruction to be carried out. Before deciding upon the system of electric traction which should be carried out on the new tramways, the Corporation appointed a deputation to visit other cities and towns to inspect the various systems in use, and this sub-committee presented a comprehensive report, in which they recommended the use of the overhead trolley wire system. This recommendation was confirmed by the Corporation, and the city engineer and electrical engineer thereupon prepared specifications for the works. The street works portion comprising two roads, viz., the Hessle Road and the Anlaby Road, was duly advertised to be let by tender, and the tender of Mr. Edward Nicholls, of Morecambe, was accepted. The contractor commenced operations, but after a short period had elapsed financial difficulties overtook him, and the Corporation took the contract out of his hands, and have finished the work with their own staff, under the supervision of Mr. A. E. White, city engineer.

The laying of the first rail took place on June 9th, 1898, the ceremony being performed by Alderman Larard.

The manager is Mr. W. J. McCombe, and the joint engineers are Messrs. A. E. White, M.I.C.E., city engineer, and A. S. Barnard, M.I.E.E., city electrical engineer.

Messrs. Siemens Bros. & Co., Limited, contracted for the electrical and overhead equipment and some motor cars, with Messrs. G. E. Belliss & Co., Limited, as sub-contractors for the engines. The boilers were supplied by Messrs. E. Danks & Co., Limited, Oldbury; the mechanical stokers by T. T. Vicars, Limited, Earlestown; pipe work, &c., by Rose, Downs and Thompson, Hull; electric pumps by Thomas Parker, Limited, Wolverhampton; economiser by E. Green & Sons, Limited, Manchester; rails by the Société Anonyme des Acieries d'Angleur, Liége; additional cars by the Westinghouse Electric Company, Limited, with Messrs. G. F. Milnes & Co., the Brush Electrical Engineering Company, Limited, and the Brill Company as sub-contractors.

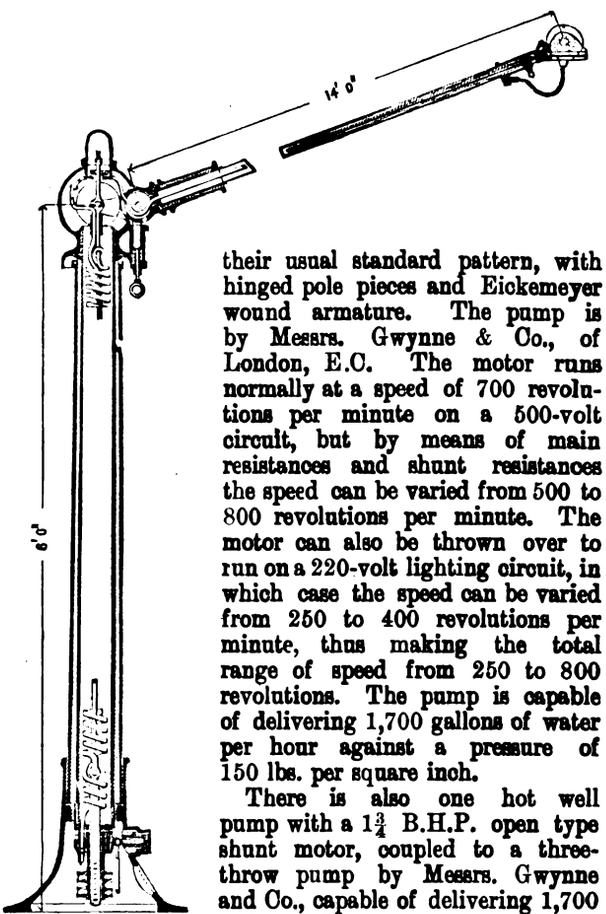
The length of the lines to be electrically equipped includes nine miles of double track, and rather over half a mile of single track. It is divided into six routes radiating in all directions from the centre of the city, but up to the present only two of these routes, or about 3½ miles of double track have been taken in hand and completed.

The generating plant consists of three Siemens H.B. 30/40 traction dynamos, each giving 550 amperes at 500—550 volts. These are coupled direct to Belliss T.E.C. 5 compound self-lubricating engines, giving 470 I.H.P., and for short periods a maximum of 700 I.H.P. when running at 360 revolutions per minute, with a steam pressure of 140 lbs., and exhausting into a condenser with a vacuum of 26 inches. Extra heavy fly-wheels are fitted, and the throttle-valve governor has been carefully designed to secure a very small speed difference with great variation of load.

The boilers are of steel, 30 feet by 8 feet, fitted with Vicars mechanical stokers, which are driven from a shaft connected by worm gear to a Parker 4½-B.H.P. ironclad motor.

The condensing plant consists of a Belliss circular cast-iron surface condenser with gun-metal tubes and having a cooling surface of 2,000 square feet.

The electric pumps consist of one three-throw ram pump driven by a 9 B.H.P. motor by Thomas Parker, Limited, of their usual standard pattern, with hinged pole pieces and Eickemeyer wound armature. The pump is by Messrs. Gwynne & Co., of London, E.C. The motor runs normally at a speed of 700 revolutions per minute on a 500-volt circuit, but by means of main resistances and shunt resistances the speed can be varied from 500 to 800 revolutions per minute. The motor can also be thrown over to run on a 220-volt lighting circuit, in which case the speed can be varied from 250 to 400 revolutions per minute, thus making the total range of speed from 250 to 800 revolutions. The pump is capable of delivering 1,700 gallons of water per hour against a pressure of 150 lbs. per square inch.



Siemens' Trolley Pole.

There is also one hot well pump with a 1¾ B.H.P. open type shunt motor, coupled to a three-throw pump by Messrs. Gwynne and Co., capable of delivering 1,700 gallons of water per hour against a head of 25 feet. By an arrangement of switch gear similar to the above, this motor may be run at speeds varying from 700 to 1,200 revolutions per minute on a 500-volt circuit, and from 350 to 600 revolutions on the 220-volt circuit.

The Wolverhampton firm also supplied the switchboards mounted on teak frames, containing the throw-over, starting, and regulating switches necessary for the above motors.

The condensing water is taken from the Dock some 100 yards away, and an Empire Company's steam air exhauster

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is fixed on the suction pipe for starting the circulating pump which circulates the condensing water.

The steam connections to the engines from the main steam range, and the cast-iron exhaust piping to condenser and alternative to atmosphere were supplied and fixed by Messrs. Rose, Down and Thompson, of Hull, who are also supplying a water softener and feed water filter. The remainder of the pipework and the boiler house plant has been executed under another contract.

The economiser is one of Messrs. Green's modern description, containing 256 pipes, equalling 2,618 square feet of heating surface. It is arranged on the maker's modern principle in two groups with a passage between and one round one side of the apparatus, so as to give easy facilities for cleaning, &c. It is made from specially constructed patterns to withstand the high pressure at which the plant is going to work.

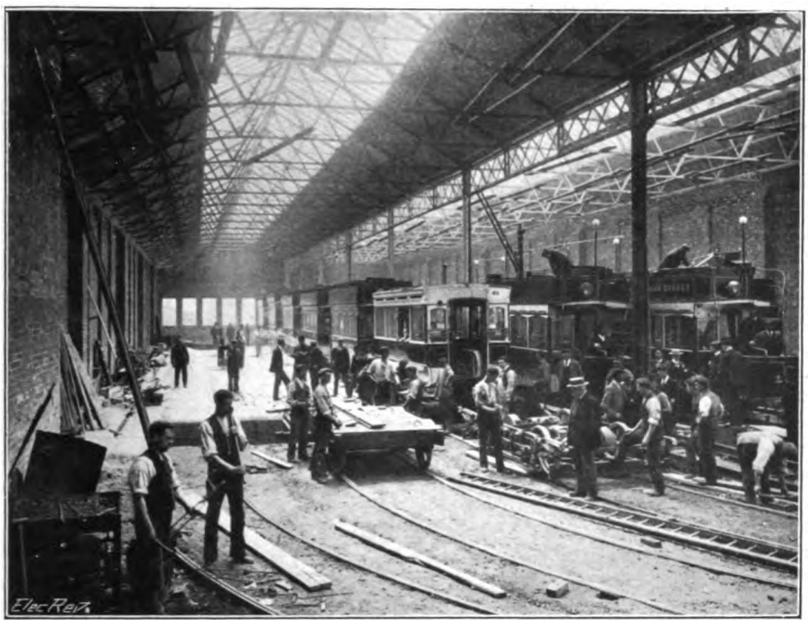
The main switchboard consists of three machine panels, two feeder panels, and one panel for the instruments prescribed by the Board of Trade. The panels are of white marble, fixed on iron frames, which are bolted together, the board being thus very adaptable for extensions. With the exception of the switch handles, no wood of any kind is used on the board, thus rendering it perfectly fireproof.

Each machine panel carries on the front:—Weston ammeter, Kelvin electrostatic multicellular voltmeter, main and equalising knife switches, shunt breaking switch interlocked with main switch, shunt regulating switch 25-way.

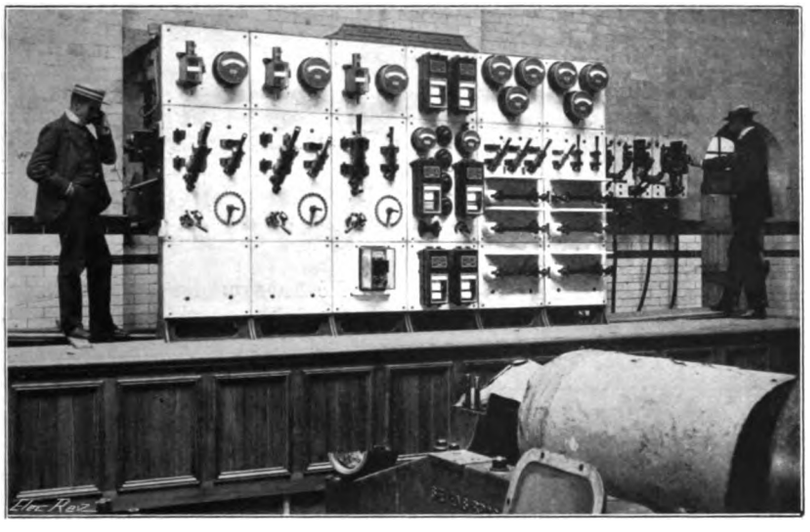
On one of the machine panels is mounted, in addition, a Thomson-Houston meter with a capacity of 1,500 amperes at 550 volts, measuring the energy supplied to the feeder panels. On the back of the machine panels are the ammeter shunts, positive, negative, and equalising bus bars, cast-iron boxes containing the shunt-breaking resistances, and on one of the panels a set of links for short-circuiting the wattmeter.

Each feeder panel carries on the front switch gear for three feeders, as follows: Weston ammeters, S.P. feeder knife switches, feeder fuses. These latter are designed with a view to special facility in removing and replacing, the complete fuse being held in spring clips. These latter are protected by porcelain covers, and marble distance pieces are used between the fuses. At the back of the feeder panels are fixed the instrument shunts, positive and negative bus bars, and on one panel a Garton Daniels lightning arrester.

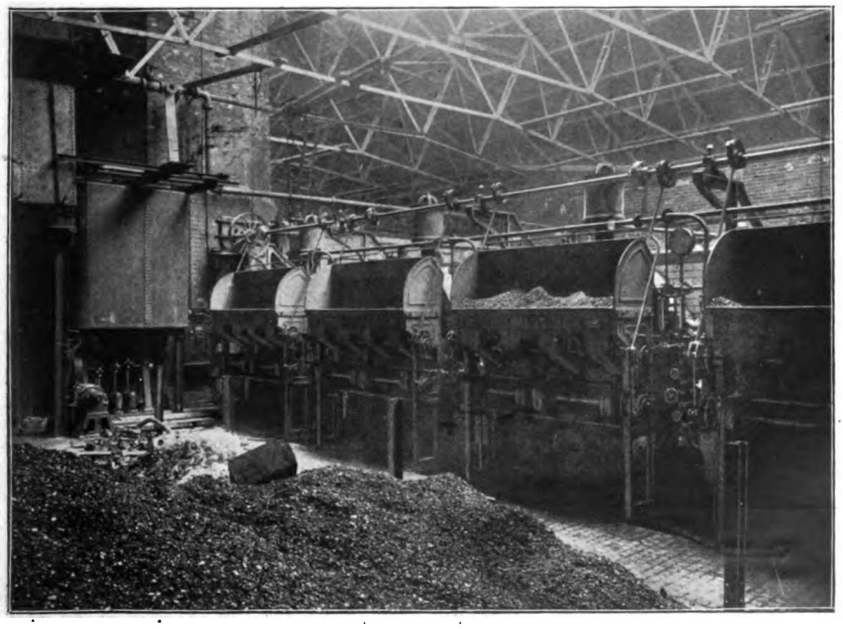
The Board of Trade panel carries on its front:—One recording ammeter, and three recording voltmeters of Messrs. Elliott's make. Two Weston K type ammeters, one having two scales; four multiple way voltmeter switches for recording the pressures at the feeding points, one three-way switch, one two-way D.P. switch. On this panel are also mounted the main recording ammeter



Turner & Drinkwater,] HULL TRAMWAYS CAR SHED. [*Photographers.*



Turner & Drinkwater,] HULL ELECTRICAL TRAMWAYS SWITCHBOARD. [*Photographers.*



Turner & Drinkwater,] HULL TRAMWAYS BOILER HOUSE.—PARKER ELECTRIC PUMPS ON LEFT. [*Photographers.*

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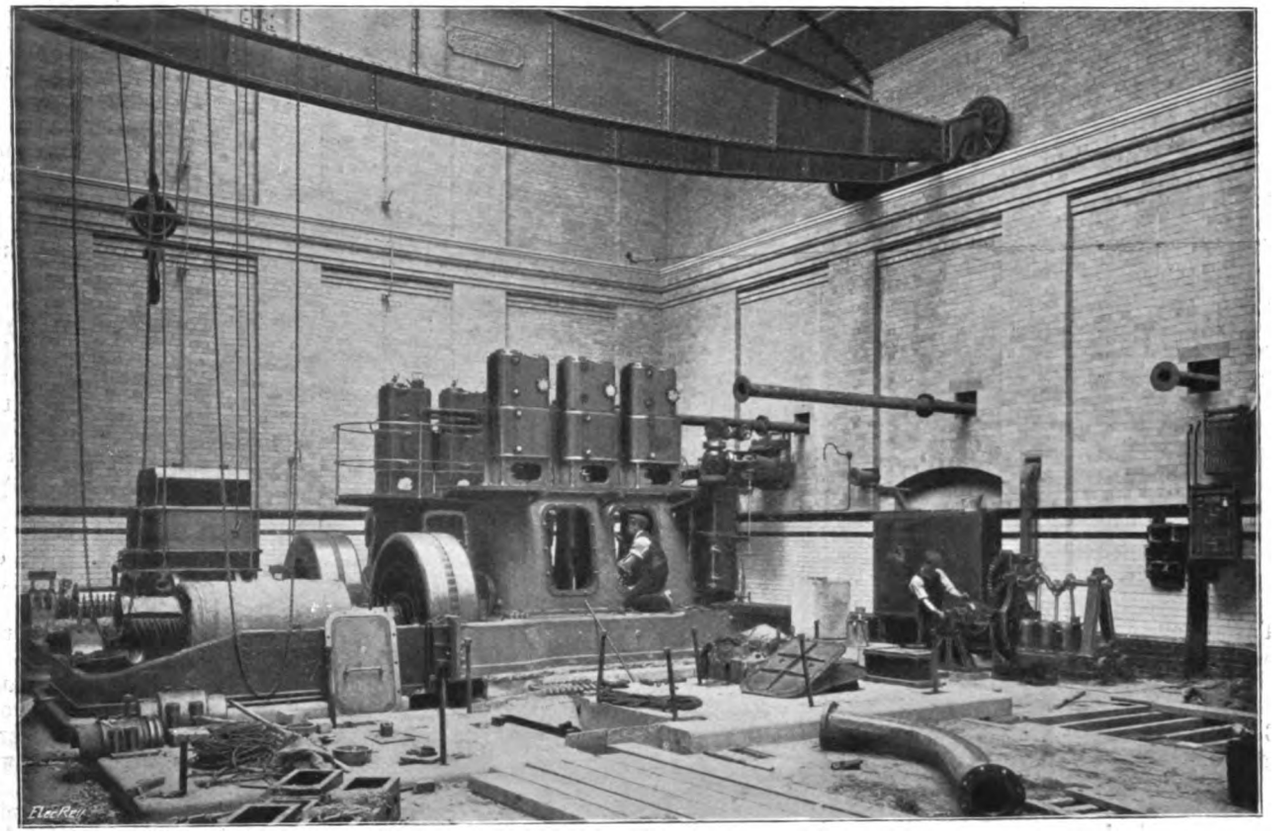
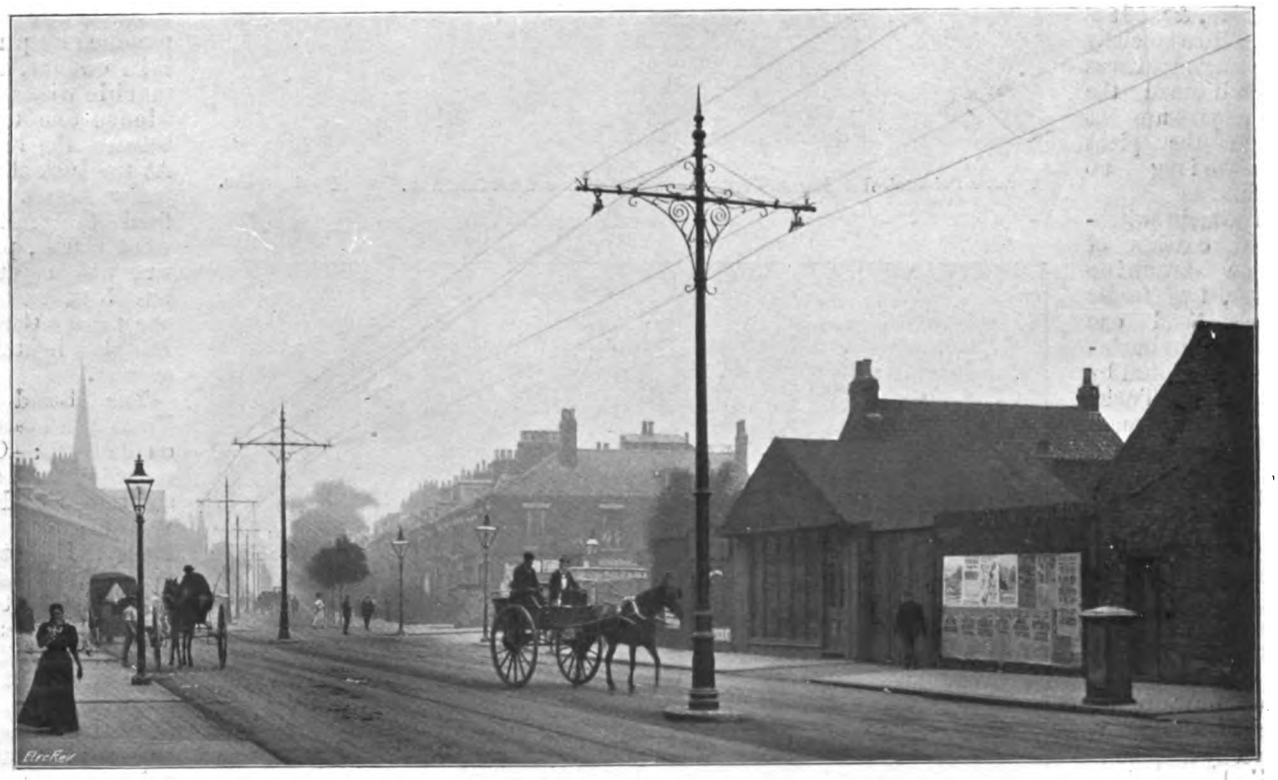
and voltmeter, the former for 1,600 a., and the latter for 550 v., of Messrs. Elliott's make. At the back of this panel are fixed the shunts for the recording ammeters and the negative bus bar.



Turner & Drinkwater, INTERIOR HULL TRAMWAYS POWER HOUSE. *Photographers.*

to the foundation by holding down bolts and connected by tie rods at intervals of 6 feet. They have been rolled by the Société Anonyme des Acieries d'Angleur, Liége. The object of adopting a centre groove is, firstly, to secure even wear on both sides of the rails, avoiding the projecting lip which is often such a serious annoyance to other traffic in worn rails; secondly, to give continuous support to the car wheels when



Turner & Drinkwater, CENTRE POLE CONSTRUCTION IN ANLABY ROAD.—SECTION PILLAR ON RIGHT. *Photographers.*

The rails are of the steel girder double-tread centre groove type, weighing about 96 lbs. per yard; and are laid in 60 feet lengths on continuous sleepers of creosoted redwood screwed

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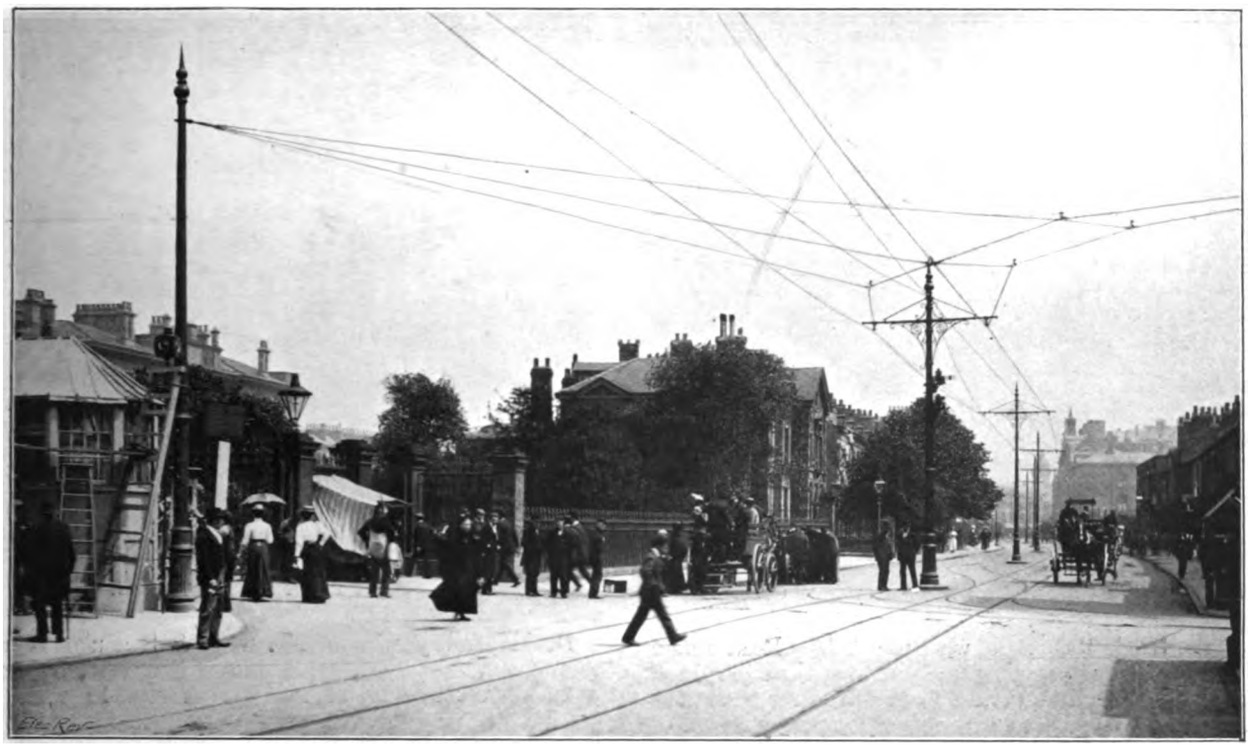
passing the rail joints (which are splayed) and when passing points and crossings; and thirdly, to increase the wearing surface of the head.

In laying the permanent way, after the excavation was completed, the stringers were packed up on bricks at the proper level, clamped tight under the rails, and secured to



Turner & Drinkwater,] Cross Over in Anlaby Road Opposite the Railway Station Gates.—Signal Box on Left. [*Photographers*

Turner & Drinkwater,] Side Pole Construction in Hessle Road.—Westinghouse Car on Line. [*Photographers*

The rails are double bonded at every joint by Neptune bonds of 0·25 square inch section, and are cross bonded at intervals of 180 feet with bonds of ·166 square inch sectional area.

them by dogs. The holding-down bolts and washers were placed loosely in position, and, after the rails had been carefully lined up, the foundation concrete was put in, special care being taken to pack it tight under the stringers.

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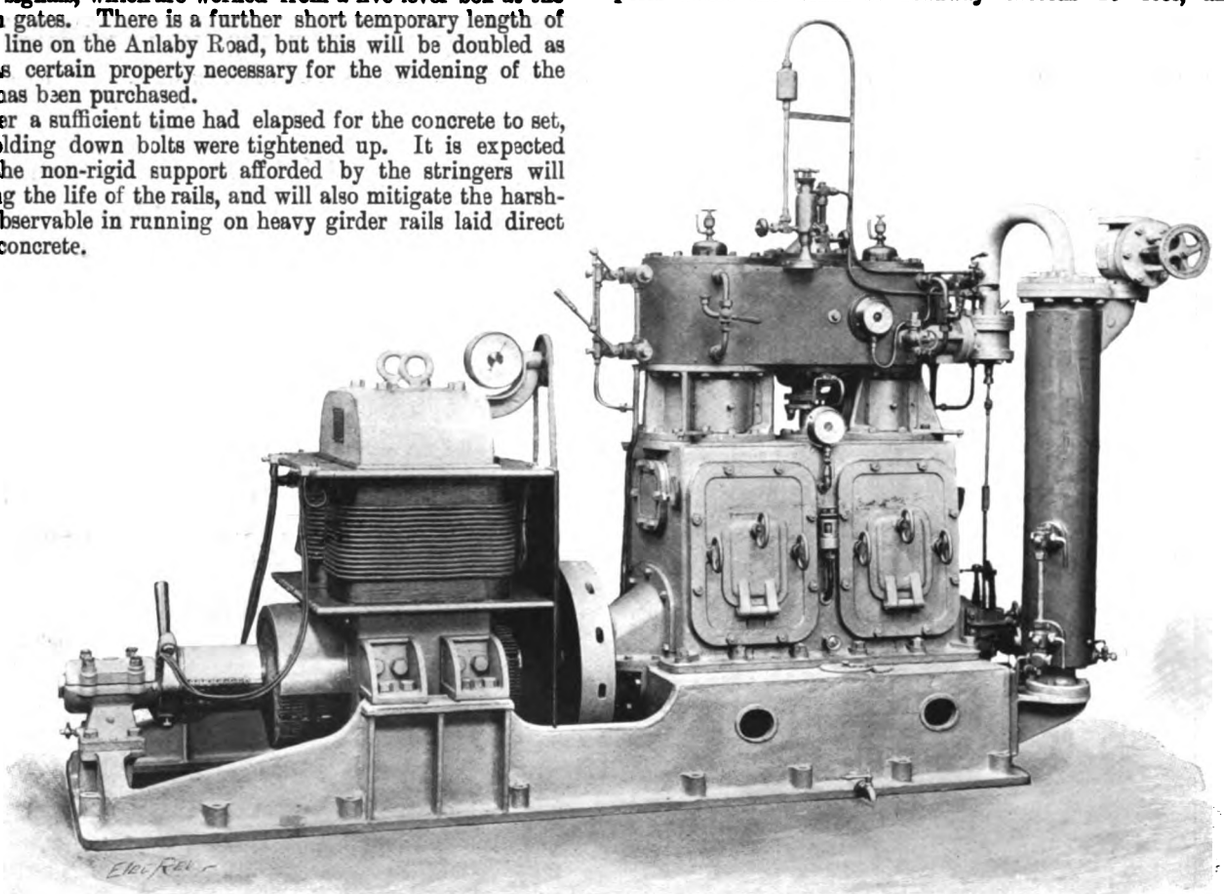
The permanent way will ultimately be double track throughout, except for a length of about half a mile in the narrower streets within the docks and a length of about 80 yards in Midland Street, immediately adjoining the junction of the Hessle Road route with the Anlaby Road route. The latter occurs very inopportunely and has necessitated the use of signals, which are worked from a five-lever box at the station gates. There is a further short temporary length of single line on the Anlaby Road, but this will be doubled as soon as certain property necessary for the widening of the road has been purchased.

Special Work for Anlaby Road Level Railway Crossing.

Rails Ready for Concreting.

After a sufficient time had elapsed for the concrete to set, the holding down bolts were tightened up. It is expected that the non-rigid support afforded by the stringers will prolong the life of the rails, and will also mitigate the harshness observable in running on heavy girder rails laid direct upon concrete.

Double trolley wire of No. 0 B & S gauge is used throughout, supported, with double insulation, by centre poles where the width of roadway exceeds 40 feet, and elsewhere by side brackets on poles erected inside the kerb. In the narrow streets of the old town it is proposed to use span wires instead of poles and brackets. These will be suspended from rosettes attached to the walls of the houses.



Electric Light and Traction Engines.—(See page 24.)

The poles consist of single wrought-iron tubes of strength proportional to the stresses they are required to bear. Each of them is provided with an ornamental finial and a cast-iron base on which the Hull coat of arms is embossed. The brackets are decorated with ornamental scroll work of wrought-iron.

The carriageways throughout the whole length of the tramway routes are being paved with wood from kerb to kerb. The wood is for the most part Jarrah and Karri, but where the traffic is lighter some Baltic redwood is being used. Part of the latter is Haskinized, but the greater part is creosoted. The Australian hardwood has been imported to Hull direct in planks and is being sawn into blocks by a local firm. The blocks are $4\frac{3}{8}$ inches deep, and are laid on a bed of cement concrete 7 inches thick faced with fine cement in the usual manner. During the progress of the work already executed, many street widenings and improvements have been carried out, and the kerb lines and levels regulated, so that virtually the streets have been reconstructed for their entire width.

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The trolley wire is divided up into lengths of half a mile by means of section insulators, connection between the sections being made by switch fuses mounted on a marble board inside a cast-iron pillar box. Provision is also made in some of these boxes for feeder connections with the trolley wire, the feeder being put in series with a choking coil, and protected from lightning discharge by an arrester of the Garton Daniels type.

The protection of overhead telegraph and telephone wires where they cross the electric tramway routes, is provided for by guard wires of No. 8 S.W.G. galvanised steel, which are suspended above the trolley wires.

Some interesting work in connection with the overhead line construction will be called for at the drawbridge over the River Hull and the bascule bridge over the lock at Whitefriargate, but up to the present the routes on which these bridges occur have not been proceeded with. We understand, however, that the first named is to be taken in hand very shortly.

The feeder cables consist of copper strand, insulated with Siemens's impregnated fibrous material, lead sheathed, and covered with tape and preservative compound. They are drawn into Doulton conduits, with a cast-iron watertight disconnecting box every 100 yards. Connection is made between the generating station and several points of the rails by means of return feeders of 0·75 square inch section, of a similar type to the positive feeders.

In order to comply with the requirements of the Board of Trade, an insulated test wire is carried to each terminus, and to every point of connection between the rails and return feeders, for the purpose of ascertaining and recording the drop of potential along the uninsulated parts of the "return" path of the current.

The test wire is looped into each of the section boxes mentioned above, in which an earthed terminal is also provided, so as to facilitate the localization of any abnormal drop of potential in the rails by enabling separate tests to be made of the different half-mile sections. The test wires form part of an air space cable which also contains pairs of conductors for the telephone circuits, the whole being lead-covered, and drawn into a separate duct of the feeder conduits. Two or more sets of telephone apparatus are provided at convenient places of call on each route, the central exchange being situated at the tramway power station.

The motor cars, of which 15 are being supplied by Messrs. Siemens Bros. & Co., are mounted on four-wheeled trucks of the Brill 21 E type; the car bodies, which are double-decked, were constructed by Messrs. G. F. Milnes and Co., Limited, Birkenhead. The Westinghouse Company supply 15 motor cars (Milnes), 10 trailers and two sprinklers, 15 motor cars (Brush) with five trailers, and five motor cars (Brill). There are also on order five trailers from the Electric Tramway and Carriage Works, of Preston.

The trucks have a 6-feet wheel base, 14 feet 6 inches spring base, and 30-inch wheels of cast charcoal iron with steel tyres. They are fitted with equalising gear journal boxes, roller bearings and life guards.

The J. G. Brill Company's cars have most charming interiors, the woodwork being very beautiful. The sliding door, too, one half actuating the other, is very convenient. The Siemens-Milnes cars, if not so taking to the eye, are most serviceable-looking vehicles, and the same may be said of the rest.

The Siemens motors are of the enclosed traction type, which has now become universal for tramways. Their armatures have toothed cores and are wound with "formed" coils, which are readily replaceable. The field has four poles, each of which carries a form-wound coil, interchangeable with any other. The magnet case is in two halves, hinged together, and specially adapted for opening easily, besides being provided with two inspection doors. When closed it is practically watertight. The whole is suspended at two bearings from the car axle, and at its other end by a "nose," supported through springs from the bogie framing in the usual manner.

The rated output of one of these motors is 1,100 lbs. pull at 8 miles per hour; which pull can be maintained for 1 hour without any excessive heating. At starting, a much greater effort can be exerted; the gearing is of the single reduction spur type enclosed in an oil-tight case, of a ratio 4·74 : 1.

Special attention has been paid to obtaining as large an output as possible with a minimum weight. The weight complete, including gears and gear case, is 1,900 lbs.

The function of the controllers is to group the motors, either series or parallel, according to the speed desired, to cut out the starting resistance, step by step, and to operate the motors as generators to act as a brake, also to reverse the direction of motion, and to cut out of circuit a defective motor. There are four power steps with the motors in series, three with the motors parallel, and four brake steps. When the controlling handle is on the latter, the motors are generating in parallel with each other through a part of the starting resistance.

The manner in which these changes are effected is novel. The various circuits are made or opened by a number of carbon-tipped switches. These are closed or opened by a series of cams, threaded on the main spindle, and which come into operation successively as the spindle is rotated.

Means are provided for making each position of the handle sensible to the motorman by feel, and the main and reversing spindles are so geared together, that both operate simultaneously in going on to the brake positions and the reversing barrel is immovable except when the main handle is at "off." The weight of each controller is about 2½ cwt.

Each complete resistance consists of three steps, and for convenience is divided into two portions, Steps II. and III. being in one frame, and Step I. in the other. The resistances are built up of spirals of narrow iron or German silver strip, the turns being insulated by thin asbestos strip. These spirals are mounted on a hollow mandrel, insulated by porcelain bushes, and tightened up by nuts on the mandrel. The latter is secured at either end in cast-iron discs, which are bolted to the car body. The terminals are carried on a strip between these discs, and are readily accessible for inspection, the cover being hinged.

The overhead collector gear of the motor cars deserves special mention. The standard, which is of wrought-iron, is of compact appearance, the spring being contained inside the tube, and therefore out of sight, and not liable to accidental injury. The pole, which is of the finest taper steel tube, is pivoted in such a way as to be readily removable. The head of the standard to which it is attached rotates on ball bearings, allowing of a lateral movement of the pole within a radius of about 8 feet from the standard, which is fixed 2 feet 8 inches from the centre line of the car.

The trolley head is of the swivelling type, and attached in such a way to the pole that it will slip off in the event of its being caught up in the overhead line, thus preventing risk of damage to the trolley wire construction or to the car.

Each motor car has two lighting circuits consisting of six 16-C.P. lamps in series, but only five of the lamps on each circuit are actually in use at any time, the two lamps in the canopy head light at the rear end of the car being short circuited by a special plug switch. Two outside lamps on vertical standards attached to the roof with half-opal globes, form a special feature of the cars. The remaining lamps are used for lighting the interior, and as signal lights, with coloured glasses to indicate the route of the car.

The trailer cars, of which there are five included in Messrs. Siemens's contract, are also electrically lighted, current being obtained through a flexible connection with the motor car. Each trailer car has one circuit only, comprising eight 16-C.P. 60-volt lamps in series.

At the end of last week we had an opportunity of going over those portions of the line just opened to the public, under the guidance of Mr. Barnard and his assistant, Mr. Clothier, and to these gentlemen and Mr. White, the city engineer, we are indebted for many of the notes from which our description has been compiled, and for devoting to us much of their valuable time at a moment when everything was being carried on at high pressure. So far as our own experience is concerned, the smoothness of running appeared to be very remarkable, and everything connected with the efficient working of the line seemed to be most complete.

As will be seen from our illustrations, the car house is not quite completed, the power house has only one set running, with a second nearly erected, and foundations for a third, but there is ample space for four more sets when required.

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On the right of this picture can be seen the Parker electric pumps, and up above is a Carrick 10-ton traveller.

In the boiler house illustration the other set of Parker's pumps are visible on the left, and in the cross over picture the signal box is represented on the extreme left.

Mr. Barnard, from years of experience, is a strong advocate for the Lancashire type of boiler; he likes a good volume of steam at hand, and we think he is right. His views, also, on the much debated question of combined *v.* separate light and power stations were published on p. 1084 of our last issue.

To Mr. Turner, of the firm of Turner & Drinkwater, our thanks are specially due for the ready manner in which he placed himself quite at our disposal for photographing the various scenes which we present to our readers, some of which were taken under conditions provocative of anything but amiability; but Mr. Turner made light of difficulties, and his unfailing good humour pulled us through.

The townspeople of Hull are to be congratulated on their enterprise, the transition from their present means of getting about being only really appreciated by those who have had to put up with it. One pleasing feature of the Hull tramways is the preponderance of English made goods, which, with one or two exceptions, is quite a new departure in British electrical tramlines.

ELECTRIC LIGHT AND TRACTION ENGINES.

III.

With reference to our last week's article, in which we gave a few illustrations of Robey engines employed in electric lighting work, Messrs. Johnson & Phillips write drawing attention to the fact that two of the alternators shown are of their manufacture. The two-phase alternator shown in fig. 2 (Vol. 44, p. 1070), which was supplied to the North-Eastern Steel Co., has worked so satisfactorily, that Messrs. Johnson and Phillips are doubling the plant there. Incidentally, it may be mentioned that the voltage is 250, and not 2,000, as stated. They also say that the single-phase alternator (fig. 3) was supplied by them to the St. Helens Corporation, the steam consumption per kw.-hour being certified by the consulting engineer, Mr. Robert Hammond, as 25·94 lbs. The figure given by us on page 1069 was 26·9 lbs.

We are now able to give an illustration (see page 22) of the compound enclosed self-lubricating engine, coupled direct to continuous current two-pole dynamos, recently supplied by Messrs. Ernest Scott & Mountain to Messrs. Cammell, of Sheffield, for driving travelling cranes. A few particulars appeared in our last issue.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 17.)

The Advantages of Open Competition.—The following letter appeared in the *Financial Times* of Tuesday last:—

The Improvement in Telegraphy to South America.

Sir,—I notice under this heading in your issue of to-day that a correspondent draws attention to a great improvement during the past few years in telegraph communication between this country and South America, using this as an antithesis to the lack of improvement in the cabling facilities to Australasia. This comparison is one which your correspondent and others can better make than I. In his letter, the remarks made by "A. E. B." would lead one to believe that the improvement in telegraphy to South America is only due to American competition. This is not correct, as my company, the South American Cable Company, an English company, has also played its part by encouraging the development of the landline service across France and Spain, and in Brazil. This encouragement has in the past seven years met with such success that to-day messages from London to Rio de Janeiro, *viâ* France-Spain-Teneriffe-Norontia and the Brazilian landlines, are correctly and properly exchanged in less than two hours. We shortly hope to reach the Argentine by the same means. This development and the American route have affected the revenues of the old lines to such an extent that their owners have paid much greater attention to their service, and as a consequence the public have benefited. The effect on the revennes has been as follows:—In 1894 the joint revenues of the Brazilian Submarine and Western and Brazilian Companies amounted to £488,298; in 1892, when our route was opened, to £396,738, whereas last year the total was £362,461. These figures give a solid reason for attention to the clients, and have doubtless contributed to the betterment in the South American service which your correspondent has observed. If similar conditions ruled in Australasian business perhaps "A. E. B." is right in assuming that the service to Australia would be improved.

I am, &c.,
E. W. Parsons, *Secretary.*

South American Cable Company, Limited,
106, Cannon Street, E.C., *July* 3*rd*, 1899.

Pacific Cable.—On Monday and Tuesday last Mr. Chamberlain and the Chancellor of the Exchequer met the High Commissioner for Canada, and the Agents-General for New South Wales, Victoria, New Zealand, and Queensland, with a view to examining into the opinions held by the Dominion and the Colonies on the organisation of the Pacific cable scheme. In a few days this conference will be joined by Mr. Tarte, Minister of Public Works in the Canadian Ministry, and Sir Sandford Fleming, who, together with Lord Strathcona and Mount Royal, have been appointed by the Canadian Government as Canada's representatives on the conference. Both in the Government and among the colonial representatives there is a desire to make the scheme as comprehensive and as broadly in keeping with a great Imperial idea as circumstances will allow.

It is reported in the *Daily News* that at the conference held on Tuesday a basis satisfactory to both sides has been reached, and that the general principles on which the scheme is to proceed have been provisionally agreed to. The Colonial Governments will at once be communicated with. Probably a board of delegates will be appointed to settle certain details, and take all preliminary steps. Unless some fresh hitch occurs the cable will be an Imperial affair, in the fullest sense of the words. Those who have consistently advocated the scheme have reason to rejoice that the Government has at last been aroused to a sense of its importance.

In the House of Commons on Tuesday Mr. Hogan (Tipperary, Mid.) asked the Secretary of State for the Colonies whether the business of the approaching conference of representatives of the Imperial and Colonial Governments would be limited to a readjustment of financial responsibilities in connection with the construction and working of the proposed Pacific cable, or whether it was proposed to discuss questions generally affecting the telegraphic service of the Empire.

Mr. Chamberlain, in reply, said the only purpose of the conference is to discuss matters relating to the proposed Pacific cable.

Reduction of Telegraph Rates to India.—On Wednesday of last week Mr. Webster asked the Secretary to the Treasury, as representing the Postmaster-General, if his attention had been called to the present high charges and inequalities in the scale of charges for sending telegrams from the United Kingdom to many British possessions and foreign countries; and if the Government proposed to take any steps to remedy this state of affairs by suggesting an International Conference in regard to them or otherwise. Mr. Hanbury: "The attention of the Postmaster-General has from time to time been called to this matter. He has not received any general representation on the subject, but I understand that communications have recently been addressed to the Chancellor of the Exchequer, by whom, no doubt, they will be carefully considered. With the consent of the companies, considerable reductions were made at the last International Telegraph Conference at Buda-Pesth, and at the next International Telegraph Conference, to be held in 1901, there will be an opportunity for again bringing the charges under review."

As regards this reply, we may remark the year 1901 seems to us to be rather too much in the future, especially when we call to mind that at the Buda-Pesth International Telegraph Conference, although some reductions were made, the companies firmly declined to make any reduction in Indian rates, notwithstanding the pressure put upon them from several sources, notably from the Indian Government Telegraph Department, who, we understand are willing to bear their share in a reduction of the rates. We understand that the proposed deputation to Mr. Balfour, on the subject of cheapening telegraph communication, has been postponed, pending the receipt of despatches from the Government of India.

The Telephone Service.—In the House of Commons the other day, Mr. Kimber asked the Secretary to the Treasury if he, or the Post Office, or any other Government department had made any estimate of the probable return which the State would obtain on the expenditure of the two millions of money in competition with the National Telephone Company, and of its effect on the royalties of £114,000 a year now receivable from the company; whether, for comparison therewith, any estimate had been made of the probable return which would be obtained at once if the company were extinguished or converted into a State department and its capital converted into a stock with a limited interest of 3 per cent.; if so, would he lay a copy of such estimate before the House; and, if no such estimates had been made, would he cause them to be prepared; and would he also lay a copy of the proposed new arrangements with the Telephone Company before the House, and not merely before the members of the Standing Committee. Mr. Hanbury in reply said: The two millions are intended partly for the provinces and partly for London. So far as the provinces are concerned, the expenditure will be chiefly in places where the company is not working or where there is already competition between it and the Post Office. No question of royalty arises in such cases. In London, where there will be competition with the National Telephone Company even if the rates of the company, and therefore the royalty, are reduced, this reduction will, it is anticipated, be more than counterbalanced by the increased number of subscribers. The answer to the second paragraph is in the negative. The proposed new arrangements have already been laid before the House in the usual printed notices.

CONTRACTS OPEN AND CLOSED.

OPEN.

Annfield Plain.—July 18th. The Urban District Council invites tenders for the supply of the necessary plant required

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for an installation of electric light for the lighting of their district: (1) For engines and dynamo; and (2) for poles, cables, &c. Particulars on application to Mr T. J. Trowsdale, Surveyor to the Council.

Barton-upon-Irwell.—July 18th. The Guardians want tenders for the electrical plant for lighting their new infirmary buildings at Patricroft. See "Official Notices" this week.

Battersea.—August 31st. The Vestry wants tenders for an overhead travelling crane (hand or electric), and batteries for the electricity works. See "Official Notices" this week.

Brighton.—July 17th. The Council wants tenders for the supply of C.I. water tanks (40,000 gals. capacity) with supporting structure at the electricity works. See "Official Notices" this week for particulars.

Canary Islands.—July 16th. Tenders are being invited until July 16th by the Spanish Post and Telegraph Authorities in Madrid for the concession for the establishment and working of a telephone system between Haria and Arrecife with three intermediate stations on the island of Lanzaroto, Canaries. Tenders to be sent to La Direccion General de Correos y Telegrafos, 10, Callede Carretas, Madrid, whence particulars may be obtained.

Denbigh.—The North Wales Counties Lunatic Asylum Committee wants tenders for the supply of engines, dynamos, switchboard, injector, piping, and foundations, also wiring of buildings for electric lighting. See "Official Notices" this week.

Dublin.—July 10th. The Richmond District Asylum Committee is inviting tenders for establishing telephonic communication between Portrane Asylum and Broadmeadow Waterworks. Mr. G. C. Ashlin, 7, Dawson Street, Dublin, is the architect.

Edinburgh.—July 18th. The Council wants tenders for installing the electric light at the Central Fire Station, Lauriston. See "Official Notices" June 30th.

Glasgow.—July 22nd. The Corporation wants tenders for boilers, steam engines (main and auxiliary), three-phase generators, continuous current generators, rotary converters, boosters, and static transformers, surface condensers, feed pumps, circulating pumps, and air pumps, all for the electric traction scheme. See our "Official Notices" June 23rd.

Glasgow.—July 22nd. The Corporation wants tenders for 80 electric tramcar bodies to sample and drawing. See "Official Notices" June 23rd.

Glasgow.—August 2nd. The Corporation wants offers for the electric work required in connection with its fire alarm and A B C telegraph systems. Specifications, &c., from the chief officer of the Fire Brigade, College Street.

Halifax.—July 19th. The Corporation wants tenders for a combined steam engine and dynamo. See "Official Notices" June 30th.

Malmo.—September 1st. The Gas Works' directors want tenders for the erection of electricity works for the city. Particulars on application to the clerk of the Gas Works (deposit 12s).

Pembroke.—July 14th. The Electric Lighting Committee wants tenders for a jet condenser with air pump and cooling apparatus. See "Official Notices" June 16th.

Rathmines and Rathgar.—July 14th. The Electric Lighting Committee wants tenders for arc lighting equipment (108 series parallel lamps, posts and switch-gear, &c.), steam and other pipes, jet condenser and cooling apparatus. See "Official Notices" June 16th.

Roumania.—July 15th. Tenders are being invited until the 15th inst. by the Roumanian Post and Telegraph Authorities in Bucharest for the supply of 30 tons of galvanised iron wire. Particulars from, and tenders to, above.

Salford.—July 17th. The Salford School Board wants tenders for the electric lighting of its new schools in Langworthy Road, Seedley Pendleton. See "Official Notices" this week.

Salford.—July 18th. The Tramways Committee wants tenders for the supply of a sample tramcar. See "Official Notices" June 30th.

Salford.—August 8th. The Corporation wants tenders for eight 750-kw. continuous current steam dynamos for electric lighting and traction. See "Official Notices" this week.

South Shields.—July 10th. The corporation wants tenders for the supply and erection of arc lamps and posts. See "Official Notices" June 30th.

Sunderland.—July 24th. The Corporation wants tenders for the reconstruction and electrical equipment of the tramways: (*a*) permanent way, (*b*) overhead construction, (*c*) car bodies and trucks. See "Official Notices" this week.

Wallasey.—July 20th. Tenders are wanted by the Council for alternating current transformers. See "Official Notices" June 23rd.

Wallasey.—July 20th. The Council wants tenders for a 300 kw. alternator with engine combined. See "Official Notices" June 23rd.

Warrington.—July 18th. The Corporation invites tenders for Babcock & Wilcox boilers, economisers, and pumps; high speed engines, direct coupled continuous current dynamos, balancers, and boosters; jet condensing plant, &c.; pipe work; 10-ton crane; switchboard, storage battery, mains, conduits, boxes; arc lamps and posts. See "Official Notices" June 23rd.

West Africa.—July 10th. The Compagnie de Mozambique, of 45, Rue do Alecrim, Lisbon, is inviting tenders until July 10th for the concession for the establishment and working of a central electric power station at Beira for lighting and power purposes during a period of 25 years. Particulars from, and tenders to, above.

CLOSED.

Aberdeen.—The Works Committee of the Harbour Board last week considered a report by Mr. Nicol, harbour engineer, regarding the class of crane which should be provided for the new sheds at Regent Quay. Inquiries, it was stated, had been made at all the principal electric crane makers in the country. After discussing the question, the committee agreed to recommend the board to accept an offer by Messrs. Wimshurst, Hollick & Co., London, to supply three electric cranes at a total cost of £2,450. These, it is expected, could be in position in about five months.

Dewsbury.—The tender of the Callender Cable and Construction Company, Limited, for the extension of the electricity mains to Springfield Terrace, and for a new feeder to be laid in Bradford Road, at the sum of £549, has been accepted by the Gas and Electricity Committee.

Doncaster.—The Electricity Committee has accepted the tender of Messrs. Isles, Limited, of Stanningley, for a 6-ton overhead traveller at £355.

France.—The French Ministry of Posts and Telegraphs have just placed contracts for the supply of galvanised iron wire as follows:—Les Forges de Franche-Comté, 260 tons, 3 mm. dia.; Les Forges de Motor, 100 tons, 3 mm. dia.; and Les Forges de Friminy, 150 tons, 4 mm. dia.

Grimsby.—The Town Council has placed a contract with Messrs. Hewins & Goodland (£11,525) for the erection of buildings for electricity works.

Halifax.—The Guardians have accepted the tender of Messrs. H. H. Nunns & Co., of Halifax, for installing the electric light at the workhouse for £885 14s., and that of Messrs. Fowler, Lancaster & Co, Birmingham, for wiring and fitting the Poor Law offices for the sum of £102 11s. 11d.

Hull.—The tender of the Danaby and Cadeby Main Colliery Company for the supply of six months' coal to the Sculcoates Lane Electric Light Works, has been accepted by the Electric Light Committee.

London.—We print the following letter without comment:—

We notice in your issue of June 23rd that you publish a list of tenders for Mr. Wyndham's new theatre, under specification from Messrs. Owen, Lucas and Pyke, and that it is notified that the Brush Company's tender has been accepted. Their tender is £2,959 10s., ours being £2,724 10s. We think it will be only fair to our reputation if you will kindly state in your next issue that the contract was offered to us, not at the price at which we had tendered, but under the price of the lowest tender, which we declined. We see in your subsequent issue of June 30th, that Messrs. Marryat & Place withdrew their tender of £2,893 10s., as they found they had made an error.

We make no comment, but think it is only fair that these facts should be known.—Yours faithfully,—STRODE & Co.

Peterborough.—After a lengthy debate as to labour clauses and rates of wages, the Council has confirmed the Lighting Committee's decision to place the tender for boilers for the electricity works with Messrs. Danks & Co.

Poplar.—The Guardians have accepted the tender of the General Electric Company for the supply of electric motors; the Hart Accumulator Company, for the supply of secondary batteries; Messrs. Speedy, Congden & Co., for the supply of cables, wires, and fittings; and Messrs. Veritys, for the supply of main switchboard and distributing boards.

Warrington.—At a meeting of the Board of Guardians on June 21st, the tender of Warrington District Electric Light and Power Company was accepted for the electric lighting plant and wiring for the new infirmary. A list of the estimates is given below:—

Drake & Gorham	£2,955
Edmundsons, Limited	2,929
Calvert & Co. (amended)	2,793
Warrington District Electric Light and Power Company (accepted)	2,778
Warrington Electric Light Company	2,486

FORTHCOMING EVENT.

Wednesday, July 12th.—At 5 p.m. The Institution of Junior Engineers. Visit to the Shepherd's Bush generating station of the Central London Railway

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NOTES.

C.G.S. Names.—Following our note of last week regarding the article in the *Electrical World and Engineer* of New York on "The Desirability of Names for the Fundamental Electric and Magnetic Units," the writer finds two faults with the present system of nomenclature of electrical units. He complains that while the C.G.S. units themselves have no names, they ought to have them; and that the names of the practical units—ampere, ohm, &c.—ought to express the relation between them and the fundamental units from which they are derived. As an illustration one or two names are suggested. For the C.G.S. unit of current "flu" is proposed, and for the ampere (one-tenth of a unit) "deciflu." In the particular case of energy, when the C.G.S. unit has a name, the "erg," it is proposed to call the joule, which is an erg multiplied by 10^7, a septerg. It does not seem likely that any substantial gain would result from such alterations or inventions of names. To take a common case where transformations of units are made. When an analytical problem has been solved, and the results have to be applied to a practical case, it is usually necessary, at least with most memories, to refer to a pocket-book or text-book for the powers of 10 required for each quantity, and this labour might be saved by giving names to the practical units which would enable the memory to recall the power of 10 required. As a matter of fact, however, this particular part of such work is so little troublesome in comparison with the mental strain of stating the original relations, and of the subsequent analytical process, that the change would make no appreciable difference. Such an arrangement does eventually add to knowledge of one kind and detracts from another, and the gain may be useful. It is probably more useful to know that the unit current is one-tenth of the fundamental unit than to recognise the name of Ampere as that of a great electrician, but this sort of advantage is easily exaggerated, while the confusion accompanying the employment of two terms for the same thing is considerable. We may quote a passage from the article. "But there is no necessity whatever to alienate the practical man from the temple of science, the doors of which should always be wide open to those who seek to enter. To give the practical man the quadrant—eleventhetgramme—second unit is to isolate him from real scientific knowledge of the science he applies." This overstates the case. The practical man who is alienated and isolated from the temple of science by talking of amperes, to whom the temple doors fly open on murmuring "Deciflu," is our old friend Aladdin. These word systems are like card houses, quite unsuitable for living in. As the writer of the article judiciously observes, "No harm can be done by the creation of these names. The worst that can happen would be that they should not come into use."

Oil v. Electric Motor Cars.—Enterprising members of Parliament, scorning to use the usual hansom or private carriage to take them to St. Stephen's, have taken unto themselves motor cars, and these are now called into requisition to convey them to the place which "is pigeon-holed and honey-combed with guinea-pigs." The story runs that two wise members travelled in *electric* motor-carriages and were duly admitted to Palace Yard, but a third, who drove an *oil* motor carriage, was only to be admitted minus the carriage, and he accordingly had to alight and foot it. There seem to have been some unpleasant occurrences in the yard with oil vehicles, and the police have since been on the scent with the result aforetold. The announcement that the policeman acted without official instructions does not detract very much from the value of the excellent advertisement that electricity has received, nor can it redeem the character of the oil motor.

Visits to the City of London Electric Lighting Station.—It may probably interest visitors to London to know that on payment of 1s. they may be shown round the Bankside station of the City of London Company. A gallery runs right round the engine room, from which excellent views of the whole of the generating plant may be obtained. The money collected in this way goes towards the employés' sick fund.

Electric Traction.—At the annual meeting of the Incorporate Association of Municipal and County Engineers held at Cardiff, Mr. A. D. Greatorex, of West Bromwich, read a paper, illustrated with diagrams and models of cars, on "Electric Tramway Traction," during the course of which he gave the palm to the overhead system. In the discussion which followed the general opinion seemed to confirm this, though it was admitted that in a few years something even better would be devised.

Gas Accidents.—Perhaps it is as well to record that a gas explosion was responsible for four deaths at the Honley Gasworks, near Huddersfield, on Tuesday. The explosion is supposed to have been caused by a spark from a workman's chisel coming in contact with some unexhausted gas in the holder, which was being removed. When an electric shock fatality occurs at an electricity works there is a good deal said about it, but we think comparative statistics showing the number of accidents and fatalities due to gas and electricity respectively, both at works and on consumers' premises, would afford interesting though gruesome reading.

The Electrical Engineers (R.E.) Volunteers.—This corps will take part in the great Volunteer review before H.R.H. the Prince of Wales on July 8th, on the Horse Guards Parade. They will march past in two companies with the 1st Middlesex R.E. Volunteers, and will number about 116 officers and men. The members will assemble at College Street, Fulham Road, near South Kensington station, at 2 30, in review order, helmet, pouch, water-bottle, and haversack; no leggings. Company drill Monday at 7, Wellington Barracks; Wednesday, 7.15, Wellington Barracks, in undress uniform; Thursday, company drill, 7 o'clock.

Electric Transmission for Brazilian Gold Mines.—The engineer (Mr. George Chalmers) of the St. John de Rey and the Morro Velho Gold Mines, in the State of Minas Geraes, Brazil, is proposing to lay down a large electric transmission of power plant to utilise the energy of some falls near the mines. A continuous current plant has been at work for some time, but the work now proposed will probably be carried out on the multiphase alternating current system.

The Tramways and Light Railways Association.—We have received a circular giving details relating to the above newly-formed association which has been brought into existence with a view to providing an efficient organization to adequately represent all interests in the tramway and light railway industries. The objects of the association may be gathered from the following extracts from the official circular:—

> **Extensive applications of electricity to tramways, the encouragement given to the promotion of interurban and other lines by the passing of the Light Railways Act, and the formation of tramway departments by various corporations, have brought new interests and capital into the industry. As all tramway and light railway enterprises, whether promoted by corporations or companies, are initiated under, and controlled by, the same Legislative Acts, they have of necessity many relations in common, and they require some organization capable of expressing and enforcing upon public attention their common views and requirements. There can be no doubt that representations on many subjects require from time to time to be made to Parliament, the Board of Trade, the Light Railway Commissioners and other authorities, and it is obvious that these representations will be made with greater force by a representative association than by separate corporations, companies or individuals.**

The association will endeavour to advance the welfare of the industry in such other directions as may seem desirable. The first members of the Council are Messrs. George Richardson, George F. Fry, Emile Garcke, J. Barber Glenn, W. M. Murphy and S. Sellon, all of whom are in the thick of tramway promotion and construction work. Mr. A. M. Wilcox, editor of the *Railway World*, has been appointed honorary secretary, and that journal will be the official organ of the association. Forms are out just now for the first election of members.

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Appointments Vacant.—The West Ham Council wants an electrical engineer for designing and supervising the construction of plant and machinery, &c., for electric lighting and traction, at £450 per annum. A shift engineer is also wanted. See "Official Notices" this week.

Appointments.—Mr. J. McFall Smyth, one of the assistants at the Blackburn Corporation electricity works, has been appointed electrical engineer of Keighley.

Mr. C. A. Midgley, chief assistant electrical engineer at Wakefield, has been appointed electrical engineer to the York Corporation.

Obituary. — We learn with great regret of the death of Mr. Thomas Connolly, of Connolly Bros., which occurred on June 21st. Mr. Connolly was a native of Newcastle-on-Tyne, where he served his apprenticeship as a mechanical engineer in the works of Messrs. Armstrong. He migrated to London early in the sixties, and a few years later abandoned mechanical for electrical engineering, being engaged by Messrs. Hooper's Telegraph Company and the Telegraph Construction and Maintenance Company. In 1880 he received an important appointment in Milan, Italy, where he initiated the electrical department of the well-known firm of Messrs. Pirelli & Co. On returning to England he settled in Manchester, where he founded, in partnership with Mr. John Shaw, the successful business of Messrs. Shaw & Connolly, insulated wire and cable manufacturers. This business was subsequently transferred to the Okonite Company, and on the closing of the latter's Manchester works Mr. Connolly retired from active business. He was, however, one of the principal shareholders in Connolly Bros., Limited. He was a man of varied attainments, and was an eloquent public speaker. He took an active part in several political, social, and scientific circles, and was much in demand as a popular lecturer on social and scientific subjects. His funeral was attended by a large concourse of friends and representatives of various societies and public bodies.

Personal.—On the 22nd ult. the electrical staff of the Dublin Electric Tramways Company entertained Mr. R. Humphries, the assistant electrical engineer, at the Royal Hibernian Hotel, on the occasion of his marriage. Mr. J. W. Towle, electrical superintendent, presided. Mr. Humphries was presented with a gold-mounted purse, containing £25 on behalf of the staff. The visitors present included several members of the British Thomson-Houston Company, who are superintending the erection of the plant at the Ringsend station for the D. U. T. Co.

"Half in Shade and Half in Sun."—Last week, in writing on the subject of the Pacific cable, a contemporary refers to "the discouraging effect of Government competition in cable enterprise," while in reference to "competitive telephony," we find that, according to the same authority, "the system will only be at its best when it is controlled, and also managed, by a State department."

CITY NOTES.

The Elmore Companies.

The issue of a circular to the shareholders in a number of Elmore Companies recalls the efforts we made years ago to prevent the waste of money in these undertakings. Years have elapsed, and tangible results for the investor are as far off as ever, but the companies have existed, and the circular bears all the old evidence of sanguine expectations. A Trust Company is to buy up the assets and liabilities of the old companies, to sell the assets to a new company, and to discharge the liabilities. It is unnecessary to follow the maze of particulars which the circular contains in explanation of the complicated arrangement proposed. One cannot but wonder why the various concerns are not allowed to die a natural death, instead of being transformed in the manner proposed. The name is given of a firm who are to provide considerable new capital. Again, it is difficult to understand why a firm, desirous of embarking in the metallurgical business, should not do so without the encumbrance of a company with "a past."

Elmore's Trust, Limited.

On Thursday afternoon last week a collective meeting of the shareholders of Elmore's Patent Copper-Depositing Company, Limited, Elmore's Wire Manufacturing Company, Limited, Elmore's Foreign and Colonial Patent Copper Depositing Company, Limited, and Elmore's American and Canadian Patent Copper Depositing Company, Limited, was held at the Cannon Street Hotel to consider the scheme for the amalgamation of the companies and the formation of Elmore's Trust, Limited, and the English Electro-Metallurgical Company, Limited.

Mr. A. S. Elmore, who presided, said it was with the greatest satisfaction that they came before the meeting to-day to explain something practical to them. Every company had sent in an overwhelming majority of proxies in favour of the scheme of amalgamation which had been before them some time. They had been through troublous times, but they had overcome all the difficulties of putting the four companies on a financial basis, such as was warranted by the merits of the business. They had followed a clear and definite policy all through the matter. They knew that a large sum of money had been put into the French Company by capitalists of well-known business ability, who were convinced that the Elmore process was all that was claimed for it. Since the introduction into the French Company of a large amount of working capital, the business had progressed by leaps and bounds, and had been earning increasing profits year by year, until that day it held a commanding position in the metallurgical world, and had become the premier copper manufacturing company in France. For the year 1898 the French Company had delivered 2,000 tons of tubes, and had made a gross profit of £90,000, with net profits amounting to 12 per cent. on the entire capital. In addition, the Elmore Company of Germany had earned sufficient to warrant the directors paying a dividend of 7½ per cent. on the preference shares. The thing they found they had to do was to try and interest some wealthy people in their business, and that they had succeeded in doing. The result was the scheme which they had had before them, and which he hoped they had all studied. They had valuable patents and large works, but no means of turning them to account. They never really had had any free working capital, which was an elementary condition of success. By the operation of that scheme they would become shareholders in a live company with a working capital of £200,000, with valuable freehold estates, and the whole backed up by the influence of some of the strongest financial houses of London and Paris. Although considerable criticism had been extended to the Elmore Company, and many committees of investigation had been appointed from time to time, in no single instance had anything been brought to light which was not strictly honourable. With regard to the scheme itself, the first thing they had to do was to arrange the basis on which the companies could amalgamate, and that was arrived at after numerous meetings of the various boards, and with the largest shareholders of the companies, and with the shareholders' committee of the foreign company, appointed to consider the question of amalgamation. The second step was to agree with Messrs. Hirsch & Co., and it was due to that firm to state that no unreasonable terms had been exacted. The whole part of that business might be summed up by saying that the Messrs. Hirsch saw it was a good, genuine business, and were prepared to recognise the present shareholders' interest in it; they determined to form an intermediary company called the Elmore Trust. It might be considered a roundabout way of exchanging shares of the old company into a new one, but there were reasons of the greatest weight for carrying this through. The shareholders would at once get their certificates in the trust for the shares they now held, and they would be marketable, he believed, at a premium instead of at a discount. Then they had to pay their debts, and that could be best done by the trust, and by raising money on the debentures they would probably make £100,000, to which had to be added £33,000 which they would receive as their proportion for underwriting preference shares. It had been suggested that they might be unable to pay the interest on the debentures and that the holders would foreclose, but the directors had foreseen that difficulty, and had added enough to the debentures to provide for their interest by sale. However, apart from that they anticipated that the profits would be sufficient. Having referred to the constitution of the board of directors, the chairman said the shareholders would get shares in the trust 33 per cent. more in value than the present shares, and the directors were convinced that they had made an equitable and admirable bargain in the interests of the Elmore shareholders, and it only remained for the shareholders to support the scheme by subscribing for the debenture stock, which should prove an admirable investment. Up to the previous day they had received 188,000 proxy papers from all the companies, which was four-fifths of the total.

Considerable discussion followed, and various questions were asked of the chairman.

In reply, the Chairman said that preferential allotment of debenture stock would be given to the old shareholders, subject to the existing debenture holders who wished to exchange. The existing debenture holders would not have the absolute right of exchange, but they had come forward and lent their money when it was a matter of life or death to the company, and he thought no one would object to them having the choice. Subject to that, the preference shareholders would have the priority. Whether the trust would continue the business or not was entirely a matter for the trust shareholders, and the directors would be entirely guided in the matter by the shareholders. Mr. Jeffrey had asked why the American Company was treated so badly, but he fancied that gentleman was under a misapprehension, for his point

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was that the Copper Company's shareholders were getting £1 from £1. As a matter of fact, however, only about a year ago those £1 shares were £2 shares, for the Copper Company reduced their capital. Really every company had received the same, except the foreign company, which got less, because their assets had been parted with to other companies. As to the patents, the original patents had still a period of life, but some were getting towards the end of their life. They had, however, filed new patents from time to time, until they were almost up to date, and if anyone tried to infringe the original patents he wished them joy—he did not think they would begin to do so. Their position from the patent point of view was very, very strong.

The meeting ended without any resolution being passed, but subsequently different meetings of the shareholders of the various companies were held, and resolutions for voluntary winding up were adoptod.

The Electric Construction Company, Limited.

The directors' report to be submitted to the shareholders on Thursday, July 13th, 1899, at Winchester House, E.C., at 12.30 p.m., reads as follows:—

	£	s.	d.
The profit of the year ending May 31st last, including the balance of £2,079 0s. 6d. brought forward, is	21,393	6	2
Which your directors recommend should be appropriated as follows, viz.:—			
In providing a dividend of 7 per cent. on the preference shares (to be paid on July 31st next) £3,500 0 0			
And a dividend of 6 per cent. on the ordinary shares (one-half to be paid on July 31st next, and one-half on January 31st, 1900) 18,452 0 0			
And in adding to the general reserve fund (which will then amount to £20,000) 8,000 0 0			
	19,952	0	0
The surplus of	£1,441	6	2

to be carried to next year's accounts. The buildings and plant have been fully kept up, and £5,000, as formerly, has been placed to the credit of depreciation account—all out of revenue. The depreciation account now amounts to £28,000. The output of the factories goes on increasing, and the high quality of the workmanship and the excellence in design of the manufactures have been fully maintained. The works are full of orders, and to meet the growing demand for electrical plant, contracts have been entered into for a considerable addition to the shops, including tools and general conveniences for the production of the larger class of machines now in demand. The additional equipment, besides tending to economy in production, will facilitate prompt execution of orders. The electrical equipment of the City and South London Railway extension to Moorgate Street has made satisfactory progress, and, it is expected, will be in operation within the next few months. The financial arrangements in progress last year have been completed, and the first and second 6 per cent. mortgage debentures have been converted into 4 per cent. debenture stock. The floating debt of the company has also been largely reduced by the issue of second mortgage debenture stock, bearing 4½ per cent. interest. The compensation paid under the Workmen's Compensation (1897) Act is, for the year, less than £20, and as your directors consider it advantageous for the company to carry its own risk, £150 of last year's profit has been carried to the credit of an insurance fund. The directors who retire by rotation at the general meeting (and who are eligible for re-election) are Sir Henry C. Mance and Mr. Philip Edward Beachcroft. Messrs. James Meston & Co., the auditors for the past year, offer themselves for re-election.

Oldham, Ashton and Hyde Electric Tramway, Limited.

The second ordinary general meeting was held on Monday at the offices, Donington House, Norfolk Street. Mr. Emile Garcke presided, and, in moving the adoption of the report, remarked that the statements of the prospectus had so far been fulfilled. It was true that there had been a little delay in completing the work of construction and in opening the lines for traffic, but this had been almost entirely owing to the delay on the part of the Corporation of Ashton, who had to supply the company with the current, in not being ready with their machinery. There was a considerable demand for electrical apparatus, and he believed that the Corporation of Ashton had found considerable difficulty in getting the plant delivered within the time. The Board of Trade inspection took place on May 25th last. A few points were raised by the Hyde local authorities, but in the main the installation was found quite satisfactory by the Board of Trade, whose certificate, however, which the company received on the 12th ult., was provisional only for three months pending the completion of the few remaining matters that had to be attended to by the contractors. He was assured by the engineer that there would be no difficulty in doing what was required within the three months, when the Board of Trade certificate would become absolute. The Corporation of Hyde claimed that the company had wrongly laid their feeders under the footpath, but the directors had been advised, not only by the engineer, but also by the best legal counsel they had been able to consult, that the company had been quite correct in what they had done. Nevertheless, a writ had been issued by the Hyde Corporation and, curiously enough, the case came on for hearing that day. He was not aware of what had taken place, and it was not advisable for them while litigation was pending to go further into this matter. As he had said, the provisional certificate granted to the company by the Board of Trade was received on the 12th ult., and not a moment was lost in opening the lines for traffic. As a matter of fact, the cars were started as soon as the telegram reached the depôt, and from that day a service of cars over the whole route had been running satisfactorily. They found, however, that they had not sufficient cars to cope with the traffic, and others had been ordered. Since the opening of the lines the receipts had averaged about £450 or £460 per week, which was in excess of the estimates upon which the statements in the prospectus were based; and he believed that when the additional cars were running the receipts would continue as good, if not better. He then referred to the directors' intention to issue, as originally contemplated, £40,000 of debentures at 4 per cent. In all probability the whole of the debentures would be placed in one lot, thus saving the expense of issuing a prospectus or making a public issue. The additional capital would be applied to paying the balance due to the contractors, to enlarging the car department, and to providing for 20 additional trailer cars, and for a small amount of extras on the contracts. They had kept well within the capital estimates, and the debenture money would also leave a small margin of working capital—sufficient, the directors believed, to meet all the company's requirements.

Mr. A. R. Monks seconded the motion, which was carried unanimously.

United River Plate Telephone Company.

The thirteenth ordinary general meeting of the shareholders of this company was held on Wednesday last at Winchester House, Old Broad Street, Mr. J. Irving Courtenay presiding.

In moving the adoption of the report, the Chairman said it was his pleasant duty to congratulate the shareholders on the greatly increased prosperity of the company during the year under review. In the opinion of the company's representatives at Buenos Ayres, in which the directors agreed, there was reason to hope that the handsome advance that had been made in the profits for the past year would be even exceeded in the year they had just entered upon. The indications for continued improvement were, they thought, more reliable than at any previous time in the history of the company. They must bear in mind that the profits had been largely increased of late by the fall in gold, and in making any comparison between the year he was dealing with and the previous years, the considerable appreciation of the paper dollar should not be forgotten. In regard to the improvement in the business of the company, they had now over 8,000 subscribers. That is a gratifying record, and as their representatives were unceasing in their efforts to give satisfaction to their subscribers, and as they would soon have it in their power to much improve the system, they were fully justified in looking forward to a constant extension of their business and addition to the number of subscribers. The most important work they had in hand was the new central office building, which was progressing rapidly and was expected shortly to be ready for use. Referring to the balance-sheet, he said the capital outlay had been increased during the year by £4,698, and they must expect to add to that largely in the future. The reserve fund of £10,000 was a new item which he was sure they were all pleased to notice, and which he trusted would regularly increase. The depreciation fund showed £1,000 increase. The balance brought forward from the previous year was £6,955, and with the profit for the year £33,333, which was nearly £10,000 in excess of last year, gave them the very substantial sum of £40,289 for appropriation. It is proposed to dispose of the profit by putting to depreciation fund £5,000, £2,000 more than last year, making £9,000 in all. From that total it was intended to write off during the present year the whole of the £5,504 now remaining on the credit side of the balance sheet on the account of the conversion of the 7 per cent. debentures and issue of 5 per cent. debenture stock. They next put to reserve fund an additional £10,000, increasing that fund to £20,000, and then after paying a 6 per cent. dividend, £17,400, they carried forward £7,889. He was sure they might congratulate themselves on the accounts.

Mr. F. Green seconded the motion and the report was adopted, and subsequently the following resolution was also agreed to:—

That of the 42,000 unissued shares of £5 each of the company, 40,000 shares shall be preference shares, and shall only be allotted and issued as preference shares.

That such preference shares, if and when issued, shall confer on the holders thereof the right to a fixed cumulative preferential dividend at the rate of 5 per cent. per annum on the capital for the time being paid up thereon, and shall rank, both as regards capital and dividend, in priority to the ordinary shares of the company.

Crompton & Co., Limited.

The eleventh report of the directors, to be presented at the meeting of shareholders at Cannon Street Hotel, on Monday, July 10th, at 3 o'clock, reads as follows:—The directors have pleasure in submitting their annual statement of accounts, made up to March 31st last, from which it will be seen that the net profits for the year amount to £23,074 4s. After providing for debenture interest, the payment of the interim dividend, and the other items set out in the net revenue account, there remains a balance of £15,499 15s. 5d. The directors propose to set aside the sum of £2,000 for doubtful debts and contingencies, to place £5,000 to a reserve fund, to pay a dividend at the rate of 7 per cent. per annum for the half-year, free of income-tax, making, with the interim dividend paid in January last, 6 per cent. for the year, and to carry the balance, £5,131 10s. 5d., forward. The manufactory at Chelmsford has been fully employed during the year, but the output has not kept pace with the orders, and in consequence, the question of the extension of the new works is forced upon the directors, in addition to the erection of the new shops for the manufacture of arc lamps, instruments, and switchboards mentioned in the last report. The contract department has been busy, and the

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order book of the company is very full. The increase of business has been satisfactory, and there seems every prospect of its continuing. The policy of employing agents in the United Kingdom has been abandoned, and instead, branch offices controlled by the company have been opened in various centres of trade. This new arrangement has proved a success, by increasing the number of orders at a reduced cost. Moreover, the goodwill of the branch offices belongs to the company and not to agents. In accordance with the articles of association, Mr. Carleton F. Tufnell retires from the board of directors by rotation, but offers himself for re-election. The auditors, Messrs. J. H. Duncan & Co., also offer themselves for re-election.

Statement of Liabilities and Assets at March 31st, 1899.

Capital and Liabilities.

	£	s.	d.	£	s.	d.
Authorised issue 54,000 shares at £3	162,000	0	0			
Issued—32,098 shares at £3	96,294	0	0			
Less calls in arrears	344	0	0			
				95,950	0	0
First mortgage 5 per cent. debentures				100,000	0	0
Loans from bankers, secured by deposit of second debentures				87,757	10	7
Sundry creditors				54,964	17	6
Three months' debenture interest accrued				1,250	0	0
Doubtful debts and contingencies account				287	1	1
Unclaimed dividends				26	8	9
Revenue account balance				15,489	15	5
				£305,725	8	4

Property and Assets.

	£	s.	d.
Freehold property	85,695	6	2
Plant, tools, furniture, fixtures, &c.	64,179	8	5
Stock-in-trade and work in progress	88,826	7	8
Trade debtors	76,894	15	10
Investments in shares of other companies	1,684	10	0
Chelmsford Electric Lighting and other subsidiary companies	12,918	16	8
Cash at bankers and in office	3,993	7	10
Patents account	11,532	15	9
Electric cooking and heating department, cost of establishing	8,000	0	0
Goodwill	15,000	0	0
	£305,725	8	4

Profit and Loss Account for the Year ending March 31st, 1899.

	£	s.	d.
To Trading expenses (steam and electric power, labour in stores, works salaries and expenses)	17,882	9	2
„ Administration and office expenses, rents, rates and taxes, salaries, advertisements, &c.	8,111	7	2
„ Repairs to buildings and plant	625	5	10
„ Depreciation of plant and machinery, patents and fixtures	4,159	11	9
„ Balance carried to revenue account	28,074	4	0
	£58,852	17	11

	£	s.	d.
By Gross profit from trading account, pupils' premiums, and dividends on investments	58,352	17	11
	£58,352	17	11

Revenue Account.

	£	s.	d.	£	s.	d.
To Interest on debentures				4,894	5	10
„ Interest on bankers' advances				2,742	16	2
„ Directors', managing directors', trustees' and auditors' fees				2,531	5	0
„ Income-tax	£186	1	4			
„ Interim dividend paid January 14th	2,386	18	2			
„ Balance	15,489	15	5			
				18,012	14	11
				£27,681	1	11

	£	s.	d.
By Balance from last year	4,606	17	11
„ Net profit from profit and loss account	23,074	4	0
	£27,681	1	11

We have examined the foregoing balance-sheet, with the accounts and vouchers relating thereto, and certify it to be, in our opinion, correct. The stock and work in progress has been certified to us by the secretary and general manager.

J. H. Duncan & Co., Chartered Accountants.
Auditors.

39, Coleman Street, London, E.C.
June 29th, 1899.

Electrical Power Storage Company, Limited.

The directors' report to May 31st, 1899, says that the net profit for the year is £4,532 18s. 4d., which, with a balance of £356 10s. 7d. from last year, amounts to £4,889 8s. 11d., out of which the directors recommend the payment of a dividend of 5 per cent. on the ordinary share capital, which will absorb £4,334 16s., leaving £554 12s. 11d. to be carried forward. The company's buildings, plant, tools, &c., have been maintained in thorough and effective repair and condition at a cost of £3,541 10s. 7d., which sum has been provided entirely out of revenue. The amount of business done during the past year is considerably greater than that of any previous year. The rise in the cost of lead and other materials has prevented the company from obtaining the full benefit of this increased output, and has necessitated the raising of the selling prices. New shops, laboratory, and stores have been erected during the year on the area recently added to the works. With these additional premises the company has only just been able to meet the demand for its manufactures. The retiring director, Sir Daniel Cooper, Bart., offers himself for re-election, also the auditors, Messrs. James Meston & Co. The meeting will be on Thursday next, July 13th.

Thomas Parker, Limited.

The annual meeting of the shareholders in the above company was held at the works, Wednesfield Road, Wolverhampton, on Tuesday. Mr. C. T. Mander presided.

The Chairman moved the adoption of the report, which appeared in the Electrical Review of last week. Mr. Mander said he had a most pleasing task to perform in bringing forward the report of their fifth year's trading. It needed no explanation on his part, except to give a reason for declaring so small a dividend as 10 per cent. They could readily have paid a very much larger dividend if they had thought it wise to do so. But he and the board did not believe in going too fast, and they carried £8,000 to reserve instead of the £2,000 last year. That sum would go into the business and be invested probably in labour-saving machinery, and help to make their working expenses less in the future. He believed in keeping the business on a thoroughly sound basis, and they had thought it wise to pay 10 per cent. only, which was very good indeed. They carried forward £2,439, as against £1,294 last year. They could do with some more debentures, because they could very readily use more machinery in their works than they had at present. Their returns were very good for the last year. They had plenty of orders, and were executing them in a workmanlike and speedy fashion. The chairman added that the directors were absolutely satisfied with the way in which the concern was going at the present time.

Mr. T. Parker seconded the adoption of the report, and remarked that there was no dark side to the statement. There was no "doctoring" of the report.

The resolution was carried.

A proposal by the Chairman for the payment of 10 per cent. dividend was agreed to unanimously.

Mr. R. Armistead was re-elected as director. Messrs. Allen, Edwards & Smith (the auditors of the company) were also re-elected. The usual vote of thanks to the chairman closed the meeting.

Greenwood & Batley, Limited.

A meeting of this company was held at the offices, 16, Great George Street, Westminster, on July 1st, to receive the report of the directors for the year ending March 31st, 1899.

The report stated that the available balance amounted to £25,136 4s. 2d., of which £10,000 was to be put to reserve; dividends of 7 per cent. on the preference, and 3 per cent. on the ordinary shares, were declared, and £2,955 13s. 5d. was carried forward. The works were in good condition and well employed, and the prospects for the current year were satisfactory. The company has acquired an interest in the English De Laval Steam Turbine Company, Limited, from which good results are anticipated.

In moving the adoption of the report, the Chairman, Mr. A. Greenwood, referred to the arrears of work due to the engineers' strike, which caused great delay during the preceding year, and prevented the profits from being so large as was expected. The customers, however, had been very reasonable, and few orders were cancelled. In view of extensions of the business, and in order to commence the formation of a reserve fund, the directors considered it prudent not to pay a large dividend. The capital account now stood at £255,269. A site adjoining their Leeds works had been leased to the De Laval Company, which was now erecting workshops upon it; an agreement into which they had entered with the above company secured to them the sole rights of selling the turbines in the British Empire, and in China, and Japan, as well as the manufacture of all the dynamos used with the turbines, of which 2,000 were already in use on the Continent.

Mr. R. Batley expressed the disappointment of the ordinary shareholders at receiving so small a dividend, and suggested that the reserve should have been built up by degrees.

In reply, the Chairman explained that Greenwood & Batley's works were entirely closed for seven months during the strike, so that they suffered more than many large firms, whose works were only partly affected.

The report was adopted unanimously.

Major-General Micklem, the retiring director, and Messrs. Peat and Co., the auditors, were re-elected, and Mr. R. Batley proposed a hearty vote of thanks to the chairman and directors, which was carried unanimously. The proceedings then terminated.

British Thomson-Houston Company, Limited.

The report states that further progress has been made in the winding up of matters in connection with the old company, referred to in the last report. Those losses, which have been determined, have been entirely written off, whilst subsequent losses and contingencies with respect to these contracts taken over from the old company are allowed to stand over against the profits upon other contracts in course of execution entered into by the new company. Such profits accrued on March 31st, 1899, but not taken credit for, are estimated to considerably exceed any loss that may result from the closing of these old accounts. The directors anticipate that before the next general meeting all outstanding matters in connection with the old company will have been cleared off. The profits, after deducting general and technical expenses, discounts, and interest, amount to

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£52,090, and the available balance is £29,732. The directors recommend dividends at the rate of 5 per cent. on the "A" and "B" shares, and a further 5 per cent. on both classes of shares.

Prospectuses.

The Metropolitan Electric Supply Company, Limited, has been inviting applications this week for an issue of £125,000, 3½ per cent. mortgage debenture stock at £97. For supplying its present districts the company has already established five generating works, and for the purpose of coping with its increasing business, has recently acquired a large freehold property at Willesden, and is erecting thereon generating works of exceptional importance and magnitude. The site is bounded by two railways, the Grand Junction Canal and Acton Lane, thus offering unusual facilities for obtaining coal and other materials on the most economical terms. The first of the three contemplated sections of the Willesden works, having a capacity of 7,500 H.P. (4,500 kilowatts), will be in operation in the coming autumn. A second section is in course of construction, and the erection of a third section is in contemplation. The estimated total output of these sections will, when completed, amount to 22,500 H.P., or 13,500 kilowatts. The estimated cost of the first section of the Willesden works now nearing completion is £150,000, and the engineer of the company estimates the cost of each of the remaining two sections at approximately a similar amount. The list of applications closed on Thursday.

The Press has contained notices of the prospectus of the City of Carlisle Electric Tramways Company, Limited, which has been floated with a capital of £60,000 in £1 shares, and £40,000 4 per cent. debenture stock. The routes of the railway radiate from the centre of the city to the suburbs, and comprise a total length of 7¼ miles of track. The list closed on Wednesday.

Electric Construction Company.—The directors have resolved to recommend a dividend on the ordinary shares for the year ended 31st ult. at the rate of 6 per cent. per annum, one half payable on 31st prox., and the other half on January 31st, 1900.

Cape Electric Tramways, Limited.—The directors announce an interim dividend of 3½ per cent., free of income-tax, payable on the receipt of the transfer returns from South Africa. The transfer books will be closed from 6th to 11th prox., inclusive.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending July 1st, 1899, were £768 0s. 8d.; aggregate to date, £10,089 8s. 4d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending June 30th, 1899, were £3,214 11s. 7d.; corresponding period 1898, £2,884 11s. 1d.; increase, £330 0s. 6d.

The City and South London Railway Company.—The receipts for the week ending July 2nd, 1899, were £980; week ending July 3rd, 1898, £988; decrease, £8. Miles open, 8½.

The Dover Corporation Electric Tramways.—The receipts for the week ending July 1st, 1899, were £210 14s. 6d.; week ending July 2nd, 1898, £182 19s. 4d.; increase, £27 15s. 2d. Total receipts to date, 1899, £4,231 18s. 6d.; corresponding period, 1898, £3,339 0s. 11d.; increase, £892 17s. 7d. Miles of track open week ending July 1st, 1899, 8; week ending July 2nd, 1898, 8. Car miles run week ending July 1st, 1899, 4,476; week ending July 2nd, 1898, 3,629. Number of cars, week ending July 1st, 1899, 11; week ending July 2nd, 1898, 10.

The Dublin United Tramways Company.—The receipts for the week ending Friday, June 30th, 1899, were as follows:—D. U. T. Co., horse cars, £2,232 19s. 6d.; ditto, electric cars, £1,317 6s. 8d.; D. S. D. Co., electric cars, £1,036 12s. 5d.; total, £4,586 18s. 2d.; corresponding week last year—D. U. T. Co., horse cars, £2,237 2s. 1d.; ditto, electric cars, £558 19s. 4d.; D. S. D. Co., electric cars, £773 11s. 9d.: total, £4,219 13s. 2d.: increase, £367 5s.; aggregate to date, £95,419 6s. 3d.; ditto last year, £89,276 16s. 3d.; increase to date, £6,142 10s. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 11 miles electrically, and 31 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending July 2nd, 1899, amounted to £1,462; corresponding week last year £1,566; decrease, £104.

The South Staffordshire Tramways Company.—The receipts for week ending June 30th, 1899, were £694 8s. 2d.; aggregate receipts for 26 weeks, £16,520 8s. 9d.; week ending July 1st, 1898, £700 7s. 10d.; aggregate receipts for 26 weeks, £15,801 10s. 7d.

STOCKS AND SHARES.

Wednesday Evening.

With the holiday season softly settling down over the electric lighting market, in company with other departments of the Stock Exchange, we seize an opportune moment in which to sum up a few of the leading changes during the past half-year. That these should be mostly in the nature of small declines (City of London being the only violently affected member of the group) is not very surprising when one considers the eager boom of last year, which at the beginning of 1899 was rapidly subsiding. From the most prominent electric lighting companies we take the following list:—

Company.	January 3rd.	July 3rd.	Rise or fall.
Bournemouth and Poole ..	11½	13½	+ 2
Brush Electric	1¾	1⅝	+ ⅛
Charing Cross	12	11	− 1
Chelsea	9½	8	− 1½
City of London	23	15	− 8
House-to-House	9½	8	− 1½
London Electric	3¼	3⅜	+ ⅛
St. James's	16¼	17	+ ¾
Westminster	16	14½	− 1½

No account has been taken of dividend distributions, and when these are allowed for, the electric lighting market will be found to have suffered, after all, very little loss. The fear of Vestry competition has latterly been heard very little of, and we see no reason why the course of the market should not show a steady improvement between this and New Year's eve.

In the little electric railway section the feature has been the heavy fall in Waterloo and City stock. The reason for this is the policy adopted at the first by the directors in not publishing the traffic receipts separately, but lumping the returns with those of the London and South-Western Company. Reports got about that the line was doing badly, and a good deal of stock was pressed for sale on the Stock Exchange.

Here is our list:—

Company.	January 3rd.	July 3rd.	Rise or fall.
City and South London ..	68	68	..
Central London	10	10¾	+ ¾
Do.	6 (£6 paid)	8¾ (£8 paid)	+ ¾
Waterloo and City	112½	105½	− 7

Central Londons have been bought by those who anticipate great things from the opening of the line. Metropolitan Districts are 3 points down since the first business day of the year, the Metropolitans have fallen 8½.

Traction shareholders will contemplate with equanimity the list of representative securities which we have selected; in only one case has a fall to be noted, and that was not astonishing. The rapid strides made with electric traction and light railways in this country and all the world over, have led to a series of substantial rises, which, in most cases, are fully warranted.

Company.	January 3rd.	July 3rd.	Rise or fall.
Barcelona Trams	13½	16	+ 2½
Buenos Ayres and Belgrano ..	2	3½	+ 1½
British Electric Traction ..	16	18½	+ 2½
Imperial Trams	17	25	+ 8
New General Traction	5	4	− 1

The advance in Barcelona as in Bordeaux tramway shares is due to the fact that both companies will, in all probability, be acquired by the respective Governments of the countries in which the undertakings are situated, but British Electric and also Imperial Tramways shares are both higher owing to the development in electric traction just referred to. The telegraph record runs:—

Company.	January 3rd.	July 3rd.	Rise or fall.
Anglo-American "A"	17	13½	− 3
Commercial Cable	185	192½	+ 7½
Cuba Submarine	10½	9½	− 1
Eastern	176	160	− 16
Eastern Extension	17⅞	16	− 1
Reuters	7⅛	7⅛	None
Globe Telegraph and Trust ..	12½	11¼	− 1¼

The one company whose stock stands higher now than it did at the beginning of the year is the Commercial Cable, which is an American concern, and little affected by the causes that shake the London market. Eastern Telegraph stock has been as low as 156 this year, and as high as 183½. It was rudely upset, in the first place, by the wireless scare, and has lately had the Pacific cable as a thorn in its flesh. National Telephones have lost a few shillings since the year began.

In the manufacturing division Babcock & Wilcox have risen over 10 points during the period under review, but Edison & Swan have declined ½. Electric Construction exhibit no change. Callender's Cable are 4½ to the good, and Henley's Telegraph Works are up £2 10s. per share.

In none of the examples quoted have dividends been calculated.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, June 28th.	Closing Quotation, July 5th.	Business done during week ended July 5th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	101 —105	100 —104 xd	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90 xd	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	61 — 64	61 — 64	62⅜	61¼
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	111½—112½	112 —113	113	112
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	12½— 13	13¾— 14¼	13 15/16	12⅞
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15¼— 15⅝	15 — 15⅛xd	15 7/16	15 1/16
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	110 —114	108 —112 xd	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	185 —192	190 —195 xd	192½	191¼
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106 xd	105⅝	103½
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	...	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9⅛	9
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	4	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	105 —109 %	103—107% xd	...	...
60,710£	Direct United States Cable	20	3 %	3½ %	...	11½— 12	11¾— 12¼	11⅜	11 9/16
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	102 —105	100 —103 xd	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½ %	7 %	...	163 —168	153 —158	166½	152
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	100 —104	100 —104	103	100
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104	101 —104	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	118 —122	115 —120	116	115
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	16 — 16½	15¼— 15¾	16⅜	15¼
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	100 —104	99 —100 xd	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	101 —104	100 —103 xd	...	...
330,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	120 —124	118 —123	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	101 —105	99 —103 xd	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	102 —105	100 —103 xd	102	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	103 —106	103 —106	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	4 %	...	...	102 —105%	102 —105%	102	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5⅛ %	11 — 11¼	10⅝— 11¼	11⅜	10 13/16
180,043	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15¼— 15¾	15¼— 15¾	15½	...
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	31½— 32½	31 — 32	31½	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	101 —104	100 —103 xd	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	53 — 56	52 — 55	...	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	⅝— 1	⅝— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	4⅝— 5⅛	5⅛— 5⅛	5⅛	5⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	11 — 13	12½— 13½	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	11 — 13	12½— 13½	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	4⅝— 5⅛	5⅛— 5⅛	5⅜	5¼
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —103	99 —102	100½	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	105 —108	103 —106 xd	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	5 — 5½	5 — 5½	...	...
151,732£	Do. do. 5 % Debs.	Stock	...	...	...	105 —108	103 —106 xd	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	100 —103	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	103 —106	101 —104 xd	...	...
889,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	105 —108	103 —106 xd	105½	...
88,321	West India and Panama Telegraph	10	1 %	2%	...	1½— 1⅝	1½— 1⅝	1 3/16	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10¼— 10¾	10¼— 10¾	10⅜	10⅜
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8¼— 9½	8¼— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	105 —108	103 —106 xd	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10½— 11½	10 — 11	11¼	10⅝
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	..
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	8 — 9	7½— 8¼xd	8	7¾
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	112 —114	112 —114	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	14 — 16	15 — 17	15⅜	14
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 15	13 — 15	14	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	123 —128 xd	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 12	11 — 11½	11 5/16	11¼
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
220,000	Do. 4½ % Deb. Stock, Prov. Certs (£60% to be paid) Rd.	...	...	...	...	54 — 56	52 — 54 xd	53	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	...	5¼— 5⅝	5¼— 5⅝	...	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	7½— 8½	7½— 8½	7⅝	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	8½— 9½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3¾— 4	3½— 4	3 13/16	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6¾— 7	6½— 7	6¾	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	16¾— 17¼	16½— 17½	16⅝	...
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	15¾— 16¾	15½— 16½	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	118 —121	117 —119 xd	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	16 — 17	16 — 17 xd	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	17 — 18	16½— 17½	17¼	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	4½— 4⅝	4½— 4⅝	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14 — 15	14 — 15	14 15/16	14⅝

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation June 28th.	Closing Quotation July 5th.	Business done during week ended July 5th, 1899. Highest.	Lowest
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3¼— 3⅜	3¼— 3⅜	3 7/16	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	18 — 19	18 — 19	18½	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	14 — 14½	14 — 14½	14½	14⅜
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	13¾— 14¼	13¾— 14¼	14⅛	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	128¼	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅜— 2	1⅞— 2⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2⅛— 2⅜	2¼— 2½	2 5/16	2 3/16
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½%	15 %	14 — 15	14 — 15	14⅜	14¼
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	114 —117	112 —115 xd	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10½— 11	10½— 11 xd	10⅝	...
178,303	Do. do. do. £8 paid	10	...	...	...	8½— 9	8½— 9 xd	...	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	3 — 3½	3 — 3½xd	3¼	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	5¼— 6	5¼— 5¾xd	...	...
630,000*l*	City and South London Railway	Stock	1 1/16%	1⅞%	2⅛%	67 — 69	67 — 69	68¼	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £5 pd.	10	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3¾— 4¼	3¾— 4¼	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 —102	99 —102 xd	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½%	6 %	...	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½%	6 %	...	4 — 5	4 — 5	4½	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	97 — 99	95 — 97 xd	96	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2¼— 2½	2 — 2½	2 5/16	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	4 — 5	3 5/16	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	95 — 97 xd	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ⅞	⅝— ⅞	⅝	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 12	10 — 12	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	24½— 25½	24½— 25½	24⅞	24½
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18 — 20	18 — 20	19	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	...	112 —115	112 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21 1/16	21¼
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	101 —105	101 —105	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞%	3¼%	3¼%	8½— 8¾	8½— 8¾	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	14 — 14½	13¾— 14¼	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	38 — 42	38½	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	105 —108	103 —106 xd	103	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9⅜	9¼— 9⅜	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	104 —107	104 —107	105	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

***Birmingham Electric Supply, Ordinary £5 (fully paid) 10½.**
British Aluminium, Ordinary, 10½—11½; 7 % Pref., 11½—12½.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7⅞—8¼. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 5/16—7/16.
Smithfield Market Electric, 3—4.
***T. Parker, £10 (fully paid), 18.**

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd. 1899).

MARKET QUOTATIONS. Wednesday, July 5th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	32/-	32/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	37/-	37/-	..
a Ammonia, Muriate (crystal) .. per ton	£26	£26	..
a „ „ .. .. per ton	£24	£24	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£27	£27	..
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a „ White Sugar .. .. per ton	£31	£31	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3½d.	3½d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6 5	£6 5	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5 0	£5 0	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£65 to £137	£65 to £137	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8½d.	..
c „ Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c „ Wire, basis .. .. per lb.	8½d.	8½d.	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d
e

METALS, &c. (*continued*).	This week.	Last week.	Increase or Decrease.
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£86	£86	..
g „ Wire (basis price) .. per lb.	10½d.	10½d.	..
g „ Sheet .. .. .. per ton	£86	£86	..
g „ Rod .. .. .. per ton	£86	£86	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/0½ to 4/1½	4/1½	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	69/1	66/-	3/1 inc.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£10 12 6	£10 12 6	..
g Lead, English Ingot .. .. per ton	£14 7 6	£14 7 6	..
g „ „ Sheet .. .. per ton	£15 7 6	£15 7 6	..
l Mica (uncut slabs 8" long) .. per lb.	6/8	6/8	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 5	£8 5	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd strip & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£126 10	£120 10	£6 inc.
g „ foil .. .. per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/7	1/7	..
p White Anti-friction Metals—"White Ant" brand .. per ton	£40 to £65	£40 to £65	..
j Yarns, Cotton, Single 10lb. bundle 2 pr lb.	7½d.	7½d.	..
j „ Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j „ Hemp, 8 ply 10 lbs. .. per lb.	3½d.	3½d.	..
j „ „ Russian, 10 lbs. .. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£12	£12	..
j „ Manila, 24 thread .. per ton	£32 10	£32 10	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£30	£30	..

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
l Messrs. Sanders, Wake & Co.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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MACHINE TOOLS.*

The importance of modern machine tools and labour-saving appliances is becoming sufficiently pronounced to demand serious attention; and an equal or greater interest is required of manufacturers who do not desire to be left behind in the ardent competition now prevailing. England, which was formerly the home of the machine tool, must look to its laurels and satisfy itself that its designs are equally efficient with those of its Continental competitors. It is true that a few English firms are keeping abreast of the times, but the number is regrettably small, as evidenced by the quantity of foreign tools imported into this country.

The existing high rate of wages, and the growing necessity for greater accuracy in manufacture, causes a demand for tools of a more elaborate and automatic character.

For the introduction and use of these modern appliances to the best advantage, the designing and construction of machine tools should hold a more prominent position in the training of superintendents and operators.

Only a few of the more important tools will be described in this paper, a sufficient number of examples of the more familiar tools being given by way of comparison.

Distinctive Features in Modern Tools.

Perhaps one of the most noticeable features of modern workshops is the much larger variety of tools employed, due to the specialisation of each elemental operation, which, in combination with the automatic character of the movements, results in marvellous accuracy and interchangeability of the productions.

The not infrequent English practice of using rough cast gear wheels (or at best emery cleaned) is supplanted by the adoption of machine cut wheels — in many cases cut direct from the solid.

The employment of ball bearings for machines having considerable end thrust (especially where sensitiveness is required) is growing more and more general. When first introduced they were regarded more in the light of a luxury, but are rapidly claiming for themselves the position of necessity.

Screw cutting arrangements of lathes have been greatly improved by the introduction of "neat" gearing, controlled by the simple manipulation of a lever on the front. The regulation of the feed (from a back shaft), worked by a lever in front, deprives the operator of all excuse for not employing the most economical speed. The hardening and grinding of important working parts is receiving an increased amount of attention.

Automatic machines, especially those of the capstan and wire feed type, have made great strides, and the introduction of an electric system of driving is another indication of modern practice.

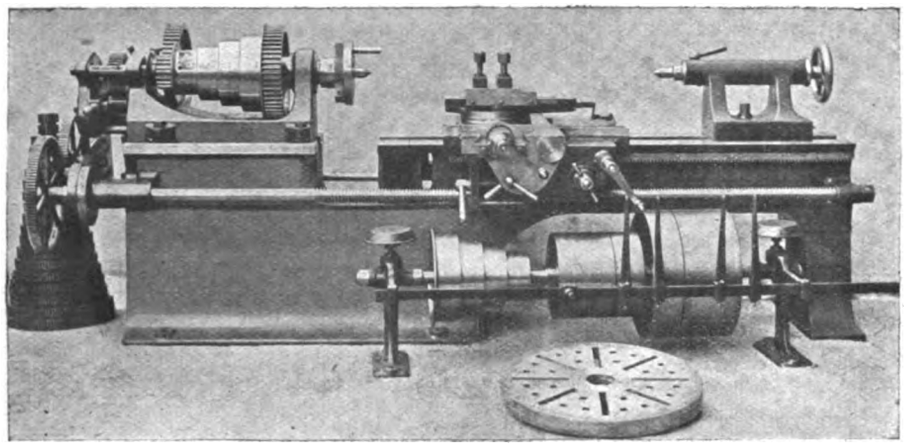

Fig. 1.

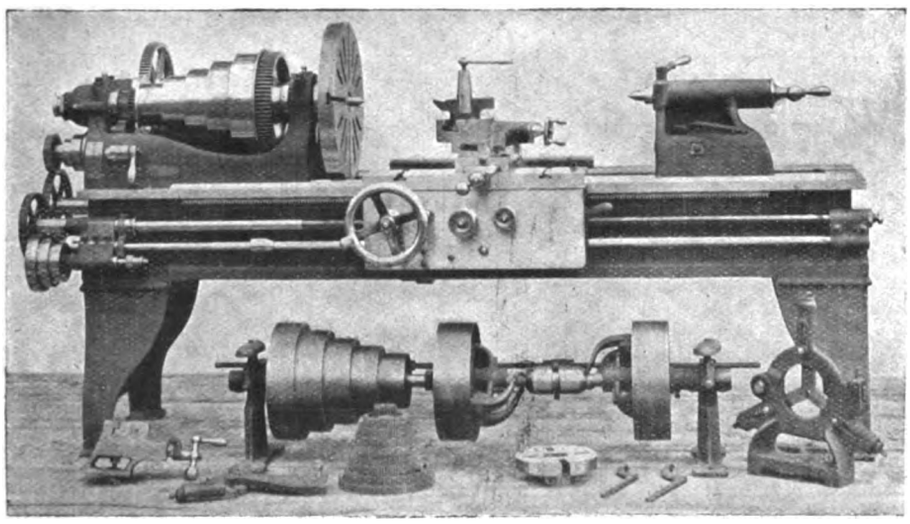

Fig. 2.

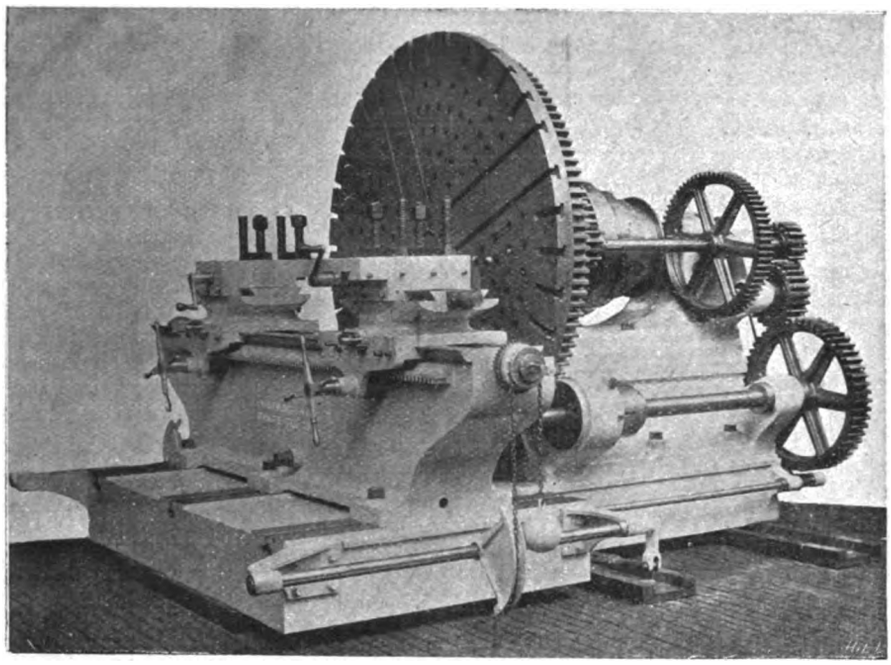

Fig. 3.

The limits of space preclude reference to numerous other

* Editorial abstract of a paper on "Machine Tools," by E. C. Amos, recently read before the Society of Engineers.

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characteristics of the modern tool, which, judging by the present rate of progress, will itself, in the not distant future, become obsolete.

* Description of Tools.—*Lathes—Plain Types.*

In referring to lathes, the late Sir Joseph Whitworth should have special honour, owing to his having introduced the true elements of accuracy by means of universal gauges and threads, and the perfecting of the surface plate and measuring machine.

The following are among the essentials of a good modern lathe: (1) Hollow spindles; (2) Machine-cut wheels; (3) Hardened steel cones or bushes for fast headstock; (4) Turret-headed slide rests; (5) Friction clutches to back gear; (6) Sliding speed of saddle regulated by lever in front of lathe; (7) Ball thrust and other features mentioned elsewhere.

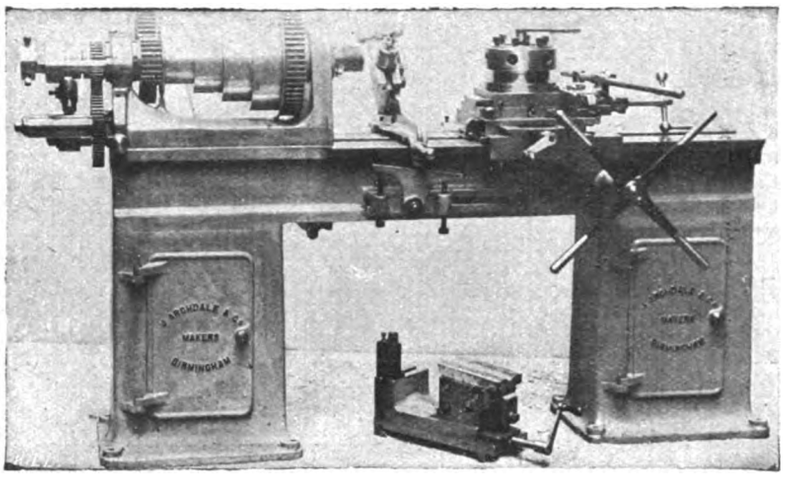

Fig. 4.

Light Screw-Cutting Lathes.

Illustrations, figs. 1 and 2, represent two types of lathes, the one English, the other American. The English is the stiffer of the two, greatly due to the box form of bed. The gap allows the employment of a larger face plate.

Heavy Screw-Cutting Lathe.

An example of heavy lathe by Messrs. Hulse was described, 5 cwt. of steel per hour being removed by this lathe, with a cut 1½ inch deep by ¼ inch thick.

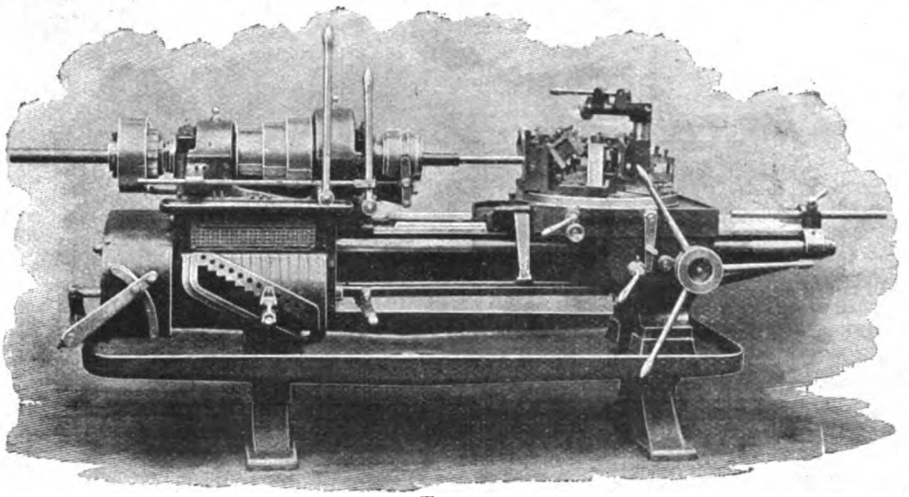

Fig. 5.

Heavy Face Lathe.

Fig. 3 represents a powerful Whitworth 8-foot face plate lathe, and is specially useful for turning large fly-wheels and pulleys, the hub being bored simultaneously with the turning of the rim.

Brass Finishers' Lathe.

Fig. 4 shows one of Archdale's brass finishers' lathes, having a 2-inch hollow spindle and 9-inch centres, with a six-tool turret and the cutting-off tool carried on the back of the cross slide. The chasing apparatus for external screws is worked from a master thread on the back shaft and has an improved arrangement for cutting taper threads. This tool is more substantial than its American *confrère*, one with a 6-foot bed weighing 1¼ tons.

Capstan Lathes.

This type of lathe, which has come so rapidly to the front during the last few years, is made in so many designs that it is difficult to know which particular pattern to select for description, and their appearance is so familiar that an illustration is not required. Those made by H. W. Ward & Co. are among the most up to date designs, and compare favourably with those produced in America, combining the best points of the two countries. The wire feed is a feature common to many capstan lathes, and merits a brief description, being the final adjunct necessary to complete the automatic character of the tool. It is an arrangement which provides for the feeding up of the work through the hollow spindle of the lathe. The operation is as follows:—The rod from which the finished articles are to be produced is placed through the hollow spindle and held in position by a self-centering gripping chuck, which is actuated by a lever at the back of the headstock; a sliding carriage produces a constant pressure against the rod by means of a weight. By releasing the lever, and thereby the work, the weight causes the rod to be pushed through the hollow mandrel any desired amount and regulated by a stop placed in the capstan rest. The rod is then gripped again, the next pin or stud (or other article being made) is cut off, and the process repeated. The whole operation is performed without stopping the lathe. When once set, the whole machine is entirely automatic, and boys, or even girls, with little technical experience are able to produce work from these lathes, which formerly required highly skilled labour.

Flat Turret Lathe.

Fig. 5 shows an automatic chucking and self-feeding flat turret lathe of very rigid construction, designed for producing from the bar extra long work of the stud and pin nature. The machine illustrated has 9-inch centres and weighs 2¼ tons, and has 40 feeds from 4 to 300 per inch. Work can be reduced 2 inches diameter at one cut.

(To be continued.)

* The scope of this journal only admits of a selection of the tools described and illustrated by the author, and it will be readily understood that this choice must be more or less arbitrary. The editor has been guided in his selection by considerations of novelty and general utility.

POWER TRANSMISSION BY DIRECT AND ALTERNATING CURRENTS.

This subject, which was revived by Mr. Swinburne at the Civil Engineers' Conference, has been so often threshed out that one would expect to find electrical engineers agreed upon, at least, the proper bases of comparison. To fairly compare rival systems of electrical power transmission, it is essential that the *efficiency* should be the same in each case—

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otherwise one could prove any system whatever to be the best! Why, then, does Mr. Swinburne disregard this fundamental principle, and arbitrarily fix the current density? This, with a given cross section of copper, involves a fixed C^2R loss in the mains, no matter what power be transmitted by them; so that the *percentage* loss varies by as much as 200 per cent. in the cases considered by Mr. Swinburne.

This being so, the practical value of Mr. Swinburne's results is seriously discounted. We are glad to observe, however, that his calculations are based on the maximum, and not on the virtual, values of the pressure; this is so obviously the correct basis to take, that it is a matter for surprise that the contrary view should still receive support.

We have worked out the cases considered in the aforesaid paper, on the following bases:—*Weight of copper, efficiency of line, and stress on insulating material to be constant in all cases.* The results are given below:—

Case I.—One conductor to be earthed (at one point); pressure between any other wire and earth not to exceed V volts.

R = resistance of the conductors in parallel (a constant).
W = power sent into line.
w = power lost in line.
η = efficiency of line (a constant).
ϕ = power factor.
A = current in amperes on direct current system, Case I. (a constant).
A_1, A_2, A_3 = currents in amperes (virtual).

(*a*) Direct current with two wires; $\phi = 1$.
Resistance of one conductor = 2 R.
Current in one conductor = A.

$$w = 4\,A^2\,R. \qquad W = A\,V. \qquad \eta = \frac{V - 4\,A\,R}{V}.$$

(*b*) Alternating current, one-phase, with two wires; $\phi = 1$.

Maximum pressure = V Virtual pressure = $\frac{1}{\sqrt{2}}$ V

Current in one conductor = A_1.

$$w = 4\,A_1^2\,R, \qquad W = \frac{1}{\sqrt{2}}A_1\,V, \qquad \eta = \frac{V - 4\sqrt{2}\,A_1\,R}{V},$$

whence $A_1 = \frac{1}{\sqrt{2}}$ A, and W = 0·5 A V.

(*c*) Alternating current, two-phase, with four wires; $\phi = 1$.
Same as (*b*); W = 0·5 A V.

(*d*) Alternating current, two-phase, with three wires.
Common return conductor earthed. Maximum pressure between either lead and earth = V. $\phi = 1$.

Current in either lead = A_2. Virtual pressure = $\frac{1}{\sqrt{2}}$ V.
„ in return = $\sqrt{2}\,A_2$.
Resistance of either lead = $(2 + \sqrt{2})$ R.
„ of return = $(\sqrt{2} + 1)$ R.
Loss in leads = $2\,A_2^2\,(2 + \sqrt{2})$ R.
„ in return = $2\,A_2^2\,(\sqrt{2} + 1)$ R.

$$w = A_2^2\,(6 + 4\sqrt{2})\,R. \qquad W = \sqrt{2}\,A_2\,V.$$

$$\eta = \frac{V - \frac{1}{\sqrt{2}}\,(6 + 4\sqrt{2})\,A_2\,R}{V}$$

whence $A_2 = \frac{4\sqrt{2}}{6 + 4\sqrt{2}}$ A, and W = 0·69 A V.

(*e*) Alternating current, three-phase, with three wires; $\phi = 1$.
Maximum pressure between either insulated conductor and earth = V; therefore maximum pressure in one branch (star connection) = $\frac{1}{\sqrt{3}}$ V.

Virtual pressure in one branch = $\frac{1}{\sqrt{6}}$ V.
Current in each conductor = A_3.
Resistance of one conductor = 3 R.

$$w = 9\,A_3^2\,R. \qquad W = \frac{3}{\sqrt{6}}A_3\,V. \qquad \eta = \frac{V - 3\sqrt{6}\,A_3\,R}{V},$$

whence $A_3 = \frac{4}{3\sqrt{6}}$ A, and W = 0·67 A V.

Effect of low power factor:—

Take (*b*) above, with power factor ϕ.

$$w = 4\,A_1^2\,R. \qquad W = \phi\,\frac{1}{\sqrt{2}}A_1\,V. \qquad \eta = \frac{V - \frac{4\sqrt{2}}{\phi}A_1\,R}{V},$$

whence $A_1 = \frac{\phi}{\sqrt{2}}$ A, and $W = \frac{\phi^2}{2}$ A V.

In general, the power W corresponding with a power factor ϕ is found by multiplying the power found for $\phi = 1$, by ϕ^2, the efficiency being constant.

Case II.—Middle point of system earthed; pressure between any conductor and earth not to exceed V volts.

(*a*) Maximum pressure = 2 V.
Current in one conductor = 2 A (where A has the same value as in Case I.).
η is as before, and W = 4 A V.

(*b*) Maximum pressure = 2 V. Virtual pressure = $\sqrt{2}$ V.
Current in one conductor = $\sqrt{2}$ A.
η is as before, and W = 2 A V.

(*c*) Same as (*b*); W = 2 A V.

(*d*) As in Case I. W = 0·69 A V.

(*e*) Common junction earthed; $\phi = 1$.
Maximum pressure in one branch = V = max. pressure between any conductor and earth.
Virtual pressure in one branch = $\frac{1}{\sqrt{2}}$ V.
Current in each conductor = A_3.

$$w = 9\,A_3^2\,R. \qquad W = \frac{3}{\sqrt{2}}A_3\,V. \qquad \eta = \frac{V - 3\sqrt{2}\,A_3\,R}{V}.$$

whence $A_3 = \frac{4}{3\sqrt{2}}$ A, and W = 2 A V.

Case III.—All conductors insulated; pressure between any two conductors not to exceed V.

(*a*) Same as Case I. W = A V.
(*b*) Same as Case I. W = 0·5 A V.
(*c*) Same as (*b*). W = 0·5 A V.
(*d*) Maximum pressure between leads = V.
„ „ in one branch = $\frac{1}{\sqrt{2}}$ V.
Virtual „ „ „ = $\frac{1}{2}$ V.

$$w = A_2^2\,(6 + 4\sqrt{2})\,R, \qquad W = A_2\,V, \qquad \eta = \frac{V - A_2\,(6 + 4\sqrt{2})\,R}{V},$$

whence $A_2 = \frac{4}{6 + 4\sqrt{2}}$ A, and W = 0·34 A V.

(*e*) Same as Case I. W = 0·67 A V.

The results are collected in the following table (No. I.), for a power factor of unity:—

Table I.—Power Factor Unity.

Current system.	No. of conductors.	Power transmitted. Case I.	Case II.	Case III.
Direct	2	1	4	1
Alternating 1-phase	2	0·5	2	0·5
„ 2 phase	4	0·5	2	0·5
„ „	3	0·69	0·69	0·34
„ 3-phase	3	0·67	2	0·67

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In the case of an aerial line in good condition, the insulation resistance between any two insulated conductors would normally be twice that between any one conductor and the earth; hence Case II. would be the most appropriate arrangement for this purpose, as in this case the insulating material is stressed to approximately the same extent between line and earth as between the line conductors.

In the case of an underground line, with concentric cables, the stress on the insulating substance between the conductors is alone important, as the outermost may be earthed or not without effect on this stress; here Case III. is the proper basis of comparison.

Case I. may be applicable when for any reason Case II. cannot be made use of; this would, however, be exceptional.

Taking Cases II. and III., the following table (No. II.) shows the relative capabilities of the different systems with power factors, 0·9, 0·8, and 0·7—the power factor in the case of direct current being, of course, always unity :—

Table II.—Power Factor less than Unity.

Current system.	No. of conductors	Power transmitted.					
		Case II.			Case III.		
		ϕ = 0·9	0·8	0·7	0·9	0·8	0·7
Direct	2	4	4	4	1	1	1
Alternating 1-phase ...	2	1 62	1 28	0 98	0·41	0 32	0·25
„ 2-phase ...	4	1 62	1 28	0 98	0·41	0 32	0 25
„ „ ...	3	0 56	0 44	0 34	0 28	0·22	0·17
„ 3-phase ...	3	1 62	1·28	0 98	0·54	0·43	0 33

Bearing in mind the fact that an alternating current circuit is always more or less inductive, the enormous superiority of the direct current system is very evident from these figures, quite apart from considerations of line capacity, dielectric hysteresis, &c., which are by no means negligible on long lines, especially if part of their length is underground.

The commutation difficulty, however, is still a fatal bar to the use of direct currents at extra high pressures, and since the power transmitted, other things being equal, is proportional to the square of the applied pressure, the alternating current of whatever description must always be preferred for long distance transmission. It is noteworthy that the two-phase system with *three* wires is hopelessly beaten in all cases; the three-phase system is, on the whole, the most advantageous.

If the problem be altered to that of finding the size of mains required to transmit a given power, the solution is easily obtained from the results given above. The simplest plan is probably to first calculate the size of mains required on the direct current system, with a suitable efficiency, at a pressure depending upon the current system to be employed, and the maximum stress permitted on the insulating material. The relative values of these pressures are given in the following table (No. III.) where v is the maximum stress pressure as defined in Cases II. and III., and v is the pressure in virtual volts between the line conductors in the various systems—excluding the two-phase three-wire system from the list as useless :—

Table III.

Current system.	Working pressure.	Max. stress V.		Equivalent d.c. pressure.	
		Case II.	Case III.	Case II.	Case III.
Direct	v.	0 5 v.	v.	v.	v.
Alternating 1-phase	v.	0·71 v.	1·41 v.	1 41 v.	1·41 v
„ 2-phase					
„ 3-phase	v.	0 82 v.	1·41 v.	1 63 v.	1 41 v.

The direct current mains are calculated for the pressure given in columns 5 and 6, according to the system adopted; the total cross-section of copper required for the mains on any other system is then obtained, by multiplying the value of the cross-section for direct current by the multiplier given in Table IV. for the corresponding system, allowing for the probable value of the power factor :—

Table IV.

Current system.	No. of conductors.	Multiplying factor.							
		Case II.				Case III.			
		ϕ = 1·0	0·9	0·8	0·7	1·0	0·9	0·8	0·7
Altg. 1-phase	2	2	2 5	3·1	4 1	2	2 5	3·1	4·1
„ 2-phase	4								
„ 3 phase	3	2	2 5	3·1	4 1	1 5	1·8	2·3	3·1

The total cross-section divided by the number of conductors (column 2) gives the cross-section of each conductor.

Example.—To transmit 500 kw. (gross) 20 miles, on the three-phase system (Case II.), with 90 per cent. efficiency of line, maximum stress on insulation 5,000 volts, and power factor 0·9.

Here $v = \frac{5{,}000}{\cdot 82}$ = 6,100 volts, and the equivalent D.C. pressure = 6,100 × 1·63 = 10,000 volts. Drop in line = 1,000 volts. Current = 50 amperes. Resistance of line = 20 ohms. Total cross-section of copper = 2 × 0·09 = 0·18 square inch. Cross-section of copper for three-phase system (ϕ = 0·9) = 2·5 × 0·18 = 0·45 square inch. Cross-section of each conductor = 0·45 ÷ 3 = 0·15 square inch.

THE ELECTROLYTIC METHODS OF ZINC EXTRACTION.

By JOHN B. C. KERSHAW, F.I.C.

The electrolytic methods of extracting zinc from poor or refractory ores have attracted considerable attention from metallurgists during the past ten years, and large sums have been expended in testing the more promising methods worked out in the laboratory upon an industrial scale. One or two of these have been successful, but the greater number have proved failures. Since there is a tendency in some quarters to regard the failures as exceptional and the successes as capable of repetition under altered conditions, it may prove useful to present to readers of the Electrical Review a summary of the processes which have received, or are now receiving, industrial trial; and also to quote some opinions relative to the economic aspects of the problem.

All the wet processes for the extraction of zinc from its ores by aid of electrolysis, are alike in the main features of the *modus operandi*. The roasted ore is leached, in special leaching vats or tanks, with a solution of some acid or salt, which is able to dissolve out the zinc. The resulting solution of zinc after purification is then electrolysed in a second series of vats, with or without diaphragms. The processes differ merely in the solvent used and in the details of the depositing vats.

The Ashcroft Process.—The solvent used in this process as originally tried at Grays, in Essex, and at Newcastle, in New South Wales, was a solution of a ferric salt. The zinc solution obtained, after removal of the iron, was then electrolysed in vats provided with carbon and iron anodes, and with zinc cathodes. Full details of the process, and of the plant erected at Cockle Creek in New South Wales, will be found in the Journals mentioned below.* After trials extending over several months in the years 1897 and 1898, at the last-named place, the process has been discarded. Mr. Ashcroft, in a paper read before the Institute of Mining and Metallurgy in June of last year, gave the three following as chief causes of this unfortunate ending to the trials :—

1. Falling off in the metal contents of the ore sent for treatment from the concentrating plant.

* *Journal Society of Arts.* Swinburne. Vol. 44. *Elektrochemische Zeitschrift.* Vol. 4, p. 189.

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2. Inability to make the process truly cyclic in character, owing to the accumulation of manganese and other impurities in the electrolyte.

3. Insufficient financial support for maintenance of the work at Cockle Creek, upon the scale for which the plant had been designed.

The failure of this much-advertised process, for which a very large sum was paid by the Sulphide Corporation of London, has led to much mutual recrimination; and the failure will undoubtedly render it more difficult to raise money in this country for other electro-chemical or electro-metallurgical developments.

With regard to the second cause of failure mentioned above, it is not clear whether any difficulties from the accumulation of manganese had occurred during the earlier trials at Grays.

If such had arisen, it was certainly a grave error to erect plant upon a large scale at Cockle Creek before they had been overcome. If, on the other hand, manganese caused no trouble during the early experimental work at Grays, it would indicate that the ore sent over for treatment was not representative of the whole. As matters stand, the explanations given for the failure of the process are not completely satisfactory, and it is hardly surprising that the *Engineering and Mining Journal* of New York has expressed itself in strong terms upon the subject.*

The writer is informed that libel proceedings are threatened as a result of the remarks made in the issue referred to; consequently there is some chance of further light being shed upon the causes that led to failure.

The Dieffenbach Process.—This process uses as raw material a zinc-holding iron pyrites mined at Siegen, in Westphalia, containing 8 per cent. zinc before and 15 per cent. after roasting. The ore is crushed and is then roasted with common salt, in order to convert the zinc sulphide into chloride. It is then leached with water, and the resulting zinc chloride solution is electrolysed in specially designed vats, having a closed anode chamber. The chlorine obtained is, the writer believes, used for manufacturing bleaching powder. This process has been in industrial operation at Duisburg, in Germany, since 1895. In December, 1896, the works were stated to be producing 90 tons of zinc per month, and an enlargement was planned for 1897. Only ·50 per cent. zinc is left in the leached ore, and it is therefore available for use in the iron works of the neighbourhood. The zinc obtained by the process contains from ·02 to ·05 per cent. impurities —chiefly lead. Peters in a recent article,† however, states that the financial results of the Dieffenbach process are unsatisfactory, and that the zinc costs double that obtained by the ordinary distillation method. Borchers has still more recently stated that the works at Duisburg have stopped operations, but the cause of failure is not yet known.‡

The Siemens and Halske Process.§—This process was developed in order to meet the problem of the Broken Hill ores, and consists in leaching the roasted ore with a sulphuric acid solution, and in electrolysing the resulting acid zinc sulphate solution. The process is therefore merely a resurrection of the Letrange extraction process, tried on an extensive scale at St. Denis, with unsatisfactory results, some years ago. The electrolyte contains from 5—10 grammes per litre free sulphuric acid, and circulation in the depositing vats is promoted by means of air jets. Lead anodes and zinc cathodes are used. Experimental trials of this process at Berlin led to plant on a larger scale being erected for trial of the process at Lake Illawarra, N.S.W. These trials do not appear to have resulted in success, for the process which it is intended to work at Lake Illawarra is not an electrolytic one, but is dependent upon the precipitation of zinc as zinc oxide, from the zinc sulphate solutions, by means of magnesia. The Smelting Company, of Australia, are at present erecting a large plant for operation of this oxide process. A detailed description of the plant will be found in the issue of the *Engineering and Mining Journal* (New York), for September 17th, 1898.

The Nahnsen Procés consists in the use of a solution of the double sulphate of zinc and sodium as electrolyte, and it received trial at the works of the Schlesische Aktien Gesellschaft für Zinkhüttenbetrieb at Lipine, in Silesia, in 1893. The process was discarded because at that time no market existed for pure zinc. According to Nahnsen, 3 to 5 tons of coal will produce the electrical energy necessary to deposit 1 ton zinc by this process. The latest reports from Lipine are to the effect that the Nahnsen process is again in operation there, but no details are available.

The Hoepfner Process.—This process was first tried at Fuerfurth, in Germany, and it is now being worked upon an industrial scale in Germany, in Austria, and in this country at the Winnington works of Messrs. Brunner, Mond & Co. This firm produced 400 tons zinc by the Hoepfner process in 1897, while the works at Fuerfurth is said to have produced 800 tons in the same year. The electrolyte used is a solution of zinc and other chlorides—lead or sodium chloride. The cells are divided into anode and cathode compartments by diaphragms of special construction. The cathodes are rotating discs of zinc, only partly immersed in the solution. The anodes are of carbon or of lead. The rotating disc cathode is held by Hoepfner to be one of the chief features of the apparatus, since by its use treeing and other customary defects of electro-deposited zinc are avoided. The electrolyte is used warm. The method of preparation of the zinc chloride solution is not by any means clear. Schnabel states that it is obtained by leaching the ground and roasted ore with an alkaline solution; while, according to Steinhardt, it is prepared by mixing zinc sulphate solution with the calcium chloride liquors of the ammonia soda process.

In another account of the process*, lead chloride is substituted for calcium chloride, and lead sulphate is therefore obtained as a by-product, but the writer has not yet discovered how the lead chloride solution is originally prepared. Ingalls states that the output by this process is 5 kilogrammes zinc and 15 kilogrammes bleach per E.H.P. day. By a modification of his original process Hoepfner claims that he can produce 16 kilogrammes zinc per E.H.P. day, but in this case the chlorine liberated at the anode is used to raise an —ous salt to the —ic state of oxidation, and no bleach is therefore obtained. Borchers has recently stated† that the Hoepfner process has ceased operating at Fuerfurth; but this may be due to local or temporary causes, and in the light of a recent paper by Hoepfner‡ it is difficult to believe that the process has proved a failure.

(To be continued.)

* See issue for October 22nd, 1898.
† *Dingler's Polyt. Journal*, Vol. 309, p. 237.
‡ *Zeits. f. Elektrochemie*, March 2nd, 1899.
§ Patent No. 13,434. 1895.

FOREIGN ELECTRIC MACHINERY.

[COMMUNICATED.]

As the transmission of electrical energy from central stations becomes more and more universal, the nature of electrical engineering manufactures becomes correspondingly changed.

In early days the isolated electric plant was the backbone of the business; small firms all up and down the country made and installed complete plants, sometimes with and sometimes without the aid of a consulting engineer.

Nowadays isolated plants are confined to collieries and large factories, where, in fact, they are large enough to be classed among the smaller central station plants.

The demand for electro-dynamic machinery has of late set in more for dynamos of fairly large output, for the smaller consumer is better served from a central station in a town, and the large power user puts down a small central station of his own; hence dynamo-electric generators of smaller outputs are not now so much in demand as formerly.

The British makers have all along held their own in competition with the foreigner in the manufacture and installation of central station engines and dynamos, and those engaged in that branch of the business have prospered, and have still a bright future in view.

The smaller manufacturers have still left to them the motor business, but it is a branch of the business in

* *Zeits. f. Angew. Chemie*, 1899, p. 36.
† *Zeits. f. Elektrochemie*, March 2nd, 1899, p. 407.
‡ *Elektrotech. Zeitschrift*, November 3rd, 1898, p. 734.

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which the foreign competitors are most successful, not because the foreigners make cheaper or better motors, but simply for the reason that they, especially the Americans, have made it their business to manufacture motors and their accessories which meet the requirements in distributing power in mills, factories, &c.

The small motor is the motor of the future. There is no gain in placing a few large motors in a factory to run all the shafting and belting as before. To effect a substantial saving, shafting and belting must be as far as possible abolished, and to accomplish this means a motor for every machine to be driven.

This system is succeeding here, and has for long been successful in America, one place in Washington having 400 motors at work, and we know an engineer in this country who, during the past 12 months, has put in over 150 motors in various places to displace mechanical distribution.

But most of the motors put in are American; the chief reason for the adoption of foreign motors in these cases is given without hesitation, as due to the fact that the machines required can be got promptly from stock; they are complete standard machines, reliable, and well tried.

The British maker has no stock; few of them even stock the materials; some of them take orders for machines for which they have not got out the drawings, the consequence is, that in the competition the American offers at the same price machines well known and tried, complete, ready for work from stock. The British maker wants time to make his plans, buy his material, and so on, until he makes an offer to deliver, say, 20 motors in six months. At the end of the six months, in all probability, he will ask to be excused, for the reason that he cannot get castings, or wire, or something. How can we expect to do business in that way? Motor making is pretty much like sewing machine making, it cannot be carried out successfully in a small shop with a few old-fashioned tools. A modern sewing machine could not be produced in a mechanic's shop for less than £100, while in a properly equipped factory put up for the purpose it could be made for £2.

British makers are still in the mechanic's shop stage; in most shops we find dynamos and motors of all sizes, shapes and designs being constructed, no regular manufacture, large firms competing for the equipment of an electric railway and for the supply of a motor to run a milliner's sewing machine, neither the milliner's motor, nor the electric railway plant being at the time in stock.

British makers only dabble in motor making; there is not a fully equipped motor factory in Britain turning out standard motors from ¼ to 10 horse-power as a speciality, and where we could wire for 20 motors to be delivered within a week. Yet there are several such places in America.

The excuse that they are all so busy that early delivery is impossible, is nonsense; a look through the shops at once reveals the fact that everything is being made to order, and the staff and tools are limited to the minimum required to complete the orders in about from three to six months over the time fixed for delivery.

These are the views of one whose business it is to buy and deal in dynamos and motors in Britain.

THE CALCIUM CARBIDE AND ACETYLENE GAS INDUSTRIES.

By JOHN B. C. KERSHAW, F.I.C.

I.—Production.

The production of calcium carbide in the electric furnace, and the utilisation of this carbide for the generation of acetylene gas, continues to be one of the favourite subjects for inventors, and the numbers of applications *granted* during the years 1896—1898 have been as follows:—

1896, 159; 1897, 172; 1898, 124.

The total for the latter year is not yet complete, and it is probable that ultimately the total of 1897 will be exceeded. For the first quarter of 1899, the number of patent applications granted has been 84.

In France, patent litigation has been commenced, and the Moissan patent is being contested by the Société de Froges.

In Germany, the Bullier patent of 1894 has been declared void. In this country the Bullier patent of 1895, is antedated by the Willson patents (16,342 and 16,705) of 1894. It is over these latter that litigation will occur, as several companies are manufacturing in defiance of the claims of those who have bought the Willson patents.

As the writer has often prophesied, carbide manufacture is not proving a very profitable industry for some of the companies floated in this country during the past few years. The Midland Acetylene Parent Syndicate, with works at Cradley Heath, has recorded a loss of £6,418 on the first 20 months' trading. The editor of the journal of the industry in a recent number,* refers to the injury resulting from the continued trading of *insolvent* carbide and acetylene companies. According to this writer, three companies in this country are being carried on by the debenture holders, unknown to the creditors. "They have not paid—nor do they intend to pay, a farthing of their existing liabilities." Another case of failure to realize the expected business or profits, is that of the Acetylene Gas Light Power and Calcium Carbide Company, which is being voluntarily wound up.†

These financial failures completely justify the opinions expressed by the writer in the past, upon the subject of the "boom" in acetylene gas company promotions, and they are the natural result of sinking excessive capital under unfavourable conditions in this new industry.

That cautionary remarks are not uncalled for is proved by the fact that since the commencement of 1898, 14 calcium carbide or acetylene gas company promotions have occurred in *this country*, the aggregate capitalisation of these companies being £543,100. In one of these prospectuses, the vendors, who are selling their patents in a new generator for £50,000, estimate the annual profits at £40,805. The shareholders will have considerable interest in checking these expectations at the close of the first year's operations.‡

The actual manufacture of carbide is believed to be carried on by six works in this country, but owing to the pending litigation, considerable secrecy is observed, and it is difficult to obtain reliable information on the subject. The six works alluded to, are situated at Foyers, Huddersfield, Sheffield, Birmingham, Cradley Heath, Ingleton, and Woodside in Surrey. As stated above, the Cradley Heath works has not so far operated at a profit.

With regard to the details of furnaces and methods of manufacture, a description of the generating machinery and furnaces at the new carbide works at Saulte Sainte Marie will be found in the paper named below.‡

Patten, in a recent article, has given details and illustrations of all the modern forms of carbide furnace.§ A recently published book‖ contains some notes upon the carbide works at Langenthal in Switzerland. The furnaces at this works are simple in construction, and are of the movable hearth type. Three-phase current is used, and three furnaces are worked simultaneously, each furnace taking current of one phase. The current used is 1,000—1,500 amperes at 75 volts. This is the first instance, so far as we know, of three-phase current being used for furnace work.

According to the *Electrician*¶ Lamoth and McRae, of Ottawa, have patented a new form of carbide furnace, in which carbon pencils connect the two electrodes. The heating is, therefore, effected chiefly by radiation from these pencils, and not by the arc.

Forty furnaces of this type are, it is stated, to be erected at Ottawa. The *Revue Industrielle* in a recent issue** describes a method for obtaining calcium carbide without the aid of electricity. The materials are to be prepared as at present, but with excess of carbon, and heated in a furnace supplied with pure oxygen obtained from the atmosphere by means of a Linde freezing machine. Patten, in a more recent article than that referred to above, states that multiple arc furnaces are now being used for carbide production.†† The latest form of carbide furnace, according to this writer, is 30 feet high, absorbs 1,000 amperes at 65—70 volts, and produces 1,500—1,800 lbs. carbide in four hours. The Bertolus furnace is said to be in use at Bellegarde, and is described in the paper named below.‡‡

The estimates of capital outlay and manufacturing costs still show considerable variation. A writer in *L'Industrie Electrochimique* gives an estimate of £32,000 for a plant of an annual capacity of 1,000 tons,§§ while another authority estimates the capital outlay as £35,000 for double this output of carbide. This writer estimates the working costs when steam-power is used at £23,000 per annum, when water-power is used, at £17,500 per annum, on an output of 7 tons carbide per day, 350 working days being taken as the basis of calculation.‖‖

As regards the actual yield of carbide, the writer just named states that 1 E.H.P. now yields 3·5 kgs. carbide per day of 24 hours, while Patten asserts that a yield of 4·3 kgs. per E.H.P. day,¶¶ is obtained in the United States. Haber, in his handbook on "Technical Electro-chemistry,"*** states that in Germany 3 kgs. per E.H.P. day of 24 hours are usually obtained, while in the United States the yield is increased by about 1 kg. The theoretical yield of carbide is 5·4 kgs. per E.H.P. day of 24 hours, so that the thermal efficiency of the process is about 65 per cent.

In a recent report††† the number of carbide works in operation was

* *Journal of Acetylene Gas Lighting*, January, 1899.
† The *Times*, April 13th, 1899.
‡ *L'Eclairage Electrique*, November 5th, 1898
§ *Electrical World*, November 22nd, 1898.
‖ "Une Excursion Electrotechnique en Suisse."
¶ *Electrician*, November 25th, 1898.
** *Revue Industrielle*, December 10th, 1898.
†† *American Electrician*, January, 1899.
‡‡ *Zeitschrift f. Angew. Chemie*, 1898, p. 1078,
§§ *L'Industrie Electrochimique*, September, 1898.
‖‖ *Elektro-tech. Anzeiger*, April 21st, 1898.
¶¶ *American Electrician*, January, 1899.
*** "Tech. Elektrochemie," chapter 10. Leipsig, 189
††† *Engineering*, December 9th, 1898.

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given as 32, and the number of works building, as 18. To these totals must be added six others, so that at the end of the present year there may be no fewer than 56 works engaged in the manufacture of calcium carbide. The probability is, however, that some of the works now in operation, will have to cease production, owing to the difficulty of finding a market. No returns are yet available which will enable one to gauge accurately the production of carbide in Europe, or the present demand for carbide in connection with *bonâ fide* lighting developments.

II.—UTILISATION.

On the subject of generators for production of acetylene gas, Gerdes in Glaser's Annalen,* recommends those in which the carbide is wholly immersed. Lewes in Cantor Lecture III.† on acetylene gas, also advises the use of this form of generator, but states that a larger yield of gas is obtained from those generators in which the water slowly rises round the carbide. For ordinary use the latter form will, therefore, be preferred, although the gas obtained from it is less pure.

In a recent issue of the journal devoted to the calcium carbide and acetylene industry, the dangers arising from the use of faulty and badly designed generators are alluded to.‡

With regard to the properties of acetylene gas, there is little new to report. Redwood has published a note dealing with the injurious action of acetylene gas upon platinum, when used for heating purposes in the laboratory.§ Gerdes in Glaser's Annalen has reported the results of his experiments upon the poisonous and explosive properties of the gas. A summary of this paper will be found in the journal named below.‖

In the *Comptes Rendus* Claude gives details of his researches upon the explosive properties of acetylene gas at low temperatures.¶

The purification of acetylene gas upon a commercial scale, is a subject which is now attracting considerable attention. As already noted, generators in which the carbide is wholly immersed yield the purest gas, since the gas in bubbling up through the water is subjected to a washing action, and soluble impurities are thus removed. All other types of generator when worked with ordinary commercial carbide, yield very impure gas, and Stern has stated that none of the methods of chemical purification hitherto suggested or tried, have been completely successful.** A new method of purification, patented by Ullman, is described by the same writer. Chromic acid is the agent employed to absorb the impurities, and it is claimed for this new method, that all impurities can be removed in the one operation.

The use of acetylene gas as an illuminating agent in remote districts, where the cost of coal-gas is high, is slowly extending. Considerable attention is also being given to the use of mixtures of oil-gas and acetylene. In the recent Cantor Lectures on acetylene,†† Lewes gives details of his own experiments on this subject. With a mixture containing 22 per cent. acetylene the illuminating power is doubled. If oil-gas costs 6s. 6d. per 1,000 cubic feet, and acetylene 38s. to 40s. per 1,000 cubic feet in the gasometer (the estimate is based on carbide at £16 per ton at the factory), the addition will not be economical; but in those places where oil-gas costs more than 6s. 6d. per 1,000 cubic feet the use of acetylene will prove remunerative.

Details of the acetylene gas lighting plants at Wabash, Indiana, at New Milford, Connecticut, at Milford, Pennsylvania, and at Cowdenheath, Scotland, are given in a recent issue of the *Progressive Age*.‡‡ At the last named place, the users are not taking kindly to the increased cost (oil-gas was sold at 12s. 6d. per 1,000 cubic feet, while acetylene gas is charged 100s. per 1,000 cubic feet), though doubtless they appreciate the improved illumination. In a paper recently read by Vortus before the K. Ungar Naturwiss, Verein, in Buda-Pesth,§§ the author discussed the use of the gas as an illuminant, and stated that its chief service would be as an enricher for gases of lower illuminating power.

Prof. Thompson, in a short series of lectures delivered at the Finsbury Technical College in 1897, in fact stated that in the States, acetylene was being used for this purpose in nearly every gasworks. The statement has, however, been contradicted by a writer in the *Electrician* as regards the gasworks of the Eastern States.‖‖ Bork, in the paper named below,¶¶ has published details of the costs of definite mixtures of oil gas, and acetylene. Worked out to a common basis of comparison, the mixed gas is only one-half the cost of the oil-gas alone. It must be remembered, however, that in actual practice, the gain is not in cost, but in increased illumination; the tendency with a cheaper illuminant always being to increase the light rather than to reduce the cost. A good general article on the use of acetylene as a lighting agent appeared in a recent issue of the *Engineer*.*** This article is worthy of attention since it is singularly free from the extravagance which usually marks articles written in favour of the new illuminant.

With regard to the use of acetylene in gas engines, Grover has recently issued a pamphlet containing the results of his own experiments upon this subject.*

In a letter to one of our contemporaries Grover states that in his opinion there will be a great future for acetylene motors when calcium carbide sells for £5 per ton.† This, we are afraid, is tantamount to "never."

This present article can be fittingly concluded by a list of places in this country at which acetylene lighting plants are being installed. Some of these are, doubtless, now in operation:—

Barnton; North Cave; Needwood House, N.B.; Lochalsh pier and station; Osberton Hall, Worksop; Volunteer Hall, Lochgilphead; Golf Club House, Burntisland; Free Church, Montrose; Y.M.C.A., Grantown-on-Spey; shops at Crowdenheath, N.B.; and railway station at Abboyne.‡

* *Engineering Magazine*, December, 1898.
† *Journal Society of Arts*, January, 1899.
‡ *Journal of Acetylene Gas Lighting*, January, 1899.
§ *Journal Society Chemical Industry*, December, 1898.
‖ The *Engineering Magazine*, December, 1898.
¶ *Comptes Rendus*, January 30th, 1899.
** *Journal of Gas-beleuchtung*, Vol. 41, p. 749.
†† *Journal Society of Arts*, January 13th, 1899.
‡‡ *Progressive Age*, December, 1898
§§ *Chemiker Zeitung*, December 12th, 1898.
‖‖ The *Electrician*, January 7th, 1899.
¶¶ *Le Genie Civil*, November 5th, 1898.
*** The *Engineer*, March 31st, 1899.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. THOMPSON & Co. Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

12,706. "Electric muscular exerciser." A. B. MACMILLAN. Dated June 19th. (*Complete.*)

12,730. "Improved galvanic cell." P. OFFENBROICH and H. ROCKEL. Dated June 19th.

12,731. "Improvements in electrical switches, particularly suitable for high voltage connections." G. W. HOLT and A. ATHERLEY. Dated June 19th.

12,732. "Improvements in electrical switches." G. W. HOLT and A. ATHERLEY. Dated June 19th.

12,750 "Improvements in or relating to electric traction systems." E. CERVENKA and S. MAHLER. Dated June 19th. (*Complete.*)

12,757. "An improved current-collecting brush for electro-motors, dynamo-electric machines, and the like." I. LANDAUER. Dated June 19th.

12,761. "Improvements in automatic charging apparatus." C. D. ABEL. (A. B. Helbig and P. C. F. Hemmore, Germany.) Dated June 19th.

12,767. "Improvements in and connected with coin freed electricity meters" F. J. BEAUMONT. Dated June 19th.

12,772. "Improvements in electrical resistance baths." W. C. SELLAR. Dated June 19th.

12,787. "Improvements in devices for breaking electric circuits and protecting the same from excessive currents." W. P. THOMPSON. (The Rolfe Electric Company, United States.) Dated June 19th.

12,788. "Improvements in and relating to carbon conductors for electric cells and dynamos." C. W. HERTEL. Dated June 19th.

12,789. "Improvements in telephone systems." R. WIENMAR. Dated June 19th.

12,800. "Improvements in or appertaining to certain multiple safety fuse blocks for electric light wires and other similar electric conductors." M. H. BARBER. Dated June 20th.

12,829. "Improvements in obtaining metals from their fused ores oxides and salts by electrical action." J. BAXERES DE ALZUGARAY. Dated June 20th.

12,833. "Improvements in filaments for electric glow lamps.' G. BAMBERG. Dated June 20th.

12,842. "Improvements in electrostatic measuring instruments." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (E. Thomson, United States.) Dated June 20th. (*Complete*).

12,869. "Improvements in driving mechanism for dynamos." W. L. BLISS. Dated June 20th. (*Complete.*)

12,874. "Improvements in glass globes, screens, covers, or like for electrical incandescence and other lamps, and in means for manufacturing the same." E. APPLEGARTH. Dated June 20th.

12,883. "A method of repairing incandescence electric lamps." M DUMONT. Dated June 20th. (Date applied for under Patents, &c, Act, 1883, Section 103, April 12th, 1893, being date of application in France.)

12,904. "Improvements in working changing colours for advertising signs, electrical effects and the like." G. F. KENYON and W. H. BLACKHURST. Dated June 21st.

12,949. "Improvements in or relating to the connection of house service or branch conductors to electric mains." L. ANDREWS and J. GLASS. Dated June 21st.

12,951. "Improved cut-out apparatus for automatically disconnecting incandescence lamps having filaments of secondary conductivity." W. P. THOMPSON. (The Vereinigte Electricitäts Actiengesellschaft, Austria-Hungary.) Dated June 21st. (*Complete.*)

* *Engineering*, December 9th, 1898.
† The *Engineer*, February, 1899.
‡ *Journal Acetylene Gas Lighting*, January, 1899.

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12,956. "Improvements in electric furnaces." La Compagnie Electro-Metallurgique des Procedes Gin et Leleux. Dated June 21st. (Date applied for under Patents, &c., Act, 1883, Section 103, January 27th, 1899, being date of application in France.)

12,959. "Improvements in or relating to electric motors." G. Verbeckmoes and P. Cairs. Dated June 21st.

12,961. "Improvements in and relating to methods of controlling electrically propelled vehicles." P. W. Northey and The Electric Motive Power Co., Ltd. Dated June 22nd.

12,962. "Improvements in electrically propelled vehicles." P. W. Northey and The Electric Motive Power Co., Ltd. Dated June 22nd.

13,008. "Improved apparatus for converting alternating currents into continuous current." M. Deri. Dated June 22nd. (*Complete.*)

13,018. "Improvements in electric arc lamps." J. B. Barton and J. M. Gorham. Dated June 22nd.

13,054. "Improvements in holders for globes and shades of gas, electric, and other lamps." G. F. Sanders. Dated June 23rd.

13,062. "Improvements in and relating to incandescent electric lamps." H. S. Cowx. Dated June 23rd.

13,074. "Improvements in apparatus for electrolysis." P. Schoop. Dated June 23rd.

13,076. "Improved troughing for electric cables." G. Sutton. Dated June 23rd.

13,088. "Improvements in electric tramways or railways." B. J. B. Mills. (E. Bonnet, J. Paufique, and G. Liniere, France.) Dated June 23rd.

13,105 "Improvements in electric arc lamps." The Gandus Arc Lamp and Electric Co., Ltd., and A. D. Jones. Dated June 23rd.

13,111. "Improvements in and connected with electrical switches." E. J. Wade and The Electric Motive Power Company, Limited. Dated June 24th.

13,117. "An improved magnetic motor." B. Draper, W. Bayliff, and T. D. Bayliff. Dated June 24th.

13,118. "Improvements in mechanism for electrically driving Roots and like blowers." A. D. Ellis and W. B. Crichton. Dated June 24th.

13,133. "Improved means of cooling enclosed electric motors or dynamos." W. Hartnell. Dated June 24th.

13,136. "Appliance for telephone pay stations." J. E Kingsbury. (The Western Electric Company, United States.) Dated June 24th.

13,138. "Improvements in the construction of cores in electrical cables." C. C. Sonne and K. Gulstad. Dated June 24th.

13,144. "Improvements in or relating to flash light telegraphing or signalling apparatus." J. Stewart. Dated June 24th.

13,167. "An improved electric condenser and the application of the same in combination with electrical devices or machines." S. Frizzoni. Dated June 24th.

13,174. "Improvement in electric signalling apparatus." F. B. Herzog. Dated June 24th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of **Messrs. W. P. Thompson & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham,** *price, post free,* **9d.** *(in stamps).*

1897.

21,157. "Magnetic and electrical measuring instruments." J. Russell. Dated September 15th, 1897. Relates to current and energy meters, magnetic measurements. The current passes through four stationary rectangular coils. Two of these are arranged vertically, and produce a uniform horizontal field; the other two are connected so that the current flows in the same direction in all the adjacent wires in the middle. These wires are magnetically shielded to some extent by surrounding iron, which is carried by a balanced frame, and can move vertically to some extent. The balance is provided with movable weights to measure the effect of the current on the iron. The windings may be modified for use of the instrument as a voltmeter or wattmeter, with continuous or alternating currents. The iron may be in thin strips bent into U-form, and placed together from above and below the balance frame, with insulation interposed between the overlapping limbs. The instrument may be used for observation of the properties of different specimens of iron, and may be provided with current reversing and regulating switches. The iron may be stationary and the coils movable, in which case these coils may be enlarged to enclose the stationary coils. The coils may be replaced by other means for the production of a uniform magnetic field. The parts may be duplicated at the ends of the frame, so that the instrument may be used to balance the effects of two specimens of iron, one of which may be a standard piece. The balance may be replaced by a part hung by a torsion wire. In the form described a single coil of D form in plan is used. The coils are circular, the torsion wire being placed axially in them. The wire carries a short straight tube enclosing a straight part of the coil, and carrying a pointer. Two iron specimens may surround the ends of this tube, when the difference of their magnetic effects is to be observed; or iron may be placed on one end only. In a modification of this instrument the coils are modified to act in the same direction on iron at both ends of the tube. For measurements of large currents, thick strips may be used instead of wire coils. The current supplied through a conductor at some distance behind the front portion divides through two strips; the current from the part passes through a horizontal semi-circular part, a vertical part, another semi-circular part, and a vertical part; the current from the strip passes through parts symmetrical with these. The four semi-circular parts replace the coils, and the vertical parts the coils, and they act on iron pieces carried by a support hung by a torsion wire. The support may carry a damping vane in a vessel of oil. The method of using conductors partly shielded magnetically may also be applied in sensitive galvanometers and other modifications of the instrument described. 2 claims.

21,195. "An improved continuous current dynamo-electric machine." A. E. Badger. Dated September 13th, 1897. A dynamo for generating constant continuous currents of low electromotive force but considerable current strength, is composed of a bell-shaped field magnet, provided with a central core carrying the winding, and an annular armature carrying a number of longitudinal conductors. The conductors are connected at their two ends to collecting rings, upon which bear brushes connected together and to the terminals in the manner shown. Instead of employing a series of armature conductors, the currents may be generated in the armature body, which in this case is furnished at each end with a single collecting ring. 3 claims.

21,410. "Improvements in transformers, impedance coils and the like." W. E. Bornard. Dated September 18th, 1897. Inductive appliances, such as transformers and impedance coils, have a regular rectangular or similar magnetic circuit with windings on all four sides. 3 claims.

21,484. "Improvements in electric motors." W. R. Lake. (R. Arno, Italy.) Dated September 18th, 1897. Motors, alternating current. An asynchronous monophase alternating current motor is provided with only one coil or set of coils on the field magnet or stator, to which the alternating current is supplied, and the motor is started by inserting an additional resistance into the closed coil armature or motor, and giving the latter a small initial impulse. A bipolar motor having one pair of coils in the stator and a three-phase armature winding connected by brushes with resistances, capable of being thrown into or out of circuit by means of a switch, is described. The initial impulse may be obtained by keeping open one of the armature coils at starting, which may be done by arranging the starting switch so that the contacts in connection with that coil are brought together a little after the contacts. Should the armature be at a dead point, a second coil is opened by a switch. 2 claims.

21,496. "An electrical water level indicator or recorder." P. R. Cobb. Dated September 20th, 1897. Relates to apparatus for indicating at a distance, electrically, the variations of liquid level. The drum is turned backwards and forwards with the rise and fall of the liquid by means of a cord and float and a cord and counterweight. One of a series of pins is thus brought into contact with a lever (one such lever being arranged at each side of the drum), and raises and depresses it. The depression has no effect, the connected spring simply giving a little until the pin slips past the lever. But when the lever is raised against the action of the spring, it ultimately slips over the pin, and the spring in the return movement, which is controlled by a dash pot, makes a temporary contact with the next pin, and closes circuit for a split battery through the electro-magnet of the receiver. A current is thus sent through the electro-magnet in a direction dependent upon the direction of motion of the drum. The electro-magnet has four poles. Two polarised armatures (with like poles turned the same way) are provided, and each armature carries a detent arm, which, engaging with a pin on a disc, prevents its rotation under the influences of a cord and weight. By this arrangement, whenever a current passes in either direction through the magnet, one only of the armatures is attracted, and releases its disc. The disc turns through half a revolution, and one of its pins, engaging a toothed wheel, rotates this wheel, and with it the index finger of the receiver, through a small angle. Instead of an indicator, a recording pin may trace a diagram of the variations of level on a drum. 3 claims.

22,215. "Improvements in alternating current energy meters." The British Thomson-Houston Company, Limited. (R. Shand, United States.) Dated September 28th, 1897. Energy meters for alternating currents in circuits which may be inductive. An armature with retarding and registering mechanism of any desired construction is driven inductively by a current coil, C, and potential coils C^1, C^2. The coil C carries the main current, or a definite fraction of it. The coil, C^1, is connected in series with an inductance coil, C^2, across the mains. The coil C^2 is supplied by the secondary of a transformer T, the primary of which is also connected across the mains. The currents in C^1, C^2 thus differ in phase nearly 90° and 180° respectively from that in C; the dimensions are made by trial or experiment, such that the coils C^1, C^2 together are equivalent to a coil carrying a current in quadrature with the electromotive force on the mains. In a modification, one end of the transformer primary may be connected to a point on the inductance coil, C^2, as indicated in dotted line. In an actual meter the coils C^1, C^2 may be wound together and enclose the armature in a plane at right angles to the coil C. 3 claims.

22,610. "A new or improved compound or material applicable for electrical or heat non-conducting or insulating purposes." H. J. Brown, O. B. H. Schmidt, and A. Mackenzie. Dated October 2nd, 1897. Insulating compositions or materials for electrical and other purposes, such as non-conducting coverings for steam boilers, consists of mixtures of finely divided or disintegrated mica and silk, either felted together or mixed with a cement such as resin, pitch, or shellac. The material may be formed to any desired shape or may be applied directly to electric conductors. 1 claim.

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THE

ELECTRICAL REVIEW.

VOL. XLV. JULY 14, 1899. No. 1,129.

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THE

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SOME NOTES ON MOTORS.

AT a time when there is a strong tendency on the part of machinery users to adopt electric driving, some remarks on the peculiar features of electric motors might be useful.

There is no lack of information on the results of applying motors to machine driving, but unfortunately much of this is in a fugitive form, and the ordinary engineer who sets out to seek details of the advantages and drawbacks of electric motors, must have a special gift of research; and, moreover, in dealing with the superabundance of materials that will be eventually discovered, he must exercise much perspicuity and discrimination in order to arrive at correct results. He ought, as it were, to pass his information through a mental sieve, and after the operation, it will be surprising if there is anything left. In spite of the accumulated experience that exists on the subject of machine driving, it is notable how few are the conclusions one may draw from it.

Many contributions have been made on the subject before societies that are learned and some that are otherwise, but neither the papers nor the discussions have gone beyond vague generalities. To turn to these for information on a specific point is like turning to the text-books—it is not there.

Electrical engineers who have carried out considerable work in applying motors to machine driving, look up the results in their bosoms, and probably the only occasion on which the information is produced is when it is desired to confute the opinions of others. It is a curious position, but it merely shows that in spite of electrical engineering societies and their set debates, there is always a certain amount of information which is withheld. Yet it would be difficult to quarrel altogether with the custom, for it proceeds from the notion that a man is entitled to keep to himself the fruits of his experience. It is an unfortunate, and occasionally a short-sighted policy, so far as the general spread of information is concerned, and, in addition, prevents that comparison of results which gives us the truth.

Such a system operates in this wise; if a user of machinery writes to several electrical engineering contractors to ascertain the best method of driving a given machine tool, he is confronted with opinions that are entirely at variance with one another, and the most remarkable feature is that those opinions are doubtless based on actual experience. These differences might be capable of easy explanation, but they certainly fill the inquirer with misgivings, and may have the effect of putting him off electric motors altogether.

Of late, some praiseworthy attempts have been made to give information as to what power is necessary to drive a given machine of a definite size, but here again we find the vague generalising already alluded to. In one instance, it is stated that the power requisite to drive a machine of certain size is from 10 to 20 H.P., doubtless a perfectly true statement, but lacking in that definiteness which would be looked for

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by a power user. One always advances electrical driving on the score of economy, but unless one can back up a general statement by some actual details, the cause of electricity is badly served. It is, of course, interesting to know that electric driving saved Messrs So-and-so £3,000 per annum, and that Sir A. N. Other finds two boilers will do the work that formerly required ten, but one wants to know how really bad were the systems previously used, and how far can we apply to other instances the results obtained by adopting electric power? There are, of course, certain definite figures available, but, curiously enough, it is not to the proceedings of electrical engineers that one must turn to obtain the most useful information, but to such societies as the North-East Coast Society of Engineers and Shipbuilders. Incidentally, electric driving has done more than establish proofs of its own economy; it has demonstrated how utterly bad shafting can be, and it has in some quarters urged upon the owners and managers of workshops the importance of employing higher speeds for machine tools, not only in extensive works involving the transmission of power over somewhat wide areas, but in workshops and factories that do not cover any considerable ground space.

It is not difficult to obtain information regarding motor driving in a works employing their own private generating plant, but the figures in some instances must be taken with a certain amount of reserve, for one never knows how to properly apportion capital and labour charges in places where expenses are lumped together. Then, again, in making comparisons, it must not be forgotten that electricity has certain losses of its own which ought to be carefully borne in mind. The general statements occasionally made in the interests of electric driving assert that it completely does away with shafting. But it would be very undesirable if that were always the case, and, moreover, might establish the fact that an electric system was too expensive in first cost. There are numerous instances where the most economical arrangement of driving by electric motors would be to adopt motors driving on to lines of shafting rather than using separate motors, and Mr. W. C. Mountain once prepared some estimates which conclusively showed the advantages accruing to the former method. He took in each case a 200-H.P. engine and dynamo, but in one instance the work was to be performed by four large motors driving on to shafting, and in the second by 72 motors, each attached to a machine. The former was estimated to cost £2,700 and the second £4,640, a considerable difference in capital outlay, while in efficiency the system employing four motors would be considerably higher than the other. It is true that there are many conditions where it is highly desirable to use separate motors for machines, and in such cases we arrive at the paradoxical conclusion that the economy of the electric motor is mainly exemplified when it is not working.

One of the most desirable directions in which electric driving can be extended, is in the small industries whose habitat lies contiguous to the public supply mains. But, on the whole, it cannot be said that either supply companies or municipalities offer striking facilities to small users of power. The adoption of a bold and vigorous policy in some districts would result in a magnificent day load, but suppliers of electrical energy are not in the main anxious to cultivate the small power user. Yet there is everything in its favour. Mr. Wordingham, at Manchester, and Mr. Gibbings, at Bradford, have conclusively demonstrated the financial soundness of encouraging the motor business, and we should not be surprised if this branch of electricity supply should in some towns overtop the lighting; but the merits of electric driving must be brought prominently before the smaller industries, and that cannot be done at the prices charged for electricity in many places.

There is a tendency among English contractors to standardise motors, and that may be taken as a hopeful sign. When we hear that American contractors give out a stock order for 3,000 motors it affords an indication of what making to stock means. But perhaps the most satisfactory feature, from an insular point of view, is the strong efforts made by home manufacturers to meet the requirements of the times. The fire offices in a somewhat arbitrary manner ordered that electric motors should be enclosed, to meet which order there have been produced a variety of enclosed motors, many of which are very excellent in their design. At the same time it ought to be placed on record what the enactment of the fire offices means. It is nothing more or less than cutting down the efficiency of the machine to a third of what it would do if it were open. All manufacturers admit the tremendous falling off in efficiency as a result of enclosing, and some go so far as to say that the difference is 50 per cent.; we have heard of a test recently made on a motor of the enclosed type, which was rated to give 30 B.H.P., and actually gave less than 10. It is necessary in many instances to protect motors, but this can be usually done without putting them in iron cases.

The direction in which improvement is urgent, is in the switching devices. Of late we have frequently heard of the excellent work done by electric motors in large works, but the one general complaint is the unreliable nature of the switches, resistances, and cut-outs.

Ammonium Amalgam.—There is an interesting paper on this curious substance by Pocklington in the *Chemisches Central-Blatt*, II., 853, though we believe it was originally published in the *Elektrician*, Vol. 41, page 457. In order to prepare ammonium amalgam, and to measure the E.M.F. between a mixture of the amalgam with mercury and a strip of copper immersed in copper sulphate solution, the author uses a cell containing mercury, and divided into two portions by a partition which dips into the mercury, but does not reach to the bottom of the cell. The ammonium amalgam, prepared by electrolysing a solution of ammonium chloride in one half of the cell, quickly diffuses into the mercury in the other half, and here the E.M.F. between the mixture and a copper electrode in a solution of copper sulphate is tested. Whilst, before the passage of the current, the E.M.F. is only 0·16 volt, after it has passed for a few seconds it rises to 1·89 volts, but when the circuit is broken it falls quickly. Even when the froth formed on the surface of the mercury is brushed off, the E.M.F. still remains high. When dilute sulphuric or hydrochloric acid is used instead of ammonium chloride, the E.M.F. is only 0·1 volt, and with a solution of sodium chloride the E.M.F. only attains 0·62 volt in 12½ minutes, owing to the slow diffusion of the amalgam, for when crystals of the amalgam are transferred to the other portion of the cell, the E.M.F. rises to 2·146 volts. Potassium amalgam diffuses even more slowly than sodium amalgam. When ammonium amalgam is heated, its volume increases by an amount greater than that due to the expansion of the contained gases. The author concludes that an ammonium amalgam is first formed and then decomposes into mercury, hydrogen, and ammonia.

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THE ELECTROLYTIC METHODS OF ZINC EXTRACTION.

By JOHN B. C. KERSHAW, F.I.C.

(*Concluded from page* 37.)

The Cowper-Coles Process.—In this process a solution of sulphuric acid is used for leaching the wasted ore; the resulting zinc sulphate solution is then electrolysed with lead anodes and rotating zinc or aluminium cathodes.* The process is, therefore, simply a modified form of the unsuccessful Letrange and Siemens & Halske processes. It received experimental trial at Hayle, in Cornwall, in 1897-98, and more recently at the mine of the British Broken Hill Proprietary Company in New South Wales. The directors of this company in their last report state that the process is not a commercial success, but that the Cowper-Coles white lead process *may be* of some service to them. As the latter is not an electrolytic process, its description is outside the scope of this article.

The Hernek Process.—At the electro-metallurgical works of Hernek, near St. Petersburg, 714 tons of zinc are said to be produced annually by means of an electrolytic process.† No details of this process are, however, given by Dr. Rostin, the author of the statement; and neither the nature of the raw material nor the composition of the leaching solution is known.

The Swinburne Sulphide Ore Process.—This process, which was recently described in our columns,‡ differs from all the preceding ones in being a dry process. The ore is fused with certain other materials which act as solvents; and the fused mixture is then subjected to the action of the electric current. The silver, the lead, and the zinc are said to be completely separated at the successive stages of the process. The process is at present undergoing more extended laboratory trials, and in the writer's opinion is decidedly promising.

Conclusions.—So far as information is available relative to the above wet extraction processes, only two of the six have proved successful when operated upon an industrial scale, namely:—the Hoepfner and Dieffenbach processes; and if Peters' statement regarding the cost of operating the latter process be correct, the number of successful processes is reduced to one.

In the case of the Hoepfner process, the method has been specially designed for the treatment of poor zinc ores in connection with ammonia soda works, and by aid of this process, the chlorine of what has hitherto been a waste product of these works, is to be rendered available for the manufacture of bleaching powder. In the Dieffenbach process, a zinc-holding pyrites, useless for either acid making, or for iron smelting is the raw material; and not only is this ore rendered serviceable for iron production, but chlorine is again obtained as a valuable by-product of the electrolytic decomposition.

It is thus seen that the economic success of these two processes is largely due to the value of the constituent liberated at the anode. Of the remaining four wet processes, three have already proved failures; and the success of the remaining one—the Nahnsen process—is exceedingly problematical. In an earlier article upon this subject,§ the writer showed that when using zinc sulphate as the electrolyte electrical energy alone might be expected to cost 66s. per ton of zinc deposited at the cathode. With zinc chloride the expenditure under this head is less, as $ZnCl_2$ has a lower decomposing value than $ZnSO_4$. In closing that article the writer stated his opinion that it was only when working under very special conditions that the wet electrolytic extraction methods would have any chance of commercial success. In confirmation of this view, he may refer those interested in the subject to similar expressions of opinion by Hoepfner,‖ by Hasse,¶ and by Le Verrier.** The opinions of the latter have not in this country received the attention which they merit, and the writer thinks it will be of service to give a translation of portion of Le Verrier's article upon wet electrolytic methods of metal extraction.

After a detailed description of electro-metallurgical processes, wet and dry, Le Verrier points out that the Siemens and Halske process for the treatment of gold tailings and slimes is the *only successful wet extraction process.* The electrolytic processes for refining copper and silver are not *extraction* processes; nor is the electrolytic method of nickel recovery from nickel-copper mattes a true extraction process. He then continues as follows.—

> All experiments having for their object the electrolytic refining of other metals, appear to have been dropped. All electrolytic methods for treatment of minerals have failed, and a similar fate is likely to overtake the Broken Hill experiments. Electro-galvanising—which is entitled to be classed a success—comes under the category of electro deposition; the current merely transfers the metal from anode to cathode.
>
> It is to be noted that all the electrolytic methods of metal deposition worked industrially, use soluble anodes. Even in the Siemens and Halske gold process, in which theory favours the use of an insoluble anode, an anode of iron has been used, and this is dissolved in greater amount than is equivalent to the gold deposited. The current is thus never employed to produce chemical decomposition; it merely serves to effect a transfer of some metal or other element.
>
> The deposition of metal at the cathode is always balanced chemically by the solution of the same or another metal at the anode, and the process is the better the more mathematically correct is this compensation. There is thus a marked difference between these wet methods and those depending upon the electrolysis of fused salts, such as those by which aluminium, sodium, potassium, and magnesium are produced. These are true *extraction processes;* insoluble anodes are used, and the current itself produces the decomposition.
>
> In view of these facts one may certainly ask whether it will not be by *fusion methods rather than by wet methods of extraction*, that the problem of refractory ores, incapable of utilisation by purely chemical methods, will be solved, and the domain of electro-metallurgy extended.

These words, though written over three years ago, apply with even greater force to-day; for the Ashcroft process has failed as Le Verrier prophesied, and the problem of the economic treatment of refractory sulphide ores will probably be solved by one of the two dry processes referred to in the Electrical Review of December 16th, 1898.

* Electrical Review, November 25th, 1898.
† *L'Electro-chimie*, Vol. 3, page 165.
‡ Electrical Review, December 16th, 1898.
§ *Electricity*, New York, January 12th, 1898
‖ *Elektrotech. Zeits.* November 3rd, 1898.
¶ *Zeitschrift f. Berg Hüttenwesen.* 1897; p. 322.
** *Annales des Conservatoires des Arts et Metiers.* Vol. 8, 1896.

PARLIAMENTARY COMMITTEES.

Charing Cross and Strand Bill.

The Select Committee of the House of Commons considering the Charing Cross and Strand Bill resumed on Wednesday last week, when Mr. J. C. Bull was further examined.

In reply to Mr. Roskell, Witness said that the City of London Company had accumulated £190,000 depreciation account, which was invested in consols and other gilt-edged securities. That burden was imposed upon them by the City of London Electric Lighting Act of 1893. It was an obligation put upon them by the Corporation, who laid the condition down when tenders were asked for. Originally they had to put away 7½ per cent. of their total capital expenditure and 5 per cent. of their net revenue. When they came to make up their first accounts they found that they would never be able to pay a dividend at all. Consequently they approached the Corporation, and after negotiations they were relieved of this obligation to some extent. They said that if competition was to be—and they thought it unjust and unnecessary, under the circumstances—at least all competitors should start on level terms, and that if Parliament thought wise that his company should put this depreciation aside in this manner, and not allow it to be invested in their own business, which was most unusual, at least, the would-be competitor should be put under the same obligations as themselves.

The Chairman: What you complain of is, that the Strand Company are allowed to invest their money in their own business?—My point is, that any competitor should be on the same terms. If we were relieved of this obligation, which cost us last year over 1d. per unit, we could supply at the same price as the Charing Cross Company.

We are not in the position to relieve you of anything of the kind. You consider your hardship is, that you have to invest your money in consols, while the promoting company are allowed to invest theirs in their own business?—I go beyond that. They are under no obligation to put any particular percentage to depreciation at all. We are under obligation to put no less than 7½ per cent. to depreciation.

Mr. Roskell: Supposing that obligation was no longer imposed on you, at how much per Board of Trade unit could you supply it?—We should be able to bring it down to 5d., which is the maximum of the Charing Cross Company.

Continuing his evidence, Witness said it had been stated that the alternating system was not suitable for motive power. As a matter of fact, they had more motive power in the City supplied by the alternating system than by the continuous. They had 180 customers

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taking 520 horse-power, as against the 400 or 500 H.P. supplied by the Charing Cross Company by the continuous system. That was apart from the motive power supplied by his company on the continuous system. They supplied light to the *Times* newspaper, and in consequence of their taking an all-night load they charged them 4d. per unit, and they were prepared to make similar charges to other newspapers. The *Times* newspaper did not take motive power, but if they did take it the demand would be so great that they would be able to supply at from 2d. to 2½d. per unit. Newspapers, however, were very conservative, and as they had got good steam power it would be very difficult for any electric company to induce them to take power. But still, if they got the whole of the power in the City now supplied by gas or steam, it would form a small proportion of the total number of the customers. It was perfectly well known that the offices in the City only required artificial light for a short time, and the motive power being so small, it would not greatly affect the load. From a study of the Charing Cross Company's accounts he found that the total cost of that company, including depreciation and debenture interest, would be 3·17d. per unit. They gave it in evidence that the charge was 4·36 per unit, which would show a return in their present area, roughly, to be 1d. per unit profit. Their cost in the City would certainly not be less, and it would probably be a great deal more. Their price in their own district was a maximum of 6d. down to 4d., and their present proposal was practically to reduce the price by nearly 1d. per unit as compared with their own district. To pay 2 per cent. on the proposed capital of £800,000 would require £16,000, and £16,000 at ½d. per unit in profit represented very nearly 8,000,000 units. They would have to sell in the course of the year nearly 8,000,000 units. If they took that at the average of his company which was 17·9 per lamp, it represented 430,000 lights. Judging by their experience, £800,000 would not be enough for 430,000 lamps. They had only 400,000 lights with a capital of £1,400,000.

Mr. Roskell: What is your deduction from these figures?—My deduction is that their shareholders will never get an adequate return on their capital outlay.

Mr. Shiress Will: But the risk will be on the shareholders' shoulders?—Yes.

Do you fear competition?—We put it in this way; that competition under the circumstances under which our capital was invested would be unjust and unfair in view of our obligations. Doubtless a consumer would favour competition. If you say to a man, "I will supply you with something at a lower price," he does not care for broken agreements or whether the thing is supplied at a loss.

The Chairman said it appeared from counsel's opinion that the agreements between the Corporation and the City of London Company were invalid.

Mr. Roskell said the City of London Company had got opinions which differed from those obtained by the Corporation, and action would be taken to declare those agreements valid.

Mr. Balfour Browne: It is like petitions; easy to obtain them on both sides.

The Chairman: It is something like the expert evidence we get.

Mr. Shiress Will pointed out to the witness that under the Act the company was under no obligation to invest its money in consols.

Mr. Roskell said they were advised that they were.

The Hon. Sydney Holland doubted whether any lawyer would so advise.

Mr. Roskell: It is another difference of opinion.

The Chairman: Have you ever had any serious complaints as to the nuisance caused by laying mains?—At the beginning we did.

If this company gets this Bill, will it cause as much disturbance in the streets as you did?—I should say there would be quite as much disturbance.

Mr. Frank Bailey, engineer to the City of London Company, said that mains were laid over the whole of the City sufficient to deal with the whole of the ultimate demand of the City. The City was laid out into 22 separate networks, so as to isolate the different districts. In the whole of the City they had laid mains in 37 miles of streets. They admitted that on two occasions there was a partial failure due to want of engine power from the boilers, and the bad quality of the coal they then had to use. At the present moment they had three machines on order, amounting in an aggregate to 3,000 kilowatts. At present their works were capable of an output of 11,500 kilowatts, apart from their street lighting. No lowering of prices could alter the special conditions which prevailed in the City. He meant that between 4 and 6 o'clock in the day the demand suddenly increased, and lasted a very short time. Between these hours a large number of lamps were in use, at the same time that was the case with any other company. Last year the total failures of public lighting represented 1·1 per cent. of the total number of hours during which the public arc lamps burned. Out of the 41 districts in London for electric lighting, in 20 districts there was only one supply.

By Mr. Shiress Will: At the present time his company could not supply in the City at 5d. per unit, nor could any other company. Under the peculiar conditions existing in the City of London, his company, or any other undertaking, were bound to charge at least double the rates obtained in the West End of London. If the Charing Cross Company came in and were bound to supply at 5d., it would be an absolute fiasco, and confidence would be shaken in electrical enterprise. If the other company came in at 5d., customers would either leave the City of London Company, or else ask for the same price.

So they would do you equal harm whether they succeed or not?—Yes.

Further cross-examined: When they got the consent of the Board of Trade, they would lay down the continuous system, and they hoped ultimately to adopt the continuous system altogether. He was a director of the Metropolitan Company, and that company applied for an order to compete in the City, but the Metropolitan Company were not willing to be bound down to 5d. per unit. If the board of the Metropolitan Company had made such an offer, he would have called a meeting of shareholders to oppose it. He attended none of the meetings of the board of the Metropolitan Company at which it was agreed to apply for the order, and his resignation was pending had the Metropolitan Company obtained the order.

Re-examined by Mr. Balfour Browne, Q.C.: When the City of London Company was started the alternating current was supposed by electrical experts to be the best; but now the continuous system was thought to be the best for all purposes. When they got the continuous current they would be able to store energy.

Mr. Emile Garcke, managing director of the Brush Electric Company, in reply to Mr Balfour Browne, sketched the early history of electric lighting in the City. There was a feeling at first to have three different companies in three different districts in the City. It was felt at first that the electric lighting of the City would be a very speculative undertaking, both in consequence of the difficulties of laying the mains and also the large demand for such a short period of the day. The Brush Company got a concession, but at first financial people would not look at it. He said most distinctly that the Brush Company would not have tendered had it not been for the protective clause in the specification of the City Corporation. The Commissioners did not look on giving a monopoly for a certain number of years as of any importance, because they did not believe that competition was practicable. He felt at the time that the City Commissioners and the Brush Company had entered into a very fair bargain. Having regard to all the circumstances, he felt that the present price charged by the City of London Company was very reasonable. He had no interest in the present company since the Brush Company parted with the concession. He considered the City Corporation were honourably bound to prevent competition as far as possible in the City for the period of 21 years. Had he felt at the time that there was any serious risk of competition at the end of 21 years he would have held out for further conditions. They tried to get the contract inserted in the provisional order. The Board of Trade tried to get the model order, but the Commissioners of Sewers preferred to stick to the contract. The Commissioners of Sewers clearly understood all along that the Brush Company would not carry out the contract, but that another company would have to be formed with a large contract, and there was no opposition against this provided that the company was financially strong. He thought if these solemn contracts were torn up it would go to blight electrical industry in this country.

By Mr. Shiress Will: The contract was the result of many years' negotiation, during which time the Corporation were of opinion that they could deal with the matter outside the Electric Lighting Acts. The contract said, "as far as they are able to do so," the Commissioners would prevent competition, and he took it—everybody took it—that that was an honourable understanding that they would actively oppose competition. The Brush Company was a manufacturing company, and what they get from the new company was an order for the machinery.

Re-examined by Mr. Freeman: He considered that the letter of June 2nd, 1899, sent by the Corporation to Sir Courtenay Boyle, in which they stated that competition should be allowed, was a violation of their contract.

Mr. Sydney Morse, solicitor, said he had large experience since 1884 of applications for electric light orders. He acted as solicitor for the Brush Company with respect to the City concession. He was present at the conference in 1889, held by Major Marindin, when several companies applied for orders for the City, and Mr. Russell Griffiths then appeared for the City Commissioners, and he stated that the question of competition must be put out of sight with respect to the City. Mr. Blake, clerk to the Commissioners of Sewers, and Sir William Preece, then Mr. Preece, gave evidence as to how the specification had been drawn up. The words "and as far as they were able to do so," were a common phrase in such specifications. Mr. Preece then spoke against competition in the City. He acted for the Brush Company in 1890 in opposing the applications of the Metropolitan Company and the London Electric Light Company for orders for the City, and the applications were refused on the ground of want of consent of the local authorities.

The Committee again adjourned.

The Select Committee resumed the consideration of the Bill on Thursday, when Mr. Geo. Herring was called for the City of London Electric Lighting Company, of which he is a director, and said he had always taken great interest in the electric lighting of the City. At the time the question was mooted there was considerable doubt as to whether it would pay, having regard to the peculiar circumstances of the City. He, personally, had faith in it at the beginning. The first issue was an issue of £400,000, but the public only came forward for £20,000. The directors would not go to allotment unless £200,000 was subscribed, and he and his friends came forward and subscribed £200,000. The prospectus stated that the Commissioners had agreed, as far as they were able, to allow no competition for 21 years, and it was on the faith of that that he got the money subscribed.

The Chairman: Then you were under the impression that this grant of 21 years was perfectly binding?—It never entered into my imagination that it could be repudiated. It was entirely on that that we went into it.

Mr. Freeman, Q.C.: Have you the slightest doubt but that the money has been subscribed in consequence of that clause?—None whatever.

If the Corporation is allowed to repudiate the bargain, do you think it would be a serious thing for the company?—I think it would be a serious thing all round, because I think there would be no further contracts made with the Corporation. No person will invest his money on the faith of any contract with the Corporation.

In cross-examination, Witness said he was one of the deputation

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who went to the chairman of the Board of Trade, the late Sir Henry Calcraft, and that gentleman told them that the Corporation had the right to give this exclusive right to the company. He admitted that competition would do good in the way of lowering prices, but he felt that it would spell ruin to both companies.

Mr. Pember: Do you consider that the conditions of the City are such that there never ought to be competition?—That is a strong word; but I do contend this—that in face of the Corporation agreeing to give an exclusive right, and the fact that money was invested on that promise, they have no right to repudiate, and if they do repudiate it is a dishonourable action.

Were the words "as far as they were able to do so" never brought to your notice?—We were told that this was the usual form, and at that time there was no doubt as to the intention of the Corporation.

Replying to further questions, Witness said that, of course, they knew of the clause of the Electric Lighting Act of 1888, but the Corporation at the time claimed that they had an Act giving them power to deal with the public and private lighting of the City. The City of London Company were under onerous obligations with regard to sinking fund, and that placed them at a great disadvantage with regard to any other company.

Mr. Pember argued that it was all moonshine to say that the depreciation fund and reserve fund must be invested in gilt-edged securities. The only thing in the Companies Act was that reserve fund must not be used for the equalisation of dividend, and with regard to the depreciation fund, it could be invested in the plant of the company.

Witness said that so far they had considered that they were bound to invest the money as they had, and they considered that it had seriously handicapped them.

By the Chairman: More capital was required for their company than other companies in other districts. There was an expensive site for a generating station, and the mains costs a great deal to lay down. In the case of the City, if a fog came on they would have between 70 and 80 per cent. of their lamps on at the same time, and that was not the case in the other parts of London. In the City there was not a single lamp put on which was not needed.

Mr. S. Morse, solicitor, was recalled to resume his evidence of the previous day, and in cross-examination by Mr. Shiress Will, said that since 1889 until this case in the City, the Board of Trade had never dispensed with the consent of the local authority. The Brush Company, at the request of the Corporation, went to the Board of Trade and asked for the insertion of a clause in the provisional order to confirm the agreement between the Brush Company and the Commissioners of Sewers. He did not consider that it was necessary at the time, but as the Corporation wanted it he brought it forward, but the Board of Trade would not depart from their usual form. He was the solicitor to the St. James's Electric Lighting Company, who were in competition with another company in the St. James's district. The price being charged in that parish was 4·56d. per unit.

Lord Kelvin said he was well aware of the peculiar nature of the supply of electricity to the City of London. He had had the diagram showing the supply to the City before him. He found the peak of the diagram was unusually high, and no less than 60 per cent. of the lamps were in use at the same time, but for a very short time. In most residential districts the demand did not exceed from 30 to 38 per cent. of the lamps connected at the time of maximum demand. The load diagram showed that the load rose with exceptional rapidity and the heavy load only lasted for a short period. In summer the supply would not be remunerative at all. These circumstances necessitated a great deal of plant and machinery and a consequent heavy cost. The plant required was double that which was required for an ordinary district. The works of the City of London Company at Bankside were well adapted to meet the requirements of the City.

Mr. Freeman: What do you think would be the effect of introducing electricity?—It would be disastrous. The difficulties of supply would be increased by dividing the responsibilities between the two companies.

It would require expenditure in duplicate mains and plants?—Yes.

And you think the public would suffer for the expenditure?—They must in the end suffer for such unnecessary expense.

Continuing, Witness said that if the Charing Cross Company came into the main streets only and took the best customers, it would not be fair on the City Company, who had laid mains in the whole district. It seemed to him that the granting of the order asked for would be a hardship to those who had found the money, and would do no good to the public.

By Mr. Shiress Will: He thought there ought not to be competing mains or competing supply in any one district. Nowadays he did not think competition did any good to the public, but it might have been beneficial in the early days of electric lighting. The City of London Company were proposing to get the continuous system, and they could do that more economically than any other company could.

By the Chairman: He did not think it would pay both companies to go into the City.

The Chairman: Why do you think, then, this Strand Company want to go into the City?—I do not know; I do not think they could supply it at the cost they say without losing their shareholders' money. They may hope, after losing a great deal of money, to be ultimately successful, but it is a foolish policy, and ought not to be encouraged.

Mr. Jas. Parker Buck, superintendent of mains and street works for the City of London Electric Lighting Company, gave evidence as to the company having laid mains in every street and alley in the City. In many thoroughfares it was not possible to lay further mains under the subways. It would be necessary to open up the roadways to lay further mains, and in many roadways, such as Fleet Street and Cheapside, it would be difficult to go any distance in a straight line, owing to their present crowded state.

By Mr. Shiress Will: It was, of course, a question of expense to lay mains, but also of inconvenience to the ratepayers. He knew that the Charing Cross Company could not open up 30 yards per gang of roadway in the City in one night.

Re-examined: His company had made provision so that in the future they would be able to carry out any works without much interference.

Dr. Silvanus Thompson, president of the Institute of Electrical Engineers, said he was personally acquainted with the works of the City of London Company at Bankside. He was a consulting engineer of the company during the period of construction. The demand for electric light had grown very rapidly in the City, and that had necessitated additional plant, and there had been great difficulty in getting proper plant from English manufacturers who had had no previous knowledge of large machinery such as was required. During the period of construction he visited the works almost daily, and he reported as to breakdowns which took place. In recent years he found the plant work splendidly. He knew of the extraordinary conditions under which the company had to supply customers, and he agreed with the evidence of Lord Kelvin on that point. He did not think there was a station in England where they had not had breakdowns. Having regard to all the difficulties under which the company carried on the work, he thought the service was efficient, although it might be improved.

By Mr. Shiress Will: The service might be improved by better arrangements for getting up steam quickly when fog came, and also by the use of storage batteries. There would be some advantage in the company using batteries, whether they got the continuous system or not. Any company coming in now would have the advantage of the pioneer work done by the City of London Company. They would find that a man in Lombard Street who had his house wired would be able to cut off his supply from one company and take on a supply from another.

By the Chairman: There was nothing in the alternating current incompatible with its use for motive power. It was an absolute misconception to say that it would require continuous power for motive purposes. For the good of the British public he believed it was not good to have competition in the same area.

Mr. J. H. Rosenthal, engineer, said he had been largely interested in electrical enterprises, his firm having supplied the steam boilers for fully half the electric lighting undertakings in England. His opinion of the service of the City of London Company was that it was as good as any other he was acquainted with. He did not think the service could be carried out better than the City of London Company did it. He had been in the works at Bankside when a fog came on, and saw the engines in full work in 10 minutes.

By Mr. Shiress Will: He did not think that if more customers took light from the City of London Company the peak on the diagram would be reduced.

This concluded the evidence for the company.

Mr. Pope, Q.C., on behalf of the City Company, then addressed the Committee, and said that he was entitled to ask them not to confirm the order, by reason of its injustice and hardship to the company he represented. He was not sure that a little too much had not been made of the circumstance that this was an order made by the Board of Trade, for it had no additional sanction on that account. The question he would ask was whether, considering the circumstances of his company, it was fair or right that competition should be introduced into the City in order to compel them to reduce prices, or do something else which must be to their detriment and their loss. The Brush Company entered into arrangements with the City, and the City Company took over the agreements. By these agreements they gave the company the exclusive right of supply within the boundaries of the City so far as they were able to do so. He did not claim at all on the ground of being an absolute grant of a specific and absolute monopoly, but he did say the City bound itself thus far—it bound itself not to assent or forward but practically to oppose any other company coming in to disturb that monopoly. Upon that understanding his company had raised and expended a large capital. If the City had stood firm to what it had bound itself to there would have been no order, as the practice of the Board of Trade had been not to grant any such order without the assent of the local authority. If, instead of the flabby indecision which had hitherto characterised the Corporation with regard to its own position, they had been firm in the view of their honourable obligations there would have been no order. He was there for a company which had relied on undertakings with a local authority; which had raised its capital on the faith of those undertakings; and which was entitled to call on the local authority not to go beyond its powers, but to do what was necessary in order not to assist a rival company in coming into the field and entering into competition. The City of London came before Parliament with a great claim for consideration; in fact, such a claim that an overwhelming case would have to be made out for Parliament to allow competition.

The Committee again adjourned.

The Select Committee held its final meeting for the consideration of the Bill on Friday last.

Mr. Littler, Q.C., addressed the Committee on behalf of the Corporation of London, and said the position of the Corporation had always been to try and judge everything which came before it in view of serving the public interest. In this case those most interested were the persons who consumed the electric light, and when the

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question first came up the Corporation said they would give a monopoly as far as they might. That was at a time when little was known about the electric light, and even the Board of Trade had not made up its mind on the matter. Now the Board of Trade had made up its mind that competition was desirable, and at present there was absolute competition between the local authority and a company in Bermondsey. Now he wanted it to be clearly and distinctly understood what was the attitude of the Corporation in this matter. The Corporation in the first instance assented to and assisted the City of London Company in getting its powers. But what was done? The Committee had heard all about it. The Corporation felt that they had a great deal to complain of in regard to the conduct of the existing company. They got an enormously inflated capital, and had given great dissatisfaction with regard to lighting, and therefore they held themselves in this position —first they absolutely disputed that having put in the words "so far as they were able," that that precluded them if due cause was shown in taking such steps as they thought fit. But another part of their position was this: Undoubtedly, they had entered into a contract with the City of London Company, and they were now advised that that contract was void. The company were advised that the contract was not bad, and the Corporation felt very great difficulty in holding the scales, as they felt they should do perfectly fairly between the company and the consumers, and between the company and themselves, and in taking any very active or serious action at this particular time. That was one of the considerations which must guide them in the way they dealt with the company. The Corporation were not free until this had been decided by a Court of Law. He thought the Committee would not forestall the decision of the Court of Law, and the Corporation had absolutely no right whatever to attempt to forestall the decision of the Court of Law and to put the Company into a worse position by reason of some legislation. They did not in the least recognise in the fancy picture painted in tar by Mr. Pope the faintest outline to themselves. They had acted simply for the public benefit. There had been a very strong difference of opinion amongst the members of the Corporation, but that was no reason why the Corporation should not as a body act, as it had always tried to do, in the public interest. Their view of the public interest was that they were not prepared to say that the company had so completely forfeited all confidence in the future that it should be abolished, or even seriously injured, but they did not close their eyes to the fact that the company had not satisfied them even with regard to its finance or its service. But that was a matter they must consider in the future. They did not admit that they were under any obligation, honourably or otherwise, to oppose an application. They entered into an agreement to give exclusive rights as far as they were able. The Brush Company knew exactly what the Corporation were doing, because the very first advertisement they issued contained those words, and the Corporation were now told that the whole contract was void. But Mr. Pope said that no private individual would dream of taking advantage of that. He did not know whether he would or would not. It would all depend on the circumstances, and if a man had a bad tenant he would take advantage of the covenants in the contract and get rid of him. But the Legislature had said that these contracts shall be void, and as a public body how could they help themselves. They were in the position of being trustees to the public and they must obey what Parliament said. But that would not preclude the Corporation for entering into some new arrangement which would be to the interest of the public. He did not say they would, and he did not say they would not. He did not say that they wanted themselves to become the competing authority, but they were perfectly entitled to do so. He did not say, however, that they objected to any other company coming in to compete. They could not give their assent to the Charing Cross and Strand Company coming in and complicating matters. He could give evidence if it was required of the difficulty of running any more wires through the City. If there was to be any competition the Corporation was the best authority to undertake it, because they had full control over the streets, and therefore they could do what was required with much less inconvenience to the company than could any company which simply studied its own interests. The Corporation were not prepared at present to say that they were going to compete but they did say, after hearing both sides and considering everything, very distinctly and emphatically, that they did object to the introduction of any competing company in the City. They desired to hold their hands perfectly fairly and freely in the interests of the consumers. They desired not to express any opinion about what might be done in the future, but they were clearly of opinion that so far as the present was concerned that if there was to be competition it ought to be and must be the City Corporation, and so long as that was their view they could not do anything towards the introduction of another competing body. On the contrary, they were satisfied that it would not be to the public interest that another company should be allowed to come in and tear up the streets. He considered their hands were perfectly free, and they desired to exercise their freedom by asking the Committee to say that the order should not be confirmed.

Lord ROBERT CECIL said the Corporation would not call witnesses.

A discussion took place with regard to Mr. Pember's right to reply to Mr. Littler, and the CHAIRMAN intimated that Mr. Pember would have no right of reply, but the Committee would have the assistance of Sir Courtenay Boyle.

Mr. PEMBER, replying for the company, said that Mr. Pope had not contested their ability to carry out the order, or their inability to work at a profit. Therefore he contended that he could supply for 5d. per unit to be reduced to 4d. for a large supply of light, and for 3d. and 2d. for motive purposes. He had been concerned in most of the electrical matters before the House since 1889, and had heard over and over again that a good motor was nearly completed for alternating power, but up to the present it had not been found. Instead of that, it was stated that the City of London Company were at present converting the alternating current to enable them to supply motive power. He was ready and willing to supply, and, in fact, by the order, he must supply current in small quantities at 5d. per unit, and in larger quantities at 4d. per unit for domestic supply. Surely, that was a boon to the community which Parliament could not very well refuse, especially as the City Company's witnesses had insisted that they could not reduce below 6d. Mr. Pope did not attempt to deal with the dissatisfaction which was so general, and which had been so loudly expressed, both as to price, and as to the character of the supply. Then with regard to the difficulties of the City Company, there was first the peak, and then the provisions of their own order. With regard to the difficulty of the peak, that difficulty arose solely from the use of the alternating current, which precluded the use of batteries, and necessitated a hand to mouth supply. His company had a direct current, and they would use batteries to store their energy. Overcoming that difficulty, the City became an ordinary area, and every shred of argument against competition was taken away. All the other hardships with regard to the financial obligations of the City of London Company he felt he had dispelled during his cross-examination of Mr. Geo. Herring. These hardships were all supposed to arise under Section 4 of the City of London Order, but he confessed he was astonished to find, on looking at that clause, how completely Mr. Herring, and those associated with him, had either misread or failed to study at all the text of that section. The only other onerous condition put forward on behalf of the City of London Company was that they were liable to be purchased at the end of 24 years instead of 42 years; but the Charing Cross Company were prepared to take the shorter period and come to an end at the same time as the City Company itself. He contended that competition was the essence of the Electric Lighting Acts, and he did not know a case since the days of Major Marindin when competition had been refused between two companies, although it had been refused in the case of a corporation wishing to compete against a company. Then Sir Courtenay Boyle knew of the agreements when he granted the order to the Charing Cross Company, and he saw that the Corporation were hampered in their asking to compete themselves, or in assenting to other competition, and therefore he was entitled to suppose that for that, amongst other reasons, the Board of Trade dispensed with the consent of the City. But he did not care whether those agreements between the Corporation and the company were valid or not. If they were valid, it would only mean that the Corporation were justified in doing what they did on a particular day, viz., seal an agreement which contained the words "exclusive rights as far as they are able to give them." He maintained that the very phrase preserved Section 1 of the Act of 1888. But if it was made, such a mistake should not be stereotyped. Whatever might have been the action of the Corporation, whether it was legal or illegal, and especially if it had been legal, he said it must not be allowed to thwart legitimate enterprise, to hamper the discretion of the Board of Trade; to deprive the consumers of the effect of their competition in the way of getting a better article at a cheaper price, to fetter or divert the free action of Parliament, to make a nullity of the most characteristic section of the whole of the electric light legislation, or to hand over the richest and most wealthy of the business centres of London to a perpetual monopoly, in what was fast becoming a necessity of domestic and commercial life. With regard to the streets, it did not lie in the mouth of the Corporation to say one word, because they had definitely said that if there was to be competition it must be in their own hands, and they would be confronted with the same difficulties in breaking up the streets. Again, the clauses of his Bill provided for the work being carried out under the supervision of the Corporation, and if the Corporation was not satisfied it would have power to carry out the work itself.

At the request of the chairman, Sir Courtenay Boyle went into the chair, and was asked why it was that in the case of electric lighting the principle of competition had been laid down, whereas in the case of gas and water the principle was that of a regulated monopoly.

Sir COURTENAY BOYLE said the question of whether in London there should be competition was discussed at a conference held by Major Marindin in 1889, and the balance of opinion was that there should be competition. One of the considerations which influenced the Board of Trade in adopting the recommendation was that there were practically two methods of supplying electric energy—the continuous system and the alternating system—and it was felt desirable to give the consumers the opportunity of choosing which they would have. The other consideration was that strong expression of Parliamentary opinion contained in the Act of 1888, that the granting of one provisional order should not hinder or restrict the granting of another. That was held by the Board of Trade to be a very decided expression of opinion almost absolutely amounting to a mandate to the Board of Trade to allow competition. At any rate it was held by the Board of Trade to amount to a mandate to consider the expediency of competition, and looking at it in that light the Board of Trade decided to allow competition, and that policy they had adhered to since 1889.

The CHAIRMAN: You consider, naturally, that competition is desirable in this case?—The evidence before me was very decided on that point. It convinced me in making my report to the Board of Trade that, in the interests of the consumers in the City, competition was desirable.

You saw good reason to override local consent?—The Board of Trade have always hesitated to dispense with the consent of the local authority, but they have done so in a considerable number of instances. In particular with the City we hesitated, as we have a very high opinion of the City authority; but in this case we thought the evidence so strong, that we did dispense with the consent.

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The CHAIRMAN said the Committee's decision was that the order be confirmed.

TELEPHONES COMMITTEE.

ON Thursday (6th inst.) the House of Commons' Standing Committee on Trade met again to further consider the Telephones Bill of the Government.

Mr. FAITHFULL BEGG, on behalf of Mr. Lough, moved an amendment to the new clause proposed by Mr. Hanbury at the last sitting to leave out "or to another company" from the words "where it is proposed to grant a new license to a local authority or to another company." He said he took it that the object of Mr. Hanbury in inserting the clause was to secure competition, but that object could only be obtained if new undertakings were kept entirely independent of the National Company. He need not point out that there were indirect as well as direct methods of controlling a company.

Mr. HANBURY said that his view of the matter was that telephonic communication ought to be on as large a scale as possible. He was, therefore, in favour of new companies as well as municipal undertakings. There might be a great number of cases in which corporations might wish not to take out licenses themselves, but to be served by companies under their control. The Post Office, he thought, would not grant licenses to any company which had not obtained wayleaves from the local authority, and it would only issue them with conditions making it impossible for any company to buy up others.

Mr. LOUGH said that neither the report of the Select Committee, nor the Treasury minute of May, suggested new companies. They spoke only of the desirability of enabling local authorities to construct telephones. After close study of the subject, he had gradually come to the conclusion that the true solution of all telephonic difficulties was a national system. On that point he agreed with gentlemen from whom he had hitherto differed.

Mr. PROVAND pointed out that no new companies would be created unless the local authorities wished it. Even without the power which the Bill would give to municipalities, it had been almost impossible, since 1892, to establish new companies. In that year a Treasury minute was issued with conditions so stringent, that only one new body, the Mutual Company, of Manchester, had succeeded in complying with them. The solution of the difficulty was the co-operation of local authorities with companies—an arrangement which the new clause proposed.

Mr. DOUGHTY contended that there were many municipalities which did not wish to establish telephones themselves, but would be glad to make an arrangement with a company.

Sir J. JOICEY said he should support the amendment as a step towards nationalisation of the telephones.

Sir J. WOODHOUSE opposed the amendment, and said that when Mr. Lough spoke of the Select Committee not having reported in favour of the establishment of new companies he forgot that the question was not referred to them. They were only instructed to consider whether local authorities should be allowed to construct and work telephones.

The amendment was negatived by 33 votes to 3.

Mr. STUART next moved an amendment providing that new companies should only be sanctioned by the Postmaster-General when the terms of their licenses had been approved by the local authorities.

Mr. HANBURY said he agreed with the object which the right hon. gentleman had in view, viz., to prevent a license being granted to a company over the head of the local authority. He would afterwards propose words to the effect that no license should be given to a company which had not obtained wayleaves from the local authority, who, of course, would attach whatever conditions they chose.

Sir C. CAYZER said that, in his opinion, the local authority should have power not simply to attach conditions to underground wayleaves, but should also be authorised to revise fully the license granted to a company. There were matters other than wayleaves to be considered. For instance, the local authority might wish to purchase the telephone within its area, and it should be allowed to insist upon the option being left to it.

Mr. FAITHFULL BEGG said that in a Treasury minute of 1892 it was declared that no application from a new company would be entertained unless a formal resolution in its favour had been passed by the Corporation concerned.

Mr. HANBURY said he would bring in a clause practically stereotyping that minute, as that would meet the case.

Mr. STUART then withdrew his amendment.

The Committee next considered and agreed to an amendment of Mr. Hanbury's, by which it is provided that the license of an existing company should only be extended in the particular area over which wayleaves were granted to a new company by the local authority.

Mr. TOMLINSON moved that when an extension of license was granted to the National Company the words "or any part thereof" should be added to one of the conditions on which such extension may be granted, making it read as follows:—"That their (the company's) charges shall not exceed or fall below those authorised in that behalf by the Postmaster-General within that area or any part thereof."

The amendment was agreed to with the addition of the words providing that the area in question must be specified in the license.

Sir JAMES WOODHOUSE proposed a new sub-section as follows:—"(c) That they will grant to local authorities or other licensees all such facilities for interchange of communication with any telephone system to be established by such local authorities or other licensees of the Postmaster-General as and subject to the terms the Postmaster-General shall from time to time require." He said that a number of local authorities had granted conditional licenses to the National Telephone Company. Almost all of them were terminable on six months' notice. The clause now before the Committee would abolish this agreement as to notice, and would continue the existence of the National Telephone Company as long as a telephone license was held by a competitor, whether a new company or local authority. That proposal was repugnant to many local authorities. The least, therefore, that could be granted them in return was that there should be intercommunication between new telephone systems and that of the National Company, whose rights would practically be made permanent by the Bill.

Mr. HANBURY said he must oppose the amendment. By the clause a new privilege of competition with the National Telephone Company was being granted to local authorities. They would therefore have an inducement which they never had before to put an end to the wayleaves which they had granted to the company. Take the case of Manchester. There the National Telephone Company took down their overhead wires, which were doing fairly efficient service, out of which they were gaining a large revenue, and with regard to which they were independent of the local authority. They did so not merely for their own pecuniary benefit but to give a really efficient service to the Manchester district, and they expended about £100,000 in laying underground wires. Now the Corporation were going to have an opportunity of establishing a telephone service of their own. It would be an insult to the Manchester Corporation to suggest that they would say, "We will use the Bill to get a monopoly, and will confiscate the whole of the company's property." Such a course would be monstrous, and however unlikely it was that any local authority would take it, the company ought not to be subject to the risk. He would sooner lose the Bill than be a party to confiscation.

Sir J. WOODHOUSE: That is not my proposition. My amendment would give no such power to any local authority. It would leave the power absolutely in the hands of the Postmaster-General.

Mr. HANBURY said his object was to show how far the National Company had gone in the way of concession, and, therefore, to prove that the local authorities had no right to insist on this further concession. He had been in communication with the company on the subject of intercommunication between their telephone system and others. They had not finally decided what the terms should be, but his own idea was that where wayleaves might be withdrawn on short notice they should be continued for eight years longer if the company would grant intercommunication between its system and others. He was pressing that on the company, and he believed with a reasonable prospect of success. Of course, the arrangement, according to his view, should include the payment of terminals, to be settled by the Postmaster-General.

Mr. CAWLEY said that as municipalities had granted to the National Telephone Company power to rip up the streets, they were only asking for a *quid pro quo* when they requested intercommunication. This power to open streets was a very important one. Private owners would not allow the National Telephone Company or any other to work on their ground without very substantial compensation.

Mr. COHEN said he hoped the amendment would not be pressed to a division. He thought the question of intercommunication might well be trusted to the negotiations of Mr. Hanbury.

Mr. BROADHURST also spoke to the same effect, and after further discussion and another appeal from Mr. Hanbury,

Sir J. WOODHOUSE said he would withdraw the amendment, but he would reserve the right to bring up the matter again, if necessary, when the Bill was before the House.

The amendment was then by leave withdrawn.

Sir J. WOODHOUSE proposed the following addition to the clause:—"Provided, nevertheless, that where a local authority has before the passing of this Act entered into an agreement with an existing company for the grant of underground wayleaves for telephone wires, terminable by notice, and such local authority shall apply to the Postmaster-General for a license to provide telephonic communication within its area, then the local authority shall be entitled, in accordance with its terms, to determine such agreement, and the grant made thereby and to the use of the telephone wires laid in accordance therewith, on paying to the existing company the amount of expenditure which the company has incurred, or contracted to incur, in respect thereof since the agreement was entered into, together with such further sum as will place the company in a similar position to that in which it was before it acquired the wayleaves given by the agreement; any question in difference under this proviso to be determined by an arbitrator to be appointed by the Postmaster-General on the request of either party." He said he had no desire that there should be confiscation of any property of the National Telephone Company, but if a municipality wished to have the entire control of telephones within its area it should be entitled to buy out the company in the manner proposed by the amendment. There would be nothing unfair in such an arrangement, especially as the company had received its license with the knowledge that licenses might be granted by the Postmaster-General to at least other companies.

Mr. HANBURY asked the hon. member to consider again the case of Manchester. The National Telephone Company, for the sake of providing a better service, voluntarily abandoned the overhead wires, with which the Corporation could not interfere, and adopted underground wires, over which the Corporation had a certain amount of control. It would not be fair to the company to turn them out of Manchester at short notice, paying them only the cost of the underground wires. There were two sets of wires to be considered, to say nothing of goodwill. As far, therefore, as details were concerned, he could not approve of the amendment, but he admitted that the principle underlying it was desirable. The only difficulty was that he did not feel justified in forcing even the principle on the National Telephone Company after the concessions they had already made.

Mr. OLDROYD suggested the postponement of the amendment till Mr. Hanbury had completed his negotiations with the company, pro-

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vided the right hon. gentleman would promise to bear the question in mind when negotiating.

Mr. Faithfull Begg said he considered the amendment very objectionable, because it proposed that the municipalities should have power to cancel their agreements without giving any compensation. This was a design to get from the Telephone Company what would be called in the City an option for nothing, and he hoped the Committee would not countenance it.

After some discussion the amendment was withdrawn.

Mr. Stuart moved to insert words at the end of the clause to provide definitely that, except where the National Telephone Company had competitors, its license should not be extended beyond 1911. He explained that, in making this proposal, he particularly desired to free London from the company.

Mr. Hanbury said he could assure Mr. Stuart that, with regard to London, it was not contemplated that the license of the National Telephone Company should extend beyond 1911, a remark applicable also to a large part of the rest of the country. Any Government which proposed a general extension of the company's license would at once be outvoted in the House of Commons.

Sir Michael Hicks-Beach pointed out that the amendment might be taken as indicating that, although the National Telephone Company's general license should not last beyond 1911, those of the other companies should. He hoped the amendment would not be pressed.

The amendment was withdrawn, and Mr. Hanbury's clause, as altered, was added to the Bill.

It was then ordered that the measure should be reported to the House.

Bexhill Tramways.

Sir John Kennaway presided on Thursday and Friday last week over a Select Committee of the House of Commons to consider the Bexhill and St. Leonards Tramway Bill promoted by the British Electric Traction Company. Mr. Balfour Browne, Q.C., Mr. E. Moon, and Mr. Clark Williams appeared for the promoters of the Bill; Mr Wedderburn and Mr. Rickards were for the Corporation of Hastings; Mr. A. Trevor for various owners and occupiers of St. Leonards; and Mr. Pembroke Stephen, Q.C., Mr. Vesey Knox, and Mr. Fitzgerald Murphy for the Hastings and Bexhill Light Railways.

In opening the case, Mr. Balfour Browne said the Bill was to empower the British Electric Traction Company to construct tramways 5 miles 5 furlongs and 9 chains in length. Quite 4 miles 1 furlong and 3 chains were on private ground and the remainder would be on public roads. The greater portion could be constructed in Bexhill, and the Urban Council were entirely in favour of the scheme. In connection with the tramways certain roads were to be constructed which would be of great benefit to the public, and the company would contribute towards the cost of those roads. The line would extend from the west end of the Marina at St. Leonards to Kewhurst, on the west side of Bexhill. The only other local authorities interested in the Bill were the Rural Council of Battle, whose territory the tramways would just touch, and the Hastings Corporation. He did not think, however, the latter body were opposing the Bill under circumstances quite genuine. Two years ago the clients of Mr. Murphy promoted a scheme to come not only through Bexhill, but through St. Leonards and Hastings. But Hastings objected to tramways running along the sea front, and the Bill for a provisional order was rejected. Soon after the Light Railway Commissioners rejected Mr. Murphy's proposal, the British Electric Traction Company, the promoters of the present Bill, were approached by Lord De la Warr. Mr. Murphy was still making an application to the Light Railway Commissioners to construct a light railway to some extent identical with the company's scheme, but consent had not been given. The British Electric Traction Company was incorporated in 1896, with a capital of £1,200,000, and the object of the company was not merely to carry out that tramway, but to carry out tramways in various parts of the country. It had purchased a considerable number of tramways, and turned them into electric tramways. The total estimated cost of the present enterprise was £68,000. Mr. Browne proceeded to deal with the objection to the scheme, and argued that from the action of the Light Railway Commissioners and the Board of Trade it was either the scheme of the British Electric Traction Company or no scheme at all.

Several witnesses were called to show the great advantage of the scheme. The chairman asked if the need was admitted.—Mr. Wedderburn said the case for the Corporation of Hastings was that the scheme ought not to be thrust upon them, as it was disadvantageous to the town.

Considerable evidence having been called, Mr. Sellon, the engineer to the promoters, described the negotiations which had taken place which led up to the promotion of the Bill. He decided on a tramway in preference to a light railway, because instances had occurred in which the Board of Trade had refused to sanction orders of the Light Railway Commissioners on the ground that there was competition with railway companies, and that the matter should be made the subject of a Bill in Parliament. The cost of the construction of the scheme under consideration would be £43,339, but the total cost would be £68,000, and the total capital £112,000. Nowadays it was not remunerative to construct horse tramways as compared with electric tramways. There were no engineering difficulties in the construction of that line. The generating station would be in Bexhill. After hearing further evidence, including that of the Mayor of Hastings, who said the Corporation of that town felt that they were in honour bound to the scheme of Mr. Murphy, the Committee again adjourned.

On Monday the Select Committee again considered the Bill, and heard evidence submitted by the Hastings Corporation and others against the scheme. After counsel had addressed the Committee, the chairman announced that they had decided not to pass the preamble of the Bill.

LONDON COUNTY COUNCIL.

The Council at the meeting on Tuesday resolved to lend £30,000 to the Hammersmith Vestry for electric lighting purposes.

The Telephone Service.

The adjourned report of the Highways Committee was submitted in reference to the statement recently made in the House of Commons by Mr. Hanbury to the effect that licenses for new companies or corporations embarking on telephone work should be for a substantial term of 20 or 25 years, and that if that were done it would be grossly unfair not to extend the National Telephone Company's license also, subject, however, to the same restrictions and prohibition of preferential rates as were to be applied to the corporations or new companies.

The Highways Committee stated that the proposal for the extension of the company's license was in direct opposition to the views held by the Council and the local authorities concerned with the telephone system in London, and they recommended the Council to adopt a resolution against the prolongation of the existing license in regard to the area of the county of London and to forward a copy to the Standing Committee on Trade. The consideration of the recommendation was postponed.

The Sardinia Street Station.

In discussing the Holborn to Strand improvement scheme, the Bill to authorise which has now passed Committees of both Houses of Parliament, the Parliamentary Committee made the following statement relating to the Metropolitan Company's station in Sardinia Street:—

The most important case of re-instatement is that of the Metropolitan Electric Supply Company, Limited. The Sardinia Street generating station of this company must be entirely removed. The company is supplying electrical energy under Parliamentary powers to a large and important district in Central London as well as the parishes of Marylebone and Paddington, which are in great measure dependent upon this station for light. The company's cables emanate from this station in various directions, and through them light is supplied to various districts and separate customers, and it was necessary to devise some system under which, without interruption of the supply, a new station, with new machinery and appliances, could be provided, the connections of the existing cables with the old station being gradually severed and transferred to the new station. It appeared that under the existing state of things the electric company had, at very large expenditure, practically secured an important position in which it could carry on the business of generating and transforming electrical energy without risk of interruption, and it was decided by the Committee in the House of Commons, with the acquiescence of the Council's advisers, that re-instatement in this case must be properly carried out.

Electric Traction.

After detailing the futile attempts made by the Council in the direction of obtaining sanction to adopt electric traction on the tramways, the Parliamentary Committee again asked for authority to seek powers in the next session to use the conduit, the trolley, or the surface contact system of electric traction on the Council's tramways, and to annul the proviso in Section 24 of the North Metropolitan Tramways Act, 1897, prohibiting the adoption of electric traction on the lines situated in the county of London. The consideration of the recommendations was deferred.

CORRESPONDENCE.

Direct Reading Ohmmeter.

I wonder whether any other of your readers would favour us with their experience of the American Electric Specialty Company's new direct reading ohmmeter or meter bridge, described in your issue of December 23rd last.

We recently obtained from the agent in Manchester an instrument marked No. 119A, and, while finding it to be of great utility and convenience, are somewhat dissatisfied with it.

Its range is advertised ·001 ω to 2 Ω, these being the two extremes of the scale, and the degree of accuracy is said to be within ·5 per cent. These naturally depend much on the sensitiveness of one's hearing and the amount of noise in the neighbourhood of the operator.

I find that when the shop is comparatively quiet the working range of the instrument lies between 40,000 ω and ·1 ω (suitable scales, of course, being used) with an accuracy not greater than 1 per cent.

It is of no use in a noisy place. If measurements are taken in a shop when it is absolutely quiet a degree of accuracy and range much more nearly approaching that claimed can be obtained; when taking the resistance of some

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dynamo shunt coils after hours the other day I was disturbed by a bird some 20 to 30 feet up on a high girder, and had to wait until the feathered songster had ceased ere I could hear the telephone. In using the stylus it does not do to press it down and draw it across the scale, but it must be passed across the scale, lightly tapping the wire for a moment, if the best effect is to be had.

We were surprised to receive the instrument without any carrying handle or strap on the box. With a stout leather strap and a couple of yards of lightly insulated, fairly big twin flexible, that can be put away inside the cover, with nicely finished ends, the instrument may be considered complete and portable. After fitting these to our instrument, the facility with which it could be used was at once evident, as you can measure a resistance while up a ladder or hanging on to a column, standing on top of a large motor-driven tool, or in any other inconvenient position.

It would be a great advantage, I think, if the receiver were double and provided with a strap, so that you could wear it on the head like a bonnet, and thus have both hands free, besides hearing better. However, one must not expect too much for £10, and the instrument is really a great advance after being obliged to use an ordinary Wheatstone bridge and galvanometer with long leads running from the shop to the test room. If someone will bring out an instrument similar to the above, but with slightly heavier slide wire and contacts adapted to measure down to, say, ·0001ω, it would be useful for testing dynamo armatures, &c.

It is, perhaps, a pity greater effort has not been made to produce simpler workshop instruments for measuring low resistances than has yet been done.

N. C. Woodfin.
Foreman and Testing Electrician,
Paterson, Cooper & Co., Thistle Engine Works.

July 8th, 1899.

Re "Electric Launches."

I would thank you to correct the concluding paragraph relating to the recently built electric launch, *Magic*, belonging to the Dee Boating Company, which appeared in your last issue.

The *Magic* is *not*, nor ever was, the fastest electrically-driven launch on the picturesque Dee, nor does its equipment call for any special attention.

The Chester Boat Company, Limited, of Aikman's Gardens, were the pioneer company to introduce electric launches on the Dee, and their fleet of boats, which have gained such popularity, have already covered thousands of miles without interruption.

Their latest addition, the *Alpha*, designed, built, and electrically equipped by themselves, under the supervision of the writer, is the fastest boat.

The *Magic* is the unfortunate boat that was reported in the London and Liverpool papers to have been struck by lightning, during a recent storm, and lost its charge. It is almost needless to say no such thing happened.

W. Cotsworth.

Manchester.

Electric Carriages.

Self-propelled vehicles have now been sufficiently long before the public to allow the man in the street to form an opinion as to their various merits and demerits. The oil or spirit-driven vehicle has, perhaps, been the most in evidence, and, although one cannot but admire the ingenuity and compactness of the arrangements, its unavoidable vibration will probably prevent its employment for pleasure purposes except by a few enthusiasts. This vibration, due to a very rapidly reciprocating engine, is equally against the employment of steam for ordinary travelling purposes, whether for business or pleasure, though for heavy goods traffic steam will undoubtedly hold the field wherever the load is large enough to pay for the services of a skilled engineer. For all lighter work it would seem that we must look to electricity as the only satisfactory motive power.

The advantages of electricity in regard to non-vibration and absence of smell are obvious, the standard objections being the excessive weight of the batteries and the difficulty of recharging them in country districts.

With regard to the question of weight, I cannot help thinking that this difficulty is somewhat exaggerated. Horse propulsion also shows considerable weight in proportion to the load carried; a stout horse and gig, for instance, will weigh a considerable amount and yet only be expected to carry two people. Again, manufacturers have somewhat hampered themselves by using a vehicle of only *half* the ordinary length; for surely a cart with a horse in front of it, is the length of a horse-drawn vehicle, and if we dispense with the horse, and cut off the shafts, we may feel justified in making the cart twice as long. Also, we may, with a clear conscience, place the weight of the horse inside in the shape of storage batteries, though these little alterations may possibly suggest a change in the form of vehicle from the ordinary carriage type. As to what this might be, however, need not be now discussed.

The difficulty of recharging in country districts is no doubt a real one; but one may suppose that, wherever power can be obtained, it ought not to be impossible to convert the carriage motor into a dynamo for replenishing the cells. Besides, the use of larger and heavier vehicles, in proportion to the passengers carried, would doubtless enable longer runs to be made without recharging.

Alfred J. Allen.

London Institution, E.C.,
July 11th.

Electric Locomotives.

I notice in your issue of May 12th, 1899, *re* "Electric Locomotives," reference is made to train resistance caused by curves, and the tendency of the wheels to press against the inner or outer rails, while drawing a load or running light.

On a line here with 30-inch gauge, and having curves varying from 50 feet radius upwards, worked by electric locomotives, it was found, after several experiments, that the load on the locomotive when hauling the train of trucks, was quite different to the load when pushing the train.

At first it would naturally seem that when pushing, the greater load would be on the locomotive, while, in fact, it was just the reverse, and there was as much as 5 to 10 per cent. difference in the time of the journey, and at the same time the ampere load used on the locomotive varied proportionally in favour of pushed train.

The following is an explanation of the cause of this:—In the drawn train in going round a curve the rear wheels of the locomotive are drawn against the inner rail, whilst the leading wheels are forced against the outer rails, and there is great friction, while when the train is being pushed by the locomotive, it was quite evident that neither wheels are forced against either rail, but seem to oscillate between them.

To all appearances, in so far as friction on the side of the rails is concerned, in both cases, the trucks acted quite similarly. There are only centre buffers used on the system, which no doubt assists in such a result.

Hoping the above may be of interest,

W. Elsdon-Dew.

Pilgrim's Rest, Transvaal.

P.S.—I do not consider the same result would be noticed on any line, for it all depends on the position and distance of the buffers from the wheels.

The Distribution of Electricity.

History is said to repeat itself, and it is the coincidence of some of the recommendations in Mr. Taite's interesting paper, read at the Municipal Electrical Association, being similar to mine as set forward in 1883 that causes me to address you.

I refer to the saving of expense and facility of making connections to house services when "the distributing boxes instead of being buried in the ground, are placed in a sort of pillar box above ground."

I forward you a copy of a paper entitled "The Supply of Electricity by Local Authorities," read by me at Association of Municipal Engineers and Surveyors, Oxford, 1883; the following is the paragraph (page 11) which refers to the above:—"Suitable junction boxes are provided at intervals in the form of pillars of cast-iron kept either by the side of the curb (as the sanitary boxes now in use) or close to the wall. Into these all mains are led, so that in the event of a fresh

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house connection having to be made it will not be necessary to disturb the street, but only run a subsidiary wire to the nearest box. Where a new street has to be made the kerb might be utilised so as to contain the mains by making it of cast-iron and hollow."

The method is illustrated by a plan of part of the district of Victoria, Westminster, where the first distributing station in London was planned by the then Swan United Company. This grand scheme, however, dwindled into the supply of the L. C. & D. R. station and yard, and the plant is doing good service at the present time.

In conclusion, I should like to say that I have a few copies left of my paper which I should be pleased to send to any electrical engineer who is engaged on central station distribution work, it being well understood that I am not held responsible for all the opinions put forward 16 years ago.

Killingworth Hedges, C.E., M.I.C.E.

"Situations Vacant."

May I use your columns to enter a mild protest against the way in which many people, inserting advertisements under the above heading, wrap themselves up in mystery? For one thing, I take exception to the words "state salary expected." Now, how much better would it be for everyone concerned if advertisers would state the maximum amount of salary they were prepared to pay. Take my case, as typical of many. I am out of a berth through no fault of my own. On applying personally in answer to an advertisement, and being very anxious to secure the berth, I asked a very small salary, and was told it was a pity I valued my services at so small a sum. Another time I quoted higher and my application was never even considered, my figure being too high, and all the while I would gladly have accepted less had I been offered it.

Further, the advertisements themselves, as a rule, give very meagre particulars. How often do we see an advertisement such as this:—

Manager wanted by firm of electrical engineers. State salary, &c. Apply, No. ——, Electrical Review.

For aught the reader knows, this post may be worth anything ranging from 30s. a week to £1,000 a year, and any inquiry as to size of works, or number of hands employed, is simply treated with silent contempt.

The unfortunate applicants cannot hope for much consideration, but I think advertisers would get better served if they were a little more definite.

Trolley.

BUSINESS NOTICES, &c.

Niagara Power.—The preliminary prospectus of the Pan-American Exposition, to be held on the Niagara frontier in 1901, has been issued, and makes this reference to the proposed use of Niagara power:—

The Exposition site is within 40 minutes' ride of the Falls of Niagara, which can be reached by steamboats and by steam and electric cars. That majestic panorama of the wonders of Nature, which is visited by millions of people every year, is well worth the journey across the continent or sea. This age of electricity will be signalised for the first time at an international exposition by the exclusive use of electrical power, which will be generated by the energy of that great cataract, carried over cables to the Exposition grounds. Whatever the world now knows, whatever it may know in 1901 of the mysteries of electric fluid, will be developed and illustrated with a fullness and beauty that only the power of Niagara could make possible. The street cars of Buffalo are propelled, and its streets are lighted, by electricity generated at Niagara Falls, and it is believed that all the industries of that city, which employ 70,000 mechanical and manufacturing hands and a capital of $100,000,000, will be moved by the same subtle and mysterious force.

In April, 1892, an agreement was entered into between the commissioners of Queen Victoria Niagara Falls Park, on the Canadian side at Niagara, and the Canadian Niagara Power Company, whereby the latter was granted the exclusive privilege of developing the power of the Falls on the Canadian side, in Queen Victoria Park, for the annual rental of $25,000 a year for the first 10 years, after which period the rental was to increase $1,000 yearly for 10 years until it had reached the sum of $35,000 a year, at which sum, it was provided, the lease of the exclusive privilege of development might be continued, upon due notice, for 80 years longer, making a century in all. For all the Canadian Niagara Power Company have promptly met their obligations each year in the payment of the rental, they have never yet commenced the development of power under their lease, which provided that they should have 10,000 developed horse-power by November 1st, 1898, and water connections made for 25,000 horse-power. The fact that the Canadian Niagara Power Company did not at once commence the development and proceed with it to completion, resulted in comparisons made between the development and growth on the New York side and that on the Canadian side at Niagara, and finally the Government was petitioned to declare the agreement void. A friendly suit was brought to determine the intent of the lease, and the Court decided that the Canadian Niagara Power Company had until November 1st, 1899, to complete the work above referred to. However, the agitation of the question drew out the opinions of both the Government and the Power Company, so that now an agreement of a different nature has been entered into, and in the future instead of the annual rental, the Canadian Niagara Power Company will pay a certain tariff or tax in accordance with the amount of power it develops. For the first 10,000 horse-power developed, the company will pay $1.50 per horse-power, or a total of $15,000. For the second 10,000 horse-power the charge will be $1 per horse-power per annum. For the next 10,000 horse-power the company will pay 75 cents per horse-power per annum, and for the remaining power up to 100,000 horse-power the charge will be 50 cents per horse-power per annum. This schedule will net the Government the handsome sum of $67,500 in revenue for the first 100,000 horse-power, made up of $32,500 for the first 30,000 horse-power, and $35,000 for the other 70,000 horse-power. It is the intention of the Canadian Niagara Power Company, which is controlled by the Niagara Falls Power Company, to erect a plant for the development of over 100,000 horse-power. Other companies also seek rights on the Canadian side, and it is probable that they would get the same scale of prices for the development of power. As eminent engineers have assured the Government that there is over 600,000 horse-power available on the Canadian side, it is evident that the Canadian Government is in position to very materially profit by the power development at Niagara. Up to this time the Canadian Niagara Power Company has paid to the Park Commissioners over $150,000 without receiving any practical benefit. This money has supported Queen Victoria Park without expense to the people.

The Niagara Falls Power Company has elected these directors: Edward D. Adams, John Jacob Astor, George S. Bowdoin, Charles F. Clarke, Charles Lanier, Joseph Larocque, D. O. Mills, William B. Rankine, Francis Lynde Stetson, F. W. Whitridge, and Edward A. Wickes. These same gentlemen have also been elected directors of the Niagara Junction Railway and the Niagara Development Company, both of which are allied to the Niagara Falls Power Company. The board of directors of the three companies organised by electing these officers:—President, D. O. Mills; first vice-president, Edward A. Wickes; second vice-president and treasurer, William B. Rankine; secretary, F. L. Lovelace; assistant secretary and treasurer, W. Paxton Little; executive committee, Edward D. Adams, Francis Lynde Stetson, D. O. Mills, Charles Lanier, F. W. Whitridge. The directors of the power company have been directors of the Cataract Construction Company which, having completed its contracts with the power company, goes out of business. In their new positions they take the places of the old board of directors of the Niagara Falls Power Company. Among those who retire are General Benjamin Flagler, Hon. W. Caryl Ely, Charles A. Sweet, L. W. Pettebone, Hon. Peter A. Porter, E. S. Wheeler, W. S. Humbert, Coleman Sellers, and Arthur Masten. Future affairs of the Niagara Falls Power Company will be directed from Niagara Falls, at which point second vice-president William B. Rankine will make his home. Heretofore the head office has been in New York. The Cataract Construction Company was organised under the laws of New Jersey, and supplied the money, material, &c., for the great power development. All the work up to the present time has been done on behalf of the Niagara Falls Power Company by the Cataract Construction Company. D. O. Mills, the new president of the company, is one of the best known capitalists and philanthropists in the United States.

Veritys' Motor Catalogue.—A catalogue devoted to motors and motor driving has recently been issued by Messrs. Veritys, Limited. In the space of about a hundred pages we find an interesting variety of illustrations showing some of the many applications to which electricity is put nowadays for driving by means of small motors. Messrs. Veritys manufacture three types of continuous current motors under the Lundell patents. The small and medium sizes are both of the spherical enclosed form, and the third type is a slow speed motor; illustrations showing these motors applied to tool driving are shown. The alternating current section includes two single-phase motors, one of the induction type, and the other a synchronous motor, which may be used also as a direct current motor, a generator of alternating or direct current or a rotary converter. A number of starters, regulators, controllers, resistances and circuit breakers are illustrated, and particulars for power transmission plants given, a variety of accessories being detailed in the sundries section. Space will not permit us to reproduce many of the illustrations included in the catalogue, but we have selected a few of the more interesting, showing industrial applications of electric motors. Fig. 1 shows Veritys' pedestal fan outfit for alternating current, the standard winding being for 100 volts, 100 periods. This fan is also made for continuous current. Each size is fitted with a starting and regulating switch neatly arranged in the base, whereby three degrees of speed can be obtained. Bracket fans are mounted on a swivel bracket which allows the motor and fan to be turned and set in any direction. Fig. 2 illustrates one of numerous applications of motors in a printing room. It shows a motor fixed vertically to drive a routing machine for electrotyping and "process" work. Messrs. Veritys have conducted a series of practical experiments to satisfy themselves that their

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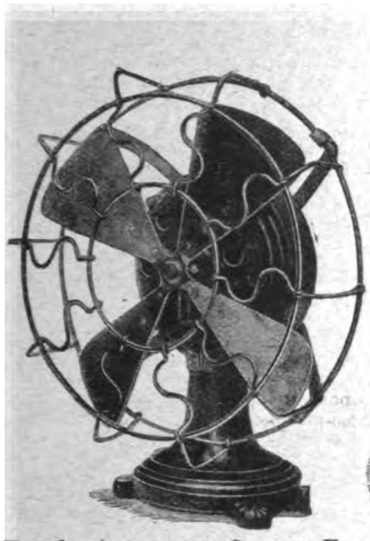

Fig. 1.—Alternating Current Fan.

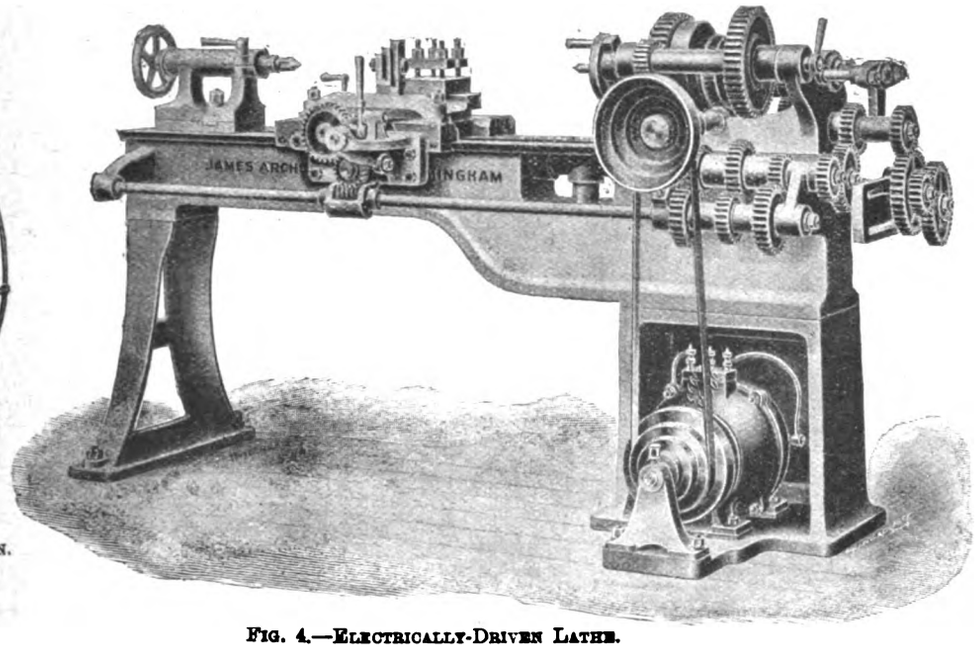

Fig. 4.—Electrically-Driven Lathe.

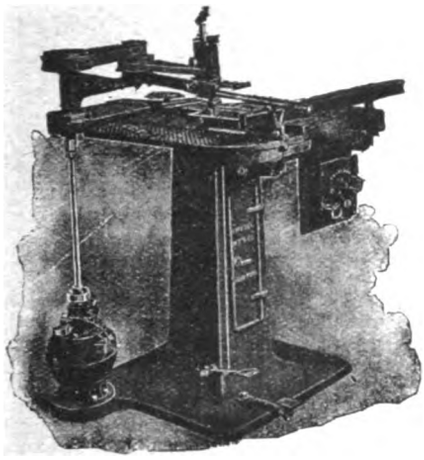

Fig. 2.—Electrically-Driven Routing Machine.

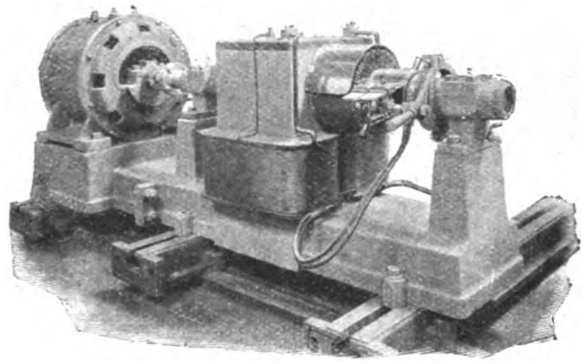

Fig. 5.—Polyphase Motor Generator.

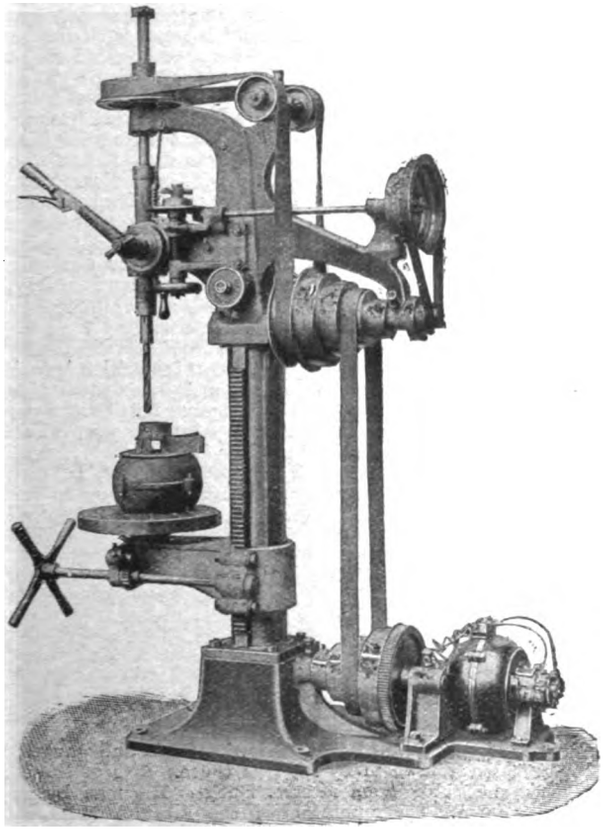

Fig. 3.—Electrically-Driven Drilling Machine.

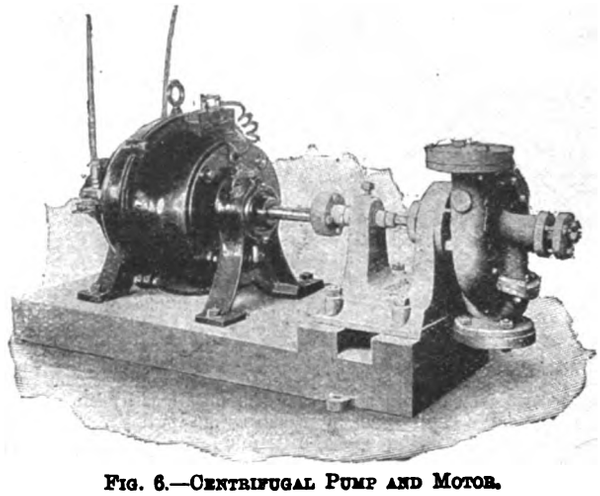

Fig. 6.—Centrifugal Pump and Motor.

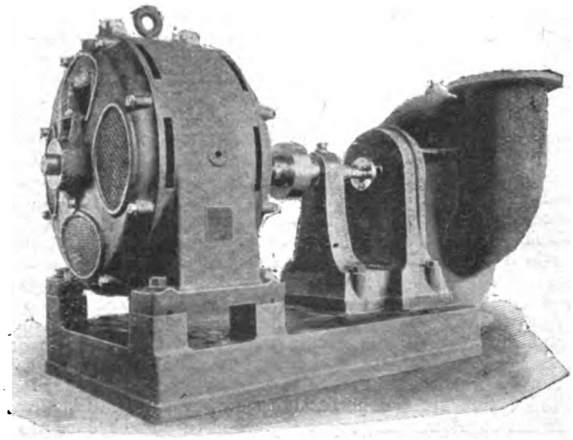

Fig. 7.—Polyphase Motor and Centrifugal Pump.

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motors for machine driving form a combination which shall be an all-round improvement on mechanical driving, also to find the most efficient and compact manner of fixing and connecting the motor. The drilling machine illustrated in fig. 3 is one of Messrs. Archdale & Co.'s make. A special base and pedestal has been cast to receive the motor, which is geared direct to a pinion on the coned pulley. The starting box is of cast-iron, and is placed conveniently for the workman If the dynamo current

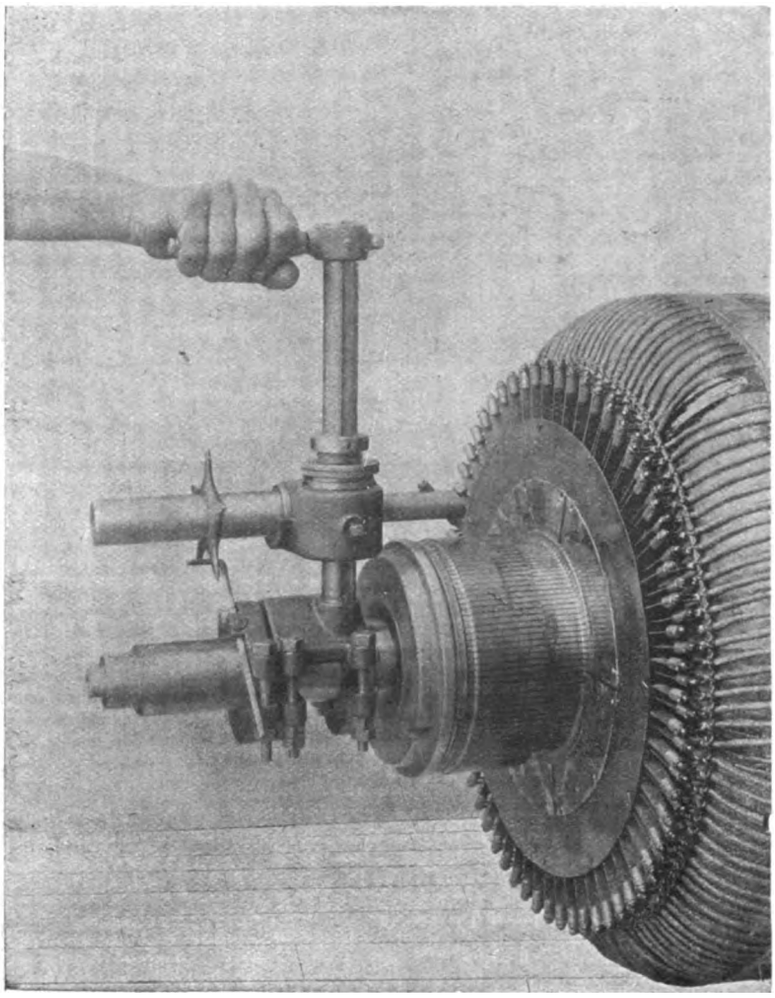
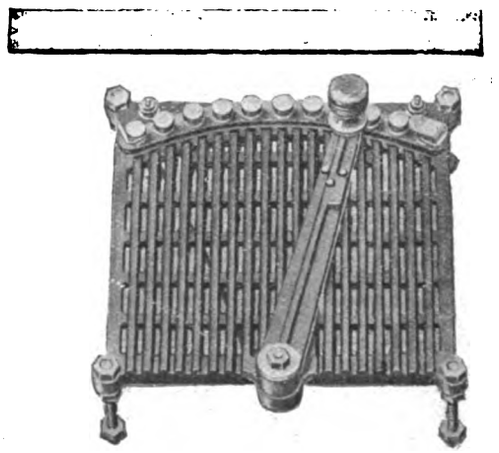


FIG. 8.—COMMUTATOR TRUING DEVICE.

be cut off or the pressure fail, the switch is automatically released. The resistance, which is for regulation as well as for starting, is enclosed in a cast-iron box on the other side of the pedestal and the switch wires pass down the interior of the column. Fig. 4 shows a lathe, of Archdale's make, with a Veritys motor. A special box leg is used to support the lathe bed at one end, and in this the motor is fixed. The latter is provided with an extended shaft, to which is fixed a coned pulley, and a third bearing is provided. The speed is reduced by worm gearing, and variations of the speed may be obtained by the regulating switch, and again by means of the coned pulleys. The starting and regulating switch is of the double-lever automatic type; for 10-inch lathes and upwards, the motor is fixed on a separate base fitted complete with counter-shafting. In these sizes the worm gearing is not employed. Messrs. Veritys are supplying two and three-phase motors coupled on the same bed-plate to continuous current dynamos of any capacity, and fig. 5 shows a two-phase motor driving a continuous current dynamo for charging accumulators. Fig. 6 is an illustration of a Lundell type motor direct coupled on the same bed-plate to a centrifugal pump. Centrifugal pumps are also supplied with alternating current motors, for single, two, or three-phase; fig. 7 shows a two-phase motor set which was recently sent out for a large colonial transmission plant. Among the host of other interesting items in the catalogue is the commutator truing device illustrated in fig. 8. This device is intended for connection by a clamp to the armature shaft, round which it is revolved by hand power. The tool is fed automatically forward with each rotation of the device round the shaft, facing the commutator perfectly true with the bearings. A small crank attachment is supplied when it is desirable to true off the commutator without removing the armature from the machine. The crank is then attached to the pulley, and the armature and commutator rotated instead of the tool. This apparatus is said to do its work much better than is possible in a lathe, as it leaves the commutator surface perfectly true with the bearings, a very important consideration, especially when carbon brushes are used.

Electro-Pneumatic Signalling.—The *Daily News* says that the Great Eastern Railway has equipped an important signal cabin with Westinghouse electro-pneumatic signalling plant. Immediately adjoining the Bethnal Green electro-pneumatic box is what may be termed the motor cabin, containing a 1-horse-power dynamo and two Westinghouse air-pumps (one being kept in reserve), supplying the air pressure, which is brought up from Bishopsgate Low Level, and is a portion of the power generated for working the lifts, hydraulic capstans, &c., at that station and at Liverpool Street. The apparatus in the box proper was manufactured by the Westinghouse Brake Company in America, and was then shipped over and put together by Messrs. McKenzie & Holland, signal manufacturers, of Worcester.

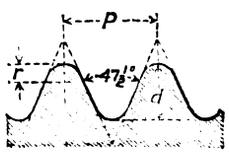
A New Rheostat.—A new rheostat for all continuous duty purposes, such as motor speed regulators, is illustrated herewith. This rheostat possesses many new and important advantages, and is extremely compact. A cast-iron plate has parallel ribs extending along the back; between these ribs there are long slot-like openings, so that a grid-like construction is obtained. The entire back surface



A NEW RHEOSTAT.

of the grid, including the walls on both sides of the ribs, is covered with porcelain enamel, and then a coil of wire is placed between the ribs and over the slot; this coil of wire is attached by enamel to both the side walls of the ribs between which it lies. The ribs extend up high enough to thoroughly protect the coil lying between them in the V-shaped space. It will be seen that this construction gives the most perfect ventilation, while holding the coil perfectly at two points in each whorl of the coil. This attachment of the wire at intervals only leaves it free to expand without producing any breaking strain on the enamel which attaches it, and yet the attachment permits of a free conduction of heat to the entire surface of the cast-iron. Thus the unusual result is obtained of having the most perfect conditions for heat convection by air currents, together with large heat absorptive capacity of the cast-iron and the very large radiating surface obtained by the grid with the extended ribs. This rheostat is the invention of Mr. H. Ward Leonard, and the Ward Leonard Electric Company have already received excellent orders for them. The grid shown in the illustration herewith is one of 40 sold to the South Side Elevated Company, at Chicago, is 10 inches × 10 inches, has 200 ohms, and will be used directly across 600 volts, so that it will carry 3 amperes continuously, and hence dissipate continuously 1,800 watts.

Screwing Tools for the British Association Threads.—The continually increasing employment of the British Association screw threads by instrument makers, and other users of small screws, has produced a demand for improved tools and gauges. To meet the requirements of the Royal Engineers, who have adopted the thread in all their smaller apparatus, Messrs. Buck and Hickman, of Nos. 2 and 4, Whitechapel Road, London, E., arranged with the American firm of Pratt & Whitney to take up the manufacture of tools for these threads, and now inform us that



a large number of sets of these screwing tools and gauges have been accepted from them by the War Office. Sets of these tools are now obtainable from Messrs. Buck & Hickman by anyone requiring them. The reputation of the Pratt & Whitney Company, the ablest manufacturers in the world of small steel appliances, makes it certain that these tools are of a high order of accuracy and excellence. We look with interest to the report of

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the British Association Committee to learn exactly how far they have been successful in obtaining closely accurate gauges of these threads from the Pratt & Whitney Company, with whom they

Fig. 1.

reported last year they were in communication. Hitherto manufacturers have met great difficulty in obtaining close approximations to the proper forms and dimensions. The illustration above shows a B.A. set No. 2, the figure on page 52 showing the shape of the thread, &c.

The G.E.C. New Catalogue.—To review the 1899 catalogue of the General Electric Company, Limited, so as to mention even a small percentage of the articles described and illustrated therein would require more space than is at our disposal at the moment. The manufactures of this company, and the catalogue as well, in fact, are so well known to the trade that nothing more than a brief mention is necessary. The new volume before us for the current year will, like previous editions, be of untold value to the electrical trade, wholesale and retail. It is interesting to note that this company started in 1878 with five employés, but the growth of the concern, concurrently with the enormous development of the electrical industry, is shown in the increased staff, which to-day figures at 2,500 hands employed at the various works at Salford, Birmingham, Clerkenwell, and Hammersmith. We hope that within the next 20 years history will repeat itself several fold, although if the firm's catalogue grows in proportion the G.E.C. may find it necessary, like the "best books" vendors, to supply a special bookcase therewith. For the non-technical purchaser there is a great deal of useful information contained in the book before us, points which will help him to ascertain his actual requirements, and when he has done this there is an excellent telegraph code so that he may place his order without waiting to change his mind. Estimates, diagrams, hints, and general instructions are here *ad lib.* The G.E.C. is the universal provider of the electrical trade. Anything from iron staples to the complete electric light and power installation, from the night light to the searchlight, all are illustrated and described in this handsome catalogue, while a thousand and one pieces of machinery, apparatus, and accessorial parts for electric light, power and traction work, also telegraph, telephone, and medical apparatus have space devoted to them. Last year we made a selection from the collection of artistic electric light fittings. At the present moment special notice should be called to the three-phase section where is to be found a description of three-phase generators and motors on the Oerlikon system. A general note of the various sections into which this useful volume is divided, must bring our notice to a conclusion:—electrical supplies and wiremen's sundries; dynamos, motors, transformers, and general electrical plant; engines, boilers, and other machinery; electric heating; electrical fixtures and glassware; electric bells and accessories; telephones; electro-medical supplies. Any of these sections are obtainable separately.

Catalogue.—The Jandus Arc Lamp and Electric Company, Limited, has issued a price list of the Jandus lamps and accessories. It contains a large number of testimonials as to the excellence of these lamps, and some interesting photographs showing their application to street lighting, also to exterior lighting for theatres, stores, shops, &c., and interior lighting for factories, &c. The illustrations are very well done.

California Water Power.—The *Financial News* correspondent at San Francisco says that the Kern Rand Company has been formed at Los Angeles to develop electricity on the Kern River and convey power to Los Angeles, a distance of 150 miles. He writes that an Englishman has been sent to England to secure capital to the tune of $1,990,000, and $10,000 has been spent upon preliminary surveys. It is stated that the weak point in the scheme is that the line is so very likely to be "washed out" in winter and "burnt out" in summer that power users would not be able to take advantage of the scheme. With 20,000 H.P. delivered to Los Angeles a dividend of 20 per cent. is looked for, but the *Financial News* representative questions whether the scheme will pay. The line will cross two mountain ranges and a desert.

Electrical Wares Exported.

Week ending July 5th, 1898.		Week ending July 4th, 1899.	
Albany .. .. ..Value	£143	Amsterdam .. ..Value	£240
Amsterdam	50	Bangkok. Teleg. mat.	58
Auckland	324	Bombay	18
Bangkok	65	Boulogne	29
Barcelona	18	Buenos Ayres	2,161
Bombay	51	" " Teleg. mat. ..	250
Buenos Ayres. Teleg. mat. ..	110	Calcutta	238
Calcutta	111	Cape Town	172
Cape Town	457	Christiania	37
Durban	76	Colombo	70
East London	62	Copenhagen	9
Flushing	87	Delagoa Bay	8
Gothenburg	97	Demerara. Teleg. mat... ..	141
Hamburg	800	Durban	342
Kolding. Teleg. mat.	471	" Teleg. mat.	52
Malaga	18	Fremantle	93
Melbourne	1,474	Gothenburg	270
Monte Video	25	Grenada	25
" Teleg. mat.	89	Hamburg	260
Otago	168	Hong Kong	330
Port Elizabeth	159	Monte Video. Teleg. mat. ..	55
Rio Janeiro	11	Montreal	26
Rotterdam. Teleg. mat. ..	25	Ostend	89
Santander	175	Port Elizabeth	55
Santos	205	Port Said	398
St. Petersburg	16	Rio Janeiro	158
Singapore. Teleg. mat... ..	208	Santos	84
Spezzia	636	Shanghai. 21 tons old teleg. wire (value not declared) ..	—
Stockholm. Teleg. cable ..	1,189	Sydney	500
Sydney	778	Yokohama	118
" Teleg. mat.	240		
Wellington	125		
" Teleg. mat.	100		
Total ..	£7,893	Total ..	£6,198

Foreign Goods Transhipped.

Hong Kong. Teleg. mat. Value	£178	Alexandria. Elec. goods Value	£85
Trinidad. Teleph. mat... ..	62	Calcutta. Elec. mat.	79
Total ..	£240	Total	£164

The Hull Tramways—The name of Messrs. Askham Bros. & Wilson, Limited, Sheffield, was inadvertently omitted from our description of the Hull electric trams. This firm supplied the points and crossings, and made the special work illustrated on page 22 of our last issue.

Bankruptcy Proceedings.—Under a receiving order made in the case of J. G. M. Hilton, electrical engineer, Trafalgar Works, Bow Common Lane, a first meeting of creditors was held on the 10th inst. at the London Bankruptcy Court before Mr. G. W. Chapman, official receiver. According to the debtor's statements it appeared that about January, 1895, he took £2,250 worth of shares in the Nalder & Harrison Construction Syndicate. The syndicate subsequently went into voluntary liquidation, and the electrical portion of the business was purchased by Mr. Nalder and himself. No actual deed of partnership was signed, but the profits were to be equally divided. After trading for a few months the debtor introduced about £2,000 into the concern, £800 of which was used to pay off a mortgage on Trafalgar Works, the balance being left in the business, which was subsequently converted into a limited liability company, known as Nalder & Hilton, Limited, with a capital of £20,000. The partners were allotted 9,000 fully paid £1 shares, and 6,000 further shares upon which 10s. was paid, the latter being held as security for £3,000 worth of debentures, which were afterwards duly issued. Second debentures to the extent of £2,000 were also issued in March, 1898, when the debtor retired from the business owing to disagreements with the holder of the principal portion of the second debentures. It was subsequently arranged that the debtor should sell his shares for £800 in cash, which was to be applied in payment of his share of the joint liabilities, and in addition he was to receive £1,200 by instalments with 6 per cent. interest. In January last he returned to the business, and brought in a further £400, which he borrowed for that purpose. The trading was continued a few months longer, and about a month ago the debenture holders took proceedings under which a receiver was appointed, who was now carrying on the business. The debtor ascribed his insolvency to the failure in the manufacture of electric apparatus by Nalder & Hilton, Limited, in which he was deeply interested, and also to want of business experience. The private liabilities were estimated at £300, and those in connection with the company were approximately stated at £2,500. The assets were not valued. No proposal was submitted, and the case will be wound up in bankruptcy by the official receiver as trustee.

The *London Gazette* contains notice of the release of trustee (Geo. Proctor) in the case of J. Fletcher and J. A. Hirst (Fletcher, Hirst & Co.), electrical and mechanical engineers, Burnley.

The first meeting and public examination in the case of A. Blackburn and J. Walker (Blackburn, Walker & Co., electrical engineers) will be held at Bradford, on July 20th and August 9th respectively.

Mr. E. H. Hawkins, 3, Barbican, E.C., has been appointed trustee in the case of A. G. Inrig, electrical engineer.

Patents in America's New Colonies.—Messrs. W. P. Thompson & Co. state that an official circular has recently been issued by the War Department at Washington, stating that in the new territories of the Islands of Cuba, Porto Rico, and the Philippines, owners of patents, trade marks, &c., duly registered in the United States Patent Office, under the laws of the United States, shall receive the protection accorded them in the United States on certain conditions.

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Labour Problems and Battery Jar Makers.—The British workman unfortunately has it in his power to largely hinder the progress of his employer's business. On the other hand, if he so choose, he may render him great assistance, and contribute to the success of our national industries. We have ventured to hope that the late engineering strike had taught a lesson which was not likely to be forgotten in a hurry by the striker and his sympathisers, but perhaps we have hoped too much. We have this week heard of a firm of glass manufacturers who have been compelled to abandon the battery jar branch of their business in consequence of trouble which has arisen with their workmen. But for the stupidity of the British workmen this business might have been a great success, as orders were very numerous. This is yet another monument to the gross unreasonableness of labour agitators. We suppose that the men who formerly thought themselves badly off in making battery jars will now find themselves without even the proverbial half-loaf.

Dissolutions, Liquidations, &c.—Messrs. R. and S. Baxter (R. L. Baxter, S. L. Baxter, and W. R. Macdonald), mica merchants, Dundee, have dissolved partnership. The business will be carried on under the same title by Messrs. R. and S. Baxter, who will attend to debts, &c.

A meeting of the Leeds and London Electrical Engineering Company will be held at 6, Lombard Street, E.C., on August 14th, to hear an account of the winding up from the liquidator, Mr. W. Colls.

Last week in the action of Threlfal v. The Electric Organ Company, Limited, Mr. Justice North made an order for judgment in a debenture-holders' action in the matter of the Electric Organ Company, of Norwich.

Books Received.—"The Value of Electrical Treatment," by Julius Althaus. Third edition. London: Longmans, Green and Co. 3s. 6d.

"Fire Tests with Floors," and "Fire Tests with Partitions," edited by Edwin O. Sachs. London: The British Fire Prevention Committee. 1s. each.

"Machinery and Supplies for Mines and Mills." Vol. I., No. 8, June, 1899. Published by C. E. Billin & Co., Chicago.

Trade Announcements.—Messrs. Krupka & Jacoby say that it has been decided by mutual consent to voluntarily wind up the Phaeton Electrical Company, Limited, of which they have hitherto been the managing directors. The Phaeton Company will not continue their business in this country, but Messrs. Krupka and Jacoby will continue the same class of business in their own name.

Messrs. Wood & Newland, who have for many years been assistants to the firm of Messrs. Wheatley Kirk, Price & Goulty, announce that certain alterations having been made in the constitution of that firm, they have resigned their appointments and opened offices at 42, Spring Gardens, Manchester, where they will conduct business on their own account, similar to that with which they have been so long associated (auctioneers, valuers, &c., &c). We understand that Mr. Wood was chief assistant at the Manchester office of the said firm for upwards of 11 years, and Mr. Newland had been in the employment of the same firm for a period of 18 years.

Messrs. Taylor, Taylor & Hobson, scientific instrument makers, announce that their business having overgrown the capacity of Slate Street Works, they have erected new factory and office buildings, to be known as Stoughton Street Works, Leicester.

The Horsfall Furnace Syndicate, Limited, intimate that the growth of their business as engineers and contractors for refuse destructors, smokeless boiler furnaces, &c., has necessitated their removal to more commodious premises at 5, Greek Street, Leeds, where all communications should be addressed.

Annual Picnic.—The annual outing of Julius Sax and Co., Limited, of Coldharbour Lane, S.E., took place on Saturday last, when a most enjoyable day was spent at Southsea.

South African Electrical News.—The *British and South African Export Gazette* for July says that an order has been placed for a supplementary dynamo capable of running 500 lights, for the Bulawayo electric lighting service, as a temporary measure, until such time as a 3,500-light dynamo can be installed. This addition will raise the service to 7,000 lights. Three dynamos, for lighting and power purposes, from the works of the Elwell-Parker Electric Company, Cleveland, U.S.A., have been installed at the Vereeniging Collieries. Two electric drills, manufactured by the Jeffery Manufacturing Company, Columbus, Ohio, have been installed at the Vereeniging Collieries.

Auction Sale.—Particulars will be found in our advertisements of the sale of certain surplus machinery used in the experimental stages of the Midland Acetylene (Parent) Syndicate of Cradley Heath. The plant for sale includes a Lancashire boiler (30 feet × 8 feet), a 90 H.P. horizontal engine, 70 kw. dynamo, transformers, &c.

ELECTRIC LIGHTING NOTES.

Ayr.—At a supper given by Mr. Fuller, the borough electrical engineer, to the employés of the electricity works on July 5th, the latter presented him with a handsome marble clock, and presented some silver plate to Mrs. Fuller, while expressing their high appreciation of Mr. Fuller's solicitude for the welfare of his subordinates. Mr. Fuller acknowledged the gifts in appropriate terms.

Alnwick.—A syndicate wants to obtain powers for electric lighting. A member of the Council will move at the Council that the proposal be opposed.

Asylum Electric Lighting.—The following five lunatic asylums are at present being fitted with complete electric light installations to the specification of Mr. A. A. Campbell Swinton, M Inst.C.E.:—The London County Council Asylum at Bexley, the City of London Asylum at Stone, near Dartford, the Berkshire County Asylum at Moulsford, the North Riding Asylum at York, and the Leicester Borough Asylum at Humberstone.

The visitors to the City and County Asylum at Burghill have decided, instead of extending the old gasworks at that institution, to adopt the electric light. The estimated cost of this and other work is £5,962.

Banbury.—The Council has received notices from three electric lighting companies of their intention to make application for a provisional order. The Council has passed a resolution in favour of the introduction of electric lighting in the borough, providing the burgesses incur no liability in the matter, and referring the question back to the Electric Lighting Committee, who were also instructed to obtain offers of terms from other electric lighting companies.

Bangor.—The Local Government Board has sanctioned, without inquiry, the loan of £2,000 for electric meters and mains.

The City Council last week arranged a scale of charges for electric current. For lighting it will be 5½d. per unit, and for motive power up to 4 p.m., 2½d. per unit, and after 4 p.m. 5d. per unit.

Bangor (Ireland).—The Drake & Gorham Electric Power and Traction Company, Limited, has notified the District Council of its intention to apply for powers to supply Bangor with electricity.

Barnsley.—At a meeting of the Town Council last week, the Harvey Institute Committee recommended that £500 be borrowed for installing the electric light in the Institute, the Public Hall, the Free Public Library and Reading Room, the School of Science and Art and the offices within the buildings. The resolution was adopted.

Barrow.—Last week the town clerk submitted plans of the proposed extension of plant, with a description of the works and estimates of cost, which he had received from Messrs. Kincaid, Waller & Manville. The borough surveyor also submitted plans of the propcsed extension of the buildings, with a report thereon. The Electric Lighting Committee has resolved to instruct Messrs. Kincaid, Waller & Manville to include in the specification a clause to the effect that in case the work is completed before the specified time, the Corporation will pay to the contractors a premium equal to the amount of the penalty for every week so completed, not exceeding four weeks. The tender of Mr. John Cox has been accepted for the erection and completion of extensions to the electricity works, at £1,038 14s. 2d.

Bath.—The noise made by the arc lamps is still the subject of much discussion by the Electric Lighting Committee; Mr. Hammond is to be invited to an interview to give his opinion on the subject. The committee has decided to reduce the scale of charges from September 30th next to the following rates:—Consumers having at least 300 lamps, 5½d. per unit; 400 lamps, 5d.; 500 lamps, 4½d. per unit. The present price is 6d. per unit.

Batley.—The Corporation have now under consideration a scheme for providing electric lighting and traction for the borough, the cost of the carrying out of which is estimated at about £107,000. Messrs. Lacey, Clirehugh & Sillar, electrical engineers, were consulted some time ago by the Corporation, and they have now submitted a report to the sub-committee that has the matter in hand. The Town Council will, in all probability, be compelled to put down an electric lighting plant in order to keep out a private company. In the report submitted to the Corporation, provision is made for lighting the public streets in the centre of the town, and for running trams to all the outlying portions of the borough. If the scheme is carried out, the overhead trolley system will be adopted. The matter will be fully considered at the next meeting of the Town Council.

Beckenham.—The sanction of the Local Government Board has been obtained for a loan of £37,000 for the purposes of electric lighting in Beckenham, and it is hoped that by March next the undertaking will be in full working order. Meanwhile arrangements have been made for a temporary supply from the Bromley Company.

Bedford.—The Council is pursuing a very vigorous policy. By a resolution passed some time ago, Mr. Hope-Johnstone, the borough engineer, was authorised to prepare plans and estimates for the lighting, both private and public, of the whole of the borough. At present the mains are laid in a little over half the area. Estimates for buildings, plant, and mains, &c., will be presented to the Council in the course of a few days. Owing to the rapid growth of the town, the Council have found it necessary to discontinue using the town supply of filtered water for watering the roads, &c. The supply now is drawn from the condenser circulating water at the electricity works. A sub-station has been built in another part of the town, and a single-phase alternating motor coupled to a centrifugal pump is being supplied to pump water from the river for the same purpose.

Belfast.—The charges for current for motive power and heating are in future to be:—2½d. per unit for the first hour between 11 p.m. and 6 a.m., and 1½d. per unit after the first hour. All other consumers will pay 4d. per unit.

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Beverley.—The Council has before it a proposal to appoint a special committee to consider and report whether the Corporation shall apply for a provisional order.

Blackburn.—The fourth annual report of the working of the electricity department has just been issued by Mr. Giles, the borough electrical engineer. The report says that the financial result, after paying all charges of generation and management, is a gross profit of £2,947. The cost of generation, inclusive of management, has been reduced from 2·51d. per unit in 1898 to 2·29d. in 1899, notwithstanding the increased price of coal, and the unfortunate circumstance of having to use cold water feed for the boilers during the erection of the economisers. The number of units sold has increased from 300,000 for the 15 months ending March, 1898, to 368,000 for the 12 months ending March, 1899. The maximum load at any time on the works has increased from 277 kilowatts in 1898 to 560 kilowatts in 1899, an increase of 120 per unit. The number of consumers has increased from 292 in March, 1898, to 403 in March, 1899. It must, however, be intimated that the increased load has been working for only a very small fraction of the year, which explains the small increase in the number of units sold for the 15 months of the last financial year. The average price obtained per unit sold is 4·05d.

The sum of £30,000 is to be immediately spent upon the further extension of the electric tramways.

Bournemouth.—The new installation which was inaugurated some days ago for the electric lighting of the Pier Pleasure Grounds and Winter Gardens comprises a steam dynamo of 45-kilowatt capacity, current being distributed at a pressure of 235 volts. There are six circuits, each having four arc lamps in series, making 24 arc lamps in all, another circuit for the incandescent lighting of the Pier, and another circuit for lighting the Winter Gardens. The C.P. of the arc lights varies from 2,000 to 2,600 each, the total C.P. in arc lighting being about 52,800 C.P. The number of incandescent 16 C.P. lamps on the pier is 100 C.P.; and the Winter Gardens about 340, making a total candle-power of 58,040. The whole of the eight circuits are controlled from the engine room. There is also an additional switchboard both at the Pier and at the Winter Gardens, where the lights are again divided into circuits consisting of from 20 to 40 lamps each. The contract for the steam dynamo was given to Messrs. Siemens Brothers, that for the laying of the cables, mains and arc lamps to the Brush Electrical Engineering Company, for the supply of the electric light standards to Messrs. Macfarlane & Co., and for the masts which are to be erected at the Pier Approach and the Square to Messrs. Spencer & Co. These masts will be 60 feet high, and will each carry three arc lamps with a lighting capacity of 2,600 C.P. The whole of the works have been designed and carried out under the supervision of the borough engineer, Mr. F. W. Lacey.

The Council's Electric Light Bill has passed through the House of Lords, and only awaits the Royal assent. The Bournemouth and District Electric Supply Company have intimated their intention to apply next session for a provisional order to enable them to supply electricity for public and private purposes within the borough over which the Corporation has jurisdiction, and, further, that it was their intention the order should extend over a certain area formerly in the Christchurch Union District.

Brazil.—The San Paulo Gas Company recently placed contracts with the Brush Electrical Engineering Company, Limited, and several other English firms for a complete electric lighting plant on the continuous current three-wire system. Owing, however, to the unfriendly attitude of the Brazilian authorities, we hear that all the contracts have been cancelled. It almost looks as if municipalities abroad were going to take a leaf out of our experience and lay down their own electric light installations. We cannot complain at their preferring to keep the work in their own hands, but we trust they will not play "dog in the manger." This would undoubtedly have been the case with some of our municipalities if the Board of Trade had not stirred them up occasionally.

Brighton.—An inquiry was held on July 6th, by Mr. W. O. E. Meade-King, M.Inst.C.E., with reference to the application of the Brighton Town Council to the Local Government Board for sanction to borrow £64,000 for purposes of electric lighting. The town clerk stated that the period for which the loan was desired was 25 years. The undertaking was an extensive one. The Corporation had already spent the borrowing powers granted to them by the Local Government Board to the extent of £290,881. They were now applying for a further outlay for 1899 and 1900. The amount estimated for 1899 was £26,350 and for 1900 £37,650, making together £64,000; this being in addition to the sum of £56,300 already granted for those two years. The money was to be expended on additional plant. Mr. Fowler said at present there were 40,000 16-candle-power lamps, and it was proposed to increase these to 42,000 lamps of 16-candle-power. The present charge was 7d. per unit per first hour per day of consumption, and 1d. per unit per hour afterwards. No opposition was offered, and the inquiry was closed.

Broughty Ferry.—A London company proposes to apply for a provisional order to provide electric light to the burgh.

Camberwell.—The General Purposes Committee has decided in favour of buying the County of London and Brush Provincial Electric Lighting Company's works, &c., in the parish for £82,328.

Cardiff.—It has been ascertained that a resolution passed by the Corporation in 1896 placed the electrical engineer in entire control of the electrical staff, so that the recent action of the Electrical Committee in seeking to promote a fitter against the wish of the engineer was really *ultra vires*.

Cheltenham.—The town clerk recently wrote to the Board of Trade stating that the Council desired to alter the standard for electric supply from 100 to 200 volts, so as to make it uniform throughout the system of mains, and inquiring if the sanction of the Board was necessary to do so. To this the Board replied that notice of the intention of the Council to apply for permission to alter the standard pressure must be published in two successive weeks in a local newspaper, stating that no change shall be made in the pressure of supply to any premises which on March 4th, 1896, were supplied with energy, except with the consent of the consumer, and that any person desirous of objecting to the proposed change might do so by letter addressed to the Board within one month from the date of the newspaper containing the first publication. It was resolved to adjourn consideration of the matter until the next meeting of the committee. There are now 313 customers on the mains and 20,000 8-C.P. lamps connected, this representing an increase of 4,000 lamps and about 50 customers since the end of last year, and being entirely in addition to the number of arc lamps running in the streets.

Chichester.—A supplementary report on the electric lighting, together with plans, has been prepared by the city surveyor. It was decided to consult Mr. Price, electrical engineer, Portsmouth, as to the soundness of the scheme, the estimate of the cost, probable financial result, &c.

Darlington.—The Electric Lighting Committee has agreed to accept certain tenders for carrying out various portions of the works for electric lighting. The whole of the works will cost about £30,000.

Dartmouth.—The Town Council last week considered a letter from Edmundsons Electricity Corporation offering to obtain a provisional order at their own expense, with a special clause giving the Council the option of purchase at the end of 14 years, and to supply the public lighting at a specially low rate. A letter was also received from the English Industrials, Limited, to similar purpose, but with option to purchase at the end of 21 years.

Derry.—The Lighting Committee met last week to consider a letter received from the British Thomson-Houston Company, submitting terms for the laying down and working of plant for private lighting by electricity. It was resolved to ask Mr. John Christie, the late electrical engineer to the Corporation, to report on the letter. The Mayor placed before the meeting certain facts which he had gathered together regarding the state of the Corporation's finances. It was proposed to spend £20,000 on a private lighting scheme, costing, principal and interest, £1,100 a year, and it was estimated that 4,500 16-candle-power lamps, at 5d. per unit, equal to 3s. 4d. per 1,000 feet of gas, would be taken up, giving a revenue of £3,812 a year. But let this estimate be reduced by one-fourth and there was still an income of over £2,000 a year towards the working expenses. Mr. John Christie, the consulting electrical engineer of the Corporation, had given it as his opinion that the present premises, machinery, and staff would give the Corporation in working a private lighting scheme an advantage of over 20 per cent.

Doncaster.—The Council in Committee has recommended that the Electrical Committee select candidates for the post of electrical clerk of works.

Dorking.—A letter was received by the District Council last week from the Electrical Power Distribution Company, Limited, giving notice of their forthcoming application for a provisional order, and requesting an interview with the Council. The Council decided to oppose the application.

Dublin.—The Corporation has instructed the Electric and Special Gas Committees to prepare a special report with reference to providing a separate staff for these committees, which staff will include a secretary, one of whose qualifications will be technical knowledge of the working of gas and electricity.

Ealing.—The Electric Lighting Committee was last week engaged considering the appointment of assistant electrical engineer. Three candidates were interviewed.

Elland.—The Council has resolved to apply for a provisional order, and to take the necessary steps forthwith. The cost of the installation is estimated at £60,000.

Erdington.—The District Council will apply for a provisional order, and expert advice is to be obtained upon the question.

Exmouth.—The District Council has received notice from the Electrical Power Distribution Company of its intention to apply for powers to supply electricity within the Council's district. The matter was referred to the Electric Lighting Committee.

Friern Barnet.—The secretary of the North Middlesex Electrical Supply Association has asked the Council to grant them an interview before passing from the matter of electric lighting. The Council has replied that it still intends lodging an objection to the proposed order.

Frome.—An engineer is to meet the General Purposes Committee about the middle of July to go into the question of electric lighting, and a special sub-committee has been appointed.

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Fareham.—An application from Mr. Blake, electrical engineer, for an increase of salary has been referred back to committee. The Electric Lighting Committee recently reported that, having had under consideration various questions concerning the lighting of the town, they were of opinion that the undertaking would be benefited and the number of consumers increased if a reduction were made in the charges for lighting. In the last year, through an improvement in the plant, £150 had been saved in the cost of coal, and the Committee considered that if the public lights were turned cut at one o'clock instead of at two, a further saving would be effected estimated at £105. If the all-night supply were discontinued, and a reduction of 1d. per unit made to present consumers, which would cost the Council about £98, there would still be a balance of £22 per annum. It was resolved that the new scheme come into operation on October 1st.

Gateshead.—The Tyneside Electric Power Company has notified the Council of its intention to apply for a provisional order.

Gloucester.—At the Guildhall, Gloucester, under the auspices of the Traders' Association, Mr. Robert Hammond lectured last week on "Municipal Electricity Supply."

Godalming.—The Council has been discussing offers to purchase the electric lighting order, and has decided to empower a committee to negotiate for a sale of the order and report.

Grantham.—The Electric Power Distribution Company and Edmundsons' Electricity Corporation have given notices of applications for provisional orders. The Lighting Committee is to report to the Council on the matter.

Hampstead.—The Vestry has accepted tenders (£10,819) for the supply of plant required for the extension of the electricity works. Plans for the new buildings have been approved. The chairman of the Lighting Committee explains that the extension will be required not later than the autumn next year. Tenders for the necessary works connected with the buildings are being invited.

Hampton Wick.—The Richmond (Surrey) Electric Lighting and Power Company intend applying for a provisional order. The County of London and Brush Company have served a similar notice upon the Council, and the letters have gone to the Legal Committee to consider.

Hastings.—At a meeting of the Town Council on July 7th the Public Lighting Committee reported on a "free wiring" agreement asked for by the Southern Electrical Installation and Wiring Company, Limited. The agreement was to the effect that the company, when required by the Corporation, should provide and fix necessary wires and fittings for using electricity on the premises of a consumer, the company to have power to refuse in any case in which the consumer did not give sufficient security for the repayment of the original cost of the installation; the Corporation to pay the company 1d. per Board of Trade unit for all electrical energy supplied and paid for, unless and until the wires and fittings are paid for, the minimum payment to be 3d. for each 8-candle-power lamp or its equivalent installed. At the end of five years the Corporation is to have the option of purchasing the installation, in cases where consumers had not purchased, at the original cost, plus 20 per cent., and less 2½ per cent. (not exceeding 50 per cent.) for depreciation. The company is to be liable for any repairs and maintenance, other than renewal of lamps and shades. The report was adopted.

Hereford.—The Electric Lighting Committee has appointed Mr. Poulton clerk of works whilst the electric lighting station is being erected. It is hoped to supply current by October next.

Hexham.—The Northern Counties Electricity Supply Company, Limited, is desirous of establishing electric light works in this district, and is bringing the matter before the Council.

Houghton.—The County of Durham Electrical Power Distributing Company intends applying for a provisional order, and a deputation will wait upon the Urban Council in regard thereto at the next meeting.

Hucknall.—The Lighting Committee has declined to entertain the proposal of the English Industrials, Limited, *re* electric lighting.

Hythe.—The Folkestone Electric Supply Company has notified to the Council that it intends applying for a provisional order for Hythe.

Ilfracombe.—The Council has decided to apply to the Local Government Board for a loan of £14,700 in connection with the electricity works.

Italy.—The local authorities of Como have voted a sum of £16,000 towards the cost of constructing a municipal central station in the town for lighting and power purposes.

Llanelly.—The Electrical Power Distribution Company has advised the Council that it intends applying for an electric lighting provisional order.

Leatherhead.—The District Council is to advertise for offers for the sale or lease of the provisional order. Six months ago similar advertisements were issued and no replies received.

Lincoln.—The Electricity Committee is trying penny-in-the-slot electricity meters in a few houses.

London, E.C.—The Court of Common Council had before it yesterday (Thursday) a notice from the District Electric Supply Company of its intention to apply for a provisional order for supplying electricity within the City.

London.—The St. George's Board of Guardians, Chelsea, has resolved to put down an installation for electric lighting at the Infirmary, the cost of the plant and wiring being £5,000. The Fulham Road Workhouse will not be electrically lighted at present.

Lytham.—The Council has appointed a sub-committee to consider the advisability of obtaining a provisional order.

Malvern.—The Council is to consider whether to engage an expert to report upon electric lighting, with special reference to the provisional order.

Newburn.—The District Council has decided to oppose the application of the Tyneside Electric Power Company for powers to supply electricity for all purposes in the district.

Newhaven.—The Council has granted permission to a syndicate to obtain a provisional order for the lighting of Newhaven by electricity, provided the Council can purchase the undertaking after 20 years.

Newington.—On 7th inst. the Vestry switched on current for private and public lighting from the electricity works recently described in the Electrical Review.

Newtown.—Mr. G. R. Peers has offered to submit a scheme for electric lighting, and the Council has referred the matter to the Electric Lighting Committee.

Oldham.—The Corporation has instructed the Klein Engineering Company, Limited, of Manchester, to erect one of Klein's patent cooling towers on the "chimney principle" at the electric light station, for 1,800 I.H.P. This plant will work in conjunction with a jet condenser in such a way that the full vacuum will be maintained without requiring fresh water for condensing purposes.

Plymouth.—At the last Council meeting Alderman Radford stated, with regard to the tenders for the supply and erection of the coal conveying plant at the Prince Rock station, that a cargo of 570 tons of coal had been received at the wharf, which the Corporation had built at a cost of less than £100, and in advertising for the coal it was found that the quotation for its delivery by sea was 4s. per ton less than by rail. After being landed, however, the coal had to be carried some little distance to the electrical works, and the committee had had under consideration the question of providing for its transit by some mechanical means. They recommended the use of an endless rope and buckets, which would necessitate a capital expenditure of about £1,000, and save at least £250 a year to the town. The acceptance of Messrs. White & Co.'s tender of £470 for the plant was subject to the sanction of the London and South-Western Company being obtained to the crossing of their railway. The committee's report was adopted.

Pokesdown.—The Poole and District Electric Supply Company has given notice of its intention to apply for a provisional order.

Poplar.—At the last meeting of the District Board of Works a report from the Electricity Committee was considered, recommending that "the letters of Messrs. Crompton & Co., Limited, on the subject of rates of wages payable by that firm, be accepted in definition of the clause in the conditions attached to their tenders relating to rates of wages, and as complying with the resolutions of the Board on the subject, and on the understanding that such letters be incorporated with the proposed contract and form part thereof; Messrs. Crompton & Co. to be informed accordingly, in order that the necessary drawings may be prepared without further delay." Mr. Valentine (chairman of the committee) moved that this be adopted, and after reading the letters sent by the firm to the Board, as already published, went on to say that the firm paid the current rate of wages at Chelmsford, where it appeared there was no actual trade union obtaining. As far as he could understand it the letter which had induced the Board to refer the matter to the committee for consideration arose from the position the firm took up during the engineers' dispute last year, when they kept their works open, but with which they as a Board had nothing to do. They had given a schedule of the wages they paid, and had agreed to give the men the rate they would receive under union rules while at work in Poplar, and for these and other reasons the committee came to the conclusion that it would be advisable to give the contract to Messrs. Crompton, which he now begged to move. This having been seconded, Mr. Coad opposed the firm having the contract on account of the rate of wages paid and the bonus system they adopted, which was the worst form of sweating. He moved that the contract be withdrawn and given to Messrs. Mather & Platt, whose tender was £170 more. This was seconded, and after discussion the amendment was put to the vote, when there were 20 for, and 19 against. A division was claimed, with the result: 22 for, 20 against. The amendment was therefore carried. It was resolved to inform Messrs. Mather & Platt of the decision of the Board, and also that the trade union rate of wages clause be inserted in the contract.

Ramsgate.—The Council will strenuously oppose the application by Edmundson's Electricity Corporation for electric lighting.

Randalstown.—The Antrim County Council has referred to the District Council a letter received from Messrs. Webb, of Randalstown, asking for permission to light the town electrically.

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Redditch.—An outbreak of fire occurred at the electric lighting station on Saturday night. Fortunately it was quickly discovered, and extinguished before any serious damage was done. A quantity of oily cotton waste became ignited The engineer in charge, who discovered the fire, went for assistance, leaving one of the gas engines running. Help was soon procured, and the fire got under; but by that time the bearings of the engine had run dry and were very much overheated, necessitating the engine being temporarily thrown out of use. As the dynamo connected with the second engine was undergoing repairs, there was a temporary stoppage of the supply to consumers.

Rhyl.—Terms are to be asked from electrical engineers to supervise the electric light scheme.

St. Anne's.—The report of Mr. Tonge regarding the scheme drawn up by the Council's electrical engineer has been received by the Council, and a canvass of the town is to be made to ascertain the probable number of consumers. A letter received from the General Power Distribution Company has been ordered to lie on the table.

Sheerness.—The Electrical Power Distribution Company has informed the Urban District Council of its intention to include Sheerness within its sphere of operations. A deputation will shortly wait upon the Council.

Shrewsbury.—The Town Council on Monday was informed by the mayor that the use of the electric light was spreading greatly in the town since the Corporation had taken over the works. The extensions to the works which were in course of being carried out would, it was added, be sufficient for two years.

Sidcup.—A movement is on foot for the supply of electricity in this district. The matter will be discussed at the next meeting of the parish Council.

South Shields.—At the last Council meeting, Alderman Rennoldson reported that the electric lighting was making good progress. They were trebling their output in comparison with the corresponding period of last year.

Southwold.—The Coast Development Company, Limited, has given notice of intention to apply for a provisional order.

Spennymoor.—The District Council has received a letter from the Northern Counties Electricity Supply Company, Limited, intimating the company's intention of applying for powers to establish an electricity works in the district. The matter was referred to the Works Committee.

Stockton.—The site for the electricity works has been cleared and the chimney foundation completed to the ground level, and a commencement made for the boiler, engine and battery houses.

Stoke-on-Trent.—At a meeting held on July 5th the Board of Guardians decided to engage an electrical engineer to report on the question of installing the electric light in the Workhouse.

Sutton Coldfield.—The provisional order having received the Royal assent, an electric lighting committee has been appointed by the Council.

Thirsk.—The Northern Counties' Electricity Supply Company, Limited, proposes to apply for a provisional order for power to establish electricity works here.

Tunbridge Wells.—The annual report of the Electric Lighting Committee ending March 31st last shows that there has been a steady advance in the prosperity of the undertaking, the new consumers being equivalent to 25 per cent. The total income of the year, after making ample provisions for allowances, bad and doubtful debts, &c., is £7,380 14s. 11d., as against £5,816 4s. 10d. last year, an increase of £1,564 10s. 1d., or 27 per cent. The total working expenses amount to £3,395 12s. 9d. as against £2,750 11s. 8d. last year, being an increase equivalent to 23 per cent., this being partly accounted for by the fact that the electrical engineer's salary is charged to revenue account, whereas last year 75 per cent. of it was debited to capital account.

Walmer.—The Council contemplates applying for a provisional order, and will, therefore, oppose the application of the Electrical Power Distribution Company.

Weybridge.—A proposal of the Urban Electric Lighting Company to apply for a provisional order has been referred to the Highways Committee.

Wigan.—A Local Government Board inquiry was held on 5th inst., relative to the application of the Corporation to borrow £90,000 for electric lighting purposes in the town and district. It was stated that sufficient promises had been obtained from tradesmen in the town and proprietors of places of amusement, as well as private householders and others, who intended adopting the light, and the profits from the undertaking would yield £5,000 per annum. Mr. Bishop, electrical engineer to the Corporation, gave evidence as to the proposed works.

Whitechapel.—It is expected that by the end of September the electric light installation will be put into practical operation.

Worthing.—On Wednesday a Local Government Board inquiry was held into the Council's application for sanction to borrow £36,900 for electric lighting.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Barnsley.—At a meeting of the Town Council on July 4th, it was decided that, in consequence of the number of applications already received for electric light, an additional 250-I.H.P. electric light plant be provided at a cost of £2,000, and that the buildings be enlarged.

Bristol.—The new system of electric tramways from the Tramway Centre to Arno's Vale Cemetery was informally opened on July 4th at midnight. The cars worked very smoothly without exception, and after all the sections had been traversed several times it was considered that the system was in thorough working order. It is intended to open this system for use by the public within the next few days.

Continental Tramways.—The *Financial News* Berlin correspondent says that an international syndicate, with the participation of the Rothschilds and a capital of £640,000 has been called into existence at Rotterdam. The object of the company is to establish in various towns of the Continent electricity works for the supply of motive power or light. Negotiations are already pending with the Netherlands Tramway Company at Heerenveers, the Utrecht Tramway Company, and the Sticht Tramway line, also at Utrecht. According to the *Hamburger Börsenhalle* it is intended to acquire the shares of nearly all the existing tramway lines in Holland, and to work them by electric power, besides which new lines are to be built.

Darlington.—At a meeting of the Town Council on July 6th, the question of the light railways was brought up and discussed in connection with the widening of Park Gate. The matter was finally referred to the General Purposes Committee.

Dewsbury.—The British Electric Traction Company's application for powers to run electric trams in this district will be heard by the Light Railway Commissioners early in August. The exact day has not been settled by the commissioners, as in the same week they have to consider the company's application for powers in the Barnsley district. The Council of Barnsley have a project of their own, so that the company will have to face strong opposition in that town as in Dewsbury, Heckmondwike and Cleckheaton.

The Corporation has approved its draft agreement with the District Councils of Heckmondwike and Cleckheaton for the construction and working by the three authorities of light railways between Ravensthorpe and Cleckheaton, and for opposing the application of the British Electric Traction Company for a light railways order.

Dudley.—The temporary electric power station of the Dudley Corporation is now in absolute readiness for the running of the electric trams. The two Westinghouse compound engines and dynamos are capable of giving an output of 200 H.P. each. It is, of course, proposed to erect a permanent station, increase the machinery, and provide facilities for public and private electric lighting as well as power. The tramlines have been laid as far as the outskirts of Netherton as a branch of the Dudley tramway, and the British Electric Traction Company have fairly commenced work on the Cradley Heath length. The tramline has also been laid as far as Reusnett, in accordance with the Kingswinford scheme.

Halifax.—The Tramways Committee has decided to recommend the Town Council to obtain Parliamentary powers to carry out the following tramway extensions:—

(1) From the boundary of the borough in Stainland Road to the Station Hotel, Holywell Green; (2) from the boundary of the borough in Elland Road to Elland and Brighouse; (3) from King Cross to the boundary of the borough in Burnley Road; (4) from the boundary of the borough in Burnley Road to Hebden Bridge; (5) from King Cross to the boundary of the borough in Rochdale Road; (6) from the boundary of the borough in Rochdale Road to the top of Bolton Brow (Sowerby Bridge); (7) from Wards End to Bull Green, *viâ* Fountain Street and Barum Top; (8) from the top of Lee Bank to the bottom of Ramsden Street, *viâ* Lee Mount Road; (9) from Northgate, up Old Market, along Corn Market and Southgate, to Wards End.

A special meeting of the Town Council has been called to consider the recommendations.

The *Leeds Mercury* says that a singular fire, resulting in the suspension for some hours of the local telephone service, took place on Monday at Halifax. Shortly after 10 a.m. a private telephone wire, running over the overhead tramway in Waterhouse Street, broke, and came in contact with the electric tram wires. The current was transmitted to the large standard surmounting the telephone call office, and the numerous wires attached to it became fused, damage being also done to the test-board. Flames broke out in the top part of the building. These, however, were soon extinguished.

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Houghton and Sunderland.—Considerable progress has been made in organising this important tramway scheme by the United Kingdom Tramway, Light Railway, and Electrical Syndicate, Limited. The whole of the Councils interested have been interviewed and their general sanction obtained. The Parliamentary plans and other official particulars are under preparation, and will be duly lodged at the statutory period in November, so that the work may be proceeded with next year.

Ipswich.—The Light Railway Commissioners held an inquiry on July 6th into an application for an order to authorise light railways in mid-Suffolk. The proposals comprised an extensive scheme of about 50 miles of railways, being a line from Ipswich to Halesworth, with branches from Debenham to Needham Market, and from Bedingfield to Haughley. The Earl of Jersey, who presided, announced that the Commissioners would in any event recommend an order for the line from Ipswich to Halesworth, but would postpone their decision as to the branches to give a central committee which has been formed from the local authorities an opportunity of reconsidering the scheme in that respect.

Leeds.—At the last City Council meeting it was moved—"That it be an instruction to the Tramways Committee to forthwith proceed with the electrical equipment of the Wortley tramway." Mr. Henry said the Council had already sanctioned the equipment of the Dewsbury Road and Hunslet lines, and while he should like to have electric cars running to Wortley and other places, they were going too fast. As soon as they could get power at the station they could equip the line in a few months. The Tramways Committee could not go any quicker than they were doing. They ordered two engines of 1,000 horse-power each. The first engine required six months to complete, and for the second the engineers required three months longer. The resolution was withdrawn.

Lincoln.—At a meeting of the City Council on July 4th, the Mayor moved a resolution approving of the construction of electric tramways in the city. The resolution committed the Council to laying tramways along two routes at least. They did not intend to proceed at once with the whole scheme, but having obtained the necessary powers, they would proceed with it piecemeal.

London.—The Bill promoted by the London United Tramways, Limited, as amended by the House of Commons, will, it is officially intimated, proceed as an unopposed measure through the Upper House. The Bill is to enable the company to adapt and work its London lines by means of electric traction.

Middleton.—At the last Council meeting it was announced that, very much against their will, the Corporation were bound to have the tramway of the British Electric Traction Company forced upon the town, so that there will be two communications with Manchester—that furnished along the new road by the Manchester Corporation, and that along the old road by the British Electric Traction Company.

Merthyr.—The Bill confirming a provisional order granted by the Board of Trade to the Merthyr Electric Traction and Lighting Company, Limited, was last week sent by the Examiner for second reading in the House of Lords. The Bill has already passed through the Commons.

Newcastle-on-Tyne.—Prof. Kennedy's report on the question of obviating the overhead trolley wires in connection with the new trams in the central thoroughfares is not very encouraging, and, says the *Newcastle Leader*, he really leaves it to the borough engineer to advise. He says, with regard to the question whether in the streets in the centre of the city some system of electric traction other than overhead traction was practicable to be worked in conjunction with the overhead system in the other streets upon the tramway routes, as to the matter of mere practicability, he might say at once that their question must be answered in the affirmative, that was to say, that there were systems not requiring overhead wires which could be worked in conjunction with an overhead system. The first and most obvious method of combining overhead with non-overhead working was to use accumulators for the latter. There were several places (Chicago, Ghent, Hanover, Berlin, Paris, and others) where battery cars were actually at work with more or less success. In Hanover, in particular, the battery cars carried also the necessary trolley (or its equivalent, the Siemens-Halske bow), for working from an overhead wire. The accumulators there were of sufficient capacity for taking cars through certain central streets, and were charged from the overhead wire while the car was running on other parts of the route. The car had not, therefore, to carry a very heavy battery, and the battery was not taken out at the station or elsewhere for re-charging. Apparently the system works well, although he had not been able to obtain exact accounts as to cost. In Ghent the figures which he obtained point also to a very economical working, although the results elsewhere do not seem satisfactory. He did not think, he was sorry to say, that any of the battery systems, combined or otherwise, which he had seen would be suitable for use on their steep streets, and he understood it was exactly on these steep streets that they wished to employ an underground system if anywhere. Even in the flat cities which he had mentioned, he was afraid that the question of maintenance of the battery plates might probably be a very serious one. He, therefore, was unable to say that at present, at all events, it would be desirable for them to adopt a battery system in combination with their overhead wires. It would require special consideration on the part of their engineer to say whether he thought that any surface system was as yet sufficiently worked out to justify his recommending that it should be tried in Newcastle. Should he find this to be the case, there would be absolutely no difficulty or complication in making the change in question. It was probable that the surface contact system would not cost more per mile than a really well-arranged overhead system. Either with a slot system or a surface contact system the steep gradients could be dealt with as easily as with the overhead system, so that no difficulty arises from this cause, as it does when batteries are in question, and the modification of the cars necessary for making them work either way would be quite inconsiderable.

The Council last week sealed an agreement with Mr. Charles Hopkinson as to his engagement as electrical engineer in the construction of the new tramways.

On Monday the Tramways Committee had before it the report of Prof. Kennedy, and it was agreed to allow the whole matter to stand over until a report was received from the city engineer, with the exception that it was decided to ask Mr. Hopkinson, the consulting engineer, for his opinion with respect to the suggestions made by Prof. Kennedy. It was arranged by the committee that, wherever the streets are 33 feet wide, or over that, from kerb to kerb, centre poles be used in preference to side poles or cross wires. It was also agreed that the selection of an architect for the central power station should be referred to the General Purposes Committee, with power to appoint, and that plans be prepared at once.

Portsmouth.—At a Town Council meeting held on Tuesday, the Tramways Committee reported that having reconsidered the arrangements to be made for reconstructing the tramways, they recommended that they be authorised to appoint a person, competent to supervise the carrying out of the work, and with previous experience in tramway construction, such person, if found capable, to be appointed as general manager, with a salary commencing at £400 per annum, and increasing to £500 per annum. The committee mentioned that they had retained Mr. J. Kincaid (of the firm of Kincaid, Waller & Manville) as a witness and valuer on behalf of the Corporation in the arbitration between the Corporation and the tramway companies, but it was now understood that if any other engineer should be appointed in reference to the reconstruction of the tramways, Mr. Kincaid would feel unable to act on behalf of the Corporation in reference to the arbitration, and as it was considered that Mr. Kincaid's evidence in the arbitration would be most important, it was thought that in the public interest, as regards the arbitration, it would not be desirable, at any rate at present, to appoint any other engineer for the reconstruction of the tramways if a suitable person for the appointment now recommended could be found. The committee also recommended that they should be authorised to appoint any assistants that might be thought necessary, and to invite tenders and give orders for the requisite number of cars, and for the reconstruction and electrical equipment of the lines. The adoption of the report was moved by the ex-Mayor, but an amendment was moved hostile to the main recommendations. On a division, however, the report was adopted by 26 to 12. An amendment, moved by Sir William Pink, that the committee should choose three men, but that the final selection should be made by the Council, was adopted, 24 voting for it, and 11 against.

Radcliffe.—The District Council has decided to apply to the Local Government Board for sanction to borrow £16,000 for electricity works. The Board has approved the system of supply. The United Kingdom Tramway, Light Railway, and Electrical Syndicate, Limited, intends asking the Council to grant permission to connect Whitefield and Radcliffe with the Ship Canal by an electric tramway, and the Drake & Gorham Electric Power and Traction Company, Limited, has written to the Council stating that it is considering the question of applying for sanction to lay a connecting line from Salford Docks through Swinton and Farnworth to Little Lever.

Rodley.—The inhabitants of Rodley are wishful for an extension of the Leeds tramways to their district. A deputation waited upon the Tramway Committee on 10th inst.

Stourbridge.—The Urban Council held a special meeting on Tuesday to consider questions connected with the construction of railway No. 4, authorised by the Dudley and District Light Railways Order, 1898, through High Street to Hagley Street, Stourbridge.

Stourport.—The Urban Council has communicated with the Kidderminster and Stourport Electric Tram Company relative to the non-user of the tramlines through High Street, Stourport. The clerk said if any portion of the lines were not used for three months, the Council could appeal to the Board of Trade with a view to getting the lines removed.

Walsall.—The Town Council on Monday resolved to make application to the Board of Trade for their approval to the Council requiring the South Staffordshire Tramways Company to sell to them so much of their undertaking as is within the borough, and extending from the borough boundary on the Bescot Road to the "Brown Lion" at the Bleck, and to take all other necessary proceedings for enabling the Council to put in force the compulsory powers of purchase now vested in them. The town clerk was also instructed to give six months' notice to the company of the intention of the Council to determine the agreement dated February 11th, 1892, entered into with them as to the use of electricity on their lines of tramway in the borough.

Wolverhampton.—The town clerk has been instructed to make application to the Board of Trade for the nomination by them of an engineer or other fit person as referee to determine, under Section 43 of the Tramways Act, 1870, the value of such portion of the undertaking of the Wolverhampton Tramways Company, Limited, as lies within the borough of Wolverhampton.

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TELEGRAPH AND TELEPHONE NOTES.

Excessive Cable Rates.—On Wednesday morning the Chancellor of the Exchequer (Sir M. Hicks-Beach, M.P.) received a large deputation of members of the House of Commons and others who desired to draw his attention to the anomalous and excessive charges associated with the cable system of the Empire.

In introducing the deputation, Sir E. Sassoon said they were present to call attention to what was universally considered as the exorbitantly high telegraph tariff levied on messages to India and the Colonies, and to all our different possessions and dependencies by the Eastern and Eastern Extension and the Indo-European Telegraph Companies. They had also with them three prominent representatives of the Chambers of Commerce of Manchester, Liverpool, and London, who could practically voice the complaints of almost every chamber of commerce in the United Kingdom and the Colonies with regard to a matter which so closely affected the business interests of almost every commercial and industrial venture in the country. They had a powerful auxiliary in the Indian Government, which had been sensible, for many years past, of the heavy burden imposed on Anglo-Indian trade by reason of the high charges for telegraphing. Official figures went to show that while the number of Indian messages, upon which no reduction had been made, remained practically stationary, the trans-Indian messages had increased 57 per cent. As regarded the net annual value, while the Indian figures showed an increase of only £18,000, the increase on the net annual value of the Australian messages was not less than £300,000. As regarded the financial position of these companies, he might mention that the capital of the Eastern was no less than £7,317,000. In spite of the magnitude of the capital they had been paying for each year of the nine years preceding 1896-7 a dividend of 6½ per cent., and for 1897-8 it was 7 per cent., and they had in reserve no less a sum than one and a quarter millions. The company had a special fund by means of which they would be able to duplicate the whole of their existing lines if they chose to do so. The ordinary stock was quoted last year at 88 per cent. premium. They prayed that Her Majesty's Government might see fit to grant them a commission with the object of investigating the whole of the circumstances of the operation of the Telegraph Companies' system, with wide powers, and with instructions to report fully as to the modifications or adjustments they might consider necessary in order to place our trade, commerce and industry upon a most satisfactory footing. If he (Sir M. Hicks-Beach) considered that the business of the session would not permit of a commission being granted, they humbly prayed for a Select Committee to inquire into this question, and into alternative routes, so that they might have some kind of hope to go upon that matters would be arranged more satisfactorily. Our empire was spreading, and public opinion was keenly alive to the necessity of facilitating the operations of our trade and manufactures if they were to keep up their position in face of the great rivalry raised against them by Foreign Powers.

Sir C. Dilke, referring to the strategic argument, said the experience of the recent war had confirmed what all military and naval inquirers on the question had made up their minds to—viz., that all telegraphic communication was likely to be destroyed in time of war.

Mr. Provand said all business with the East was now done by telegraph, and cheap telegraphy for the business of this country was as necessary as cheap postage and carriage.

The Chancellor of the Exchequer said:—I understood, I think, at first that the main object you had in view was really to ventilate the question rather than to elicit any particular reply from me. Of course, the matter in all its bearings goes far beyond my special department, and I have not the knowledge nor the right at all to express the views generally of the Government in the matter. But I may say this, that while I quite agree with your general proposition that the rates between England and India at the present moment are very unduly high, I am very far from the ideas of those (and there are such people) who desire to do what Mr. Provand deprecated, viz., to enable merchants to send telegrams to the end of the earth at the cost of the British taxpayer. That is not a proposition that I am at all prepared to undertake. I am entirely opposed to the ideas of those persons who desire to substitute a general system of Government telegraphs all over the world for the present system which now prevails. I think I have shown on the other hand where there are political or even sentimental reasons in favour of the Government assisting the development of telegraphic communication with our colonies, as it certainly was strong in the case of the Pacific cable, I have not been indisposed to incur considerable liability in a case of that kind. I hope that the Pacific cable when established will not be worked at a loss—that is certainly not the intention of any of the parties to the scheme—yet I do anticipate that there will be a reduction in the rates between England and Australia, which is part of the case which has been brought before me to-day. With regard to the Indian case, of course you are aware that three years ago an attempt was made by the Post Office to obtain a reduction of the rates between England and India in concert with the Indian Government from the Indo-European Company and from the Eastern Company. That was, I think, really defeated by the opposition of the Eastern Company. Now, the last deputation I had in this room was a deputation of the Eastern Company, making a terrible grievance of the action with regard to the Pacific cable, and as we are quite unable, at least so I am informed, to compel these companies at the present moment to vary their charges, I think you will see that just now would not be the moment at which the Eastern Company would be likely to alter their answer given to the Post Office in 1896. On the other hand, I think you will all feel that we shall be in a very great difficulty if we attempt to bargain either with the Eastern Company or with the Indo-European Company on the basis of a subsidy from Parliament for a reduction of rates. Sir Edward Sassoon very properly called attention to the large profits which are now made by both those companies; and to ask the taxpayers of this country to assume a considerable annual burden in order possibly to increase or even maintain those profits I think would be a proposition that Parliament would not be likely to adopt. I can only add that I will very carefully consider all that you have placed before me. I am disposed, so far as my personal opinion is concerned, entirely to admit that, at any rate with regard to India, there is a very considerable grievance in the cost of the telegraphic communication, and whether by a Royal Commission or by a Committee of the House of Commons, or whether it is possible, with the action of the departments principally concerned—the Post Office and the Indian Government—by some such process as Sir Edward Sassoon has suggested, of filling up gaps between the different systems, would do a good deal to improve the position in this matter, those are all points which I will bring to the attention of my colleagues.

Mr. Henniker Heaton, M.P., having thanked the right hon. gentleman, the deputation retired.

French Telegrams to the East.—M. Doumer, Governor of the Colony, has decided that all telegrams for Indo-China shall henceforth be sent over the Russian and Chinese wires, to the exclusion of the British cables.

Municipal Telephones.—Mr. Charles M'Arthur, M.P., last week received the following telegram from the town clerk of Liverpool with reference to an important point which has arisen in connection with the telephone controversy:—

> In my judgment no Corporation should have a license unless protected by having a monopoly. It is a vicious principle for Parliament to adopt to authorise a Corporation to speculate with ratepayers' money in carrying on a competition of a trading character which may end in loss to the rates. This Bill will materially hamper the Corporation in contending next session before the Municipal Trading Committee that their electric undertakings ought to be protected against competition in their own areas by companies. I cannot suggest any amendment without altering the principle of the Bill.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa ...	April 4th, 1898 ...	...
Jamaica-Colon	July 1st, 1899 ...	...
Bonny-Cameroun	May 29th, 1899 ...	...
Latakia-Cyprus	June 21st, 1899 ...	...
Para-Maranham	April 10th, 1899 ...	...
San Thomé-Loanda	July 8th, 1899 ...	July 9th, 1899
Landlines.		
Communication between Salonika and Monastir ...	March 23rd, 1899 ...	...
Siberian lines between Irkoutsk and Tschita ...	July 8th, 1899 ...	July 10th, 1899
Communication with Swakopmund	July 11th, 1899 ...	...

Telegraph Rates to India.—The other day, at a meeting of the Glasgow Chamber of Commerce, the chairman read a telegram he had sent to the Bengal Chamber of Commerce, stating that as the result of his interview with Mr. John Pender, the Eastern Telegraph Company were willing to negotiate as to the reduction of rates. The Bengal Chamber had replied that the Government would be happy to receive the Eastern Telegraph Company's proposal. This communication had been sent to the Eastern Telegraph Company, who had acknowledged receipt, and stated that it would be laid before a meeting of the Committee on Telegraph Communication.

The Pacific Cable.—Reuter's agent at Ottawa telegraphed on July 8th: The intimation that the Imperial Government contemplates contributing to the construction of a Pacific cable on the basis of the Imperial Committee's report is confirmed by Sir Wilfrid Laurier and has been well received here. It will relieve the province of British Columbia from its offer to bear one-eighteenth of the cost. A resolution authorising the Government to make a contribution on behalf of Canada will be introduced in the Dominion Parliament forthwith.

The South African Cables.—In consequence of the remarkable dearth of news from South Africa, a representative of the *Globe* called upon the secretary of the Eastern Telegraph Company, and from the result of the interview, published on Saturday evening last in that journal, we are led to understand that there was no delay, and that everything was going on as usual. One of the chief officials is reported to have spoken as follows:—"I am glad you came here to ascertain the true facts of the case, and I shall always be glad to afford you any information in my power as to the working of the line, for we only want the real facts known. The criticism we naturally object to is that which is not only unfair, but untrue." It is remarkable that, with such an ardent desire to "have the real facts known," no mention whatever is found in the report of this interview of the "real fact" that the cable between San Thomé and Loanda was interrupted, owing to repairs, at the time the interview was taking place, an interruption which was officially announced early on Saturday morning, and which should have been within the knowledge of some, if not all, of the officials interviewed. This interruption, which quite cut off telegraph communication by the west coast of Africa, occurring as it did at "a critical situation in the affairs of the Cape," quite bears out Mr. Chamberlain's remarks to the deputation from the Eastern Telegraph Company which recently waited on him. The cable was put in working order again on Sunday.

(*Continued on page* 66.)

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ASHTON CORPORATION ELECTRICITY WORKS, AND THE OLDHAM, ASHTON AND HYDE ELECTRIC TRAMWAY.

The installation which we describe below possesses many features of striking interest, and bears eloquent testimony to the progressive ideas and advanced practice of our Northern friends. The electricity works of the Corporation of Ashton-under-Lyne is a combined lighting, traction, and destructor station; the engines and dynamos are of English manufacture; the water for condensing is cooled by means of a cooling tower; the whole of the pumps are electrically driven—in fact, the plant is essentially up-to-date in all respects. We welcome the appearance of the Jackson-Sayers dynamo and the Browett-Lindley engine in the field of action—or traction.

We have at various times during the last three years noted the progress of the works, which have been carried on under the able guidance, first of Messrs. Fawcus and Clirehugh, then of Messrs. Lacey, Clirehugh & Sillar; the undertaking suffered greatly from the effects of the strike, which delayed its completion for fully a twelvemonth, but the work is now practically complete.

The buildings are situated in Wellington Road, Ashton, and were erected by Messrs. Robinson & Son, of Ashton, to the designs of Messrs. Eaton & Cantrell, architects; they comprise engine and boiler house, battery and pump rooms, chimney stack, general offices, engineers' rooms, store rooms, carpenters' shop and test room.

The boilers, three in number, are of the Lancashire type with cross tubes, and were built by the Oldham Boiler Works Company, Limited; each boiler is 28 feet long × 8 feet diameter, and has a heating surface of 990 square feet, with a grate area of 44 square feet. The boiler fittings and the high and low water alarm are of Fletcher's manufacture.

The Green's economiser consists of 280 9-feet tubes; the scrapers are driven by a Jackson ironclad motor.

The feed pump is a 3-throw ram pump driven by a 10-H.P. motor, and is capable of delivering 4,000 gallons of water per hour against a pressure of 140 lbs. per square inch. The motor is at present driven off the 440-volt mains, but arrangements are being made to run it at 220 volts also from the lighting circuit, at a correspondingly lower speed. An independent feed is provided by an injector, which is capable of delivering 3,500 gallons per hour.

The condensing plant consists of a separate Ledward ejector condenser placed in the exhaust pipe close to each engine, and fed with a head of about 20 feet of water from a tank over the pump room. From the hot well the water is pumped through a Ledward cooling tower, by means of a centrifugal pump driven by a 22-H.P. motor; a similar pump afterwards raises the cooled water to the tank above-mentioned. Each condenser can deal with 12,000 lbs. of steam per hour, and the cooler is capable of cooling 70,000 gallons of water per hour from the temperature of the hot well to that of the atmosphere.

The water supply is derived from the town water mains, of which there are two systems—one supplying drinking water, the other water for general purposes; both systems are connected with the feed pipes. Arrangements are also made to cut the economiser out when desired.

All the pump motors are of the enclosed type, and were made by Messrs. P. R. Jackson & Co., Limited, of Salford.

The steam pipes form a ring main, and are made of mild steel; the exhaust pipes and valves are arranged so that any engine may be run either condensing or non-condensing.

The generators consist of three Browett-Lindley compound engines of the Westinghouse and Rite's patent central valve enclosed type, coupled to two-pole dynamos made by Messrs. P. R. Jackson & Co., Limited. The engines work with a steam pressure of 140 lbs. per square inch; the cylinders are 16½ and 31 × 17 inches.

The governors are of the Begtrup automatic fly-wheel type, acting on both cylinders, and regulated by a sliding weight, which can be adjusted to govern at 190 r.p.m. for lighting and 210 r.p.m. for traction.

There are two fly-wheels, one outside containing the governor, the other between the engine and dynamo; the latter is 8 feet in diameter and weighs about 8 tons. The crank chamber is enclosed, and forced lubrication is used; there are two sets of pumps to each engine, one being held in reserve, and the oil is pumped at a pressure of about 25 lbs. per square inch to all working parts. Each engine is provided with a steam separator, and blow-through valves for warming up the cylinders. The "United States" metallic packing is used throughout, and there is a water circulation round the slides (chiefly for use in emergencies).

The normal output is 500 I.H.P. non-condensing, with an emergency load 25 per cent. greater; when condensing the normal output is 650 I.H.P.

The dynamos are designed to give 550 amperes at 550 volts for traction, and 680 amperes at 440 volts for lighting; a two-way switch seen on the left hand of the pole piece in fig. 7 is used to cut out the series winding when the dynamos are required for lighting purposes, while the equalising switch for running compound in parallel is on the right. The armatures are wound on the Jackson-Sayers patent system, with Lewis and Howitt's patent adjustable polar extensions; on this system the commutating coil spans the whole width between the opposing pole tips, and the reversing E.M.F. depends upon the difference in the field strengths under the two pole tips, which is practically proportional to the load. The efficiency of the system is such that the full load may be switched on and off, whether with compound or shunt excitation, without causing sparking, while the brushes need not be shifted under any conditions of load.

The field magnets are of cast-steel, and, as will be seen from the end view, fig. 7, are comparatively light; the shunt winding is placed outside the series winding. The armature is 44 inches diameter by 36 inches long, with toothed core, and is wound with solid copper bars, with evolute end connections. The commutator coils are wound outside the main winding, with end connections of the cylinder type.

The armature core is ventilated; the shaft is hollow from end to end, and is provided with Lewis's oil throwers, which lift the oil from a reservoir and throw it into a catcher, whence it flows into the bearing. The brush holders

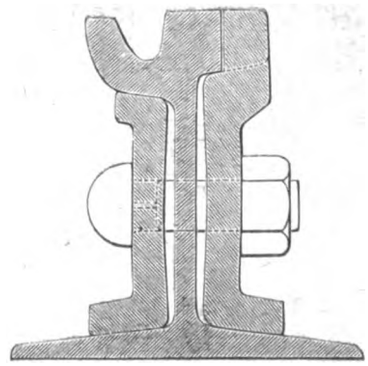

Fig. 1.—Cross-Section of Rail Joint. (See page 63)

are of Jackson's patent type, and the brushes are staggered, the middle brush, of "Boudreaux" white metal foil, leading about ¼ segment over the other two, which are of copper. The whole arc of contact covers about 1½ segments.

The armature is electrically insulated from earth—each bearing being doubly insulated with sheets of ebonite, while the coupling, which is flexible, consists of 22 steel pins fixed into the engine half-coupling, and fitting loosely into corresponding holes, bushed with rubber, in the dynamo half. Both the field magnet frame and the two bearings are magnetically insulated from the bedplates by means of thick zinc separators.

The bed consists of two massive cast-iron girders running from end to end of the set, upon which the engine bed and the field magnet frame are mounted; the dynamo bearings are carried on heavy castings, which span the two girders.

The commercial efficiency (E.H.P. ÷ I.H.P.) of the steam dynamo was found to be 86 per cent. when tested. The behaviour of the plant under load is admirable; a close observation of the tachometer shows no appreciable variation of speed, while the current is shown by the ammeter to vary between wide limits, and the engine and dynamo are almost noiseless.

The generating set in the foreground of our general view of the engine room, fig. 2, was supplying the whole of the

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power required to drive the tramcars while the photograph was being taken; it will be seen that the details come out perfectly sharp, and that there was practically no vibration.

The motor-generator and the balancer were made by Jacksons; the former, which is seen on the left hand near the switchboard in fig. 2, consists of a 75-kw. compound generator and shunt motor; the series winding is used when the machine is transferring power from the lighting to the traction mains, but may be cut out by means of a switch, thus making the machine suitable for running off the traction

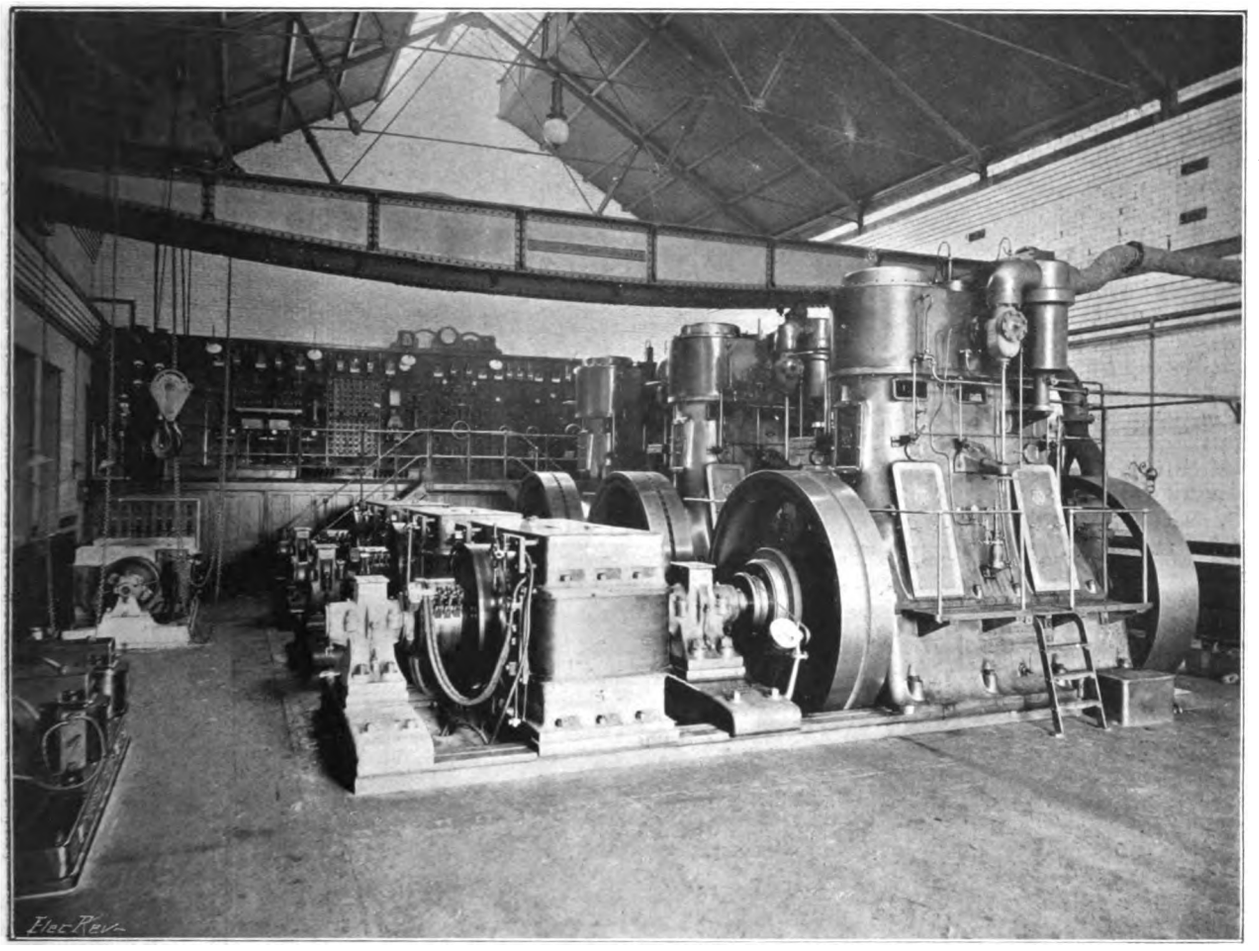

Fig. 2.—General View of Engine Room.
The set in the foreground was driving the tramcars while being photographed.

mains to assist the lighting plant, or to take the day load, or for charging the battery from either set of mains.

These machines are generally similar in design to the large dynamos. The motor-generator is provided with a fly-wheel between the two armatures, and the armature and connections are of the cylinder type, carried on extensions of the end plates; the pole tips are adjustable. Boudreaux

Fig. 3.—Balancer.

brushes are used, with a small pilot brush of carbon, about a quarter segment in advance of the others. The balancer is shown in fig. 3, and is of similar design, but without the fly-wheel.

There is a battery of 240 cells of the Planté type, in glass boxes, made by Messrs. Pritchetts & Gold, and capable of giving 50 amperes for nine hours, or a maximum of 110 amperes for a short time. The cells are arranged in a single tier in a large battery room behind the switchboard.

The main switchboard consists of 11 panels of enamelled slate, and was manufactured by Messrs. Dorman & Smith, of Manchester.

The first three on the left-hand are dynamo panels, each fitted with a double-pole main switch, voltmeter (600 volts), ampere gauge (700 amperes), duplex double-pole fuses, shunt switch interlocking with main switch, and shunt rheostat. There is also an automatic switch, which cuts out with a small reverse current; this is used instead of a minimum current cut-out, on account of the fact that the dynamos are to be used for traction as well as for lighting, and in the former case, if all the cars were to come to a standstill simultaneously, a minimum current cut-out would disconnect the generator from the line.

The fourth panel is fitted with + and − voltmeters (350

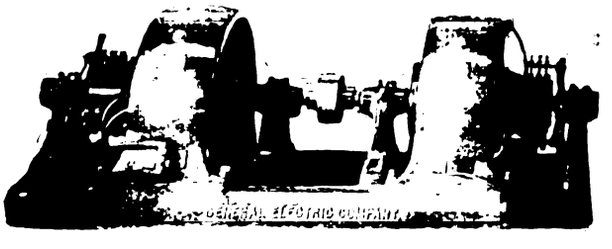

Fig. 4.—Booster.

volts), an ampere gauge (200 amperes) in the middle wire, and the following plug bars (on each pole):—

Horizontal—Four feeders, one balancing distributor, one traction (connected with traction board).

Vertical (at back of board)—Four dynamos, two motor-generators, one battery discharge.

The fifth panel bears an ampere gauge (700 amperes), double-pole switch, lightning arrester, and main circuit

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breaker, as well as a Thomson-Houston energy meter—all of which are in circuit with the whole of the current supplied to the tramway.

The next panel is set aside for the motor-generator, and carries two voltmeters (600 volts), two ampere gauges (200 amperes), current direction indicators, duplex fuses, and the following interlocking switch gear: (1) Coupled shunt circuit switches, locking with (2) coupled main bus bar switches, locking with (3) starting resistance switch, locking both the (4) double-pole motor switch and the (5) double-pole generator switch.

The motor armature switch (4) cannot be moved until the resistance switch (3) is closed, with all the resistance *in* circuit; nor can the generator switch (5) be closed until (3) is closed, with all the resistance cut *out* of circuit. It is impossible to do any wrong thing with this somewha complicated set of switches!

On the same panel there are shunt resistance switches and minimum current cut-outs.

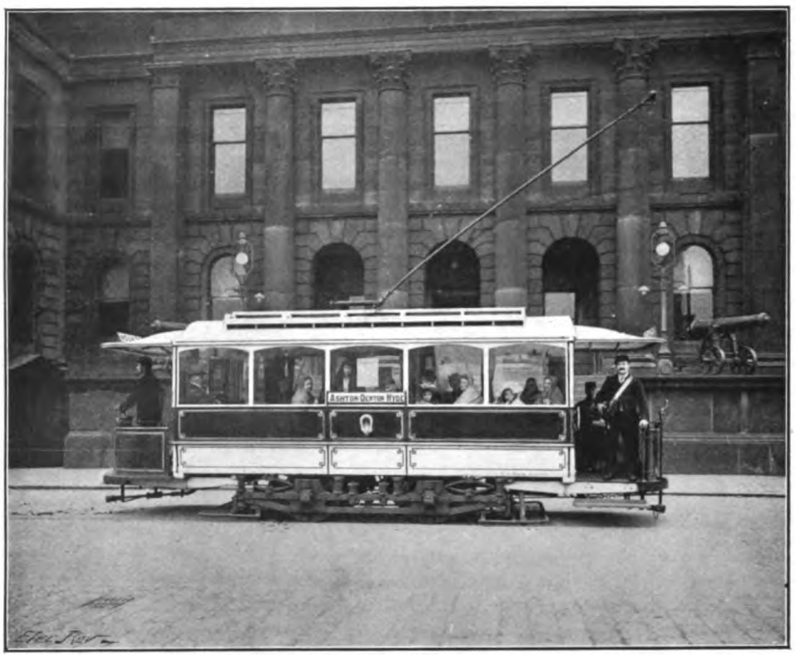


Fig. 5.—Car on Line in Front of Ashton Town Hall.

The battery panel, No. 7, is fitted with two ampere gauges (150 amperes), two voltmeters (350 volts), and a 600-voltmeter across the outers. There are also duplex fuses to the middle wire and to the outers, current direction indicators, a three-pole switch to isolate the battery, two discharging switches, and two energy meters, and there are to be added two Miller patent reversible ampere-hour meters, and charging switches.

The balancer panel carries two ampere gauges (250 amperes), two voltmeters (350 volts), current direction indicators, and interlocking switches similar to those on the motor-generator panel.

The other three are feeder panels, and are fitted each with an ampere gauge (300 amperes), voltmeter (600 volts) connected with feeding points, double-pole duplex switch and fuse, and an energy meter.

All the voltmeters and ampere gauges mentioned above are of the Kelvin type, manufactured by Mr. James White, of Glasgow. The remaining instruments (above the board) are two Weston voltmeters, joined between the lighting and traction bus bars, and two energy meters, on the balancing distributor. There is an emergency switch in the engine room to throw all the lamps in the works upon the battery in case of a breakdown, and a switchboard controlling the various motors and lamps about the works.

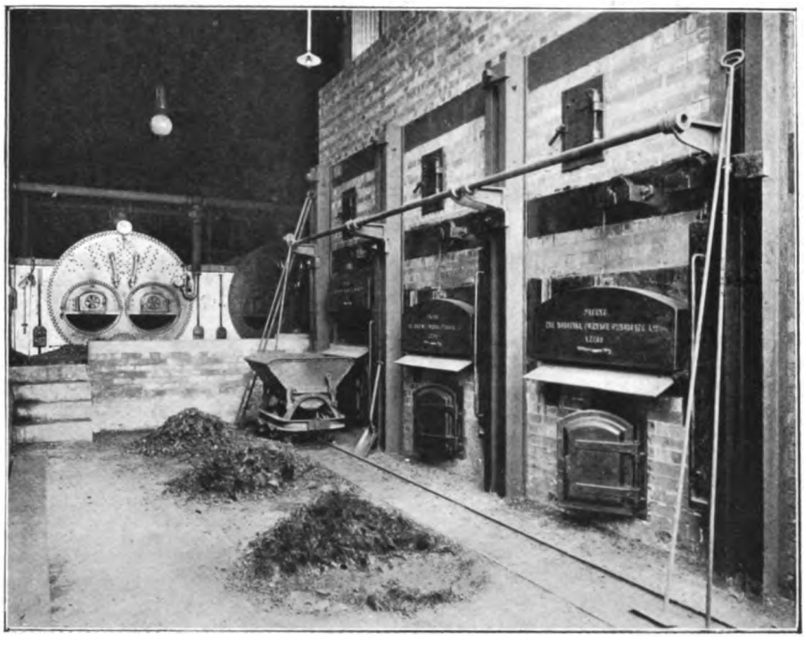


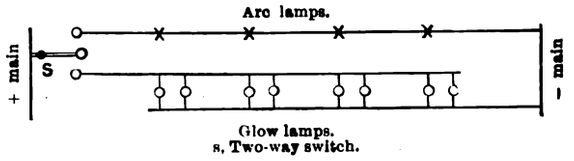
Fig. 6.—View of Destructor and Part of Boiler House.

The private lighting is carried out on the three-wire system, with 400 volts between the outers. There are three feeders to points in the town, having cross-sections of 0·4, 0·3 and 0·25 square inch respectively; these are all two-wire concentric cables, manufactured by the British Insulated Wire Company, insulated with paper, and lead-covered, and are drawn into cylindrical conduits of Doulton ware 6 inches in diameter.

There is a duplicate set of balancing distributors, each consisting of three cores of 0·06 square inch cross-section; these are similar to the feeders, and are laid in the same way.

The ordinary distributors are three-wire triple concentric cables, of cross-sections from 0·06 to 0·2 square inch, insulated with paper, lead-covered and armoured; they are laid direct in the earth. Pilot wires are brought back from the feeding points to the main switchboard.

The public lighting is done with 72 12-ampere Brockie-Pell double carbon arc lamps, arranged four in series between the 200-volt mains. Each circuit is controlled by one two-way switch; by this means the arcs are put out at midnight and replaced by two 16-C.P. incandescent lamps on each lamp-post. The connections for this purpose are shown below:—



Glow lamps.
s, Two-way switch.

The private lighting is not as yet in full swing, but 5,000 8-C.P. lamps are already connected or applied for. The Wright demand indicator system is in use, with Chamber-

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lain & Hookham meters. The price charged for electrical energy is 7d. per unit for the first hour and 2d. afterwards.

The destructor, which is situated behind the boiler house, was erected by the Horsfall Furnace Syndicate, Limited, of Leeds, and consists of six cells. The gases from the cells are led through two multitubular boilers, each 11 feet long × 8 feet diameter, and fitted with 106 tubes 3½ inches in diameter; the draught afterwards passes round the sides and underneath the boilers. The heating surface of the tubes is 1,065 square feet, and of the shell plates 154 square feet. A small tramway runs round the destructor to facilitate the removal of clinker to a mortar mill, where it will be mixed with lime and sold for building purposes.

We give in fig. 6 a view of one side of the destructor, with part of the boiler house.

The assistant engineer's office is provided with large windows, giving a full view of the engine room. The chief engineer's office is fitted with three recording voltmeters, one for recording the traction supply pressure, and the other two for the lighting bus bars on the two sides of the system. There are also two Cardew voltmeters, one for the traction bus bars, and one between the outers of the lighting mains.

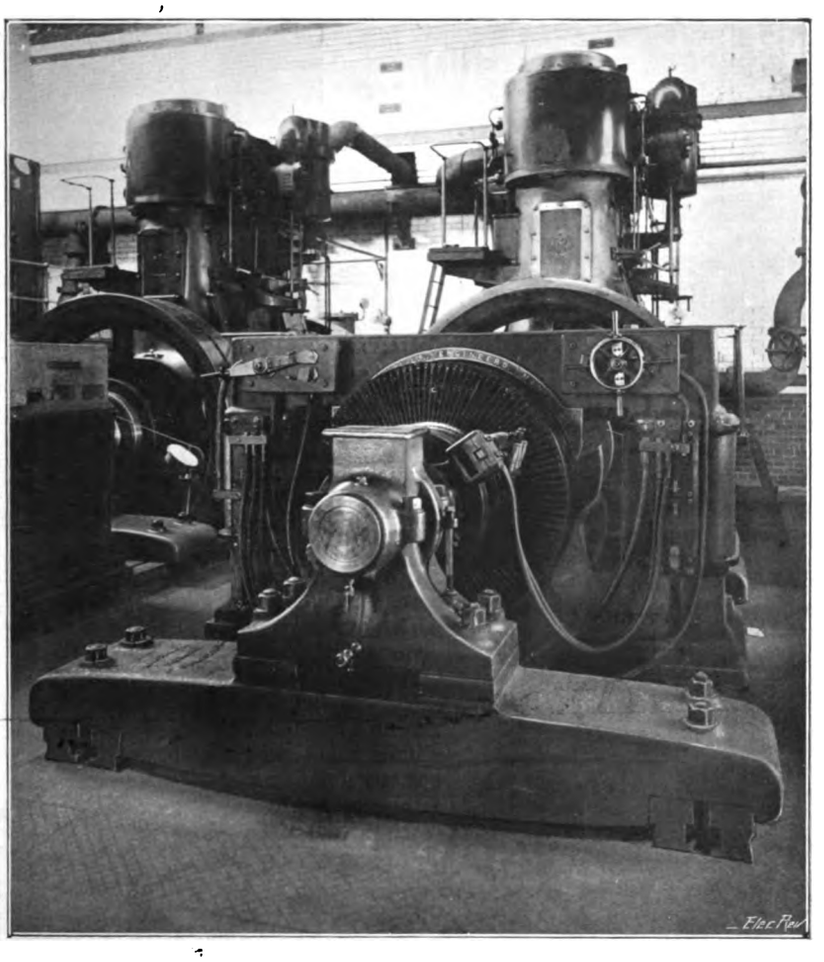

Fig. 7.—End View of Generator.

Oldham. Ashton and Hyde Tramway.

The route of the line is from Oldham boundary through the urban districts of Bardsley and Limehurst to Ashton-under-Lyne, then through Audenshaw and Denton to Hyde; the line crosses from Lancashire into Cheshire at the River Tame. The route lies through residential and manufacturing districts practically all the way; there are many sharp curves, and a very steep hill called Bardsley Brow, near the Oldham terminus, the gradient here being 1 in 11. The cars have no difficulty in surmounting this formidable slope.

The Board of Trade inspection was carried out on May 25th; Colonel Yorke inspected the track, and Major Cardew the electrical equipment, with satisfactory results in both cases. The certificate was received on June 12th, and a full service of cars was put in operation the same day, without a formal opening ceremony. Since then the service has been continued without interruption. The line is very popular; the traffic has been extremely good from the beginning, and is still increasing. The line at present consists of 8 miles of single track, with turn-outs, but important extensions are in contemplation.

The cars are all of the single-deck pattern, with the trolley mounted on the roof; there are at present 18 motor cars, but eight more are to be added, as well as 12 trailers.

The car shed and the repairing shop are situated in Denton; we are unable to give a view of the former, as it was not completed at the time of our visit.

The contract for the whole of the electrical equipment of the line was assigned to the British Thomson-Houston Company, Limited, while Messrs. Dick, Kerr & Co. received the contract for the permanent way. The following sub-contractors were employed by the British Thomson-Houston Company:—

Overhead equipment: Messrs. R. W. Blackwell & Co.
Feeder cables and laying: The British Insulated Wire Company, Limited.
Car bodies: The Brush Electrical Engineering Company, Limited.

The rail-bonding was also carried out by the British Thomson-Houston Company.

The gauge of the line is 4 feet 8½ inches. The rails weigh 94 lbs. per yard, and are in lengths of 30 feet, with 10 per cent. of shorter lengths machined at the ends for Messrs. Dick, Kerr & Co.'s patent fish-plates. The latter are 20 inches long, and are so designed as to give a continuous running surface for the car wheels, thus reducing shocks when passing over the joints. The rails are tied to gauge with tiebars, about 8 feet apart, of 2 inches × ⅜ inch flat bar, screwed at one end, and provided with nuts and washers, while the other end is notched. The rails are laid on a bed of cement concrete 6 inches thick, except where the ground is very soft; they are then laid on 12 inches × 6 inches longitudinal timbers over a concrete foundation. The space between the rails, and 18 inches on either side, is paved with granite setts. A cross-section of the rail joint is shown in fig. 1.

The overhead construction consists chiefly of span wire suspension, side brackets being used only in certain narrow streets in Denton, where the widening of the roadway is in contemplation. The usual fittings, guard wires, &c., are employed, and were supplied by Messrs. R. W. Blackwell and Co. The trolley wire is No. 0 B. & S. (0·325 inch diameter), of hard drawn copper, and is double throughout. In some instances the poles are used as arc lamp-posts, with marked advantage to their appearance.

The trolleys are of the Boston pivoted type, with Dawson swivel head; these are, however, to be replaced by trolleys of the straight under-running type, in accordance with the recommendations of the Board of Trade, and are to have detachable heads, so that in the event of the trolley jumping off the trolley wire and striking the guard or span wires, the head will be pulled off without injury to the overhead gear. The rails are bonded with two Chicago bonds to each joint, and are cross-bonded at frequent intervals. The points are Askham Brothers & Wilson's patent.

The car bodies were made by the Brush Electrical Engineering Company, Limited, and are provided with seats for 26 passengers inside and two on each platform. The length inside the body is 17 feet 5 inches, over all 26 feet. The trucks are of the Peckham cantilever type, with 5 feet 6 inches wheel base. Each truck is fitted with two G.E.—50 traction motors, with a rated output of 27 H.P.

The K 10 series parallel controllers, which are at present in use, are to be superseded shortly by the B 13 type, with Westinghouse electrical brakes, one of which is already in use;

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this is on account of the heavy gradient above mentioned. The car, which is so equipped, gave great satisfaction when

Volta Exhibition.—Alessandro Volta.

Volta Exhibition.—Luigi Galvani.

tested on the Brow. The trailer as well as the motor cars will be equipped with the electric brake, so that the whole control will be in the hands of one motorman. Our illustration (fig. 5) shows one of the cars in front of the Ashton Town Hall; incidentally, the picturesque head-dress characteristic of the Lancashire mill hands is seen to advantage.

Volta Exhibition.—Galileo Ferraris.

The traction switchboard consists of two feeder panels, one booster panel, and a Board of Trade panel. The feeder panels are fitted with British Thomson-Houston magnetic

Volta Exhibition.—Antonio Meucci.

blow-out circuit breakers, single-pole switches, and Weston ammeters. The booster panel carries two single-pole two-way

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switches, motor starting switch, and shunt regulator, as well as a 50-ampere meter in the motor circuit, a 240-ampere meter in the generator circuit, and a voltmeter reading to 150 volts, all of the Weston type.

The Board of Trade panel is of the usual type, with instruments by Messrs. Elliott Bros. The traction switchboard is at present adjoining the lighting switchboard, but will eventually be erected at the opposite end of the engine room.

The power for the line is passed through three Thomson-Houston meters, of which one belongs to the Corporation, one to the tramway, and one to both parties jointly; the charge is based on the average reading of the three.

The trolley wire is supplied by two feeders, viz.:—one to Oldham, of 0·1 square inch cross-section, and one to Hyde, 0·25 square inch (together with a supplementary feeder, 0·15 square inch). The feeders are led into 15 switch pillars, of Messrs. Blackwell & Co.'s pattern, spaced half a mile apart; telephone wires from the power house and car depôt also run into the pillars, as well as test wires for the Board of Trade panel, connected to the rails at Oldham and Hyde. The feeder cables are insulated with paper, lead-covered and armoured; the telephone and test wires are made up into a three-core cable of similar type. In addition, there is a test wire and a main track feeder, 0·4 square inch in cross-section, both of which are connected with the rails at the point nearest to the power house.

A booster cable of 0·3 square inch cross-section is led from the power house to the rails at Broomstairs Bridge, Hyde, 4 miles from the power house; the booster, which is shown in fig. 4, p. 61, consists of a G.E.C. 4-pole motor and generator, the motor receiving 50 amperes at 500 volts, when the generator is raising the pressure of the 200-ampere return current by 100 volts (the maximum "boost").

All the above cables were made and laid by the British Insulated Wire Company, Limited, a total length of 25 miles being supplied. The cables were laid direct in the ground without further protection, except in made ground, where they were laid in wooden troughs, filled up with bituminous compound.

The engineers to the line were Messrs. Stephen Sellon and Horace Parshall; the resident engineer on the construction was Mr. W. R. P. Hederstedt, A.M.I.C.E. Mr. Sayers, the power engineer to the British Electric Traction Company, rendered valuable assistance to the engineers in the electrical part of the undertaking. Mr. E. H. Mottram is the traffic superintendent.

Mr. W. H. Vincent, the borough electrical engineer, was for a long period engaged with Messrs. Siemens Bros., and erected the electric lighting plant at the Blackburn and Bury electricity works.

Mr. J. A. Fraser is the resident engineer of the tramway, and was formerly with the Brush Company, for whom he was in charge of the erection of the generating machinery at Wandsworth Electricity Works.

We are indebted to these gentlemen for their courteous and untiring assistance in the preparation of this article; we would also offer our thanks to Messrs. W. Harling and A. K. Taylor (for the British Electric Traction Company), H. Leigh (for Messrs. Browett, Lindley & Co.), F. H. Morley (Messrs. P. R. Jackson & Co.), and the various contractors who carried out the work.

Addendum.—The 15-ton travelling crane, seen in fig. 2, was made by Messrs. Taylor & Hubbard, of Leicester.

THE VOLTA EXHIBITION AT COMO.

In a letter of March 20th, 1800, addressed to the then President of the Royal Society of London, Sir J. Banks, Volta first described his electrical pile, and in recognition of the approaching centenary of this discovery, an exhibition of objects of interest connected with him and other distinguished Italian electricians is being held at Como, the scene of the birth, education, and early work of Volta. *L'Illustrazione Italiana*, an Italian paper similar in form and scope to our *Graphic*, devotes nearly the whole of its issue of June 4th to an illustrated biographical account by Sr. Ferucchio Rizzatti, of Volta, Galvani, Meucci, and other Italian electricians, and we extract from this, and other sources, some of the historical facts of this early and extraordinarily fruitful work.

The first name in the series of discoverers of the electric current is that of Galvani. He was born in 1737, and was by profession a doctor and physiologist. An accident drew his attention to the effect of an electrical discharge in exciting the muscles of a frog's leg, but though he spent many years in investigating the phenomenon, he does not seem to have made any progress at all beyond the point reached by his wife, who first accidentally performed the experiment while cooking his dinner; nor, with the brilliant exception of Mr. C. B. Harness, has anyone got any farther since. Galvani's principal book on the subject was published in 1791, but his recently discovered papers show that he had been studying the matter for at least 20 years before this. The properties of the Torpedo had been known to the ancients, had been carefully studied long before Galvani's time, and had been shown to be electrical in 1773, so that the idea of living or recently dead organisims possessing electrical properties was not altogether new. Galvani's otherwise fruitless labour served the purpose of attracting to the subject the attention of Volta, who, using the frog's muscle as an electroscope or galvanoscope (it may be recalled that no other instrument existed at that time capable of indicating the existence of small electromotive forces), discovered the properties of the pile and voltaic cell. Galvani died in 1798. An inscription on his house may be translated:—

> In this house was born on September 9th, 1737,
> and here died on December 2nd, 1798,
> Luigi Galvani,
> The genius of Italy, the glory of Felsina, the fame of the world.

Alessandro Volta was born at Como, February 18th, 1745. In 1774 he was appointed professor of physics in the Gymnasium of Como, and in 1777 he left his native town for the first time to travel through Switzerland, where he formed an intimate friendship with De Saussure. In 1779 a chair of physics was founded in Pavia, and Volta was chosen to occupy it. In 1782 he undertook a journey through France, Germany, Holland, and England, and became acquainted with nearly all the scientific celebrities of that day. In 1791 he received the Copley medal of the Royal Society. In 1801 Napoleon called him to Paris to show his experiments on contact electricity, and a medal was struck in his honour. He was made a senator of the kingdom of Lombardy. In 1815 the Emperor of Austria made him director of the philosophical faculty of Padua. In 1819 he retired and settled down again in his native town. He died on March 5th, 1827, and was buried at Como.*

Volta's first papers were of a speculative kind on the mechanism of the forces of electrical attraction and repulsion. In 1775 he wrote to Priestley describing the electrophorus, asking if the discovery was new, and in 1782 a paper on condensers and their applications to the study of electrical phenomena was printed in the *Phil. Trans.* He afterwards studied atmospheric electricity, and was the first to conceive the idea of and to construct an absolute electrometer, which was a suspended disc instrument on a sensitive balance.

The study of Galvani's experiment brought him to the facts of the contact electricity of metals and electrolytes, the construction of the pile, and the steady electrical current. Volta announced his discovery to the President of the Royal Society of London in a letter dated March 20th, 1800; and on April 30th of the same year Carlisle and Nicholson succeeded with the aid of the pile in decomposing water, and a little while after in decomposing metallic salts. Before the end of 1800 Humphrey Davy and Berthollet proclaimed Volta's pile to be the most powerful agent of chemical decomposition then known. The pile described by Volta in his letter to Sir J. Banks was constructed of discs of tin and copper, or tin and silver, separated by moist porous matter.

Volta himself and another Italian, Brugnatelli, were among the first to discover the action of the pile in decomposing metallic salts, and the experiments of Brugnatelli on metals, which are very little known, published in his annals of chemistry and natural history, clearly justify his claim to have been the first to apply the electric current to gilding.

As Volta's name is associated with the long and undetermined controversy on the contact electricity of metals, so is Meucci's with that of the discovery of the telephone.

* *Encycl Brit.*

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Antonio Meucci, the friend of Garibaldi, and till a few years ago the father of the Italian colony in New York, was in 1849 chief machinist of the Tacon opera house in Cuba, where his wife was in charge of the wardrobe. He occupied his leisure hours with physical experiments of all kinds, and especially studied the frequency of vibration of sonorous bodies, the lengths of waves, the mode of progression of waves along stretched strings, and the influence of the material on the intensity of the sounds. In 1851 he was experimenting with the simple telephone made of a stretched string between two parchment diaphragms, and it occurred to him that electricity might be made use of for the better realisation of the idea of the instrument. He worked this out, and produced in 1871 an instrument identical in construction with that afterwards invented by Bell. The Bell telephone, similar to that previously discovered by Meucci, was exhibited at the Philadelphia Exhibition of 1876, and only within recent years a decision of the American Courts has vindicated Meucci's claim to the discovery; but the credit due to Bell is not diminished by the justice done to the old Garibaldian.

The Italian paper from which we are translating these extracts gives an interesting view of a house in America occupied together at one time by Garibaldi and Meucci. The fourth portrait we print is that of the late Prof. Galileo Ferraris, the inventor of the rotating magnetic field. We have on our table for review a copy of his lectures, published since his death, from the notes of some of his distinguished pupils. His work is too recent to be treated with that of Galvani and Volta, but we shall take the opportunity of giving some account of his life and work in the course of the review of the book.

A long list of other Italians eminent in the history of electricity is given by Signor Rizzatti, and many of them are very familiar. The names of Melloni, Fabbroni, Minotto, Zamboni, Caselli, Pacinotti, Righi, all recall some familiar piece of apparatus.

We regret to learn from dispatches to the daily press that the exhibition has been entirely destroyed by fire. The fire developed very speedily, literally eating up everything within its grasp. It is reported that the outbreak occurred in the French electro-technical department, the cause being fusion of electric wires. Every endeavour was made to save the Volta memorials, and after more or less daring pursuits the picture of Volta showing his battery to Napoleon, the sword of honour presented to him by the latter, and various personal relics were rescued, but the only authentic portrait of Volta, his will, his valuable MS. and books, his original battery, and other invaluable objects of interest were all reduced to ashes and can never be replaced. One correspondent telegraphs that the other exhibits shared a like fate. Magnificent silks in all stages of manufacture from the worm to the woven goods, were destroyed, electric appliances and machines of all kinds, old and new, were bent out of all recognition, and the priceless tapestries of the time of Cosmo de Medici and Paolo Giovio are all gone. By the superhuman efforts of the soldiers and firemen the sacred art department and the exhibit of the Docks and Lake Navigation Company escaped unscathed. It is stated that the noble and immense building on the edge of the blue smiling Lake Como became in a few moments a red-hot furnace that could be seen in Milan and Switzerland. The committee of the exhibition, with real heroism, at once agreed to go on with the festivities, and to rebuild the exhibition building. They very quickly collected a handsome sum for the purpose. No lives were lost. The International Congress of Electricians is to be held as previously arranged.

The *Times* account is that at 10 minutes past 10 on the morning of the 8th an apparently accidental contact of two electric conductors in the neighbourhood of the marine section set fire to the marine gallery. For a few minutes the pumps refused to work, and when they were got into working order the fire had become unmanageable. At 10.20 the rotunda fell in; at 10.30 the principal façade tottered and came down with a crash. Immediately afterwards the immense boilers exploded. Two compressed air gasometers likewise blew up. At 10.45 the whole exhibition, valued at nearly £500,000, was utterly destroyed.

The following telegram of condolence was sent on Saturday night last to the Sindaco of Como (Signor Cadenazzi) by some of the members of the Institution of Electrical Engineers on receipt of the news of the burning of the Volta Centenary Exhibition:—

To the Sindaco of Como.

We, the president and members of the Institution of Electrical Engineers of London, having heard with great regret of the fire at the Volta Exhibition, send you the assurance of our most profound sympathy.

Silvanus P. Thompson,
William H. Preece,
David E. Hughes,
William E. Ayrton,
John Perry,
Henry Edmunds,
Philip Cardew.

To this message there was returned on Monday the following acknowledgment:—

President, Institution of Electrical Engineers, London.

I thank you with emotion for your cordial participation in the very deep grief of the country of Volta.

Mayor Cadenazzia.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page 59.*)

The Proposed British Imperial Telegraph Company.—We make the following extract from the "City Notes" of the *Globe* for Wednesday last week:—

In financial circles much has been the discussion with reference to the recent Pacific Cable Conference between the Marquis of Tweeddale, his colleagues, and two members of the Government. Among shareholders in at least two companies—the Eastern and Eastern Extension Company—there is considerable resentment that this step was taken at the present juncture, and it is stated that steps are about to be taken to practically give voice to this. Much as the step is to be regretted—probably none more than those responsible feel their mistake—we can see no good purpose to be served by internal dissensions. They can only tend to impair the shareholders' property, and from this point of view alone such are to be deprecated. An error of judgment has been committed, whereby there has sprung into actual reality a condition of affairs which might have for years remained outside the pale of reasonable expectation. It is now for those who have committed the blunder to repair it, and their hands should not be hampered by useless agitation. It can serve no good purpose, and already its effects are being felt on the price of the shares.

The Telephone Service.—At a meeting of the Manchester Corporation Telephone Special Committee on Monday a number of replies were received from local members of Parliament, acknowledging the receipt of the resolution passed by the City Council with reference to Mr. Hanbury's Telephone Bill. The resolution condemned the proposals of the Government relative to the Telephone Bill, as outlined by Mr. Hanbury in the House of Commons, whereby in cases where competition with the National Telephone Company is established by a local authority, or another company, the wayleaves and license of the National Company shall be guaranteed until the licenses granted to the local authority or new company lapse, "as injuriously affecting the principles of local government, and as contributing to the permanence of a monopoly which has grown to be a national grievance." A letter was also received from Mr. Hanbury, M.P., suggesting that a deputation of the Committee should wait upon him, to discuss the subject, on Thursday. The Committee resolved that a deputation should proceed to London.

It is stated that the text of the Telephonic Communication Bill, as amended by the Standing Committee on Trade, was issued on Saturday, and is backed by Mr. Hanbury and the Chancellor of the Exchequer. It is provided that, where an existing company have, before the passing of the Act, furnished a system of telephonic communication, their license shall be allowed to continue for the period for which a new license may be granted to a local authority or other company, but on the same terms and conditions, and subject to certain restrictions as to charges and to special agreements with the local authorities. It is also enacted that an existing company shall not, without the consent of the Postmaster-General, given after the passing of the Act, in each case, open an exchange in any area included in their license, in which they had not, before the passing of the Act, established an effective exchange. It is finally provided that where a local authority or new company, under a license from the Postmaster-General, provides a system of telephonic communication in any area in competition with an existing company, licensed by the Postmaster-General before the passing of this Act, then subject to certain restrictions as to charges, &c, the license of the existing company shall, within the area in question, be extended and continue for the period for which the license of the local authority or new company may be granted; but, except as varied by this Act, the provisions of the license of the existing company shall remain in force.

The Works Committee of the Hull Corporation met last week to consider the new clause which Mr. Hanbury moved whilst the Telephone Bill was in committee. Alderman Larard moved that the Corporation protest against the clause which the Government propose to insert in the Telephone Bill, whereby the Corporation would be required, as a condition of acquiring a telephone license, to continue wayleaves to the company for the full term of such license, and this was carried unanimously.

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The Telegraph Wire Export Trade.—The returns for June show that the month has been an unusually quiet one as regards the exports from this country of telegraphic wire and apparatus connected therewith. The value of the shipments during the month only amounted to £27,817, which compares with £31,377 in the previous month, and with no less than £145,281 in June last year. With regard to the shipments during the first half of the current year, these are of a satisfactory character, a total of £501,673 having been reached, as against £500,896 in the first six months of last year, and £470,726 in the first half of 1897.

CONTRACTS OPEN AND CLOSED.

OPEN.

Annfield Plain.—July 18th. The Urban District Council invites tenders for the supply of the necessary plant required for an installation of electric light for the lighting of the district: (1) For engines and dynamos; and (2) for poles, cables, &c. Particulars on application to Mr. T. J. Trowsdale, Surveyor to the Council.

Barton-upon-Irwell.—July 18th. The Guardians want tenders for the electrical plant for lighting their new infirmary buildings at Patricroft. See "Official Notices" July 7th.

Battersea.—August 31st. The Vestry wants tenders for an overhead travelling crane (hand or electric), and batteries for the electricity works. See "Official Notices" July 7th.

Birkdale.—August 19th. The Urban District Council invites tenders for the transfer of its electric lighting powers.

Brighton.—July 17th. The Council wants tenders for the supply of C.I. water tanks (40,000 gals. capacity) with supporting structure at the electricity works. See "Official Notices" July 7th for particulars.

Canary Islands.—July 16th. Tenders are being invited until July 16th by the Spanish Post and Telegraph Authorities in Madrid for the concession for the establishment and working of a telephone system between Haria and Arrecife with three intermediate stations on the island of Lanzaroto, Canaries. Tenders to be sent to La Direccion General de Correos y Telegrafos, 10, Calle de Carretas, Madrid, whence particulars may be obtained.

Denbigh.—The North Wales Counties Lunatic Asylum Committee wants tenders for the supply of engines, dynamos, switchboard, injector, piping, and foundations, also wiring of buildings for electric lighting. See "Official Notices" this week.

Edinburgh.—July 18th. The Council wants tenders for installing the electric light at the Central Fire Station, Lauriston. See "Official Notices" June 30th.

Edinburgh.—July 31st. The Council wants tenders for coal measuring gear and extensions to shafting, &c., for driving mechanical stokers. See "Official Notices" this week.

Glasgow.—July 22nd. The Corporation wants tenders for boilers, steam engines (main and auxiliary), three-phase generators, continuous current generators, rotary converters, boosters, and static transformers, surface condensers, feed pumps, circulating pumps, and air pumps, all for the electric traction scheme. See our "Official Notices" June 23rd.

Glasgow.—July 22nd. The Corporation wants tenders for 80 electric tramcar bodies to sample and drawing. See "Official Notices" June 23rd.

Glasgow.—July 31st. The Corporation wants tenders for the supply of concentric and single lead-covered main cables. See our "Official Notices" this week.

Glasgow.—August 2nd. The Corporation wants offers for the electric work required in connection with its fire alarm and A B C telegraph systems. Specifications, &c., from the chief officer of the Fire Brigade, College Street.

Halifax.—July 19th. The Corporation wants tenders for a combined steam engine and dynamo. See "Official Notices" June 30th.

Hastings.—July 25th. The Corporation wants tenders for the supplying and laying of high and low tension cables. See "Official Notices" this week.

Malmo.—September 1st. The Gas Works' directors want tenders for the erection of electricity works for the city. Particulars on application to the clerk of the Gas Works (deposit 12s).

Pembroke.—July 14th. The Electric Lighting Committee wants tenders for a jet condenser with air pump and cooling apparatus. See "Official Notices" June 16th.

Rathmines and Rathgar.—July 14th. The Electric Lighting Committee wants tenders for arc lighting equipment (108 series parallel lamps, posts and switch-gear, &c.), steam and other pipes, jet condenser and cooling apparatus. See "Official Notices" June 16th.

Salford.—July 17th. The Salford School Board wants tenders for the electric lighting of its new schools in Langworthy Road, Seedley Pendleton. See "Official Notices" July 7th.

Salford.—July 18th. The Tramways Committee wants tenders for the supply of a sample tramcar. See "Official Notices" June 30th.

Salford.—August 8th. The Corporation wants tenders for eight 750-kw. continuous current steam dynamos for electric lighting and traction. See "Official Notices" July 7th.

Sunderland.—July 24th. The Corporation wants tenders for the reconstruction and electrical equipment of the tramways: (*a*) permanent way, (*b*) overhead construction, (*c*) car bodies and trucks. See "Official Notices" July 7th.

Wallasey.—July 20th. Tenders are wanted by the Council for alternating current transformers. See "Official Notices" June 23rd.

Wallasey.—July 20th. The Council wants tenders for a 300 kw. alternator with engine combined. See "Official Notices" June 23rd.

Warrington.—July 18th. The Corporation invites tenders for Babcock & Wilcox boilers, economisers, and pumps; high speed engines, direct coupled continuous current dynamos, balancers, and boosters; jet condensing plant, &c.; pipe work; 10-ton crane; switchboard, storage battery, mains, conduits, boxes; arc lamps and posts. See "Official Notices" June 23rd.

CLOSED.

Belfast.—The Electric Committee has given an order to Mr. James Proctor for a mechanical stoker at £164 15s. (the lowest tender).

Derby.—The Special Purposes Committee has accepted the tender of Mr. Edwin Haslam, amounting to £83 17s., for lighting the Becket Street offices with electricity. The only other tender received amounted to £87 6s. 3d.

Hackney.—At Wednesday's meeting of the Vestry, the Electric Lighting Committee brought up a full report from their consulting engineer, Mr. Robert Hammond, upon the tenders recently received for the first instalment of the mains to be laid under their provisional order. It was reported that on the tenders being opened by the committee, it was found that Messrs. Siemens Bros. & Co., Limited, declined to conform to the rate of wages clause, and therefore their tender was not handed to the consulting engineer for analysis. Schedule rates were submitted by each tenderer, and in order to compare the various tenders, Mr. Hammond set out in his report details of the lengths that would probably be required for each class of troughing, trenching, &c. With regard to the cable, he made use of the lengths set forth in the specification, with the result that the tenders worked out as follows:—

Name of firm.	Trenching and boxes.	Troughing and cable.	Boxes.	Total.
	£	£	£	£
British Insulated Wire Co., Ltd. ..	14,629	48,921	2,961	66,511
Callender's Cable and Construction Company, Limited	10,892	54,055	2,416	67,963
Western Electric Company	9,871	58,144	2,489	70,504
W. T. Glover & Co., Limited	12,423	54,385	5,099	71,907
W. T. Henley's Telegraph Works Company, Limited	16,864	58,586	2,446	77,896
Reid Bros.	13,832	(only)		

As the amount of the capital expenditure to be incurred was limited to £60,000, a comparison of the tenders, reduced in proportion to this figure, was made as follows:—

Name of firm.	Amount of tender.
British Insulated Wire Company, Limited..	£60,000
Callender's Cable and Construction Company, Limited..	60,770
Western Electric Company	63,600
W. T. Glover & Co., Limited	64,880
W. T. Henley's Telegraph Works Company, Limited ..	70,280

Concluding his report the consulting engineer said:—

Considering the magnitude of the work, the figures are remarkably close together, but, on the whole, the final choice rests between the two lowest, viz.:—

No. of tender.	Name of firm.	Amount of tender.
1 ..	British Insulated Wire Company, Limited	.. £60,000
8 ..	Callender's Cable and Construction Company, Limited	.. £60,770

I now leave the matter in your hands.

The Electric Lighting Committee recommended that the tender of the British Insulated Wire Company, Limited, be accepted, and this recommendation was adopted by the Vestry meeting on Wednesday evening.

Leyton.—Tenders were received as follows for the electric lighting of Goodall Road Schools:—Barlow & Co., £567 8s.; Edmundsons, £660 18s.; Rawlings Bros., £553 11s.; Vaughan & Brown, £943; W. R. Woodward (accepted), £473 5s. 9d.

Morecambe.—The Council has received tenders as follows for the supply of an economiser for the electricity works:—E. Green and Sons, £152; Roberts Bros., Dukinfield, £130.

Plymouth.—The Electricity and Street Lighting Committee has accepted the tender of Messrs. R. White & Co., Widnes, for the construction of an endless rope and buckets for the transport of coal at Prince Rock for £470.

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Rhyl.—The Urban District Council has decided to put down a refuse destructor by Messrs. Manlove, Alliott & Co., Nottingham, at a total cost of £3,350, exclusive of buildings. Electrical engineers are to be asked their terms for supervising the electric light scheme.

Shrewsbury.—The Town Council has accepted the tender of Mr. G. H. Bickerton, of Shrewsbury, amounting to £850, for extensions to the electric light station, so as to accommodate the additional boilers and generating plant.

Wolverhampton.—The Town Council has accepted the tender of the District Electric Company, Wolverhampton, amounting to £84 3s. 4d., for the electric fittings at the new swimming bath.

THE REPORT OF THE PACIFIC CABLE COMMITTEE.

(*Continued from page* 5.)

(*b*) As to the cost of maintaining the cable for a period of three years after the completion of the whole line. In the case of each of those who submitted regular tenders, the cost of maintenance is included in the amount of the tender; but in the evidence the details of the amounts apportioned for maintenance are to be found. Mr. R. Kaye Gray allows for two cable-repairing ships at £20,000 per annum each, and also £30,000 yearly for 150 miles of cable which might be required. Messrs. W. T. Henley's Telegraph Works Company allowed £115,000 a year as the cost of maintenance, subject to a reduction if the spare cable provided for the purpose be not used. Messrs. Siemens made an offer of £90,000 a year for this purpose which included an estimated possible expenditure of 200 miles of cable; this estimate Mr. Siemens regarded as a full one, which, if continuous for 25 years, besides being regarded as a repair fund, would admit of the complete renewal of the cable. As regards the maintenance for three years, Messrs. Siemens make this offer, subject to a reduction, if the actual repairs cost less than the sum named. The Fowler-Waring Company stipulate that a fixed sum of £300,000 be allowed, to guarantee maintenance and repair for three years. Mr. Herbert Taylor estimated the cost of two repairing ships at £16,000 or £18,000 a year each, and as regards the cable required for possible repairs in the first three years, pointed out that the surplus cable left over after laying, which would probably amount to several hundreds of miles, would be available for purposes of repair, and that thus the annual bill for repairs and maintenance ought not at first to exceed £30,000 or £40,000. Admiral Wharton gave the annual cost of a surveying ship at about £12,000 a year. Mr. Hesse estimated the annual cost of two repairing ships at £50,000, but could give no idea of the amount of cable required for possible repairs, while the Marquis of Tweeddale considered the risks so great along the Vancouver to Fanning Island route, that his company could not undertake to maintain it "on any terms."

This opinion seems to a great extent based upon the unfortunate experience which Lord Tweeddale had with the 1874 Atlantic cable and others of a similar class, but it should be borne in mind that these were laid when the knowledge of cable making and laying was comparatively elementary, and when a thorough survey of the ocean bottom was not looked on as requisite. Sir Sandford Fleming estimates the cost of maintenance at £50,000 (based on the figure of £6 per mile). Mr. Lucas gave no guide as to the cost, but said he had seen estimates made (he did not say by whom) for this particular cable, in which two maintenance ships were included, and it was estimated that they would be employed two months in the year each. Sir W. H. Preece gave £30,000 each as the cost of two repairing ships, and pointed out that the surplus cable after laying, would be available for repairs. Mr. Lamb gave £30,000 as the figure for maintenance, but stated that it was a low estimate. It certainly is considerably below the figure given by Sir W. H. Preece. Mr. Playford also quotes Sir Charles Todd, the Postmaster-General of South Australia, at some length, but it is, perhaps, better to ignore information coming from a source which, on several occasions in connection with Pacific cable matters, has been proven to be based on incorrect information. This can hardly be wondered at, as neither Sir Charles Todd nor Mr. Playford has any personal experience concerning cable matters, and thus they are forced to gather information as best they can.

(*c*) The annual working expenses—the amount set aside for this by Mr. R. Kaye Gray is £26,000 as far as staff is concerned. Mr. Siemens said that he did not think the expenses for the staff and offices would exceed £24,000 per annum. In Appendix "C" Sir Sandford Fleming, referring to this figure, says: "I have increased Mr. Siemens's allowance for management to £6,000, the two making in all £30,000 per annum. This charge will be constant, and will suffice, as pointed out by Mr. Siemens, for a business more than six times greater than that estimated for the year 1898, and by introducing duplex working for traffic 10 or 12 times greater." The amount required for working expenses according to the representatives of the Eastern Company, would be something between £30,000 and £35,000 per annum.

Sir W. H. Preece could express no opinion on the subject from his own experience, but Mr. Lamb gave £10,000 as "a very low estimate of current expenses." There is a considerable variation in the opinions expressed above on the three points under consideration, but as regards (*a*) the cost of laying, we are in agreement with the opinion expressed by the Committee, always bearing in mind the variations which may have occurred in the price of raw material, and we also think the provision made for maintenance (*b*) is quite sufficient, but as regards working expenses (*c*), the £22,000 per annum recommended by the Committee might, with advantage, be increased by another £5,000 per annum.

(*To be continued.*)

NOTES.

E.M.F. Produced in Flame by Magnetic Action.—A communication was made recently before the Paris Academy of Sciences on the "Electromotive Force Produced in a Flame by Magnetic Action," by M. R. Blondlot, and is abstracted in the *Engineer*. If two platinum wires are placed symmetrically at the opposite edges of an ordinary gas flame and connected with a capillary electrometer, only a feeble oscillatory movement of the mercury is noticed, but a steady deflection is produced when the flame is placed between the poles of an electro-magnet. This phenomenon, says the author, is doubtless due to electro-magnetic induction, the effect of the heated gases constantly ascending in the magnetic field being the production of an electromotive force, the direction of which is normal both to the lines of force and to the direction in which the gases are moving.

Wireless Telegraphy.—It is stated that the Admiralty has ordered two sets of Marconi's wireless telegraph apparatus to be fitted to two of the battleships of the Channel squadron, to enable them to experiment in keeping up communication during the forthcoming naval manœuvres.

King's College Awards.—On Wednesday afternoon Prof. Jebb distributed the prizes and certificates at King's College. In the evening class division in the list of special prizes are the following names:—Electrical Engineering (Elementary Lectures) Arthur John West; Electrical Engineering (Advanced Lectures), Charles John Wawn; Electrical Engineering, Frank Lindsey Moysey.

Scholarships.—As a result of the recent entrance scholarship examinations, the following awards have been made by the Electrical Standardising, Testing, and Training Institution:—To Mr. Leonard Roseveare, of the Technical Schools, Plymouth, an exhibition of 30 guineas, tenable for two years; to Mr. Alfred Smyth, a special prize of 20 guineas.

Electricity for Mines Drainage.—The South Staffordshire Mines Drainage Commissioners, at their meeting last week, again discussed the question of providing electrical appliances for mines drainage purposes, and they adopted a scheme prepared by Messrs. E. Howl and E. B. Marten, the engineers, for the laying down of 50 electrical pumping stations where ordinary pumping is impracticable. It was also decided to lay down an experimental electrical plant, to cost £500, the cost to be defrayed out of capital account.

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Save us from our Friends!—The non-technical reporter has broken out again in Glasgow, in the columns of the *People's Friend*. Describing the electric tramway generators he says :—

. . . . Put on your thinking cap and let us tackle the subject, determined to understand it or die!

A generator is a machine consisting of a series of copper plates all fitted on to a shaft, each being insulated—that is, separated from the others by a substance which won't conduct or carry electricity. This shaft with the copper plates is about 3 feet in diameter, and it revolves at the rate of about half a mile per minute inside a big casing. In this casing are fixed eight immense magnets or reservoirs for holding electricity.

Now, here comes in the most mysterious part of the whole affair. When these copper plates revolve inside of these magnets they drain away, rob, carry off the electricity, and the magnets, following their example, steal an equal quantity from the earth. The more the copper plates carry off the more do the magnets steal. [Are these steel magnets?—Eds.] The copper plates tapering out at the end of the shaft have a number of "brushes" lying against them. These brushes are also made of copper, and as fast as the copper plates become full of electricity so do these copper brushes carry it off into the electric cables.

It looks a little more simple now, doesn't it? But you mustn't think these generators are toys, for each one is constantly making enough electricity to equal the power of 300 horses. . . . .

An electric motor is the simplest thing on earth—when you understand it. You know that if you hold a magnet near a piece of steel, the steel flies to it. Well, that is the principle of the electric motor, only instead of one magnet you have a number, and instead of the pieces of steel being free, they are fixed all round an axle. What is the result? One magnet attracts one piece of steel towards it, but the steel is fixed to the axle, and can't move. The magnet pulls the steel towards it, however, and consequently the axle and steel move round; as soon as they are near the magnet, the axle is moved on by the force of another piece of steel and magnet, and so on.

We would suggest that the copper be laid on the track; such barefaced lying and stealing savours of impedance. We presume that our friend is now dead.

Lord Kelvin.—It is reported by the London correspondent of the *Glasgow Herald* that Lord Kelvin, who is at present in London, intends immediately to resign the Chair of Natural Philosophy in Glasgow University.

Cricket.—A match between the Engineer-in-Chief's Office and the Controller of Stores Office (G.P.O.) was played on the ground of the Grecian Cricket Club, Streatham, on Wednesday, July 12th, and resulted in a win for the Engineer-in-Chief's Office, on the first innings, by 10 runs. Scores:—Controller of Stores Office, 35 and 83 (innings declared closed with four wickets down). Engineer-in-Chief's Office, 45 and 61 for five wickets.

Obituary.—We learn with regret that Dr. Lessing died yesterday (Thursday) morning, after a short illness, from inflammation of the lungs. It is hoped that the works, under the management of his sons, will continue to manufacture carbons in the same way as before.

The Electrical Volunteers.—The *Times* article on last Saturday's review by the Prince of Wales says that the two companies of Electrical Engineers marched past perfectly, "in spite of being a young corps."

The corps has commenced its annual training at defended ports. The first detachment left Waterloo Station for Plymouth on Saturday for eight days; other detachments will go to Portsmouth, Isle of Wight, Gravesend, and Sheerness.

Institution of Junior Engineers.—On Wednesday next, July 19th, at 6 p.m., the Institution will visit the works of Messrs. James Simpson & Co., Engine Works, Grosvenor Road, Pimlico.

Williamson & Joseph, Limited (In Liquidation).—Mr. S. P. Child has been appointed liquidator on behalf of the shareholders, under the supervision of the Court. A meeting of creditors will be held at the Guildhall Tavern, E.C., on Tuesday, 18th inst., at 2 p.m., to receive a statement of affairs, and to discuss matters,

The Visit of the Institution of Electrical Engineers to Switzerland.—We learn from the secretary of the Institution of Electrical Engineers that the reunion of the Institution in Switzerland from September 1st to the 10th next is likely to be well attended. We are informed also that the Council have found it necessary to decide that, with the exception of candidates for election to the Institution whose proposal forms shall have been passed by the Council for ballot, only members and ladies and children accompanying them can be authorised to participate in the visit. The secretary of the Institution of Electrical Engineers furnishes us with the following provisional skeleton programme of the visit. The list, we are informed, is subject to alteration before issue in its final form within the next three weeks :—

Saturday, September 2nd.—Leave Basle for Zurich, *via* Rheinfelden and Baden. Visit to the Rheinfelden power station, and Messrs. Brown, Boveri & Co.'s works. Arrive Zurich.

Monday, September 4th.—Visit to the Oerlikon works and tramways, the works of Messrs. Escher Wyss & Co., and the municipal central station.

Tuesday, September 5th.—Visit to, and meeting at, the Polytechnikum, with exhibition of plans and photographs of electrical power schemes.

Various visits in Zurich.

Banquet given to members by the Swiss firms and Electrotechnischer Verein.

Wednesday, September 6th.—Visit to Schaffhausen, including the central station, upper works, twine and worsted factories.

Exhibition of plans, &c., and lecture by Mr. Amsler, on "Schaffhausen, with a view to its character as an ancient and modern power transmission city." Proceed to Lucerne.

Thursday, September 7th.—Visit to the Stansstad-Engelberg Electric Railway, and other places of electrical interest, near Lucerne. Proceed to Interlaken.

Friday, September 8th.—Visit to the Jungfrau Electric Railway and power station, and to the central station at Interlaken.

Saturday, September 9th.—Visit to the Kanderwerk at Spiez, and to the Burgdorf-Thun Railway. Return to Interlaken.

American Electrical Works for Manchester.—The Central News is enabled to state, says the *Sheffield Independent*, that the Westinghouse Electric Company, of the United States, will immediately begin the construction of workshops at Manchester, practically duplicating their Pittsburg establishment, and capable of employing 5,000 men. Lord Kelvin will be the electrical adviser of the company in this country, and Mr. George Westinghouse, the famous inventor of the air brake, will be directly associated with the enterprise. One hundred acres of land have been acquired on the Trafford Park Estate, Manchester, 40 acres of which will be occupied by the new electrical works. The new works, although laid out on American plans, with the newest type of American machinery, will be backed by a million and a half of British capital, and will employ British labour.

Appointments Vacant.—The Tunbridge Wells Corporation wants an electric light mains superintendent. See our "Official Notices" this week.

The Watford Council wants a resident electrical engineer, at £200 per annum. See "Official Notices" this week.

The Portsmouth Corporation wants an engineer to supervise the reconstruction and electrical equipment of the tramways, and to afterwards act as general manager. See our "Official Notices" this week.

Armature Testing in Repair Shops.—On the North Jersey Street Railways of Jersey City and Newark a system of motor testing has been introduced by Mr. Adams. A G.E. 1,000 field is mounted on a frame and next to it a 1,200 G.E. field arranged to be slid parallel to its armature shaft. The shafts are kept in line, and the upper halves are arranged to be lifted back without unscrewing bolts, which are replaced by taper keys. When a G.E. 800 and 1,000 armature have been repaired they are carried to the fields and put in place with a sleeve to connect the pinions. One is then run from the railway circuit and the other as a generator, its current being taken up by a water rheostat and read on a convenient switchboard. The two are then reversed by means of a double-throw switch, the driver being now driven, and in this way each motor is tested. Every motor which comes in for the smallest repair is thus tested.

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Personal.—Mr. Frederic H. P. Berlyn, of the firm of Donnison, Berlyn, Sillen & Co., will be married on the 26th inst. to the eldest daughter of Bernard Fookes Bussy, Esq., of Clapham Park, S.W.

City and Guilds of London Institute Central Technical College.—The Old Students' Association of the College held its annual dinner on Thursday, July 6th, at the Restaurant Frascati, the Dean of the College, Prof. Armstrong, taking the chair. A large number were present, including the Professors, a number of the junior staff, Sir Philip Magnus, Director of the Technological Examinations Department, and Mr. A. L. Soper, assistant secretary to the Institute. Prof. W. E. Ayrton, in proposing the toast of "The Association," referred to the progress of the College and the insufficiency of accommodation due to the continued increase in the number of students; he announced that the Electrical Department would soon be greatly extended by the erection of a large new dynamo room nearly six times the size of that at present in use, and occupying a considerable part of the ground floor of the new building of the Royal School of Art Needlework adjoining the College. The accommodation for this department would be further increased by the completion of a new drawing office and a new lecture theatre. The toast was replied to by Mr. Maurice Solomon, secretary of the Association. Sir Philip Magnus, in proposing the toast of "The College and its Professors," said that when first he had the honour of drawing up the scheme of the college it was prophesied that nobody would go to South Kensington to learn engineering. But, in spite of the fact that they had a harder entrance examination than any other institution of the kind, there were now 250 students in a building only designed for 200. The college was that day entering on a new period in its career, for it was likely to become an integral part of the new University of London, which had decided the day before to move into new quarters at the Imperial Institute, next door to the college. The needs of the college were recognised in the new University by the decision to appoint a faculty of engineering for the first time in the history of university education, and by the variation of the University matriculation examination to suit the requirements of different classes of students. The toast was replied to by Prof. Henrici. The toasts of "The Athletic Clubs" and "The Chairman" followed.

American Municipals in Convention.—The National Association of Municipal Electricians of the United States and Canada, will hold their annual convention in Wilmington, Del., U.S.A., on September 5th and 6th next, at the Grand Opera House. Papers, discussions, and an electrical exhibition of merit are included in the arrangements.

CITY NOTES.

India-Rubber, Gutta-Percha, and Telegraph Works' Company.

The half-yearly meeting of the shareholders of this company was held on Thursday, July 6th, at the Cannon Street Hotel, the Hon. Henry Marsham presiding.

The Chairman, in proposing a resolution sanctioning the payment of an interim dividend of 2½ per cent., or 5s. a share, free of income-tax, said that he would, as usual, take the opportunity of addressing a few words to the shareholders on the general position of the company's affairs. He had much pleasure in informing them that, during the past six months, the turnover of the company in its general business exceeded in value the highest amount for any preceding similar period. Although such a statement was a very satisfactory one to be able to make, yet, to prevent the shareholders from drawing too sanguine a deduction therefrom, he would like them to know that high prices for raw material still continued, and that trade competition was keen. The judgment in the cycle tyre patent case, Palmer *v.* Dunlop, dispelled for the moment any question of the Palmer Company obtaining any damages from the Dunlop Company for what they considered were infringements upon their patents. That decision affected them, because they were shareholders in the Palmer Company under agreement; but, as the question of infringement was still before the Courts, he would not further refer to the matter. With regard to submarine cable work, they would, in about a week's time, despatch one of their cable steamers, the *Dacia*, to the West Indies to lay a single core cable between Havana and Key West, deliver a heavy sheathed three-core cable, and execute some cable repairing operations for their friends the International Oceanic Telegraph Company of New York. Although the season of the year was not a particularly favourable one for carrying out such operations in these latitudes, yet their men were experienced, and had the advantage of knowing the locality well. It was gratifying to them to continue in friendly relations with the International Oceanic Telegraph Company, and the contract which that company had placed in their hands was considered by them to afford a flattering recognition of the quality of the company's work they had done for the International Company during the last 30 years. Having referred to orders from various Governments for torpedo cables, as affording satisfactory proof that the company's manufacture of India-rubber insulated cables was appreciated, he also remarked that the Governments thus agreed with the opinion of the majority of the best of the electric lighting and power companies of Great Britain and the Colonies. He said that the establishing of telegraphic communication across the Pacific, between Vancouver and Australasia, was now generally considered to be a necessity for the welfare of the Empire. The information he could give with regard to that cable had already been made public. Mr. Chamberlain appointed a committee some three years ago, and the report of that committee, which was composed of representatives of the Home Government and the Canadian and Australian Colonies, was presented to Parliament last April. The work would be a very large one, and the board were of opinion that the best interests of their company, and of the State, would be served by H.M. Government distributing the work between the various contracting firms. Their tender amounted to £1,517,000 for a 12-word cable, and it was dated March 19th, 1894. Owing to the rise in raw materials, they estimated that an additional £170,000 should be added to that figure, which would bring their tender up to £1,687,000. The committee's report stated that the Eastern Extension Telegraph Company's estimate, given in 1896 for a Pacific cable, was £1,650,000; but that amount, while providing for a heavier weight of conductor than their proposed type, did not comprise the furnishing of two repairing vessels, which their estimates included. He gave these figures for comparison of estimated costs, and they would see that they agreed within 2¼ per cent. To prepare for eventualities the board continued from time to time buying India-rubber and gutta-percha, and it was anticipated that during the period allotted for the completion of the Pacific cable contract, even should the whole contract be granted to them, and although the market for raw insulating material is restricted, they would have ample opportunity of completing at a fair price the purchase of as much of these products as they might require. The board thought it was desirable that he should say something to them on the Pacific cable question which has been slowly approaching fruition since the planting of the seed at the London Colonial Conference in 1887.

Mr. S. W. Silver seconded the motion, and it was carried.

Subsequently, at a special meeting, resolutions were passed—(1) providing for the holding of the annual meeting of the company in the future on the last Thursday of November in each year, or within 28 days of that date; (2) altering Article 43 of the articles of association, giving the directors power to borrow money not exceeding the amount of the capital subscribed for the time being, in place of the two-thirds to which the old article binds them; and (3) giving the board power to appoint the present engineer-in-chief of the company as a director.

A vote of thanks to the chairman for presiding concluded the proceedings.

Crompton & Co., Limited.

The annual meeting of this company was held on Monday at Cannon Street Hotel.

Mr. John Trotter, the chairman, in moving the adoption of the report and accounts, which were printed *in extenso* in last week's Electrical Review, said a few words upon the accounts and general position of the company. He first congratulated the shareholders on the return of the company to a dividend-paying condition, and upon the satisfactory returns they had obtained for the year. Turning to the profit and loss account, they would see that the gross profit on trading had this year been £53,352 against £41,418 last year. They would naturally, from that, conclude that there had been a considerable increase in their trading during the year, and that was the case. He thought he might say that it was a record year in the company's history as to the work carried out. Of that £53,000 there was a considerable portion taken up by expenses. The trading expenses had been £17,382 as compared with £16,853. There was an apparent increase in the trading expenses, which would be perfectly legitimate, considering the large amount of business done. The actual trading expenses for this year, as compared with the last, had actually been smaller, although they had done a larger trade. The increase was due to their having put special things in those trading expenses which had previously, and perfectly legitimately, been debited to capital, that was to say, a certain number of tools which are not of such a permanent character as others. Hitherto they had carried all tools to a plant and tools account, and written off a certain portion every year. They had dealt this year very drastically with that item, and had taken out all that was not of a permanent character, and had written it off in the annual expenses. In a business of this kind, which was of a highly scientific kind, there was considerable expense incurred every year in experiments and so forth. These had been written off the patent account every year, but this year they had treated them as an annual expense. If the trading expenses had been dealt with in the same way as in previous years, the £17,382 now shown would have been £15,382 as compared with £16,853 a year ago on a lesser trading. The administration and office expenses had been £8,111 as compared with £6,758

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in the previous year's accounts, but the system of doing business in the country had been changed, branches having being instituted in place of agencies. By this change the company had obtained more business and at less expense; and they also had the further advantage of the goodwill being attached to the company's business by the present system. In spite of those increases it was rather interesting to notice what the ratio of expenses to the gross profit was for the year. Previous to the fire in the old days the ratio to the gross profit was 77 per cent.; it was gradually worked down to 72 per cent., and last year to 67 per cent., and this year, although they had charged so much more to those expenses, it was still further reduced to 64 per cent. That was a satisfactory feature of the accounts. An interim dividend had been paid at the rate of 5 per cent. per annum, and the board now proposed a final dividend at the rate of 7 per cent. per annum, to carry £5,000 to a reserve fund, and to set aside £2,000 to meet possible debts which might or might not arise. There were one or two old accounts which might give them considerable trouble, but they had a good case. The debentures now amounted to £100,000 as compared with £86,600 a year ago, the increase being owing to the fact that the directors had issued the balance of the first debentures; but the loans from bankers had been decreased to a corresponding extent, having amounted to £49,000 a year ago as compared with £37,000 on March 31st last. The sundry creditors figured in the present balance-sheet for £54,964, against £51,058 a year ago; but the trade debtors had advanced from £61 900 to £75,894, and the stock-in-trade from £80,362 to £83,826. The stock-in-trade, which amounted to a considerable sum, had been very carefully ascertained, and he had no hesitation in saying that it was a first-rate asset. In regard to the plant, tools, and fixtures item, they had added a considerable amount of expensive tools during the year, but by the natural writing off every year, and by carrying such a very large amount to annual expenses, the sum was a diminishing one instead of increasing. With reference to the Chelmsford Electric Lighting Company, this stood under several headings in the balance-sheet. During the year proposals were made to them by the authorities at Chelmsford with regard to purchasing the undertaking, and the board went very carefully into the matter. It ended up by their proposing to sell the whole undertaking for £42,000. They might very well ask where that sum was in the accounts. That figure included a great deal of work in the way of buildings which had not yet been executed. They were to have carried out certain things which would make it up to £42,000, and they would have transferred a considerable portion of the old factory which stands at present under freehold property in connection with the company. They would also have transferred a considerable amount of machinery, which at present stood under "Plant, Tools and Machinery." Although the amount standing in the name of the Chelmsford Company was £12,918, there was a considerable amount of property which would have been transferred. The authorities made an offer not at all acceptable, and, as reported in the electrical papers, they did not feel disposed to part with the property unless they got a satisfactory figure. They considered the undertaking a satisfactory business altogether now, in the way it was being conducted. It was an asset which was being increased in value every year, but, on the other hand, it did not produce so much as they could make out of the capital if invested in the business of manufacturing. If anybody came along, therefore, and gave them a satisfactory offer for it they would be prepared to accept it. They were quite content to wait, otherwise, because the value was yearly increasing. There was a pressing matter he must mention, viz., the great increase of the business of the company. They had brought the business to a fairly satisfactory condition, but there was room for further improvement. It was difficult to keep pace with the amount of business brought to them with the existing appliances. They moved part of the factory from the old to the new works, and the change had been economically beneficial to the company, but they could not cope with the new business at the new factory. Last year the orders in hand were greater than the year before, and this year they had 50 per cent. more than at the beginning of last year, and that increase was going on. It was perfectly impossible for them to stand still. It was desirable that new machines should be added to enable them to do a larger business. There was not sufficient accommodation at the old works for the lamp business, and very considerable and increased profit could be made by moving the lamp factory to the new works and closing the old works up altogether. They could recommend a much larger scheme, but they believed in going slowly, but it was absolutely necessary that they should make provision for turning out a larger amount than at present. They therefore proposed to issue the whole or part—probably the whole—of the remaining shares, and shareholders would have the advantage of taking them *pro rata*, and considering the price at which the shares now stood in the market, it would be a benefit to those who had stood by them in bad times, for it was proposed to issue the £3 shares at £3 5s. In this way funds would be provided for the extensions required. Having referred to the fact that relations between the workmen and the company were now entirely satisfactory, and having paid a tribute to the manager, Mr. Reeves, who had now been relieved of the secretarial duties, the chairman mentioned the difficulty that now existed at Chelmsford in finding sufficient labourer's cottages and accommodation of that class for their growing staff, and for the men employed at other factories in the neighbourhood. He moved the adoption of the report and declaration of dividend.

Mr. R. E. Crompton seconded the adoption of the report. He said that as the oldest and largest shareholder, he had to express unqualified satisfaction with what had taken place. He thought if they described the position of Crompton's as one of quiet confidence in the future on the part of everyone who knew the affairs of the company they would describe it accurately. There was no doubt that their position had been strengthened in every way during the past year; not only had they got a larger increase in all orders, but the orders had been of an improving class, and those that they now had before them (which were not yet orders, but which they believed soon would be) were of a still more important class, that was to say, larger profits would be earned in proportion to the money spent upon them. They had reason thus to be confident of the future of the company. His only anxiety was that they should be able to cope with orders. There was such a demand at the present time that one could not help feeling that on every side there was a fear that rivals would spring up and secure some of the work that was going, and naturally they did not want to see that occur. For that reason there was no question that the two points in which Crompton's required strengthening were enlargement of the works and better means for housing their workmen, which was of very great importance to them. It might interest them to know that if they separated the items of their property and capital portion of the balance-sheet out into the portion that was invested in their engineering works by which they made a profit, and in the Chelmsford lighting, which yielded a small and increasing profit of a quite different kind, they would find that the capital in the manufacturing business had yielded 12 per cent. during the past year, and he thought that that was mainly due to the splendid business-like qualities of the chairman, and the support received from the manager, Mr. Reeves. He (Mr. Crompton) had been chief engineer to the company for a great number of years, and he hoped he had been improving every year, but he was beginning to despair until Mr. Trotter joined the company. The chairman had prevented the fruits of their labour being lost, and the way in which Mr. Trotter had set to work and arranged matters had given him (the speaker) new life. He felt 15 years younger than when Mr. Trotter joined them.

Mr. Reed, a shareholder, expressed gratitude on behalf of the shareholders, and paid a special tribute to Mr. Crompton, without whom neither the new chairman nor the manager could have made matters turn out so satisfactorily. He believed the company was now established on a progressive basis, and the steps taken by the board were not only likely to be satisfactory to the shareholders, but they were absolutely necessary if they were to hold their own. The shareholders had full confidence in the programme which the board had sketched out for them to adopt.

The resolution was carried unanimously, as was also a motion to declare a 7 per cent. dividend for the six months ended March 31st last.

The retiring director (Mr. Tufnell) and the auditors (Messrs. J. H. Duncan & Co.) were re-elected.

British Thomson-Houston Company.

The fourth ordinary general meeting of the shareholders of the above company was held last Tuesday at the offices, 83, Cannon Street, E.C., Mr. E. A. Lazarus, presiding.

In moving the adoption of the report and accounts for the year, the Chairman said there was very little to comment on in the report, but he thought it would be interesting to the shareholders to know that the number of contracts they had in hand, excluding ordinary sales, was 55, aggregating up to £869,000, and the principal contracts they had were in connection with the Central London Railway, the Bristol Tramways, the London United Tramways, the Sheffield Corporation Tramways and the Cork Electric Tramways and Lighting Company. No profit had been taken in the present accounts in connection with any of these contracts, although a good amount of work had been done on them. It was proposed to increase the capital of the company from £240,000 to £400,000, so as to take up manufacturing work. Several convenient sites had been offered to the company for this purpose, but the board had come to no decision up to the present in regard to any of them. The new shares would be issued at a premium of £2 10s. each almost immediately. This would represent £40,000, and the whole of it would at once be placed to the credit of the reserve fund.

Mr. F. Down, a shareholder, seconded the motion, and the report was adopted.

The retiring directors, Messrs. W. A. McArthur, M.P., J. T. Mery, Sir Thomas Thompson, Bart., and E. Thurndner were then re-elected for the ensuing year.

Dividends of 10 per cent. on both the "A" and "B" shares were then declared out of the profits for the 12 months ended March 31st last on the capital issued at that date.

The auditors having been re-elected, a vote of thanks to the chairman for presiding concluded the proceedings.

The British Continental Electricity Company, Limited.

The directors' report, which was adopted in general meeting on Saturday last, at Westminster, of the position of the undertaking at the end of the year 1898-99, reads as follows:—During the year the number of clients has increased 75 per cent., while the number of lamps added during this period, calculated on the usual basis of 8 C.P., has been 2,150, being an increase of about 44 per cent. Notwithstanding a reduction of 20 per cent. in the price of light made to all the clients of the Società Co-operativà, in accordance with the terms of the purchase contract, the gross receipts from sale of current show an increase of 30 per cent. over those of the preceding year. The directors regret that, owing to the very considerable rise in the price of coal, owing chiefly to the Welsh coal strike, the working expenses have been exceptionally heavy. Had it not been for this unfortunate circumstance there would have been a substantial balance, after meeting the full preference dividend for the year. After setting aside £10 1s. 3d. as depreciation in respect of furniture, tools and

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meters, and writing off £46 1s. from preliminary expenses, the balance standing to the credit of the revenue account is £191 6s. Of the above balance, £88 5s. 10d. has been absorbed in the payment of the interim dividend at the rate of 5½ per cent. on the preference shares, leaving a balance of £103 0s. 2d. now to be dealt with. The directors propose paying a dividend at the rate of 2¾ per cent. per annum for the second half year on the preference shares, making, with the interim dividend paid in March, 4½ per cent. for the year. The directors propose to forego one-third of their fees, thus making the balance to be carried forward £44 5s. 3d. The sum of £1,110 1s. 2d. has been spent on capital account in respect of new plant, buildings, and mains. The board regret that Mr. W. R. Cooper has resigned his directorship, owing to pressure of other work; but they are glad to announce that they have been fortunate enough to secure the services of Mr. H. W. Buddicom in his place. In accordance with the articles of association, Mr. Rudolf Alioth retires from his directorship, and, being eligible, offers himself for re-election. The auditors, Messrs. Hercules Nicol & Barker, also retire, and, being eligible, offer themselves for re-election.

Prospectus.

A PROSPECTUS is in circulation of the Epicyclic Manufacturing Company, Limited, which has been formed to acquire the patent rights of certain inventions of Messrs. Humpage, Jacques and J. C. Howell respectively, in relation to machine gearing, and for subsequent inventions in relation to epicyclic reduction gears by the above-named inventors during the next 15 years. The capital is £20,000 in £10 ordinary shares, of which £10,000 is offered for subscription. The directors are J. C. Howell and J. Harrop. Mr. P. E. Scrutton is secretary, and the offices are at 24, Queen Victoria Street, E.C. The prospectus refers to the large and increasing demand for reduction gears for electrical transmission and distribution of power and motor car machinery. The vendors are Epicycle Limited, who take £10,000 in shares and £5,000 in cash.

The Direct United States Cable Company, Limited.—The Board has resolved to recommend a final dividend of 3s. per share, and a bonus of 2s. per share (both free of income-tax); such dividend and bonus to be payable on and after the 31st inst., making with the three interim dividends already paid, a total distribution of 3½ per cent. for the year ended June 30th last, and after placing £10,000 to reserve fund account, carrying forward a balance of about £3,000. The transfer books of this company will be closed from July 11th to the 25th, both days inclusive.

Edmundsons' Electricity Corporation.—The profits for the year ended March 31st, including £1,001 brought forward, amount to £12,269. After writing off the expenses of issue of debenture stock, amounting to £1,446, a dividend of 6 per cent. per annum on the 6 per cent. cumulative ordinary shares of the company is proposed for the year ended March 31st, 1899, with the payment of a dividend of 1 per cent., being the balance of dividend unpaid for the year ended March 31st, 1898, leaving £2,570 to be carried forward.

British Insulated Wire Company.—The directors of the British Insulated Wire Company, Limited, Prescot, have declared an interim dividend on the ordinary shares at the rate of 10 per cent. per annum for the half-year ended June 30th, being 5s. per share, less income-tax. Dividend warrants will be posted on July 15th. Warrants for the half-year's dividend on preference shares Nos. 1 to 27 500, being 3s. per share, less income-tax, will be posted on the same date.

British Aluminium Company.—Report for year 1898 shows a gross profit of £28,581. From an available balance of £9,780, the directors recommend the payment of the dividend on the 7 per cent. preference shares up to January 1st, 1897.

The New St. Helens and District Tramways Company, Limited.—The dividend warrants for payment of the preference interest on the shares of this company for the half-year ended June 30th have been posted.

City Meetings.—Yesterday (Thursday) meetings of the Electrical Power Storage Company and the Electric Construction Company were held in the City. Reports will appear in our next issue.

Consolidated Telephone Construction and Manufacturing Company, Limited.—The directors recommend a dividend of 1 per cent. for the year ended March 31st.

St. James's and Pall Mall Electric Light Company.—An interim dividend has been declared for half-year ending June 30th at the rate of 10 per cent. per annum on ordinary shares.

Hampstead Electric Supply.—Warrants for the second half-yearly dividend to July 1st on 5 per cent. preference shares have been posted.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending July 8th, 1899, were £889 18s. 4d.; aggregate to date, £10,979 6s. 8d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending July 7th, 1899, were £3,158 11s. 4d.; corresponding period 1898, £3,181 14s. 2d.; increase, £21 17s. 2d.

The City and South London Railway Company.—The receipts for the week ending July 9th, 1899, were £1,087; week ending July 10th, 1898, £913; increase, £124. Total receipts for half-year, 1899, £2,017; total receipts corresponding period, 1898, £1,901; increase, £116. Miles open, 8½.

The Dublin United Tramways Company.—The receipts for the week ending Friday, July 7th, 1899, were as follows:—D. U. T. Co., horse cars, £2,107 11s. 2d.; ditto, electric cars, £1,227 1s. 5d.; D. S. D. Co., electric cars, £1 021 2s. 3d.; total, £4,355 14s. 10d.; corresponding week last year—D. U. T. Co., horse cars, £2 499 1s. 8d.; ditto, electric cars, £1,148 8s. 8d.; D. S. D. Co., electric cars, £834 13s. 7d.; total, £4,476 18s. 1d.; increase, £121 3s. 8d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 11 miles electrically, and 31 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending June 25th, 1899, were £1,198; total receipts to date, 1899, £17,110. Miles of track open, 6½. Car miles run, 18,382. Number of cars, 16.

The Liverpool Overhead Railway Company.—The receipts for the week ending July 9th, 1899, amounted to £1,589; corresponding week last year £1,589; decrease, £50.

The South Staffordshire Tramways Company.—The receipts for week ending July 7th, 1899, were £683 9s. 6d.; aggregate receipts for 27 weeks, £17,203 19s. 8d.; week ending July 8th, 1898, £648 14s. 1d.; aggregate receipts for 27 weeks, £16,450 4s. 8d.

STOCKS AND SHARES.

Wednesday Evening.

TELEGRAPH issues have again suffered this week, Eastern Ordinary stock being down at one time nearly 34 points below the highest touched this year. The grave situation existing in the Transvaal and the Pacific cable have saddled the market with as much stock as it can conveniently carry. Upon these considerations depend the immediate future of both Easterns and Eastern Extensions, and he who can most accurately read the sky of diplomacy is the one that will make money in the stocks of either company. Direct United States went better a trifle upon the announcement of a 3s. dividend and 2s. bonus, but Anglo-American descriptions are being sold by tired "bulls" anxious to clear their books before packing up for the holiday.

Manufacturing shares are well supported, the impression gaining ground that some of the companies will reap considerable benefit from the various new cables now being projected. Henley's are creeping up again.

Electric Constructions, however, are not much wanted, and there is some annoyance expressed that the payment of the dividend should be spread over nearly six months. Telegraph Manufacturing shares at 9½ appear to be worth an investor's notice.

The St. James's and Pall Mall Electric Lighting Company announces an interim dividend upon its Ordinary shares at the rate of 10 per cent. per annum, but the notice was received with indifference by the market, and no alteration occurred in the price. In fact, with City of Londons down to 13½, the dealers would require a very strong inducement to take fresh courage after the disheartening fall in the shares of the last few weeks. The supporters of the company still speak cheerily of its prospects, but in the meantime, holders are becoming nervous as the value of their shares so persistently shrinks day by day. Charing Cross are also lower, our contention becoming recognised, that the *entrée* of the company to the City will mean a tremendous expenditure at first. Metropolitans dropped under the enervating influence of the new issue, and on the whole the electric lighting market is not very gay. House-to-House naturally fell with the heavier shares.

British Electric Tractions eased off a fraction when it became known that the House of Commons had reversed the decision of the Upper House by throwing out the company's Bill for constructing a tramway between St. Leonards and Bexhill. No little astonishment was expressed at the action of the Select Committee, since it was thought that, after passing the House of Lords, the Bill was comparatively safe. New General Electrics are dormant.

Among the cheaper descriptions of electrical shares Nernst have relapsed a trifle.

In the electric railway market, Central Londons have returned to quietude again, and we look for no further advance until the beginning of winter. There is a fairly large contango account open in the shares, and the rate charged for continuation was nearly 6 per cent., the stiffness being attributed to the stringency of the money market. City and South Londons are dull, pending the declaration of the dividend, which will go against a distribution of 1½ per cent. this time last year. Waterloo and City stock is pretty well assured of its 1½ per cent.

Bordeaux Tramways new shares are beginning to feel their way in the market, and the price is nominally 2 to 4 premium. There is, however, a seller at 3 premium, and not many buyers. Anglo-Argentine Trams are better, the company reporting another good traffic for the week.

National Telephone shares show weakness. At their present price the shares do not look at all dear.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, July 5th.	Closing Quotation, July 12th.	Business done during week ended July 12th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104 xd	100 —104	100	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90 xd	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	61 — 64	61 — 64	61½	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	112 —113	112 —113	113	112
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	13¾— 14¼	13¼— 13⅝	13 11/16	...
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½xd	15 — 15½	15⅝	15
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	108 —112 xd	108 —112	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	190 —195 xd	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106 xd	104 —106	105¼	104½
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9¼	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103—107 % xd	103 —107 %	...	...
60,710£	Direct United States Cable	20	3 %	3¼ %	...	11¾— 12¼	11½— 12	11⅝	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103 xd	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½ %	7 %	7 %	153 —158	150 —155	155	151
1,795,000	Do. 8½ % Pref. Stock	100	...	...	...	100 —104	100 —104	101½	100
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104	101 —104	..	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	115 —120	115 —120	116	115
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	15¼— 15¾	14¾— 15¼	15½	14¾
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —100 xd	99 —100	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103 xd	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	118 —123	116 —121	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103 xd	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103 xd	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	103 —106	103 —106	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5½ %	10¾— 11¼	10¾— 11¼	11⅛	10¾
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15¼— 15¾	15 — 15½	15 7/16	15
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	31 — 32	30 — 32	31	...
80,500	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103 xd	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	52 — 55	48 — 52	50	48
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¾— ½	¾— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	5¼— 5½	5⅛— 5⅜	5 7/16	5⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12½— 13½	12½— 13½	13⅜	13¼
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12½— 13½	12½— 13½	13¼	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5⅜	5¼— 5⅜	5¼	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	100¼	99
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106 xd	105 —108	105½	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	7⅛	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	5 — 5½	5 — 5⅜	5 5/16	5¼
151,783£	Do. do. 5 % Debs.	Stock	...	...	...	103 —106 xd	103 —106	105½	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	100 —103	...	...
80,008	West Coast of America, Nos. 1—80,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	101 —104 xd	101 —104	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106 xd	103 —106	...	...
88,321	West India and Panama Telegraph	10	1 %	⅝%	...	1½— 1⅝	1½— 1½	1 5/16	...
84,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10⅝	10½— 10⅝	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	103 —106 xd	103 —106	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	9½— 10⅛	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅝— 6¼	5⅝— 6¼	6	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8¼xd	7½— 8½	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	112 —114	112 —114	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	15 — 17	13 — 15	15⅜	14
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 15	13 — 15	14⅜	14
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	123 —128 xd	123 —128	125	123½
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 11½	11 — 11½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
220,000	Do. 4½ % Deb. Stock, Prov. Certs (£60% to be paid) Rd.	...	...	...	...	52 — 54 xd	52 — 54	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	...	5¼— 5⅜	5¼— 5⅜	...	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	7½— 8½	7½— 8½	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	8½— 9½	8½— 9½	...	...
£110,000	London Electric Supply Corporation, Limited, Ord. ...	8	...	...	...	3½— 4	3½— 4	3⅝	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 7	6⅝	6 9/16
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	106	105
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	16½— 17½	16 — 17	16⅝	16 5/16
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	15½— 16½	15½— 16½	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119 xd	116 —118	115¾	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	16 — 17 xd	15½— 16½	17⅛	16⅞
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	16½— 17½	16½— 17½	16⅝	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	4⅛— 4⅜	4⅛— 4⅜	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14 — 15	14 — 15	15	14¾

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation July 5th.	Closing Quotation July 12th.	Business done during week ended July 12th, 1899. Highest	Lowest
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3¼— 3⅜	3¼— 3⅜	3⅜	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	18 — 19	18 — 19	18½	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	14 — 14½	14¼— 14⅜	14⅜	14 1/16
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	13⅜— 14¼	13⅜— 14¼	14¼	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	127 —130	129½	129
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅞— 2⅛	1⅞— 2	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2¼— 2½	2¼— 2⅜	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	103 —106	101 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	14 — 15	14 — 15	15	14⅜
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115 xd	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10½— 11 xd	10½— 11	10⅞	10¾
178,303	Do. do. do. £8 paid	10	...	...	...	8½— 9 xd	8½— 9	...	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	3 — 3⅛xd	3 — 3½	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	5¼— 5⅜xd	5¼— 5⅜	...	...
630,000*l*	City and South London Railway	Stock	1 1/16 %	1⅞ %	2⅛ %	67 — 69	67 — 69	68½	68⅛
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £5 pd.	10	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3¾— 4¼	4 — 4½	4	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 —102 xd	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½ %	6 %	...	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½ %	6 %	...	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97 xd	97 — 99	96⅜	96
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2 — 2⅛	2⅛— 2⅜	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	4 — 5	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	95 — 97 xd	103 —106	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ⅞	⅝— ⅞	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	...	10 — 12	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	24½— 25½	24½— 25½	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	18 — 20	19 — 21	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	112 —115	112 —115	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21½— 22½	22⅛	22
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	101 —105	101 —105	103	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅝ %	3¼ %	3¼ %	8½— 8¾	8¾— 8⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13⅜— 14½	14 — 14⅜	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	38 — 42	38 — 42	38	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106 xd	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9⅜	9¼— 9⅜	9¼	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅜— 6¼	5⅜— 6¼	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	104 —107	104 —107	106½	104

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

***Birmingham Electric Supply, Ordinary £5 (fully paid) 10½.**
British Aluminium, Ordinary, 10½—11½; 7 % Pref., 11½—12½.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7⅞—8⅛. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 5/16—7/16.
Smithfield Market Electric, 3—4.
***T. Parker, £10 (fully paid), 19¾.**

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, July 12th.

CHEMICALS, &c.		This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	37/-	37/-	..
a Ammonia, Muriate (crystal) ..	per ton	£26	£26	..
a „ „	per ton	£24	£24	..
a Bleaching powder	per ton	£5 15	£5 15	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£16 10	£16 10	..
a Benzole (90 °/₀)	per gal.	7/-	7/-	..
a „ (50/90 °/₀)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£27	£27	..
a Lead, Nitrate	per ton	£23 10	£23 10	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/9	2/9	..
a Naphtha, Solvent (90 °/₀ at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8¼d.	8¼d.	..
a „ Caustic (75/80 °/₀) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6 5	£6 5	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5 0	£5 0	..
a Soda, Caustic (white 70 °/₀) ..	per ton	£7 10	£7 10	..
a „ Crystals	per ton	£3	£3	..
a „ Bichromate, casks ..	per lb.	2¾d.	2¾d.	..
METALS, &c.				
b Aluminium Wire, in ton lots ..	per ton	£224	£224	..
b „ Sheet, in ton lots..	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£70 to £145	£70 to £145	..
c Brass (rolled metal 2" to 12") basis	per lb.	8½d.	8½d.	..
c „ Tube (brazed)	per lb.	10½d.	10½d.	..
c „ Wire, basis	per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).		This week.	Last week.	Increase or Decrease.
f Ebonite Rod	per lb.	8/-	8/-	..
f „ Sheet	per lb.	5/-	5/-	..
g Copper Bars	per ton	£86	£86	..
g „ Wire (basis price) ..	per lb.	10¼d.	10¼d.	..
g „ Sheet	per ton	£86	£86	..
g „ Rod	per ton	£86	£85	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha, fine	per lb.	6/-	6/-	..
h India-rubber, Para fine ..	per lb.	4/1½ to 4/3	4/0½ to 4/1½	inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants)	per ton	70/6	69/1	1/5 inc.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 ..	per ton	£10 15	£10 12 6	2/6 inc.
g Lead, English Ingot	per ton	£14 7 6	£14 7 6	..
g „ Sheet	per ton	£15 7 6	£15 7 6	..
l Mica (uncut slabs 8" long) ..	per lb.	6/8	6/8	..
m Manganin Wire No. 28.. ..	per lb.	8/-	8/-	..
g Mercury	per bottle	£8 5	£8 5	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd strip & sheet	per lb.	From 1/2½	From 1/2½	..
o Platinum	per oz.	£3 10	£3 10	..
p Silicium Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n	p. ton	to £40	From £15	..
i Steel, Magnet, in bars		£58	£58	..
g Tin, block	per ton	£126 10	£126 10	..
g „ foil	per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16	per lb.	1/7	1/7	..
p White Anti-friction Metals—				
"White Ant" brand ..	per ton	£40 to £67	£40 to £67	..
j Yarns, Cotton, Single 10lb. bundles	per lb.	7½d.	7½d.	..
j „ Best Flax, 6 lea. ..	per lb.	4½d.	4½d.	..
j „ Hemp, 3 ply 10 lbs. ..	per lb.	3½d.	3½d.	..
j „ „ Russian, 10 lbs.	per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove ..	per ton	£12	£12	..
j „ Manila, 24 thread ..	per ton	£32 10	£32 10	..
k Zinc, Sheet (Vielle Montagne bnd.)	p.t.	£28 10 f.o.b. Antwerp.	£30	dec.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
l Messrs. Sanders, Wake & Co.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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THE MUNICIPAL ELECTRICAL ASSOCIATION.

Discussion on Mr. C. D. Taite's Paper on "Notes on Distribution of Electricity," read at Bristol, June 15th, 1899.

Mr. Nisbett expressed the opinion that with reference to the relative advantages of transformer boxes and the sub-stations, he did not quite follow Mr. Taite's point as to banking the transformers. It seemed to him just as easy to find out whether they were banked properly if they were separated by 200 yards of cable or close together. At any rate, the transformers would be inclined to bank better if they had the resistance of a considerable length of cable between them. His company had recently made a high tension sub-station switch gear for Mr. Qain, of Blackpool, which they thought was quite the best thing that had been got out in this direction. It was not their design, it was Mr. Qain's. It consisted of a large cast-iron box containing the whole of the high tension connections both of the feeders and interconnecting cables and transformers. The box was preferably built into the wall of the sub-station, so that the front was flush, and it was securely earthed by means of the lead covering of the cables taken into it. The connections both of the mains and transformers were so arranged that they could be broken at will by plug switch fuses. The sockets for these plugs were about half the depth of the box, and were completed through the cover by ebonite tubes, the box being entirely filled in with compound. The plugs were sheathed with ebonite to such a length, that the sheathing entered the ebonite ends to the sockets before the plug became alive, so that by no possible carelessness in putting in a plug could a shock be received. There was no exposed metal in the plug switch fuses, and the fuse itself was entirely enclosed. Neither when the switch fuses were removed, nor when they were in position, was it possible for the most careless or unskilled attendant to receive a shock, and even should a man wish to commit suicide, he would find it difficult to effect without some amount of electrical knowledge. He need not dilate upon the advantages of so safe and compact an arrangement, and the relief from anxiety to the engineer which it effected. With regard to the question of disconnecting boxes, it seemed to him working round almost in the direction of making each surface box a disconnecting box. It gave them this advantage, having a new consumer to connect they could go to the surface box on either side of the consumer and disconnect the length between the two without putting either in darkness for any period of time. Another point struck him which might be easily arranged by municipalities which got very much their own way in their own town; one surface box should be put on for two or three houses, and, if possible, the service main should be taken into one house, and taken through from there to the other houses, making one common service for a block. At any rate, they might put a service box on for two houses which might be easily arranged with the landlords, and would save considerable expense. He agreed with Mr. Taite that meter rents should not be charged. He went further, and thought that the whole thing should be done for the consumer. That the electrical engineer should bring the energy up to the front wall and say, "There it is; look after yourself!" seemed to him bad business policy. If they went to a customer and said, "We will, as part of the capital cost of the station, supply you with light," and even gave him his lamps, they would be wiping the gas supply off the face of the earth. It was the bad way in which the commodity was offered to the customer that hampered electrical supply. They went half-way to meet him, and then left him to flounder about as best he could. Of course, capital charges were being reduced year by year, and some of them might live to see the time when Corporations would not have sinking funds to pay.

Mr. Ellis (Bolton) said the great thing nowadays was to get the working classes as consumers of electric light. The great drawback, however, was the cost of the connections, and if that could be brought down to £6 as at Hanley, he saw very little difficulty. He would like to know from Mr. Cowell whether £6 was the correct figure.

Mr. Cowell (Hanley) said he did not know where the figure came from, but it did not include the cost of the meter.

Mr. Missenden (Croydon) remarked that Mr. Taite had raised one point in his paper to which he would like to take exception, viz, the necessity of shutting down distributors when connecting house services. It might be customary, but it was by no means necessary to do this. They had made over 400 services in Croydon with concentric cables. Even in triple concentric cables it was not necessary to shut down if the joint be off the outer and middle. Only once had there been a slight "short," and never to his knowledge any shock. True, the jointer's hands are better insulated than the hands of those he was addressing, and many of them were literally "horny-handed sons of toil," so that they had not as much difficulty as might be expected. Another point was the banking of transformers. He would point out that not only would different sizes sometimes bank badly, but transformers by the same maker, of the same type and equal drop, but of different magnetic leakages, would take loads differing by as much as 25 per cent. It was therefore necessary, in testing transformers for banking, to run them on a load as inductive as that on which they would have to work.

Mr. Andrews (Hastings) supported all sub stations being above ground if possible. At Hastings they had several pits built a few years ago, and they used to have transformers in them, except those on the consumers' premises. They had to shut off the high tension supply to one district, because it was not safe for the men to go down into the pits when the mains were alive. It required a plucky man to go down into one of these pits when they had a high tension feeder intermittent for more than two hours. Another advantage was that if they had their sub-stations above ground they only needed one man to do the work of two or three. They had to send two men, and very often three, into the pits. He would like to ask Mr. Taite whether in the case given in his paper the feeders were permanently coupled to the transformers, or was one kept dead and merely changed over when required?

Mr. Taite: Yes.

Mr. Andrews said they put in two mains to every station to keep them both permanently connected up, so that if they got on a short circuit with one main it was automatically cut off and the other main continued the supply. If they had to send a man round to switch the main off the light was not continuous, and if the light was off half an hour it was as serious as being off two or three hours. With regard to the suggestion that disconnecting boxes should be placed every 100 yards, it rather depended upon the district they were supplying. If they had a street full of shops they needed them, but in a residential district there was no difficulty in running a main for half a mile or even more without a disconnecting box. Mr. Taite had also referred to the cost of connecting on as £11 14s. They found that it averaged £10 per consumer, and the difference was they did not use the joint box, but were using sweated cables entirely. Some people said they could not make a sweated joint on a concentric cable, but he found no difficulty. It cost 6s. or 7s., instead of about 30s., and he thought it was a much more satisfactory job. Where they had a mechanical joint box they were liable to mechanical connections working loose. Another thing, they did not put in demand indicators to all their consumers. It was a mistake to put it in if they were satisfied beforehand that it would not be needed. Consumers who derived benefit from it applied for it. They had a large number who were not on the demand system, and in that case they saved the cost of the demand indicators. He did not agree that there should be no charge for meter rents, because he thought it rather answered the other objection to putting on small consumers. He looked upon a meter rent as being the only way they could recoup themselves for a big capital outlay to connect on very small consumers.

Mr. Snell (Sunderland) believed the use of the pillar boxes referred to might be found very beneficial. They were going to adopt the system on a small scale, and he was sure they would not have a repetition of the experience of last year of the whole station being out. The continuity of supply would be much increased.

Mr. Quin referred to points raised by Mr. Andrews, who he said had been misunderstood by most of the gentlemen present. He (Mr. Andrews) did not want three direct feeders, but wanted to follow somewhat the same lines as Blackpool. Mr. Qain then proceeded to give details of the Blackpool system. Speaking of the fact that men did not complain of shocks, he said he had known some men put their hand across a 200-volt alternating circuit and keep it there.

Mr. Cowan said he wished to offer a third interpretation of Mr. Andrews' method of protecting the sub-stations at Hastings from failure of supply in the event of a short circuit occurring on a feeder. He thought that the last two speakers had quite misunderstood Mr. Andrews, and that the Hastings sub-stations were being arranged with duplicate feeders, both alive, and both fused at the generating station end, and provided with return current cut-outs at the sub-station end. Then, if a fault occurred on one of the feeders, its fuse blew at the generating station end, and the return current cut-out disconnected it at the sub-station end, the other feeder maintaining the supply. He considered that this was the most reasonable way open to an engineer of providing a reserve supply to a feeding point, because the action was automatic, and only a flicker in the light resulted from a fault on either feeder. Mr. Taite's notes on the paralleling of transformers, coupled with Mr. Minshall's remarks, interested him a good deal. It was quite true that two transformers with the same initial volts and the same drop would not necessarily divide the load proportionately under all conditions. If one of the transformers had a larger magnetic leakage than the other it would have a larger drop on an inductive load than one which had less magnetic leakage. It therefore became necessary to use transformers of the same make, which presumably would have equal magnetic leakage, or to test the transformers, before putting them to work, upon a circuit having the same inductance as the circuit they were required to supply.

Mr. Edgcomb (Kingston-on-Thames) spoke of banking transformers, and the difficulty of dealing with old transformers.

Mr. G. M. Harris said their station was one with a considerable number of small consumers, and it would be impossible to work it if the connections cost anything like the figure set down by Mr. Taite. Their cost was not £6. They had had seven years' experience and had had no trouble, and were going on connecting still. Another point was in connection with the statement, if they used concentric cables at all, they must use them throughout. They found twin wires very convenient when they had to connect one line with street lamps. They had to connect 200 street lamps, and they connected with twin wires.

Mr. Munro spoke in favour of a continuance of the rental for the meter.

Mr. Hart (Hanley) said one point advanced had been that every transformer chamber where possible should be above ground. There were few towns where it was possible. He could not see why it should be absolutely necessary for them to be above ground. If they had them underground and plenty large enough, he did not think there was much danger. At Hanley arrangements were such that a man could not get a shock.

Mr. Jones (Southport) alluded to the cost of connecting, and said if they were going to compete with the gas companies that was one of the things which would have to be faced by electrical engineers. The cost of putting on gas was about £4; the cost of installing electricity £14 to £16.

Mr. Chamen said he was sorry to find that Mr. Snell and himself were the only low tension men who had anything to say about the

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paper. He suggested that the low tension current engineer should take the paper and discussion seriously to heart. There was a great deal the continuous current engineer could learn from the alternating current engineer, although it was not commonly supposed to be so. They (at Glasgow) had no transformer sub-stations, but they had to deal with the almost exceptional difficulty—with tram points where they had feeders carrying 600 or 700 horse-power. The fuses presented great difficulty. They had tried at some tramway roads to use the large base of the tramway poles for the purpose, but had not succeeded. There was not sufficient room. The flash with 500 volts was something terrific. The problem had been met in their case by the use of non-return cut-outs. There was another point he wished to ask Mr. Taite to tell them something about—namely, his joint boxes. Were they of the type in which it was necessary to cut the whole of the three conductors? He thought that was bad. He had one accident in Glasgow. There was a great difficulty as compared with three separate conductors, as they had to break at least two. That meant introducing a large number of joints into what was often a most important distributing line.

The Chairman (Mr. Rider) said he regarded the paper as an extremely interesting one. He agreed that transformer sub-stations should be above ground when they could get them there, but in a busy and populous town it was exceedingly difficult to get places except at an exorbitant cost. It was possible to have them below and safely if they went about it in the right way. Mr. Taite seemed to like pillar boxes for transformers. He preferred transformers in boxes in the footpath. There was no doubt these pillar boxes would make nice leaning posts in cold weather. The inconvenience of doing all the work under the eyes of passers-by was against pillar boxes. The gentleman from Southport had alluded to the need of reducing the cost of connecting their service. If they took the costs Mr. Taite gave they would find three heavy items. First, the joint box; second, the record meter; and third, the demand indicator. The total was between £11 and £12, and the cost of gas service £4 to £4 10s. Did that £4 or £4 10s. include a meter? The large item of £5 in the electric service was for a meter, and that was something their manufacturing friends must give their attention to. They wanted meters not to cost more than £2, and he did not see why not. It was at present a heavy cost in this house connection. Perhaps the joint box, £1 10s., was too high. They did not cost that amount. The demand indicator also became a large item, but they could leave that out if they liked. The author did not consider rent should be charged for meters, and he agreed. The price of the meter should go to capital charge, and the price charged for current should include charges of that kind. The reason Mr. Taite gave for not charging for the meter was, however, not a sound one; he (Mr. Taite) said they should supply meters free just as a tradesman supplied his scales for weighing the goods he sold to his customers. Mr. Taite forgot the tradesman used one pair of scales for all his customers. In electrical supply they had to use a pair, so to speak, for each customer.

Mr. Taite replied briefly, and said so many points had been raised, he preferred to answer the majority in the *Journal*. In gas distribution the cost of a good size meter would scarcely be more than £2. They were mechanically made, and often not touched for years. Electrical meters had to be removed at least every year for testing. That was a big item. As regards Mr. Chamen's point about joint boxes, they cut the outer. With triple concentric they had to cut the middle cable—the outer one. One of the points in favour of sub-stations above ground was they only required one man.

AUTOMOBILES.

The recent meeting of the Automobile Club has served the purpose of showing the present state of the industry and furnishing a few statistics of performance. Recent accidents to benzolene cars have served to demonstrate that more than ordinary care in construction is necessary if painful accidents are to be avoided. Whatever its other disadvantages the electrical vehicle with properly designed batteries is at least free from explosion or serious accident. Only two electrical vehicles, however, competed in the Richmond trials of June 9th, and they only made average speeds of 10·36 and 7·56 miles respectively, whereas the Delahaye car ran 14·77 miles per hour for 50 miles on June 12th with a consumption of ·24 pint per mile at a cost of ·27d., the oil costing 9d. per gallon. The Iveagh car ran at an average speed of 14·42 miles per hour and burned 0·4 pint of oil per mile, costing ·45d. Other cars increased the time of the Delahaye car, viz., 3 hours 23 minutes to various figures up to 4 hours 32½ minutes.

Twenty cars, all using light oils, took part in the light car trials of June 12th. Next day the heavy trials were carried out over the 20 miles return journey to Uxbridge. Five vehicles put in an appearance, including two steam driven and three oil driven.

A Delahaye light car ran a straight mile on June 14th in 2 minutes 13⅘ seconds, or at 27 miles per hour velocity.

A Thorneycroft steam waggon, using coal at 20s. per ton, cost 1·058d. per mile. A heavy oil vehicle, with oil at 9d. per gallon (about 1d. per lb.) only cost 1·8d. per mile, and a similar light oil Post Office car cost 1·35d. per mile. Thus, compared with coal, at one-ninth the price, oil only costs about half as much again.

In heavy vehicles we note that weights are as much as 4, 6, and even 8 tons or more, the speeds being 4 to 6 miles per hour. The automobile vehicles seen about the streets of London are thus really heavy, and it is a matter of wonder that no provision is made for the prevention of accidents by running over pedestrians. Guards are altogether absent, and there is not even an attempt made to provide them. This is wrong. To be run over by a heavy motor vehicle would be very serious, and we cannot but think that before long many such accidents will be reported, and injury will be done to the interests of automobiles by neglect of obvious precautions.

In light vehicles it appears that a four-wheeled car weighs 14 cwt. in all, and can run 70 miles on one charge. Leitner accumulators for this weigh 5 cwt, or fully one third the total load. The capacity is 120 ampere-hours. Another vehicle is credited with a weight of 23 cwt., of which the battery weighs 13¼ cwt.; the capacity is 24 H.P.-hours, and a run of 50 miles is claimed to be possible. Nothing appears to show that our previously expressed opinions on motor cars need revision. Accumulators cannot yet compete with oil, and it is only because of its high price that oil is beaten by coal. For private cars outside city limits oil will continue for the present an easy first, but more care must be exercised in design to avoid the deplorable explosions of the very inflammable oils which are employed. Construction must be of the best, and something must be done to prevent the overheating of containers. It is necessary to provide some heat to vaporise even the lighter oils, for otherwise the abstraction of vapour and the absorption of so much heat of vaporisation cools down the remaining oil below a temperature at which it will vaporise. Probably the explosions which occur with light oil vehicles are due to overheating of these containers. Clearly if this is so, there is some need of regulation, and we should expect that this would be best effected through the medium of circulating water. A maximum limit of temperature would be thus secured, and probably it would not be difficult to devise a thermal cut-out to regulate the amount of water circulating.

ELECTRIC POWER IN BRAZIL.

By E. and H. KILBURN SCOTT.

There appears to be a splendid field for the establishment of electric transmission of power in Brazil, for it is impossible to go far from any of the larger cities without finding abundant water-power. All fuel has now to be imported at great cost, and although British coal at present holds the market, the time will shortly come when the thousands of water horse-power with which Nature has so liberally endowed Brazil will be exploited. If, therefore, British capitalists, merchants, and manufacturers wish to keep a hold on Brazilian developments, they must move with the times. The connecting up of these inexhaustible water-powers with the various centres of civilisation by means of copper lines should prove as sound a business as the transmission of potential energy represented by the exportation of Welsh coal. In an enormous country like Brazil—and very few recognise its magnitude and gigantic possibilities—the secret of success lies in cheap and easy means of communication. It is, in fact, the same problem which has had to be tackled by the United States and Russia. The first named found a solution in the opening up of valuable anthracite coal beds, whilst Russia has been able to bring into use the immense natural oil supplies of the Caspian. Brazil does not appear to have either coal or natural oil, but she has water-power enough and to spare, and it is common knowledge what the Swiss have accomplished by means of the electrical development of water-power. All the mills, factories, tramways, and railways, are worked by this means, and such is the skill of Swiss engineers—thanks to their many opportunities of gaining the necessary practical experience—that they are even now exporting large quantities of electrical machinery to England.

Brazil is still entitled to be called "The Golden" (see the recent report of the St. John del Rey Gold Mining Company), but she has many other valuable commodities besides gold. The district known as Diamentina is still extremely rich, and the recently developed manganese mines are amongst the finest in the world, whilst there are also exports of coffee and rubber. Now it happens that all these commodities are found or produced in the remote interior, and it is to bring them down to the sea coast that Brazil requires cheap railway transport. It has already been suggested in influential quarters that a start should be made in equipping the Central Railway of Brazil with electric motive power, and when we consider that all the fuel used on this railway has to be shipped some 7,000 miles, it will be seen that there is much to be said in favour of so drastic a change.

The large electric manufacturing combinations of the United States—especially the General Electric Company—are giving Brazil a good deal of attention, and the Americans have already secured several large contracts, including the tramways of Rio de Janeiro, Para, and Manaos. The Germans are also beginning to busy themselves in the same quarter, and it is interesting to note that a company called the Brazilianische Electrizitäts-Gesellschaft has recently been promoted by the following firms:—Deutsche Bank; Heineman Elektrische, &c., Gesellschaft; Metteldeutsche Credit Bank; Siemens and Halske, Actiengesellschaft; Schlesischer Bankverein; Bergische Markische Bank; Oberrheinsche Bank; Teodor Wille. The articles of association state that the object of the company is to construct and exploit in Brazil and other countries of South America all kinds of electrical installations, and to organise similar going concerns or concessions, especially those for electric traction, lighting, and telephones. The capital of the company is fixed at 5,000,000 marks, divided into 5,000 shares of 1,000 marks each, of which 50 per cent. was payable on the constitution of the company. Our own English

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Manufacturers' Association, promoted to work the same ground, drops into insignificance beside this new German company, but it is to be hoped that British firms will wake up sufficiently to secure, at any rate, a few of the contracts which will undoubtedly be placed within the next few years.

LECTRICAL AND MECHANICAL ENGINEERING CONTRACTS IN THE METROPOLIS.

Action of the London County Council.

About five months ago the London and District Association of Engineering and Shipbuilding Employers, of which Mr. Alex. Siemens is the president, presented a petition to the London County Council, asking the Council to consider the question of modifying certain clauses in the engineering contracts offered for public competition. The petition was referred to the General Purposes Committee, who after considering the question, prepared the following report which, with the recommendations appended, was adopted after a brief discussion between the presenter of the petition and the chairman of the committee at a meeting of the Council last week. The report, although somewhat lengthy, will be of interest to electrical and other engineering firms. It is as follows:—

(a) Dismissal of Foremen.

The committee of the Association in their letter state that the Council's clause involves in many cases the subjection of old and trusted servants to the absolute discretion of third parties; furthermore, that the employer is often not in a position to comply with such a stipulation, inasmuch as the terms of the contract of service between himself and his foreman do not permit him to dismiss them without due notice except in cases of gravest misconduct; and that any dealing with foremen on the basis of benefit or profit sharing scheme is rendered impossible where the authority to dismiss them without notice is so delegated.

The clause in the Council's form of contract is as follows:—

The contractor shall give all necessary and proper personal superintendence during the execution of the works, and shall constantly employ at least one good and competent foreman to manage and direct in the absence of the contractor, and such foreman shall, on behalf of the contractor, receive and have charge of all drawings, writings, papers, specifications, and documents which may be delivered to or for the use or guidance of the contractor, and such foreman shall also, on behalf of the contractor, receive, execute, and obey all such instructions and directions as may be given by either the engineer or authorised persons, and shall not be changed without the consent of the engineer. Any such foreman may, nevertheless, be objected to or dismissed by the engineer if and when he shall see fit; and thereupon the contractor shall forthwith cease to employ him and shall employ another good and competent foreman in his stead, to the satisfaction of the engineer, and so from time to time. The contractor shall employ in and about the execution of the works only such clerks, foremen, superintendents, agents, and workmen as are careful and skilled in their various trades and callings; and the engineer shall be at liberty to object to or dismiss any person employed by the contractor in or about the execution of the works who shall, in the opinion of the engineer, misconduct himself, or be incompetent for, or negligent in, the due and proper performance of his duties or any of them, and thereupon the contractor shall cease to employ such person, and shall employ another person in his stead to the satisfaction of the engineer, and so from time to time.

The contracts of the Council in connection with engineering works may, speaking generally, be divided into three classes, viz., (1) Contracts for work carried out away from the contractors' premises, as, for instance, sewer works, bridges, &c. (2) Contracts for the construction of machinery for which there are detailed specifications, such as pumping engines and boilers; and (3) Contracts for the construction of machinery for which there are no detailed specifications, as for instance, patented articles and manufacturers' specialities, including mechanical stokers, fuel economisers, and possibly gas engines. In the case of contracts under classes 2 and 3, the work is nearly all, if not entirely carried out on the contractors' own premises, and it is with regard to these contracts that we think some modification might be made in the clause to which we have called particular attention. It would appear that under the existing clause the man who is objected to must quit the service of the contractor altogether; whereas the Council's object would probably be equally well attained if he were removed from the particular work being carried out for the Council. We may add that we have been unable to ascertain that the power has been enforced on any one occasion.

We have had inquiry made of H.M. Office of Works, the School Board for London, and the Metropolitan Asylums Board, and in the contracts of each body there is a clause which gives power to require the dismissal for misconduct or incompetency of any foreman or workman from the site or works.

Although, as pointed out above, the power has not, we understand, been enforced on any one occasion, we think, perhaps, it would be well if the clause were amended so as to limit the removal of the foreman or workman objected to from the particular work being carried out for the Council.

We recommend (*a*) That the following be substituted for the clause at present inserted in forms of contract, viz.—

The contractor shall give all necessary and proper personal superintendence during the execution of the works, and shall constantly employ at least one good and competent foreman to manage and direct in the absence of the contractor, and such foreman shall, on behalf of the contractor, receive and have charge of all drawings, writings, papers, specifications and documents which may be delivered to or for the use or guidance of the contractor, and such foreman shall also, on behalf of the contractor, receive, execute, and obey all such instructions and directions as may be given by either the engineer, or authorised persons, and shall not be changed without the consent of the engineer. The engineer shall have full power to require the contractor immediately to cease to employ in, about, or in connection with the execution by the contractor of this contract, any foreman, workman, or other servant engaged or employed in or about the execution of the works under this contract, or any part thereof, who shall, in the opinion of the engineer, misconduct himself, or who, in the engineer's opinion, is incompetent, and the contractor shall forthwith comply with such requirements.

(b) Arbitration.

The committee of the Association contend that the clauses to the effect that the officers of the Council should be the sole arbiters of any dispute which may arise as regards the terms of the contract are "manifestly unfair, and probably illegal—unfair, in that the setting up of one party to a contract as sole umpire as to its meaning deprives the other party of his civil rights under it altogether, and renders the agreement nothing more than an arrangement by one party to do certain work subject to such terms as the other may at his discretion dictate; and illegal, in that a reference of all matters in dispute to a single arbitrator goes beyond the utmost limits of the Arbitration Act of 1889, and amounts, in reality, to a contract to oust the jurisdiction of the Courts of Justice themselves." In considering the question of arbitration we thought it well to obtain copies of the arbitration clause inserted in the contracts of the Admiralty, the London and India Docks Joint Committee, and some of the large railway companies. In the case of the Admiralty and three of the railway companies no outside arbitration is admitted. In the case of one company arbitration is allowed in certain events, and in another case on completion of the works. Only in the case of one company is arbitration allowed apparently without reservation. A clause similar to the one now in the Council's contracts was inserted in the contracts of the late Board, and in view therefore of the fact that the Council has not established a new practice, and of the fact that a similar principle as to arbitration is adopted by the Admiralty and some of the larger railway companies, we consider it inexpedient to amend the clause. We accordingly recommend—(*b*) That no alteration be made in the present arbitration clause in the Council's engineering contracts.

(c) Rates of Wages.

The committee of the Association state that as a rule an absolute conformity to the highest majority rate prevailing in the London district is required from the contractor in place of the usual stipulation as regards the wages current in the trade, and that if, therefore, the contractor happens to have in his service any one workman who is earning less than this, and amongst all classes of skilled artisans, it is urged, there are men of different ages and different degrees of competence, his wages have, on taking the contract, to be put up to the stipulated level, or the workman has to be dismissed. The Association further state that either course is likely to result in embarrassment to the contractor; dismissal is likely to cause bad feeling in the shops, and an increase of wages may create dissatisfaction amongst the hands who are paid at higher rates, and so incite them to ask for an equivalent rise by way of still marking and keeping up the distinction to which their superiority entitles them. As the result it is contended that "a natural fear of disturbing their shops and of rendering competition with other employers as regards general work more difficult, precludes many important firms paying high rates of wages from tendering where such clauses are insisted on; hence the area of selection open to the Council is dangerously narrow, and the benefits to the public resulting from free competition are in a great measure lost."

The question of the rates of wages has been discussed and the policy adopted with regard thereto, confirmed frequently by the Council, and we conclude that it will not be the wish of the Council now to re-open the matter. We recommend—(*c*) That no alteration be made in the conditions with regard to rates of wages laid down in the Council's engineering contracts.

CAST-WELDED AND OTHER RAIL JOINTS.

The *Street Railway Journal* contains some interesting information on cast-welded rail joints as put down in Milwaukee. The standard rail is a 6-inch 72-lb. tee rail in 60 feet lengths and laid on oak ties, 6 inches × 8 inches × 7 feet. About two years ago the Falk Company made some experiments on track so poor that without them reconstruction would have been needful. In the two years this track has worn to a better surface, and it is estimated that five or six years additional life has been given to the rail by the cast joints. By the end of this year all the joints in the city limits, some 40,000 in number, will be cast-welded. A similar process to the Falk process is that of the Milwaukee Rail Joint and Welding Company. This company places a jacket round the joint and pours inside this jacket, which remains in position after the clamps are removed. A slip joint is provided every 500 feet to allow for movement which amounts to about 1¼ inch per 100 feet of track, an amount, no doubt, much in excess of anything likely to occur in England. The standard suburban construction consists of 56-lb. rail 4¼ inches high in 60 feet lengths. The overhead construction is of 000 wire of fig. 8 section, and it is noted that though there are some centre poles and brackets these are not liked, and span wire construction is preferred by the public. In the same issue is described a method of electrically welding rail joints in which the weld is made from a boss on a bar or fish plate and not direct upon the flat of the bar. The system is stated to be perfect as a rail joint, and as a bond for rail returns it reduces electrolysis to a minimum. In this process of rail welding, the rail head is but little heated, so that there is no annealing such as occurs when the rail is made red as in ordinary welding. The joint

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bars have projecting bosses on them, and only this boss is heated, and in contact with the rail, thus reducing the heating effect on the rail. Even with a stress of 350,000 lbs., a weld thus made has not been sheared off, and no breaks have occurred except in very cold weather, due to contraction.

Each bar measures 3 inches × 1 inch, and has an ovoid boss at each end, and a transverse flat boss at the middle. The bars are welded first at the middle, then at the ends.

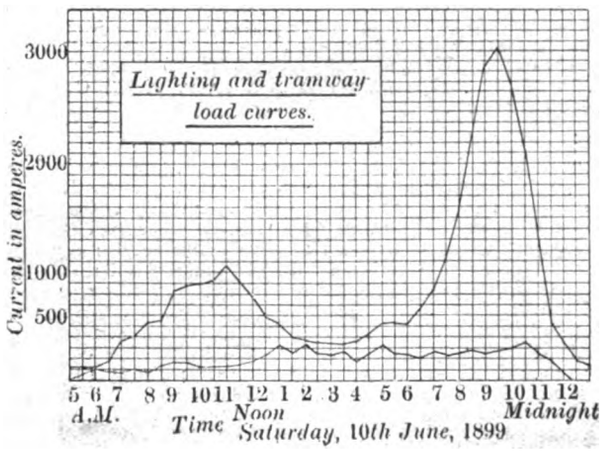
As the bars cool, they pull the rails forcibly together. The power necessary for joint welding is 75 kw. even at 300 volts, and a sand blast is used to clean the rail.

THE GENERATION OF POWER FOR ELECTRIC TRACTION.

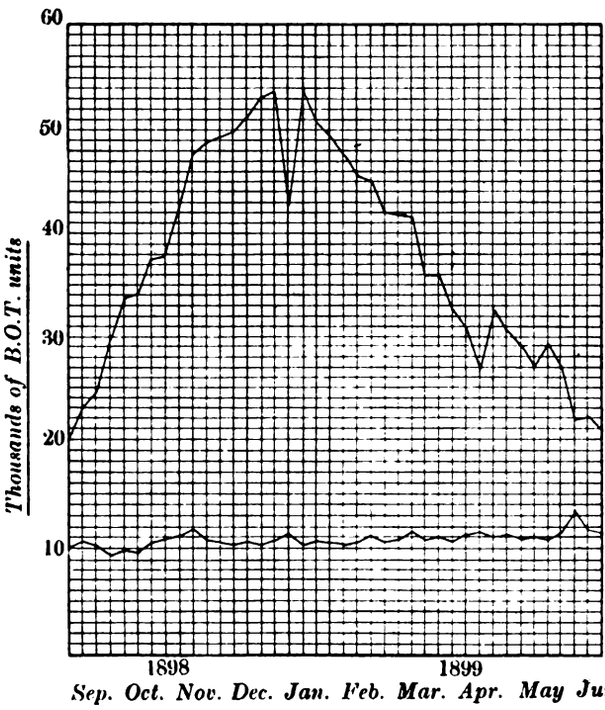
By J. GRAY SCOTT.

(*Continued from Vol. 44, page 1072.*)

With the kind permission of Mr. Gibbings, the author has prepared two lighting and tramway load curves, which are reproduced herewith. The first is simply a typical load curve representing the output on a Saturday in summer

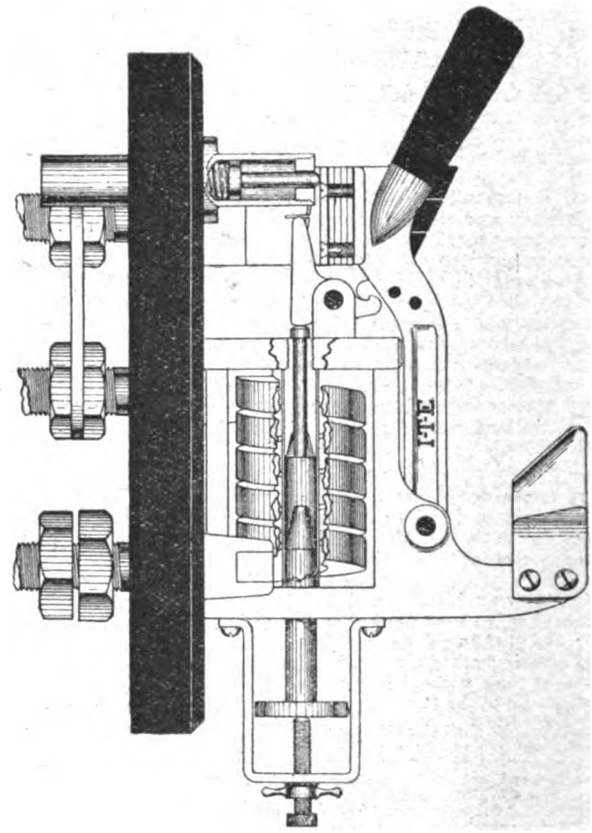

Lighting and tramway load curves.
Current in amperes.
3000
2000
1000
500
5 6 7 8 9 10 11 12 1 2 3 4 5 6 7 8 9 10 11 12
A.M. Noon Midnight
Time Saturday, 10th June, 1899

for lighting and trams respectively; the second is plotted from the weekly returns of units for some nine months, which include the winter season. From inspection of



these curves, it will be seen how regular is the tramway load in each case as compared with the lighting load, and this appears to support the author's contention that the peak on the daily or yearly curve may, in the case of the tramways, be neglected.

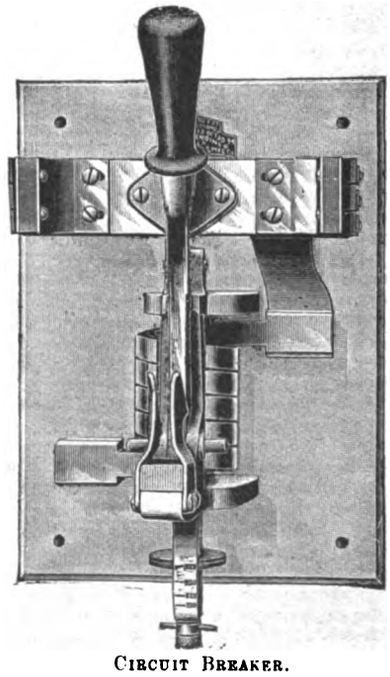
Of course, the electric tramway system in Bradford is not a large one, but an increase in the number of cars running should not affect the contour of the curve in this respect, and, moreover, it may be said that such an increase effects a considerable *decrease* in the range of the fluctuations of the daily curve, both literally, and relatively to the



Circuit Breaker.

increased average load. The daily curves have been plotted over the running hours of the trams, starting at 5 a.m. and finishing after midnight.

It will be noticed that at 6 a.m. the two are almost coincident, although throughout the day the lighting load in amperes is higher. An important fact, often overlooked



Circuit Breaker.

however, is that if the two curves are plotted in amperes the scale is not the same in each case, the tramway supply being at 500 volts and the lighting supply at 230, and thus the *equivalent* curve for trams would be considerably higher.

The second curves are plotted in units and thus present no such discrepancy. The lighting curve shows to advantage

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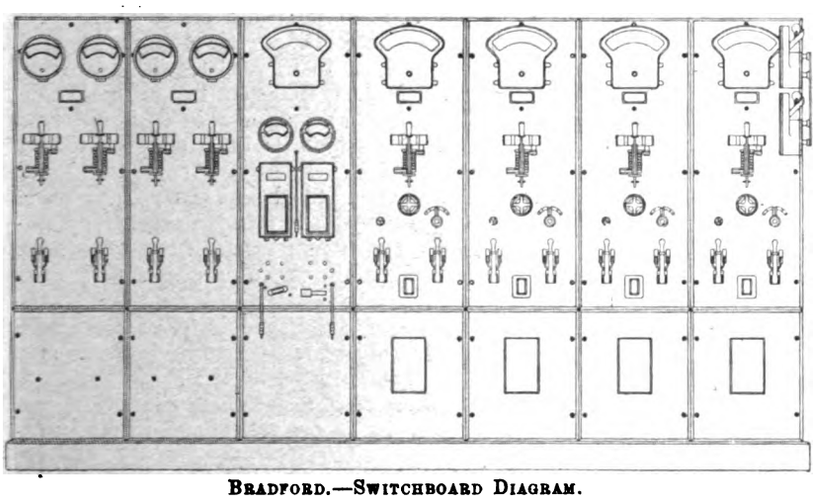
the excellent day load which obtains in Bradford, reaching a maximum of over 1,000 amperes at 11 a.m. During the week this load, or a close approximation thereto, is maintained throughout the day, but naturally falls off considerably on a Saturday.

Bradford.—Switchboard.

With regard to the tramway curve, we find a gradual increase till 1 p.m., and the load is well maintained during the afternoon and evening, with diminutive peaks at 5 p.m.



Bradford.—Switchboard Diagram.

and 10.30 p.m. The week-day curve is very similar, with perhaps an additional peak about 6 p.m. at the close of the business day.

Referring now to the second pair of curves, which, as stated above, are plotted from weekly returns of units over the period indicated, we find the same uniformity of the tramway curve as compared with that for lighting. The drop just after Christmas is an item we must class under that far-reaching category, "The effects of the holidays." It is more than a coincidence, be it noted, that a depression on the lighting curve, and a peak on the tramway curve, occur simultaneously—a fact particularly noticeable at Christmas, Easter, and Whitsuntide.

One of the most interesting, certainly one of the most handsome, portions of the station equipment at Bradford is the traction switchboard, which, as regards appearance and design, reflects the greatest credit on the contractors, Messrs. R. W. Blackwell & Co.

The board, of which a photo is reproduced herewith, consists of seven panels, comprising four generator panels, Board of Trade panel, and two feeder panels. It is of polished slate, stands 7 feet 6 inches high, and being erected on L and T irons throughout, its structural design should satisfy the most fastidious.

Each generator panel comprises main ammeter, main circuit breaker, shunt regulating resistance, shunt breaking resistance with pilot lamp coupled in series, and shunt make and break switch.

A double-pole main switch, voltmeter plug switch for paralleling or changing over, and main meter, complete the equipment.

The main ammeter is of the well-known Weston type, having a range of 0—1,200 amperes, while each generator ammeter ranges from 0—1,000 amperes. The former, together with the voltmeter, are mounted on a swinging bracket at the right hand extremity of the board, and thus easily

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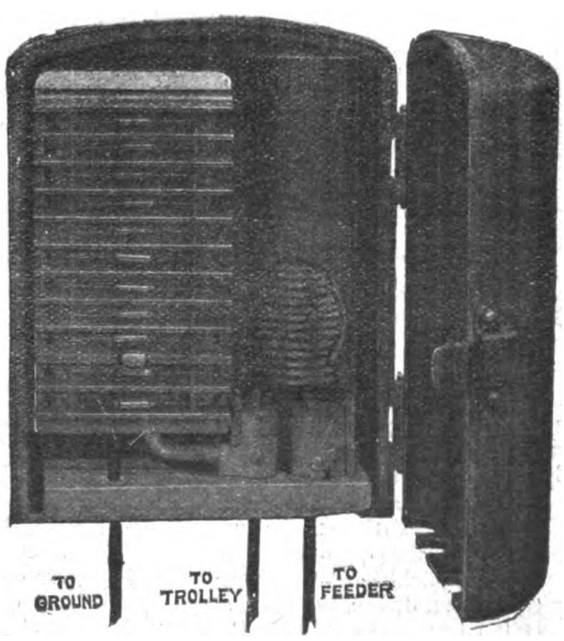
readable from any of the generator panels, on each of which, as already stated, is fitted a plug switch for connecting the voltmeter when paralleling.

Each feeder panel controls two feeders, each of which is in circuit with an ammeter, circuit breaker, and single-pole switch.

As some may not be familiar with the construction and action of the circuit breaker, as commonly used on tramway circuits, one of these is here shown in perspective and section. This represents a medium size, and is employed for currents ranging from 500 to 1,000 amperes, though its range may be adjusted by means of a thumb screw at its lower extremity, and within 5 per cent. of which adjustment, the circuit breaker is guaranteed to act. The construction and action of the instrument are very clearly shown in the part section. The central coil carries the main current, which, in the event of its exceeding the value corresponding to the adjustment of the instrument, overcomes the action of gravity upon the plunger, attracting it upwards. Having once left its position of rest, the magnetic attraction of the coil accelerates its motion, and the plunger impinges on the striker pin with considerable impetus, causing the catch side of the striker plate to be tipped downwards. This disengages the switch arm, which is immediately thrown back by the spring plunger, clearly seen in section at the top of the instrument.

Why these devices are not more generally adopted in place of fuses, particularly on motor circuits, the author fails to understand. Their greater cost, no doubt, is a prominent consideration, but there are many cases within the knowledge of the author, in which the inconvenience and cost of fuse replacement, and the ultimate insertion of a fuse with

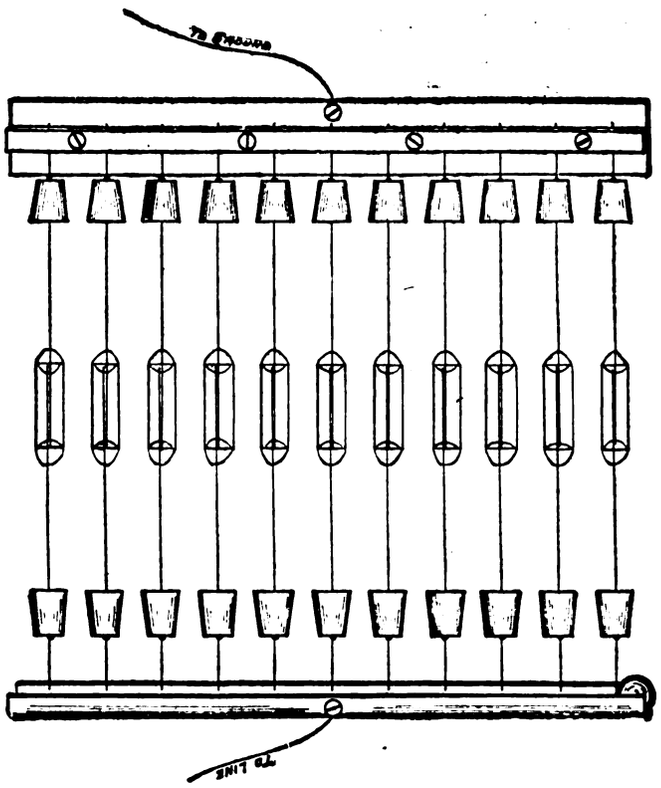


Lightning Arrester.

a *minus* factor of safety—resulting in an armature burn out—have greatly exceeded the initial cost of a circuit breaker. Their greater reliability, quicker action, increased convenience, and *non*-deterioration are among their many advantages, and it is to be hoped that in the distribution boards of the future, fuses will be replaced by some form of cut-out acting on the above principle—a reformation surely spelling satisfaction to consumer, contractor, and electrical engineer alike.

The shunt regulating resistance is a departure from the conventional coils of wire, inasmuch as it is formed of strips of high resistance alloy, wound on an iron framing and insulated by sheets of mica and asbestos cards—the whole being neat and compact.

In order to protect the line from lightning, each feeder is fitted with a lightning arrester of the "Ajax" type. The construction and general arrangement may be seen very clearly from the following diagrams:—



Lightning Arrester.

The fuse (which is the central portion enclosed in a glass tube) simply consists of two pieces of No. 26 brass wire lying adjacent to each other over a distance of about 1 inch, the insulation between the two, which forms the discharge gap, being two single thicknesses of silk, amounting to little more than 2 mils. The entire length of fuse and connecting wires is about 3 inches, and perhaps a dozen of these are fitted in a case of convenient size, and so arranged that one after the other is automatically brought into circuit as each fuse is consumed in turn.

(To be continued.)

ELECTRIC PIPING.—A SUMMARY.

Some three months ago we published an article in these columns dealing with the subject of electric piping in general, and insulating steel conduit in particular, with a view to getting the opinions of our readers as to the best pipe system for electric wiring. We drew special attention at the time to the fact that although the question of a standard set of wiring rules was being considered by the Institution of Electrical Engineers, no attempt had been or was being made to standardise the various methods of wiring generally employed, and we expressed the opinion that, if this were done, the labour of those engaged in amending the wiring rules would be greatly minimised.

Since the appearance of the article in question we have had many letters on the subject, and the correspondence may be said to have been fully terminated by Mr. Fred. Bathurst's letter in our issue of June 30th, in which he goes over much of the ground touched on by our article and by other correspondents.

As Mr. Bathurst's hobby was the hub of our article, and as it also suffered some mauling from the severity of critics and the kindness of friends alike, it was perhaps only fair that he should have had the last word in a discussion which assumed a partisan character very rapidly. Where many systems are in the field, and particularly two such well standardised ones as the Simplex steel conduit and the Insulating Steel Conduit, such a result is bound to come about,

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and, of course, as the very principles which these two systems advocate with regard to insulation of wires are diametrically opposed, this correspondence served to point out some of the advantages and disadvantages of each system, and this should be an important factor in the unification of wiring practice.

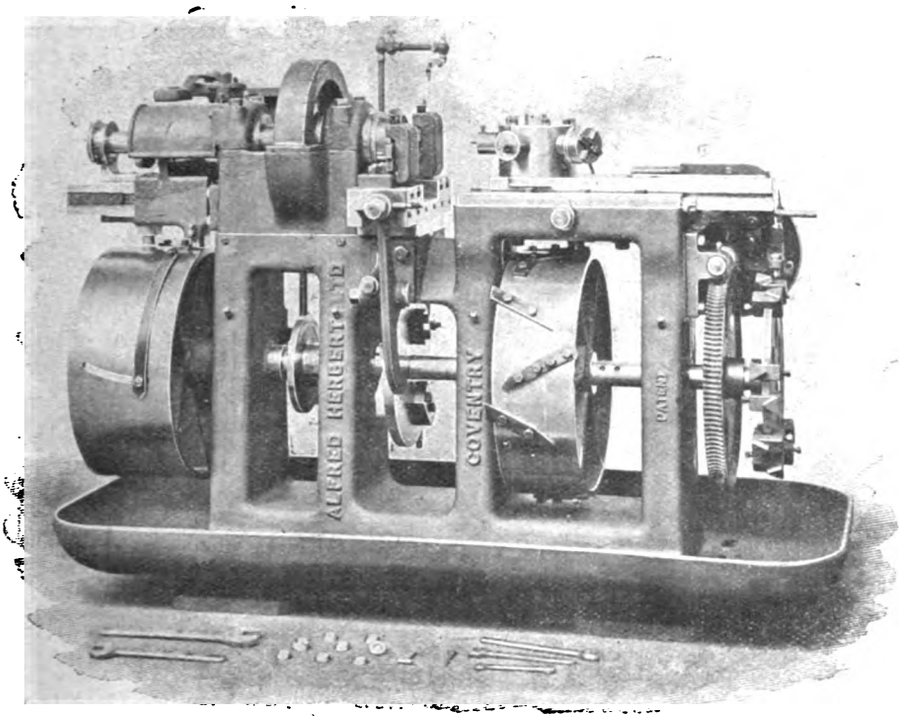

Fig. 6.—Machine Tools (See page 83).

It is, perhaps, a pity that the correspondence was confined more to a discussion of the relative costs and mechanical advantages of insulating and uninsulating piping *as they stand* than to the modifications which we particularly drew attention to, namely, earthing the outer and using bare copper wire; but evidently our correspondents had had no experience in these directions, or, having ideas on the matter, fought shy of expressing them. Consequently, many red herrings were drawn across the path of "order," and the success of any system was, perhaps, more rightly than wrongly made dependent on the behaviour of the "pore British working man," who, if he only appreciated the real nature of all that is expected of him, might become more alive to the responsibilities of his position. Into the pros and cons of rival systems we cannot enter; our position is to hold the scales evenly between them, letting the weight of actual experience decide which is the best. We can, therefore, without prejudice, summarise the views expressed by our correspondents, and see how far these have tended to indicate a common line of practice in wiring.

Mr. Albert B. Butt, for instance, is greatly in favour of the insulating conduit. Not only does he show that by using an ordinary hand saw with a Lancashire blade for cutting the pipe, all burrs are avoided, but he points out that the tubing can be quite easily bent cold, and he informs us that it can be extended from the wall to form brackets. He also advocates the use of 400-megohm taped wire within it, owing to the absence of condensation.

Mr. J. G. Barchell attacks this point, and avers that it is far better to have a highly insulated wire, so as not to depend on the insulation of the conduit. Perhaps both writers have forgotten the fact that it is possible to have a high grade insulation wire without increasing the diameter of the same with braiding. We have also not been told whether the insulating lining is not liable to crack if the tube is bent cold. Mr. Barchell thinks that insulating conduits should only be used for out of doors, and declares unhesitatingly for Simplex tubing. He, however, points out the one great disadvantage of this system, namely, that it cannot be bent cold. We are, however, under the impression that by properly using the bends supplied with this system, any difficulty can be surmounted. Mr. Harold E. Owen also points out the many advantages to be gained by using Simplex tubing, and, in his opinion, this system has solved the problem which we set before our readers. Messrs. Troup, Curtis & Co. are also of the same opinion, and naturally Mr. L. M. Waterhouse does not favour insulating steel conduit, but in this direction he may be said to be as prejudiced as Mr. Bathurst is in the opposite direction. Mr. Waterhouse bases his arguments on cost of installation, but it must be pointed out that if he saves in cost of tubing and labour, Mr. Bathurst saves in cost of wires by reducing the insulation on the wires. It remains to be seen, all other things being equal, which method effects the greater saving.

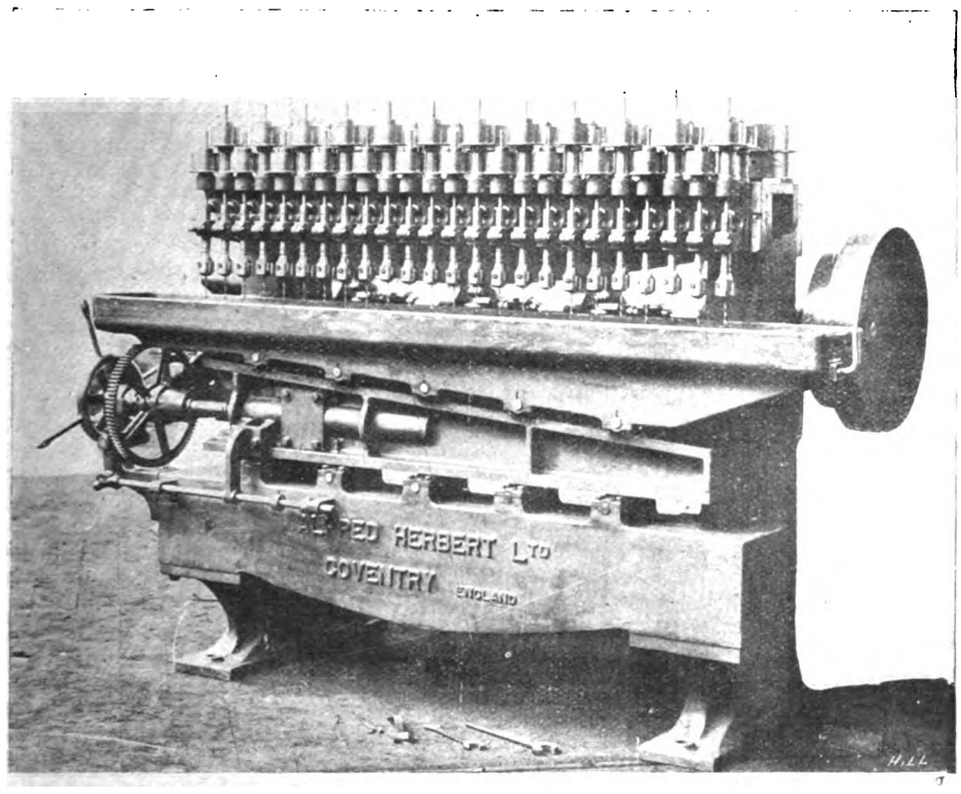

Fig. 7.—Machine Tools (See page 83).

Mr. W. H. Isherwood rather hesitates, perhaps, at first, and then settles on gas pipe as the best system, provided always that it is well laid out, well installed, and that no bad workmanship is used. He is, however, alone in his advocacy of this system, and as regards his conditions, these apply to every system under the sun; the proper way to compare the advantages of different systems being without doubt to

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assume that the men who instal the systems are all born idiots with permanent malicious intent. A correspondent signing himself "J." is decidedly reactionary. He falls foul of all known systems, but seems to prefer compo pipe, casing, and specially prepared gas barrel—all jumbled up indiscriminately in a house. He does not tell us where this specially prepared gas barrel comes from, nor how much it costs, but we presume it is made in the "land o' cakes."

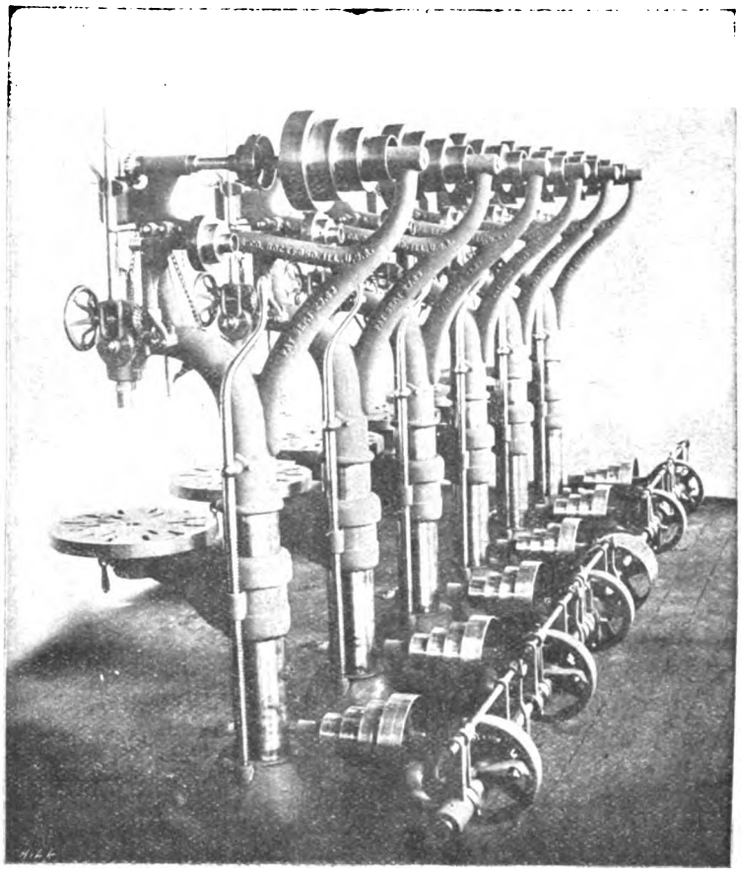

Fig. 8.—Machine Tools (See page 83).

Incidentally "J.," who writes from Edinburgh, deprecates the use of twin lead-covered wire, as this is often damaged by the heavy boots of workmen. But he was reckoning without Mr. B. H. Jenkinson, who happens to be a great advocate of twin lead-covered wires, and this gentleman curtly reminds "J." that London contractors do not employ navvies with policemen's tens to put up electric wires, although this custom may be in vogue in Edinburgh. "J." returns to the attack, points out that Mr. B. H. Jenkinson is biassed in favour of twin lead-covered wire whilst professing impartiality, and suggests that the Edinburgh wireman, far from being a navvy, is a City and Guilds

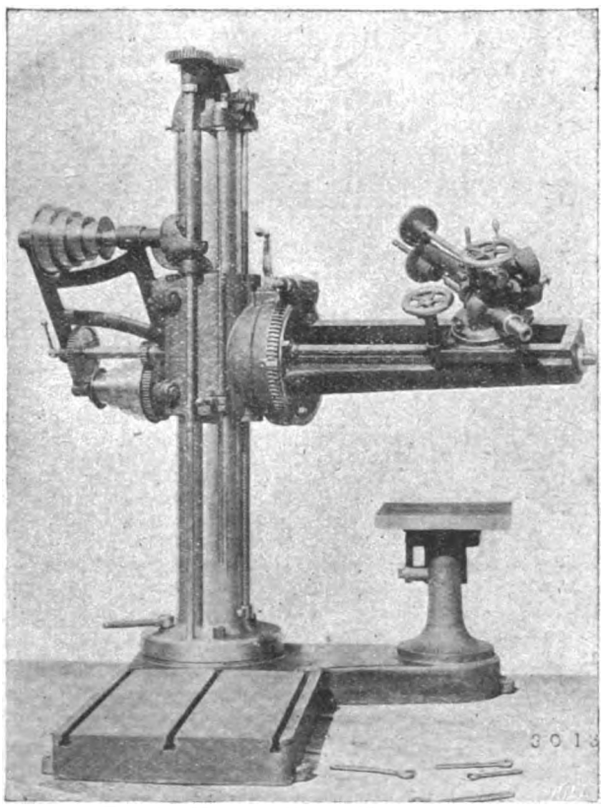

Fig. 9.—Machine Tools (See page 83).

of London Professor, or something to this effect. This is again contradicted by "G.," who gives Edinburgh wiremen a very bad character and prefers insulating conduit, plain iron piping, and Simplex steel conduit, in the order given. Mr. J. E. Clarke also favours twin lead-covered wires, and Mr. Alfred Schwartz points out an error in our article.

All this correspondence is, however, very wide of the mark. We all know that, with the systems in vogue, there are occasions when any one of these will be generally more desirable than all the others. Also that a bad workman can spoil any job. We must, however, assume, that all workmen are bad, and then we must take the best qualities of the systems we know and combine them to form the ideal system. And whilst considering this, we must not lose sight of the fact that there are at present certain rules to be observed, which it is the business of those who think that some of these rules prevent the due development of their system to have altered. For instance, we think it will be admitted that, say, on a 4½-inch wall, the Simplex system (of pipe systems) is the most suitable, that is, it takes up very little room.

On the other hand, if Mr. Bathurst could only do away with the objection the supply companies have to "earthing" the outer, he could put a bare copper wire through his conduit and so reduce the diameter of the latter that it would, perhaps, be less than that of the Simplex conduit; but Mr. Bathurst, in his able defence—for such it is—does not tell us how he is going to run more than one bare copper circuit in the same tube. He points out that we must consider, in discussing "first cost," labour and material combined, and, of course, the insulating conduit is expensive; but then, can it be put up cheaply, especially if we are depending on its metallic continuity for the conductance of the "outer"? Mr. Bathurst considers our supposition that a workman may damage the interior of an insulating pipe "captious," but workmen are capable of doing the most remarkable things, and in criticising such a system we must always assume the worst conditions and see if the system will stand them.

The insulation inside a box or on its lid can easily be damaged. These things lie about in buildings to be wired, and they may be walked on, or damaged in many other ways. In most other points Mr. Bathurst scores, and if our criticism is described as "captious," it has at any rate given him an opportunity to be drawn on certain obscure points in connection with his system. We are glad that he accepts our criticism as to the danger of harping too much on the "fire bogey"; but it is just amongst ourselves that we know how little cause there is to conjure it up in this country.

We cannot agree with Mr. Bathurst's interpretation of our analogies. A razor in a child's hand is not the same thing as a fuse in the hands of a grown up person, who can distinguish right from wrong and knows the risk he runs by interfering with what he does not understand. Also the man who ties down a safety valve is just the man who has not had a trained experience, or else is exceptionally reckless.

However, we consider that Mr. Bathurst has made out a fairly good case, which the metre of his poetry does not improve. *Poëta nascitur, non fit*, and if Mr. Bathurst applies his study of "feet" to tubing and not to iambics he is more likely to excel. It only remains for him to get the objection to "earthed outer" removed, when the wiring

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question will assume quite a different aspect. In the meantime the advocates of various systems will find out gradually where they can make an improvement by taking to heart the results of "bitter experience," and unless we agree to adopt one system or the other by common consent, we must rest content with the knowledge that each advocate is pursuing his business in the manner which he thinks best suited to serve the interests of the profession, and that a common end must ultimately lead to a common method.

MACHINE TOOLS.*

(*Continued from page* 34.)

Full Automatic Screw Machine.

Fig. 6 is an Alfred Herbert's automatic machine for the production of screws, collars, studs, &c., and is entirely automatic in its action. The various automatic actions are controlled by the cam drums and disc plate. The cams are adjustable and have two speeds, slow for cutting, and rapid for bringing the tools up to their work. The turret possesses the novel feature of having four longitudinal positions upon the saddle, each of which is positively locked.

Drilling Machines.

The variety is almost equal to that of lathes; a few examples only will be given. H. W. Ward & Co. make an excellent form of sensitive drill which possesses the following features:—Ball thrust, enabling the action of the drill

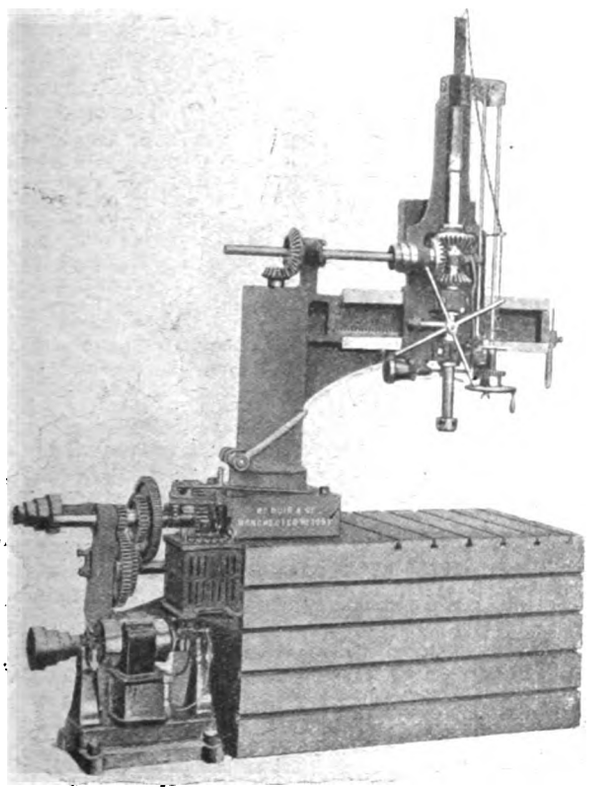

Fig. 10.

to be *felt* by the operator, and thus prevent the breakage of drill; self-centering vice for shafts, the spindle is kept free of the belt pull by the driving pulley being mounted upon a sleeve, the spindle is balanced by a coiled spring in a box.

Fig. 7 is a multiple drill by Herbert, Limited, the feed is not given by motion of the spindles but by the table, which is fed upwards by a wedge and rollers.

Fig. 8 shows an American gong drill by Barnes, and requires no explanation.

The old-fashioned pillar drilling machine is rapidly being superseded. Drilling machines should possess the following essentials:—A rigid table capable of being swung clear, gearing machine-cut and encased, rapid change from single to double gear, spindles should be balanced, and have ball thrusts, and be provided with quick-withdrawal and hand-feed motions besides self-acts.

Radial Drilling Machines.

Before describing radials proper, mention should be made of a semi-radial imported by C. Churchill & Co., Limited. It is a combination of a radial and pillar machine. The revolving arm is very short, and the table revolves on balls; very long and accurate holes can be drilled with ease, owing to the vertical travel of the drill head.

Fig. 9 illustrates a universal radial drill by the Niles Tool Works Company, Ohio, and by its use holes at any angle in the vertical or horizontal plane may be drilled.

Fig. 10 is an example of a motor-driven drill by W. Muir and Co.

The growing demand for electrically-driven tools is largely due to the elasticity in placing them (being independent of line shafting), and the economy in space. The determination of the power absorbed by various classes of tools is also rendered easy.

(*To be continued.*)

* Editorial abstract of a paper on "Machine Tools," by E. C. Ames, recently read before the Society of Engineers.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, *to whom all inquiries should be addressed.*

13,176. "Manifold printing and writing by electricity." A. A. Govan. Dated June 26th.

13,177. "Improvements in arc lamps." G. Hill. Dated June 26th.

13,194. "Improved method of winding coils for continuous current dynamo and motor electric machines." A. W. Tomkins. Dated June 26th.

13,206. "A new or improved means of recuperating atmospheric electricity." Pierre de Dual de Salyerne. Dated June 26th.

13,226. "Improved construction or arrangement of appliances for underground or conduit traction by electricity." J. H. Rose and C. Hall. Dated June 26th.

13,227. "Improvements in telephones." E. Wilson and C. J. Evans. Dated June 26th.

13,230. "Apparatus for supporting pendant globes applicable to the globes of enclosed arc lamps." T. I. Söderlund and O. A. Ervall. Dated June 26th.

13,233. "Improvements in apparatus for periodically producing electric current by wind power." M. Gehre. Dated June 26th.

13,244. "Improvements in the manufacture of reflecting opalescent surfaces for electric lamps or glass reflectors." The Improved Electric Glow Lamp Company and A. Barnes. Dated June 26th.

13,256. "Improved means of lessening the danger attendant upon the employment of overhead conductors in electric tramways." M. H. Smith. Dated June 27th.

13,257. "Improvements in connection with underground conduits for electric tramways." M. H. Smith. Dated June 27th.

13,270. "Improvements in telephone exchange systems." D. Sinclair and W. Aitken. Dated June 27th.

13,271. "Improvements in telephone exchange systems." D. Sinclair and W. Aitken. Dated June 27th.

13,274. "Improvements in the manufacture of accumulators." A. Schanschieff. Dated June 27th.

13,276. "Improvements in or relating to enclosed motors or dynamos." P. Rosling and H. W Appleby. Dated June 27th.

13,280. "Improvements in connection with channel rails for electric tramways." M. H. Smith. Dated June 27th.

13,314. "Improved method of electrically firing submarine or other mines." E. Edwards. (F. Mäylander, Germany.) Dated June 27th.

13,328. "Improvements in electric coin-freed delivery apparatus." J. H. F. Krull. Dated June 27th. (*Complete.*)

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13,329. "Improvements in electrode plates for accumulator batteries" R. HADDAN. (Berliner Accumulatoren und Electricitäts-Gesellschaft mit beschränkter Haftung, Germany). Dated June 27th.

13,341. "Improvements relating to the electrolytic decomposition of alkaline salts." E. EDSER and R. W. WEEKES. Dated June 27th.

13,404. "Improvements in electric lamps." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (E. Thomson, United States.) Dated June 28th. (*Complete.*)

13,418. "Improvements in or relating to telephones and the like." R Hammerstein. Dated June 28th. (*Complete.*)

13,424. "Improvements in electric cranes and similar revolving appliances." J. G. W. ALDRIDGE. Dated June 28th.

13,431. "An improvement in brush-holders for electric machines." J. BURKE. Dated June 28th. (*Complete.*)

13,509. "Improvements in or connected with electric cranes." J. G. W. ALDRIDGE. Dated June 29th.

13,526. "Improvements in rail-bonds for electric railways." A. J. BOULT. (F. H. Daniels, United States.) Dated June 29th. (*Complete.*)

13,549. "An improved electric appliance for exploding shots in mines blasting and the like." N. SCHMIDT. Dated June 30th.

13,559. "A method of controlling electrically-propelled trains." E. H. TYLER. Dated June 30th.

13,561. "Improvements in means to be employed in electric traction." M. J. BARREAU. Dated June 30th.

13,565. "Improvements in method of, and apparatus for, controlling alternating electric current motors." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (A. H. Armstrong, United States.) Dated June 30th. (*Complete.*)

13,568. "Improvements in thermostatic electric circuit-breakers." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (C. D. Haskins, United States.) Dated June 30th. (*Complete.*)

13,570. "Improvements in electric generators for gas engine igniters." B. MCINNERNEY. Dated June 30th. (*Complete.*)

13,593. "Improvements in secondary batteries." D. TOMMASI. Dated June 30th. (Date applied for under Patents, &c., Act, 1888, Section 103, January 23rd, 1899, being date of application in France.)

13,614. "Electro-magnetic compensating devices for power steering mechanism." J. D. WILLIAMSON, JUN. Dated June 30th. (*Complete.*)

13,616. "Improvements in motor electric meters, parts of which are applicable to motors and dynamos generally." EVERSHED AND VIGNOLES, LIMITED, and S. EVERSHED. Dated June 30th.

13,617. "Improvements in electrical measuring instruments." E. C. RIMINGTON. Dated June 30th.

13,646. "Improvements in electrical motive power apparatus." T. D. HOLLICK. Dated July 1st.

13,650. "Improvements in bonds for electric tramways and railways." W. E. KENWAY. Dated July 1st.

13,656. "Improvements in brakes for electric motor vehicles." H. LEITNER. Dated July 1st.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON & Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, *price, post free,* 9d. (*in stamps*).

1897.

22,218. "Improvements in electric measuring instruments." THE BRITISH THOMSON-HOUSTON COMPANY, LIMITED. (E. Thomson, United States.) Dated September 28th, 1897. Relates to electro-dynamometers for use as voltmeters. A frame, angular in plan, carries a fixed circular coil on supports, and a vertical shaft on bearing screws. The shaft carries a bent aluminium strip supporting obliquely a mica ring, on which the movable coil is wound. Current is conveyed to it by flexible connections. The turning of the shaft is opposed by flat spiral springs connecting it with arms, and is indicated by a pointer moving over a graduated scale. The pointer carries a thin aluminium damper pressed on to an aluminium wire. The coils are made of copper wire, bobbins carrying additional high resistances of German silver or manganin are placed in a recess in the base. A switch is provided in the base. 3 claims.

22,250. "Improvements in or relating to the prevention of sparking at a controller resulting from breaking a contact." W. P. THOMPSON. (Thorsten von Zweigbergh, United States.) Dated September 28th, 1897. Relates to means for preventing sparking at the main contacts of a controller for motors. A shunt circuit is made before breaking contact in the controller, which shunt is subsequently broken at contacts which are easily accessible. The shunt circuit is controlled by an electro-magnetic switch, connected with certain of the contacts on the controller. A box contains a magnet core, which may be integral with the box when the latter is of iron. The core has a main winding and windings on the legs in opposite directions. The armature is journalled on a stud, and is oscillated according to the direction of the current flowing in the legs. It carries a contact adapted to engage with one of the contacts. These contacts, which may be hinged at and forced down by a spring, are the supplementary contacts at which the sparking takes place. The contacts are so arranged and cross connected, as to give the desired connections. In a further modification the magnet has only two windings. 16 claims.

22,251. "Improvements in safety fuses for electric devices." W. P. THOMPSON. (G. H. Goodhue and F. A. Hart, United States.) Dated September 28th, 1897. The case has end caps, through which terminals carrying the fusible wire are passed, and contains fillings, preferably of asbestos, and partitions, between which is an air space. A sliding block, having a cavity and a pin, is normally held in position by the wire. Should this wire fuse the spring forces up the block, covers the perforations in the partitions, and causes the outer end of the pin to project beyond the cap, or to actuate an electro-magnetic audible or visible signal. In some cases the block may be made to rotate after the wire fuses and to actuate a pointer. Other slight modifications are described, in all of which the partition covering and signalling device is normally held in the inoperative position by the unfused wire. 10 claims.

22,444. "Improvements in machinery or apparatus for transmitting motion from electric motors to other machinery." J. W. HULSE. Dated September 30th, 1897. Relates to toothed gearing for transmitting, at a reduced and variable speed, the motion of an electro-motor to machine tools and other machinery. The invention is described in connection with a lathe, the headstocks of which support, by means of a beam, the motor. The motor shaft is connected by wheels to a subsidiary shaft which carries sliding pinions adapted to engage with wheels upon a sleeve. This sleeve is loose on a shaft which carries a pinion in gear with a wheel on the lathe face plate, and a wheel and a pinion, which together with the wheel on the sleeve are adapted to gear respectively with the pinion and wheels arranged to slide on feathers on the shaft. The wheel may be locked to the sleeve when desired by means of the disc. The spindle may have a slow motion imparted to it in the ordinary way from the main spindle, a quick motion can be imparted to it from the shaft through the wheels. 2 claims.

22,521. "Improvements in electric furnaces." W. S. HORRY. Dated October 1st, 1897. A stationary hopper has its two inclined sides lined with firebrick or the like to support carbons between which an arc is formed. The powdered materials are placed in the hopper, and the fused product falls into a rotatable receptacle. This consists of two discs and a barrel carried by a shaft in stands and rotated by a gear wheel, worm and hand wheel. The hopper is hung between the discs from the stands. The receptacle is completed by bolting overlapping plates on the edges of the discs below the hopper as the receptacle is turned. The product, such as calcium carbide, can thus be moved away from the arc as it is formed, so as to keep the current steady; the plates and product are removed at the other side of the apparatus, which thus works continuously. 3 claims.

28,882. "Improvements in or relating to electric switches for electric valve-controlling apparatus." G. BARKER (G. J. Schoeffel, United States). Dated December 7th, 1897. Electrically operated valves and switches.—Relates to electrically operated valves or whistles for use on board ship, &c., and particularly to the construction of a weather-proof switch. The whistle, the valve of which is controlled by an electro-magnet, and provided with an automatic time switch, so that signals may be given at desired intervals. The contact mounted on a rotary disc, and which, according to its position on the terminals, the circuit from the battery is broken, and is made direct with the whistle, or is made through the switch, is loosely mounted on a spindle, being prevented from rotating on it by a feather spring. It is contained within a cylindrical body which screws into the casing, suitable packing rings being provided. The three wires are made into a cable and introduced through a suitable stuffing box. The wires are then connected to terminals on a plate provided with ports engaging with the lower ends of the contacts. These contacts may be spring plungers, in which case the plate is fixed. The handle for operating the switch carries a hood for protecting the cylindrical body. Within it is arranged a row of notches engaging a spring plate for holding the switch in position. 6 claims.

28,895. "Improvements in insulating supports for the third rail or electric conductor of electric railways." A. ANDERSSON. Dated December 7th, 1897. Electric Railway Insulators.—Insulators for the third rail or electric conductor. A metal base with a securing flange and perforations is perforated at the top to receive a screw bolt. The bolt has a head which together is covered with moulded insulating material, two or more vertical ribs being formed on the head. A metal cap having internal grooves to fit the ribs is secured on the bolt and is provided with a shed. The third rail or conductor is secured to the cap by a fixed claw and a removable claw. 4 claims.

28,956. "Improvements in electric cables." J. H. KELMAN. Dated December 7th, 1897. Relates to electric cables, the conductors of which are insulated by coating with a linseed oil varnish or baked japan, and after drying are bound together by two opposite spirals of tape. An external armour protects the tapes. 2 claims.

29,960. "Improvements in pushes for electric bells and the like." A. W. STAVELEY and J. H. PARSONS. Dated December 7th, 1897. A push for electric bell or other circuits has a barrel soldered to the front plate. Two cups, 1 and 2, are secured at the outer end of the barrel by a screw. A headed screw is insulated from the cup and serves as one terminal, the wire being gripped by nuts. The spring push-button has a pin passing through the cup 2, so that by pushing in the button the circuit is completed through the headed screw pin and cup 2 to the second terminal. The device may be arranged as a pull, the pin being normally drawn inwards by a spring, thus keeping two spring contacts apart, these spring contacts completing the circuit when the pin is pulled outwards by a knob. 3 claims.

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THE

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THE

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1899

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THE STRANGER WITHIN OUR GATES.

ANYONE but a close student of electrical affairs would be filled with surprise at the enormous amount of work which is being carried on at the present moment by electrical contractors; indeed, it can hardly be doubted that in electrical matters we are passing through a period of extraordinary activity. There is hardly a manufacturer who is not suffering from a superabundance of orders, with the inevitable result that he has been rapidly falling in arrears.

Nor does there appear to be any immediate prospect of a slackening in the demand for electrical plant. Electrical tramways are being constructed all over the country; the municipalities or supply companies of large towns are employed in carrying out extensive additions to their already existing works, while towns that have been hitherto difficult to win over to the advantages of a public supply of electricity are engaged on schemes. Nor do these represent the only directions in which plant is being utilised. In all parts of the country manufacturers, and owners of factories and workshops, are becoming alive to the advantages of electrical driving, and the instances where scattered steam engines and shafting are being abolished, in order to make room for modern methods, are multiplying. In addition there is a growing use of electricity in chemical operations, and in this direction alone there ought eventually to be a large outlet for electrical machinery.

Having regard to the enormous use that is being made of electrical plant, coupled with the fact that English workshops are in a highly congested state, it is not surprising that foreign electrical manufacturers should have contemplated invading the English market, with a view to obtaining some share of the business. Already the Germans have shown a certain degree of activity in forming companies designed to carry on manufacture here on German methods. The instance of the Schuckert Company is fresh in the minds of our readers; while rumour has been of late busy with the name of a second well-known Continental house.

The formation of the British Westinghouse Company, with a capital of £1,500,000, for the manufacture in this country of every description of electrical machinery is an event of the first magnitude. For some years past a branch of the American Westinghouse Company has been located in London, and has presumably secured a fair share of profitable business. It is the intention of the new company to carry on its business on an exceptional scale, and for that purpose it has secured in the neighbourhood of Manchester, adjacent to the Ship Canal, a large area of land which will permit the erection of buildings able to accommodate, in the first instance, 5,000 workmen.

The English daily press has a woeful lack of knowledge concerning English electrical manufactures, and it is not surprising, therefore, that the Westinghouse scheme serves as an occasion upon which it laments the smallness and backwardness of the British electrical manufacturer. Even

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a newspaper so usually well informed as the *Pall Mall Gazette* says: "It is notorious that for the better part of the electrical apparatus employed in this country we go abroad to the United States or Germany." Hitherto, the German interests in this country, as far as importation of electrical machinery is concerned, have been insignificant; but in the development of electric traction the Americans have for some time exerted a controlling influence. It is not difficult to assign reasons for the pre-eminence of Americans in this direction. They came into the English market with their plant cut and dried, and were able to offer complete equipments that were based on years of experience. While electrical men in this country were fighting the battle of the overhead wire, their American *confrères* on the other side were putting up lines in all directions, and evolving the most suitable type of plant. When, therefore, the English public had become educated up to the trolley systems, our home manufacturers had had little or no experience; and, naturally, the American who could supply a finished article, obtained much of the business. But if we examine a list of the electric lighting works in this country we find that very little American plant is in use; indeed, there is probably not more than one electric lighting works in the whole country that is fitted throughout with American-made machinery. In that branch of the industry, English manufacturers have in the past held their own; and, indeed, for ordinary lighting plant of moderate size, we believe that home manufacturers could supply a good deal cheaper than our American friends. But then the tendency of the lighting engineer is towards large units and three-phase systems, and in both these directions the Americans have gone far.

In traction work, which American contractors have practically made their own, there is one important fact to be borne in mind. Up to the present moment American contractors have had practically no competition from their English rivals. Naturally, that state of things is not going to continue, and we are confident that before many months are past more than one English contractor will be able to do battle with his doughty American opponent. The competition which has been hitherto carried on, such as it is, has been with machinery made in the United States; but the question becomes totally different when the Americans put down a factory to compete with us on our own ground. Let us examine the influence that such a departure is likely to exert on home manufacturers. It is beyond dispute that the Westinghouse Company possesses some most valuable patents for electrical machinery, and what is of quite, if not greater importance to such a company is, it has at its disposal a fund of accumulated experience which must enable it to meet very readily new problems as they arise. In this respect it is probably in a superior position to an English company. That, however, is not the whole of the matter. It has been always assumed that the American contractors, when competing with English manufacturers, had the advantage of standardisation and better labour conditions. No doubt the Westinghouse Company will be able on this side to carry out its admirable standard practice, but where will the improved labour conditions be? Designedly the company will employ British labour; in other words, they will be subject to all the vagaries of labour that are experienced by other manufacturers. American methods may count for much, but they cannot, at any rate in this country, rise superior to the British workman, and the attitude of such labour champions as Messrs. Burns and Barnes will probably be watched with interest, if not with some anxiety. It is not very long ago that large tramway works were opened at Preston, and these are being run on American lines, and in a great measure by American engineers; but have they been wholly able to counteract the deep-set labour notions that prevail among many of their workmen? County Councils and municipalities, with few exceptions, insist upon labour clauses in their agreements, and though they have been prone to modify these conditions in American contracts, they are not likely to relax their regulations when a company employs labour in this country. It is quite likely that we may witness on this side a repetition, in a mild form, of the great trust companies that have become an integral part of the financial state of America; but while large electrical companies in America have carried out some magnificent work, and have unmistakably developed a certain class of machinery, it is entirely another question as to whether they have achieved any very striking financial success. A favourite method in America in dealing with competitors is to buy them out; but there would be always greater difficulty in following out such practices in this country. Moreover, it must never be forgotten that the owners of many large contracting works in England are exceedingly wealthy, and the raising of fresh capital for extending works would never be difficult to achieve. It cannot be denied that the new Westinghouse Company is in a strong position, and will be able, no doubt, to meet the stress of competition; at the same time, despite its accumulated knowledge and experience, it would be a mistake to underrate the strength of English contractors. On the other hand, English manufacturers ought not to assume that the direct competition which the Westinghouse Company will be able to bring into the field will not be a serious one, the reputation of the company alone would secure them a large business, and the fact that they start out with an established connection makes the company all the more formidable. Although Americans will be largely, if not solely, employed in the direction of this large business, it possesses the advantage of a British directorate, and British capital will supply the sinews of war. The strength of the position of the Westinghouse Company will be largely reinforced by the American house, which will in all matters help its English offshoot. From a spectator's point of view it will be interesting to watch the growth of this American factory—for such, in fact, it is—and notice in what direction their methods are superior to our own. That they will involve great departures from ordinary English practice none could deny, and in that respect it may serve to stimulate English manufacturers to adopt newer methods where they are found to be superior to theirs. It is fully expected that the improved system of manufacture which the company will import from America will enable them to increase the individual output, and that alone ought to determine home manufacturers to introduce fast-running tools, without which it is impossible to obtain that rapid output of work which is so essential in these days of high pressure. Probably existing manufacturers will view the impending competition with a certain amount of equanimity; their shops are full of work, and it is unlikely that any new competitor will, for some time to come, exercise much effect on their business; moreover, there is every probability that the boom in electrical affairs may continue for several years. But there is bound to be eventually a falling off in the demand, and it is during periods of depression, and when orders are few, that superior organisation and more economical methods of production begin to tell. If the new company realises expectations, it ought to show to a marked degree the advantage of manufacturing on a large scale. How far the Westinghouse methods are superior to our own remains to be seen.

It would be wrong to regard the British Westinghouse Company in a hostile spirit; even if it were more foreign in character one could hardly wish it otherwise than a permanent success. It enters the electrical field at a time when the demand is greater than the supply; it will supply machinery of undoubted excellence, and its affairs will be managed by men of experience. Under those conditions it is difficult to see why it should fail.

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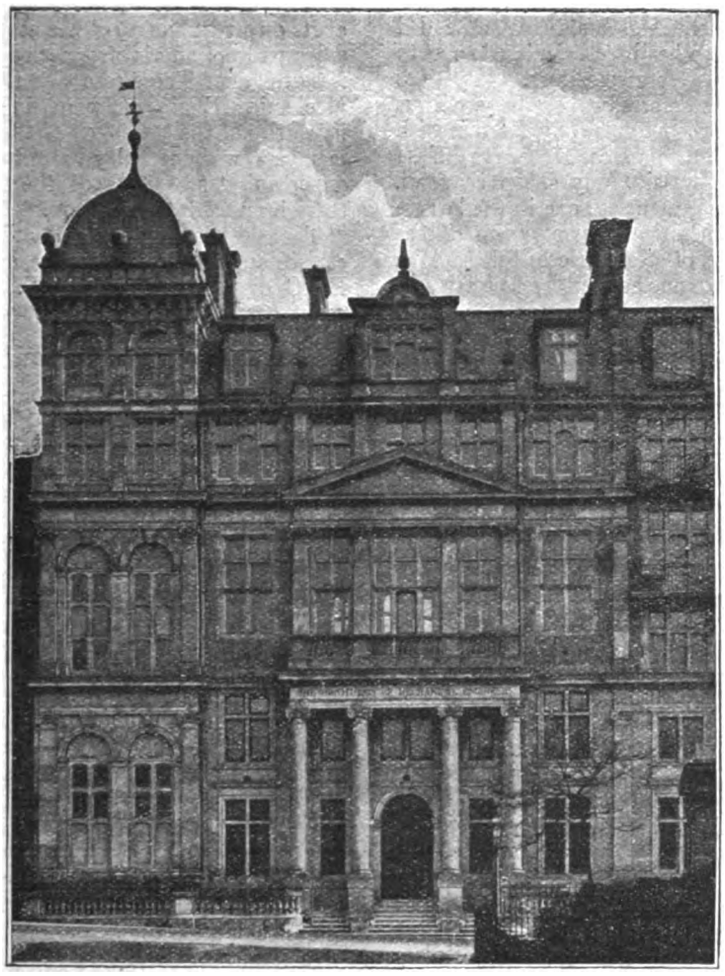
INSTITUTION OF MECHANICAL ENGINEERS.

The Institution of Mechanical Engineers entered into possession of its new home at Storey's Gate on Tuesday, May 16th, an event marking the commencement of a most important era in the history of the Institution. Hitherto the meetings of the Institution have been held by the kindness of the Council of the Institution of Civil Engineers at the Institution, 25, Great George Street, and the members have always felt that such a condition of things was hardly consistent with the rapidly increasing growth and importance of the Institution of Mechanical Engineers.

The design of the new buildings, which were formally opened on May 16th, received the most careful attention of the committee appointed by the Council for the purpose of settling such details; in fact, it may be stated that the labours of this committee have extended over nearly five years. The result, however, cannot fail to reflect great credit upon the individual members in their several capacities, each and every one of whom has spared neither time nor trouble, and has given his best attention to the thousand and one matters that came under consideration from time to time.



Institution of Mechanical Engineers.

The building has an extremely handsome exterior, the façade being of Portland stone and red brick. The architect, Mr. Basil Slade, is greatly to be congratulated upon the result of his labour, and a brief extract from his own description of the building will, perhaps, best convey an accurate idea to the minds of our readers:—

"The entrance-hall and staircase are treated with Hungarian oak panelings, floorings, arcadings, balusters, newels, &c., French polished, and surmounted by plain Persian red walls and enriched ceilings.

"Immediately opposite the entrance is the main doorway into the lecture theatre. This apartment has a Georgian ceiling with central glass dome, from which the room is lighted by day, and by night from a cluster of incandescent electric hanging lamps. The floor is constructed of movable platforms, which can be arranged to form terraces or a level floor, as desired.

"The ornamental ceiling is hung from the top and free from walls, and has a bold cove, behind which the wall-diagram rollers are hidden. It is trusted this arrangement of ceiling will give good acoustic results, and prevent any echo.

"On this floor, approached by a broad corridor, is the council chamber, a room treated with a more Jacobean freedom, with an oaken ribbed star pattern ceiling, and a bold cove for the cornice.

"On the entresol floor below is found the marble tea room or withdrawing room, running under the full length of the entrance hall. This room has been lined and decorated with costly marbles throughout; floors, walls, arcadings, and access staircases have been treated with both new and rare stones. The treatment is of latter date, in style following the Italian. The pilasters are antique sienna with statuary white caps and bases; the surbase is of dark dove with dado of cippolino and verte antique plinth. The panels are picked Mexican onyx, arranged to show the veining to best advantage, with delicate outline or border of pale dove with pavonazzi ground; the whole surmounted with a light statuary moulding and cippolino frieze.

"The ceiling is kept simple in design, with a few lines of gold to enhance the contract of the richly-coloured walls. The flooring is of piastraccia and dark grande antique squares.

"The tea room is served by a kitchen and pantry adjoining.

"On the same floor is to be found the principal lavatory, also treated in marbles, teaks, &c.

"The space under the lecture hall is occupied by two floors of very extensive area with annexes for the storage of 'proceedings' and other papers, amply large enough to provide accommodation for many years to come.

"On the basement floor are to be found the boiler room, ventilation ducts, and general electrical and mechanical accessories.

"Reascending the stairs, to above the entrance hall, is found the reading and smoking room — a room all in white of a simple Georgian character. On the same floor are the secretarial offices and galleries of the lecture hall.

"The fine and light hand-wrought iron work to the staircase and lift shaft deserves special notice.

"The whole of the floor above is occupied with the library, a lofty apartment with annexes and book-galleries. A bold cove and pendative ceiling is brought forward over the book-cases, giving the appearance of the books being recessed in the walls.

"The library is treated in the Elizabethan style, Hungarian picked oak being used throughout. The upper gallery is supported by bold cantilever oak modillions and Ionic columns and caps standing on a table-height shelf.

"Bastard statuary pilasters, an oaken impost, and arcades separate the main library from the annexes.

"The remainder of the building is occupied with offices for the staff, a room for the meetings of graduates, spacious drawing and diagram rooms, and apartments for the housekeeper.

"The principal rooms are ventilated on the plenum system. The fresh air is drawn by an electrically-driven fan, 4 feet diameter, from the north area in the park, and cleansed over fibre screens automatically washed with water, then passed over a radiation coil and along a duct up to the various apartments, whence the vitiated air is forced up vents to the top of the building."

The lecture hall and its equipment have, perhaps, received more attention and consideration than any other part of the building. Of course, in a sense, the success of such an Insti-

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tution building is conditioned by the character of the lecture hall. It is here that the main business of the Institution is transacted, and no attractions in other parts of the building can possibly atone for bad acoustics, indifferent lighting, or inconvenient equipment in the lecture hall.

Perhaps the most novel feature is the introduction of movable platforms composing the floor of the hall. This idea, we believe, originated with Mr. W. H. Maw, chairman of the House Committee. By this means a level floor or a floor rising in tiers, can be arranged at will. As far as our knowledge goes, such an arrangement has never before been introduced in a lecture hall.

The acoustic property is excellent, it being an extremely easy room to speak in, and entirely free from echo. A gallery runs the whole width of the room at the back, and affords accommodation for a lantern by means of which views of all descriptions can be thrown upon the screen. Around three sides of the room, wall diagram rollers are fitted high up behind the cove, thus being entirely out of sight when not required. The hall is lighted entirely from the central octagonal glass dome, eight 100-candle-power incandescent lamps enclosed in holophane globes, being suspended one from each angle. The drop has been calculated so as to light the whole of the beautiful Georgian ceiling, and yet not extend below the sight line of members in the gallery. Thus any member in any part of the room can see any diagram with equal facility. The effect of the holophane globe is to diffuse the light and entirely do away with any sharp shadows. Two sets of two-way switches are fitted, one in the lecture hall and one in the gallery within convenient reach of the lantern operator, and by means of an electric bell fitted with plug attachment under the table on the platform, signals can be transmitted to the lantern operator in the case of a paper illustrated by slides according to a pre-arranged signal, thus lending perfect smoothness to the alternation of the views as the paper proceeds. By means of the two-way switches, it is possible to turn the lights on or off either from the gallery or from the lecture hall floor. In addition to this, a double-pole switch is fitted in the gallery by means of which the lantern operator can turn off all the eight lights and turn them on at will. A 40-ampere plug protected by a double-pole switch is also fitted in the gallery for use with the electric lantern or for driving models or other gear; about 10 H.P. can be taken from this plug. A similar plug protected in a similar manner is fitted behind the lecture table on the platform for a similar purpose.

Throughout the building clock faces have been fitted, the hands of which are actuated by electricity from a master clock in the basement. The hands are moved forward every half minute simultaneously all over the building. The clocks were erected by Messrs. The Synchronome Company, Limited.

The building is fitted with two lifts, one for passengers and the other for books, &c. Both are operated by electricity and were erected by the Otis Elevator Company. All the ventilating fans throughout the building are driven by electric motors; in fact, with the exception of the heating, it may be said that electricity has been employed for every purpose usually required in such a building. The wiring was carried out upon the continuous conduit principle by Mr. V. G. Middleton, the contractor selected to execute the work. The principle of sub-division has been rigidly adhered to, the lights on each floor being served by a separate pair of mains terminating at the distributing fuse-board from which circuits are taken off through a fuse on each pole to feed groups of not more than eight lamps each. Separate mains have been run for all motive power, and special precautions have been taken in the design of the fuse-boards in order to suit the higher voltage adopted. The main switch and distributing boards are arranged with a view to a possible extension by the Supply Company of the principle of higher voltage. In regard to the fittings, the aim has been to secure efficiency of lighting combined with simplicity and grace of design. The Florentine bronze pendants in the entrance hall and reading room are from designs by Messrs. Hardman & Powell, who also manufactured the brackets for the staircases and library. These latter were designed by Mr. B. Slade, the architect of the building, and have already evoked much attention on account of their simple but attractive design.

The superficial area of the site available rendered a number of floors necessary to obtain the required space. At the same time little fault is to be found with the size of the lecture hall, which is an extremely fine room, 60 feet long by 40 feet broad by 40 feet high. The lecture hall, Council room, secretary's office, and other important parts of the building, are connected by a complete system of speaking tubes and electric bells. At each entrance also there is an electric alarm bell which is to be used in case of fire or other urgent necessity, each push communicating with and ringing simultaneously gongs erected in various parts of the building so as to ensure someone's attention being attracted in the event of the alarm bell being used.

A complete fire service has been fitted up by Messrs. Merryweather.

Of a building such as this it is impossible to write adequately in a few lines. It represents the result of years of thought on the part of a large number of co-operating experts, each skilled in his own particular subject. The system of ventilation, the marble design, the wood carving, the system of heating, &c., each might well have an article devoted to it since each represents the highest development of its own particular science at the present date. However, space will not admit of our entering into details at length in these matters. Those who wish to study the new Institution of Mechanical Engineers, which in all its mechanical appliances is worthy of the traditions of the Institution, should become members without delay in order to have ample time and opportunity for study of the various mechanical devices there brought into operation.

The electric lighting and other electric equipment were carried out under the design and superintendence of Mr. Ed. C. de Segundo, A.M.I.C.E.

INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(*Continued from Vol.* 44, *page* 1053.)

Roller Bearings.

The importance of diminishing the friction between the axles and the bearings in the journal boxes, is self-evident, especially when starting a car from rest, where to overcome the inertia, the expenditure of current is most wasteful at the ordinary voltage. The difference between rolling and rubbing friction, even with polished surfaces, is exemplified by the rate of inclination of the planes on which a roller and a flat die of the same weight and depth will respectively start moving from rest. A rate of inclination of 1 in 200 will produce motion in the former, while it requires 1 in 14 to do so in the latter, the ratio per cent. being as 1 to 14; or, in other words, the resistance to motion produced by rolling friction is but one-fourteenth of that of rubbing friction. Ball bearings in case of heavily loaded journals are unsuitable owing to the fact that the load is carried on an interrupted line of points or on several separate parallel lines of the same character. The coefficient of rolling friction within certain limits increases inversely as the diameter of the wheel or roller, that is, the smaller the diameter the greater the amount of friction generated between the surfaces in contact. With ball bearings presenting an interrupted line of points the greater the diameter of the balls the greater the distance between the points of support and the smaller the bearing surface of the journals. To increase the amount of bearing surface, the balls have to be decreased in diameter and the number of parallel lines forming the ball path increased, the result being a heavy proportional increase in the journal friction and an undesirable increase in the width of the journal boxes to hold the extended ball paths. The great advantage afforded by substituting a roller of the same diameter for a ball lies in the fact that with a prescribed minimum journal bearing surface the width of the journal boxes with rollers can be made about the fortieth part of what balls would require. A roller path like a ball path presents along the width of the journal boxes a series of

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continuous lines instead of interrupted lines of points as the bearing surfaces between the journals and the axle boxes. In practice, the actual contact surface of a 1-inch ball in a loaded bearing is about one-fortieth of the actual contact surface of a cylinder of the same diameter 1 inch in length.

Ball bearings for cycle purposes, and for all machinery where the load on the bearings is comparatively small, will undoubtedly hold their own and leave little to be desired in the way of improvement, but there can be no question as to the superiority of roller bearings where the load is great, in respect to compactness and diminution in the wear and tear of the journal box liners and the journals themselves.

The rollers or cylinders used in bearings may be either solid and rigid, or elastic and flexible. The first type has been manufactured in Great Britain for some years by the Roller Bearings Company, Limited, and has met with considerable success and favour on railways and tramways both in the United Kingdom, the Continent, and the Colonies. These rollers are made like the balls for ball bearings, of hardened and tempered crucible steel ground down to the utmost perfection of surface and dimensions. They are controlled and held in correct relative position by a floating cage; the axle box liners are also made of steel hardened and finished to the greatest accuracy. The conditions precedent to satisfactory working in these bearings are that all the rollers in the path shall be of exactly the same size, perfectly finished, and kept absolutely parallel with the journal or shaft, and the latter parallel with the liners of the axle box. These conditions are difficult to ensure in tramway practice where the unavoidable unevenness of the road bed and the constant shifting of the load in the car causes the pressure between the journal and the boxes to be constantly varying in amount and distribution, disturbing the position of the rollers in the floating cage. Hence the rigid and solid roller bearing is better fitted for fixed machinery

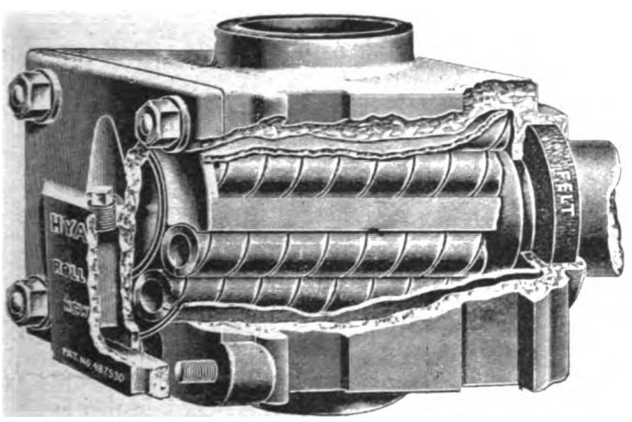

Fig. 47.—Axle Box for Electric Tramway Car.

than for electric traction purposes. On the other hand, the elastic and flexible roller is exactly what is required. In this type (fig. 47) the rollers are formed of a cylindrically coiled steel ribbon, and they are, therefore, elastic in the direction of their diameter and flexible longitudinally, and are able to readily adapt themselves to all the varying conditions of pressure between the journals and the box liners. These coiled rollers are made of untempered open hearth steel, and do not require the accurate finish of the solid roller. Neither do the journals or the box liners require special finish or accuracy in their construction. They are held in position by a yoke guide of gun-metal; the liners are made of sheet steel with a spiral joint, and a similar sleeve is slipped over the axle, the rollers travelling between the two. The sleeves obviate the necessity for specially finished surfaces on journals or box, and form a wearing surface much more durable than wrought or cast-iron. These bearings are known as the Hyatt roller bearings after the name of the inventor.

The Franklin Institute has lately carried out some conclusive experiments to test the relative merits of solid and flexible roller bearings, the latter being helically coiled and elastic, both transversely and longitudinally, of the Hyatt roller type. The frictional resistance of the two types of bearing was carefully measured and compared. The rollers were 11 inches long and ¾-inch in diameter, and four of each type were used. Tested between smooth plates the flexible roller bearings showed a frictional resistance amounting to only 48 per cent. of that of the solid rollers, and when between rough plates the average coefficient amounted to 77 per cent. of the same.

The special advantages of roller bearings for electric traction purposes, as compared with ordinary brasses, may be summarised as follows:—

1. Lubrication more thorough and requiring less attention and less frequent renewal.
2. Bearings more cleanly in operation, and wear and tear and risk of heating reduced to a minimum, &c.
3. Power required to start a car reduced, in some cases, to one-tenth, and that required to keep it in motion to three-quarters.

The importance of the third advantage enumerated above in electric traction cannot be over-estimated, as by this means the heavy strain on the motor at starting, which is so often the cause of burned out armatures, is relieved; less power is wasted on the rheostat, and the car is started with less shock and jerk to the passengers. The economy in power effected by the use of these bearings may often save overloading a central station or a line wire, and thus avoid costly burn outs or the enforced substitution of line wire of larger sectional area at a comparatively earlier date than ought to be necessary on a given road. These bearings have a record of over 150,000 miles per set without repairs, and with this record it was found that neither rollers nor bearings had reached their limit of durability, the wear shown being very slight.

Life Guards.

Although the fencing of railways in the United Kingdom has almost entirely done away with the necessity for cow catchers in front of the engines, the guards in front of the wheel being as a rule amply sufficient to remove all accidental obstructions, while in horse tramways the pace is so limited that it is generally easily possible to avoid running over anything that may get in the way, the case is quite different when we come to electric tramways. Here the speeds are comparable to railway speeds, and it would often be impossible to draw up in time to avoid running over a human being or an animal who accidentally or designedly got suddenly in the way. It is most important both for safety and for humanitarian reasons to provide a means of preventing any living obstruction from passing beneath the wheels if it should happen to be knocked down by a motor car or be lying in its way across the track. An adjunct of the character of a cow catcher would no doubt save the car but it would inevitably seriously injure the obstruction. To avoid this the life guards must be spring balanced with the outer edge close to the rails, and possess an elastic platform of sufficient area to support and carry the obstruction till the car can be brought to a standstill. The Peckham adjustable life and wheel guard, of which fig. 48 gives a general view,

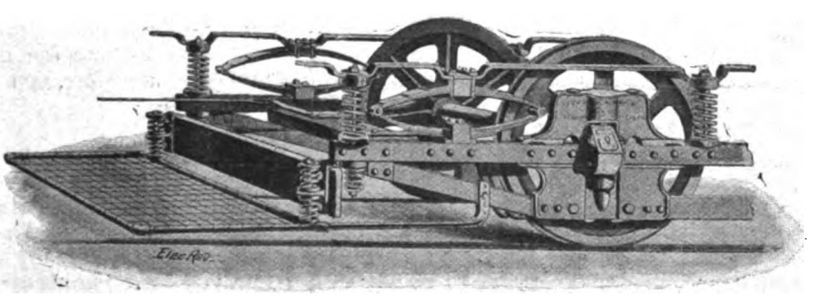

Fig. 48.

meets the requirements indicated above most satisfactorily. The rectangular frame carrying a netting has two arms which are bolted to the lower frame of the truck truss as shown in the figure, and is supported about half way along its length by a pair of double springs attached to the end of

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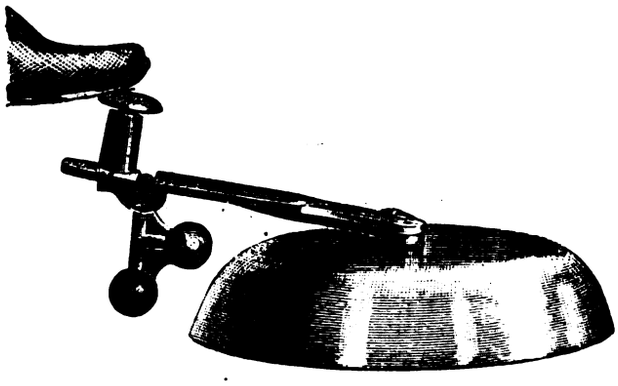
the cantilever framing. These double springs allow the fender to move up and down with sufficient freedom to adjust itself to any weight it may carry, and they also absorb and quickly do away with oscillations which might cripple the fender by bringing it into repeated contact with the road or through throwing off anything carried on the fender. The outer edge of this is carried low, but the spring arrangement enables it to lift automatically over any small inequalities of the road and to depress easily to meet and catch up out of the way of the wheels any obstruction lying on the road. This combined life and wheel guard is strong, light, elastic, and easy of adjustment, and can be carried at any desired height above the rails, and being placed in close proximity to the wheels, does not come too soon into operation, and hence allows of considerable reduction of speed before obstructions are struck, lifted, and carried forward by the cars.

Gongs.

In the old horse car the gong is used simply for notifying the driver when to stop and drive on, or, in other words, for the passenger's benefit, obstructing traffic or persons, being warned by the driver's whistle, but in electric cars the whistle is no longer sufficient for the latter purpose, and a foot gong has to take its place. The motorman requires a means of unequivocally notifying the approach of the car at a much greater distance than is the case in the horse cars, and the steam whistle not being available, the foot gong has provided the requisite means of doing this. These gongs have to be actuated by the foot for the same reason as the sand box has to be worked in this way, because the motorman's hands and attention are required and occupied in other indispensable ways. Fig. 49 shows



Foot Gong.
Fig. 49.

the arrangement and action of such a gong, as manufactured by the Ohio Brass Company.

Track Scrapers.

No one who has observed the way in which the grooves in the rail heads on horse tramways are cleared, by running a long deep shovel with a projecting depressed lip along the rails, a man armed with this weapon at the end of a long handle, working along each rail in succession, can have done otherwise than marvel that such a primitive process could have continued so long in use. The speed and other conditions of working tramlines by electricity render it imperative to substitute a more reasonable system in their case, and make it indispensable to add an efficient scraper to each car end as a permanent adjunct of its equipment. The leading scraper is the one operated in every case, and effective traction is secured by its use whenever the rails are greasy and the grooves choked by dirt, mud, snow or ice, the scraper cleaning the rail thoroughly before the wheels pass over them. The principle on which these scrapers are constructed can be readily gathered from the accompanying figure (fig. 50), where it will be seen that the scrapers consist of plates with a projection fitting into the rail groove fixed at an angle to the axis of the truck so as to self clear the materials scraped from the track. These plates are borne upon arms fastened to a bar working in two sockets in the truck frame, a plate is fixed vertically at the centre of this bar, to the ends of which the ends of a chain are fastened, which run round a worm at the bottom of a vertical ratchet post moved by an ordinary ratchet brake handle. The whole arrangement is simple, light, effective and inexpensive.

Track Brush.

The necessary complement of the track scraper is the track brush. This finally clears away all the mud, &c., dislodged

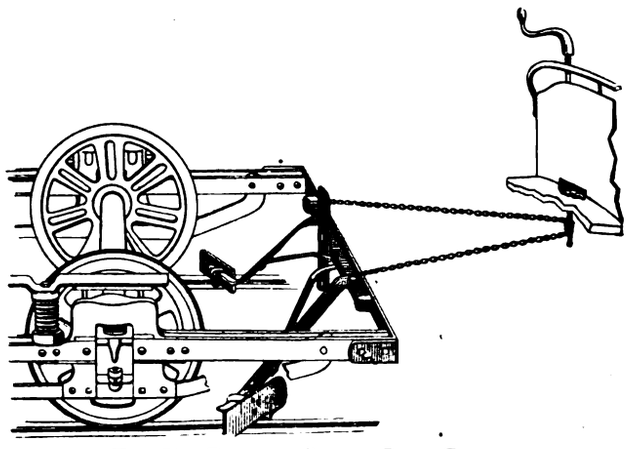


Fig. 50.—Peckham Patent Track Scraper.

by the scraper which would otherwise once more become spread over the rails and fill up the flange groove, and thus interfere with the proper propulsion of the cars. The track brushes are fitted to the guard boards at either end of the car with sufficient clearance from the rail when thrown out of work to prevent the wire heads from touching. There are two forms of holders in use, both produced by the Ohio Brass Company, fig. 51, known as the "adjustable," and

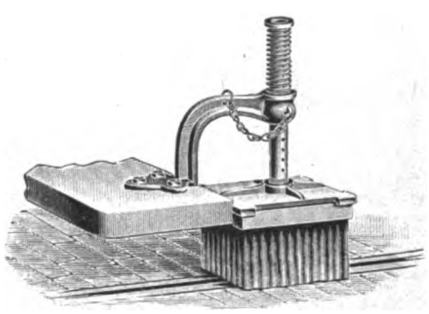


Fig. 51.—Track Brush.

the other as the "reversible and adjustable," both being fitted to either vertical, horizontal or inclined guard boards as required. With the first the brush is placed in position by depressing the pipe standard, compressing the spring, and inserting a cotter into a hole in the standard at the required height, the brush being disengaged by the action of the spring when the cotter is removed. In the second form the height of the brush is not adjustable and the disengaging is effected by throwing up the holder, the engaging being automatic on the holder being thrown down. The sole advantage of this form lies in the brushes being examinable without removal, but their not being adjustable, as in the first form, is a decided drawback. These adjustable track brush-holders increase the life of the brushes some 500 per cent., and, therefore, save expense and trouble.

Sand Box.

The accessory which follows next upon the track scraper in importance as an economiser of power and an improver of tractive efficiency is the sand box. To be efficient this must be arranged so as to be readily brought into use without entailing any distraction of the motorman's attention from driving his car, and must, therefore, be actuated by a movement of his foot. The internal construction must be such that the sand should never cake in the tapering funnel and shall always run easily and freely. The accompanying fig. 52 shows a type of sand box which meets both these requirements very satisfactorily. It is actuated by the pressure of the motorman's foot on the projecting stud, and the wedge piece vertically fixed above the valve effectually prevents the sand from caking.

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HEATERS.

Although in the Southern portion, at least, of the British Isles the question of heating tramway cars can practically be ignored, for it is only once in many years that a winter occurs

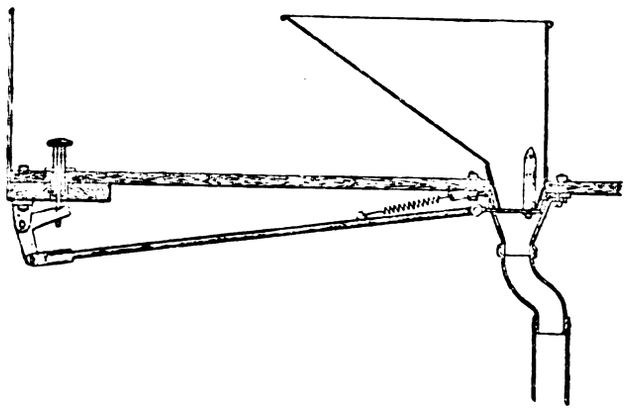

FIG. 52.—DIXOTT "COMMON SENSE" SAND BOX.

when heating is required, still in the Northern parts of the same Island winter can be depended upon as a yearly event, and not a mere accident, and there the question of the suitable form of car heating is one of considerable interest to the public travelling on electric tramways. Just as on railways the only satisfactory method of heating is by steam, so on electric tramways the only satisfactory method is by electricity. In both cases the propelling power is thus utilised for heating purposes. In the United States the heating of railway carriages is generally effected by a closed stove burning anthracite or coke placed in one corner of the car, and to this stove can be traced some of the most appalling consequences of railway accidents. On the other hand, on British railways the chemical or hot-water foot warmer is generally the safe but wholly inefficient medium for conveying warmth to the feet of long journey passengers. Both of these methods of heating have found their application on tramcars, electric and otherwise, but neither can be called a success. The stove takes up too much room and requires more attention than the employés can find time to bestow, and the foot-warmer is even worse in a tramcar than in a railway carriage, as it cools far quicker and cannot so readily be replenished or exchanged. What is required in a heater to make it efficient for tramway purposes is that it should be: (1) light and compact, (2) easily manipulated by motorman or conductor, (3) not subject to getting out of order, (4) giving a uniformly distributed heat, which can readily be regulated between certain limits, (5) applicable without structural alterations to any form of car body.

(To be continued.)

REVIEWS.

Unités Electriques Absolues. Leçons Professées à la Sorbonne. Par M. G. LIPPMANN, Membre de l'Institut. Rédigées par M. A. BERGET, Docteur ès Sciences. Paris: Georges Carré et C. Naud. 1899.

This reprint of a course of professional lectures at the Sorbonne is a more important piece of work than its modest title indicates. It is a clear, consecutive introduction to the electrical argument of the ether. The book opens with an introduction dealing with physical dimensions; then follows a section of five chapters on the electrostatic system, leading to a statement of the circumstances in which energy is stored in the charges, and of the electrostatic system of dimensions. A section of five chapters on the magnetic system is succeeded by a chapter on the relation between the two systems of units, the meaning of the quantity v, and the different methods for its determination. The theorem of Kirchhoff that a disturbance travels along a conductor of small resistance with the velocity v, introduces the conception of v as the velocity of transmission through a medium, and terminates the section. A chapter follows, giving a brief statement—too brief—of Maxwell's theory of the mode of transmission of the simplest electrical disturbance—a plane wave—in a non-conducting medium, and some account of the identification of the corresponding speed with the known velocity of light. A final chapter on the two principles of the conservation of energy and electricity and their application to reasoning on the properties of matter concludes the argument. An appendix describing an ingenious mercurial galvanometer is like the seal of a document; it identifies the writer, but adds nothing to the substance of the writing.

M. Lippmann's treatment of the subject is that of a physicist, not of a mathematician. Much of his argument is, of course, stated in symbolic form for reasons of brevity, but there is very little which could not be clearly given in words. The object set out in the preface is conspicuous before the author's mind at every point. He desires to state briefly, lucidly, cogently, the experimental facts, and the course of reasoning that have established the accepted theory of electrical action, and he recognises that neither exact statement, nor clear apprehension of the argument, requires the use of the specialised logical processes of higher mathematics. Simplicity of treatment is the note of the book.

Pourtant la complexité de cet ensemble n'est qu'apparente. Les unités absolues ne servent qu'à simplifier les trois équations élémentaires qui régissent les phénomènes de l'attraction électrique, de l'électromagnétisme, et de l'induction. Ce sont ces trois équations élémentaires qui, seules, sont mises en œuvre dans tous les problèmes, sans que l'on ait à faire intervenir de théories ou d'hypothèses supplémentaires. Si l'édifice est grand, la charpente en est simple: c'est ce que j'ai cherché à mettre en évidence dans ces Leçons. On n'y trouvera donc qu'une analyse limitée au strict nécessaire, et que des descriptions de méthodes et d'appareils réduits presque à leurs principes.

In several ways M. Lippmann's treatment of the subject differs from that of the English books. The electrical potential at a point is defined in the first place as a geometrical function of the distances from the charges, not as the measure of the energy of a charge placed there; and care is taken not to suggest any similarity between electrical energy and a force function. The student's attention is drawn directly to the analogy of the movement of electricity with that of heat, and away from any analogy with the movement of matter. The question between the two modes of treatment is one of educational convenience, and the success of the teaching is the critical test. M. Lippmann's method seems to have the disadvantage that the student's previous familiarity with the notions of mechanics and attractions, which though difficult must of necessity be acquired, is not made much use of. On the other hand, it leads to the exceedingly elegant treatment of problems by means of reversible and irreversible cycles, similar to those used in the theory of heat. We have not seen this interesting treatment used in any other educational work on electricity. On the whole, M. Lippmann seems to be quite right. The difference between the flow of a frictionless massless fluid, such as a student must inevitably, for the present, picture in his mind electricity to be, and the movements of rigid bodies, is so great that the student may lose more time than he gains by learning to extend, to the properties of electricity, the dynamical conceptions obtained from the mechanics of rigid bodies. At the same time, M. Lippmann is careful to point out the great distinction between the modes of the flow of heat and electricity along conductors, and gives Kirchhoff's proof, that in a steady flow of electricity there is no charge in the mass of the conductor, an argument that leads inevitably to the corollary that the flow of energy takes place in the dielectric.

Among points that have attracted our notice in reading this book we may mention Prof. Lippmann's absolute electrometer, the measurement of resistance in absolute measure in electrostatic units, and the very clear account of seven different ways of measuring it in electro-magnetic units. The representation of the couple produced by an element of current on a magnetic pole, and the proof that it vanishes with a closed circuit, is an elegant geometrical proposition, but exhibits forcibly the artificiality of the whole conception of single poles. We note an error here: the angle, θ, on which the argument turns is the complement of that defined. In Kirchhoff's important theorem of the propagation of an electric disturbance along a wire, v is introduced in a way

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that is unintelligible without further explanation, but the editor has probably omitted matter that the professor would have introduced into a verbal discourse.

The final chapter on the principles of conservation of energy and electricity is of great interest, as employing a mode of reasoning not commonly found in educational works on the subject.

We have given to the notice of this work more than usual space, because, more than any other comparatively elementary book we know, it is cast in the mould of logical sequence, not of the historical succession of discovery. M. Lippmann has extracted from the material of elementary works on electricity only what is necessary for a statement of his theory, and from the two primary facts, the mutual actions of two charges at rest and of two charges in motion, giving the electrostatic and the electro-magnetic forces, he advances up to the theory of the propagation of electrical disturbance in a dielectric, and places the student in a secure position for further advance. The introduction of the idea of a magnetic pole, an idea connected only with the properties of iron and quite superfluous in the subject of electro-dynamics, is rendered inevitable by the definitions of the units. We greatly appreciate a book which places the electrical argument so clearly before students, free from the symbolic haze so repulsive to some, and from the mass of experimental detail not to be assimilated by others.

En resumé, je n'ai pas songé à condenser, en un court volume la matière de plusieurs ouvrages spéciaux. Je désire seulement avoir rendu l'étude de l'Electricité plus claire pour les jeunes physiciens, peut-être aussi pour quelques mathématiciens curieux: ceux la n'ignorent pas combien il importe de savoir, en Physique Mathématique, ce que l'on met dans ses équations.

Municipal Electricity Supply. By A. H. Gibbings.

We have received a copy of the above publication, which deals almost solely with the "Commercial and Business Aspects" of municipal supply. In the preface the author says:—"My experience teaches me that it is the want of a *full, exact, and comprehensive knowledge*, which accounts in too many cases for a hesitating and unbusinesslike policy on the part of electricity committees. I have, therefore, endeavoured to present the matter in such a form, that the ordinary business man may gain *some idea* of the peculiar conditions which render the supply of electric energy different from that of most marketable commodities." (Italics ours.) The author is too modest, for if his book will not do more than give "*some idea*" to his non-technical readers who possess business instincts, they must be very dense indeed, and we can hardly see the object of writing a book with the intention of giving "some idea," when a "full, exact, and comprehensive knowledge" is said to be necessary, except upon the socialistic principle of a gradual education, so that unborn generations may reap the full advantage of hereditary training.

The book is divided into 12 sections. Section I. deals with Committees of Management, and is practically a *résumé* of a paper read by the author at the last Convention of the Municipal Electrical Association. An extract of three or four lines will explain the objects of the section:—"In a few years the necessity will arise in all but the very smallest townships to form numerous small sub-committees, each of which will be separately responsible to a main or general committee." This is a debatable subject, and amongst municipal engineers opinions are divided, some holding the view that supervision of detail by committees or sub-committees is even now frequently overdone. With this view we are inclined to agree, when we see committees taking a tour all over Great Britain, or, perhaps, the Continent, in order to settle a point upon which their engineer should be quite competent to advise them. Directors of large companies leave such matters of detail to their officers, and wisely so, we think.

Section II. deals with the wiring of premises by the local authority. Quoting the Corporation of Bolton, who do their own wiring, it says:—"Another advantage gained by doing wiring is, that should anything go wrong, our customers have only one party to deal with, viz., the Corporation." From the customer's point of view this is doubtless an advantage, but we should hardly think it is so to the Corporation.

Section III. deals with the various methods of charging for energy.

Section IV. refers to electric motive power, and shows the advantages to be derived both by the user and the undertaker by its extended adoption. In replying to the objection that in the winter the motor load overlaps the lighting load, the author says:—"A certain proportion of the power for motors is bound to overlap the maximum of the lighting load, but the greater proportion undoubtedly occurs before 5 p.m. throughout the year." As in London in foggy weather it is frequently quite dark at 4 p.m. or earlier, the overlap may be serious if motive power to any great extent is demanded.

Section V. is a detailed description of the system of "hiring out of motors, arc lamps, &c.," as adopted by the Bradford Corporation, including the book-keeping with book heading report forms, invoices, &c., complete. In this section also appears "Directions to be observed to ensure the safe and satisfactory working of Electric Motors," including amongst other directions the following:—"The motor must never be started with load on," and "it must not be used until full speed has been attained." Both very desirable precautions, but what becomes of the objection so frequently urged against the use of alternating current motors, viz, that they cannot be started on load?

Section VI. is a dissertation on the advantages of "free wiring" when conducted by a well-known "Free Wiring Company," and we should think the remainder of the numerous advertisers in the book will be justly jealous when they discover that this firm practically monopolises a whole section of nearly 17 pages.

Section VII. deals with and describes the merits of the system of free supply of incandescent lamps in vogue at Bradford. The author points out that the terms "free wiring" and "free supply of lamps" are incorrect, but are used for convenience. As a matter of fact, the lamps are "given away" very much as the teapot and other things are "given away with a pound of tea."

Section VIII. describes the method of supply by means of "penny-in-the-slot," or prepayment meters, and goes considerably beyond the alleged object of the book in describing at length the detail construction of different meters, and one case apparently consists of the greater part of the patent specification, including the detail drawings.

In Section IX., on side-street lighting, the author waxes justly enthusiastic as regards public lighting by electricity generally, and we cannot help admiring his confidence when he says: "It may be taken for granted that it has already been amply proved that arc lighting is the most satisfactory, the most economical, and, in fact, the only practically possible way of lighting the main streets of any town, and that all other methods will shortly become obsolete." The systems of lighting side streets by means of incandescent lamps, as adopted by Bradford, Brighton, Chelmsford, Hanley, Derby, Portsmouth, Taunton, and other places, are described, and a good case made out in their favour.

Section X. is headed, "Fitting up and Managing a Corporation Showroom," but consists chiefly of a list and particulars of the various causes of dissatisfaction of the public. The author in this section refers to the notable unreliability of fuses, and considers that a more desirable arrangement would be a maximum current automatic cut-out switch, which could be readily replaced by the consumer. We are of opinion, however, that if fuses are troublesome, automatic switches would be far more so, as the rush of current due to a momentary short has been known to knock over main cut-outs before the small single-lamp fuse could "go," thus putting a whole house in darkness where only one lamp would have been extinguished had the much-maligned "main fuse" been used instead.

Section XI. deals with extensions to outlying districts, and the last section describes various purposes for which electrical energy may be used. The book contains much that is of interest to municipal men, and should be the means, if read by members of committees, of giving them a far better idea of the commercial side of electricity supply than many of them now possess. At the same time, we are of opinion that much of the matter is irrelevant, and might with advantage have been omitted.

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Dictionnaire Technique, Francais-Anglais, des outils et utensiles employés dans les métiers manuels, la petite industrie, le ménage, &c. By A. S. Lovendal. Paris: Boyveau et Chevillet.

This is a small collection of the names of tools used by French mechanics with English equivalents or translations, and contains many curious and unfamiliar terms. The tools referred to are exclusively those used in a few small manual trades, and the book would be useful rather to tool and hardware dealers than to engineers. The arrangement of matter of this kind is obviously rather difficult. The editor disposes the items in two ways. He collects together the names of all the different tools of one kind, where these are numerous, as in the case of files, of which more than 120 different sorts are named, and of pliers, about 100 different sorts; and collects together the names of tools used in each particular trade. This is probably convenient for persons who have some knowledge of the subject they are dealing with, but very inconvenient when that knowledge is absent. In the advertisement are mentioned several French tools with curious names, as instances of the difficulty of recognising such terms without a book of this kind. We wonder how many Englishmen would know the meaning of *Fer de moulure de doucine, Bigorne, Vastringue, Bedane.* The book should interest lexicographers.

CORRESPONDENCE.

The Price of Electrical Energy at Morecambe.

Referring to the notes on the above in last week's issue, I should like to point out that as Morecambe is quite a summer resort, many of the shops and restaurants, as well as the piers, &c., close during the winter season. The former are charged 5d. per unit, whereas the latter have had the charge increased to 7d. per unit.

I may mention that a firm of electrical contractors have been fitting up one of the piers since the beginning of the year. When nearly completed, the Pier Company are informed by the Council's engineer, who also is, or was, the Pier Company's consulting engineer, that the price to them would be 7d. per B.T.U. Subsequently we hear of the gas-fitters on the job.

Can the Council afford to lose such consumers? I hardly think so.

Their summer load corresponds exactly with the winter load of most inland towns, where there are similar consumers to the piers, &c., but up to the present I have not heard of any town increasing the price to such consumers 40 per cent. per unit, which, without doubt, is exorbitant.

Personally, I should advise the Council to adopt the "Wright" system of charging and equalise the above prices.

D. O. F.

July 12th, 1899.

Electrolytic Methods of Zinc Extraction.

My attention has been drawn to an article appearing in your issue of July 14th, entitled "The Electrolytic Methods of Zinc Extraction"; I should like to point out several errors occurring in the particulars given of my process. In the first place, the process has not been tried by the British Broken Hill Company in New South Wales; in the second, the works in Cornwall are about to be removed to near London, where the process will be worked on an extensive scale.

Shed. Cowper-Coles.

Westminster, *July 14th*, 1899.

I have read the above letter from Mr. Cowper-Coles with interest.

With reference to the first error, I may refer Mr. Cowper-Coles to the reports of the directors of the British Broken Hill Proprietary Company for the half-year ending December 31st, 1898, which contains the following statement:—

Mr. Cowper-Coles's inventions for extraction of zinc, while presenting many elements of ingenuity and promise, have disclosed anomalies, when tested on a commercial scale, which have not hitherto been remedied, and no other process has come under the observation of the directors which appears to answer their requirements.—*Times*, April 5th, 1899.

Whether the actual trials which led the directors to this decision were made in this country or in New South Wales, is certainly of secondary importance.

As regards the second error, I stated in my article that the Cowper-Coles zinc extraction process had been tried in Cornwall in the years 1897-98. Mr. Cowper-Coles now *confirms* this statement by the information that "the works in Cornwall are about to be removed to near London." Where is the error?

John B. C. Kershaw.

July 17th.

Disclaimer.

We notice in your issue of yesterday a report of the first meeting of creditors of J. C. N. Hilton, electrical engineer, of Trafalgar Works, Bow Common Lane. The debtor in his statement of affairs refers to his connection with the firm of Nalder & Hilton, Limited, whose business, he states, is now conducted by a receiver for debenture-holders. As the similarity of names may cause some confusion both to the trade and to the public, we think it only right to inform you that neither our company, nor any director, servant, or agent thereof, is, or ever has been, directly or indirectly connected with the firm of Nalder & Hilton, Limited, or the Nalder and Harrison Construction Syndicate mentioned by the said debtor.

We shall feel obliged if you kindly publish this letter.

Nalder Bros. & Thompson, Limited.

E. Thompson, *Managing Director.*

LEGAL.

Agents and Parliamentary Bills.

Before the Court of Referees at the House of Commons on July 11th, an interesting case arose as to the ability of a public company to withdraw the powers it had granted to its agent in the promotion of a Parliamentary Bill. The South Staffordshire Tramways Company are promoting a Bill in the present Session to empower them to lease their tramways to the British Electric Traction Company, by which the lines could be worked by electricity. This Bill had been approved at a Wharncliffe meeting of the company though three of the shareholders who dissented were now petitioning against the Bill. In their petition they were joined by about 20 other shareholders, and the *locus* of these was opposed by the company, though the *locus* of the original dissenting shareholders was necessarily allowed. But since the petition was presented the position has changed. A week ago the tramways company held an extraordinary general meeting at which it was decided that Messrs. W. and W. M. Bell should be appointed agents to their Bill in place of Messrs. Sherwood & Co., and that they should take such steps as they thought fit to withdraw the Bill or appear before the Committee.

Mr. Littler, Q.C. (instructed by Messrs. Bell) now appeared for the company, and said they did not propose to object to the *locus* of the petitioners.

Mr. Chandos Leigh, Q.C. (the Speaker's counsel) said, so far as that House was concerned, Messrs. Bell were not the agents of the promoters of the Bill. The rules of the House did not allow an agent to be changed without the consent of that agent, and Messrs. Sherwood had not consented.

Mr. Littler contended it was against the law of the country for any agent to act without the authority of his principal. No rules in the world could ever override that doctrine.

Mr. Chandos Leigh repeated that, so far as that House was concerned, there had been no change in the agents. The examiner, Mr. Somerset, had refused to allow any change in the name of the agents of the Bill, and Messrs. Bell had no power in the matter.

After some discussion, the Chairman said the Court thought the question between the two parties should be settled outside, and disallowed the *locus* of the petitioners.

Metropolitan Electric Supply Company, Limited, v. Armanni.

At Bow Street on July 17th, before Mr. Lushington, Luigi Armanni, mechanical and electrical engineer, of Warwick Court, Holborn, appeared to an adjourned summons charging him with feloniously abstracting and consuming electricity belonging to the Metropolitan Electric Supply Company, Limited, contrary to the Electric Lighting Act, 1882. Mr. R. D. Muir supported the summons on behalf of the

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company; Mr. Lloyd Humphreys defended. In this case, which has been in progress since May 26th—this being the sixth hearing—it is alleged that the defendant, by making a connection between two fuse boxes in his installation, had thrown the meter out of circuit and thus prevented its registering the amount of electricity consumed.

Two expert witnesses were now called for the defence, who said that the suggested short circuit would, if it had existed, have been immediately detected by the company's wireman, and accounted for the small register of the meter by the fact that (possibly owing to the vibration caused by the mechanical work in progress) a screw in the meter had worked loose, which would at first cause it to register imperfectly, and did, in fact, eventually stop it altogether on June 27th.

Mr. Lushington said that the case was one for a jury, and committed the prisoner for trial, allowing bail in two sureties in £50 each.

Anglo-American Telegraph Company, Limited, v. Metropolitan Finance Corporation, Limited.

In the City of London Court on July 14th, the Anglo-American Telegraph Company, Limited, 26, Old Broad Street, sought to compel the Metropolitan Finance Corporation, Limited, Parliament Mansions, Victoria Street, to pay a sum of £8 10s. 6d. for transmitting cable messages to America.

Mr. T. H. Aldous (Messrs. Aldous & Welfare), solicitor for the plaintiffs, stated that in February Dr. Griffin, the chairman of the defendant corporation, asked the plaintiffs whether he might open an account with them, and send cables. They stated that he might, and cable messages were received from the defendants, one letter being written by the managing director of the company. Now the defendants wanted to say that the Doctor had sent the messages on his own account, and not on behalf of the company. The managing director, in answer to the summons, said the corporation had never sent cables through the plaintiffs, and they were in no way liable for what Dr. Griffin had chosen to do. The company had in no way been a party to the account sued for being incurred.

Mr. Commissioner Kerr said he would adjourn the case for Dr. Griffin to be added as co-defendant.

The Glasgow Telegraphs.

The Railway and Canal Commissioners—Lord Stormonth-Darling' Sir Frederick Peel and Viscount Cobham—sat in the High Court of Justiciary on July 11th and 12th, when the difference which had arisen between the Postmaster-General and the Corporation of Glasgow, on an application by the Postmaster to lay lines of telegraphs in certain streets in Glasgow, came under consideration. Evidence was led on both sides on July 11th, and Mr. Shaw, Q.C., had addressed the Commissioners on behalf of the Corporation when the Commissioners rose that day.

On the following day the Solicitor-General, on behalf of the Crown, said the Postmaster-General was there dealing with a body which had a very limited interest in the matter under consideration, because it had only an interest to this extent—the surface so far as that was to be used for purposes of ordinary traffic, and the subsoil so far as they required it for the placing of sewers or drains. But they had no other right at all—no right of proprietorship or any other right whatsoever—as construed in the case of the Glasgow Coal Exchange against the Glasgow City and District Railway. The question therefore came to be not between parties having private or proprietary interests, but between two bodies, the representatives of the public in two capacities—one the Postmaster-General, representing the whole public using the telegraphs or telephones, and in an especial degree representing the city of Glasgow, because they would necessarily use these telephones; and the other a body representing the same public, so far as Glasgow was concerned, having rights of passage over the streets. The question was as to how the interests of the public were to be represented, and there was a greater public interest represented by the Postmaster-General than by the Corporation of Glasgow. If compensation were to be given that was not one of the matters which the Commissioners should be asked to measure, but was a Lands Clause matter. The Corporation had only a right to keep these streets in order and to allow the people to travel on them. The public would travel just as before, and the drains and pipes would be there just as before. What, then, was the basis upon which the Corporation were to get pecuniary consideration? On the question of pecuniary consideration what were they to give the Postmaster-General? They didn't give any right. If they got their pipes accommodated they had no right in anything else. They had no right in the subsoil of the street except it was occupied by their pipes. They had no title to give, and their consent did not give the Postmaster-General any right, because, if any man had a right to the soil, the Postmaster-General had to pay him for that. The Corporation were not vested in that property, and they had no right, title or property in it at all. The basis of compensation, he maintained, completely failed, and the soil ground for the Postmaster-General being entitled to ask consent was just, because in 1863, when the consent was first stipulated for, the Court said that was a matter in which, in so far as the public interest was concerned, the body vested in the streets for public purposes was to be heard. It failed in every respect, in fact, in law, and in equity. Nothing was taken from the Corporation and nothing should be paid. Further, that was a thing that had never been done before. The Commissioners were asked to make an entirely new departure, and to impose pecuniary terms upon the Postmaster-General for matters which had been arranged with other towns without any such terms having been thought of. What was proposed to be done was all in the general interests of the community, for any alteration in the systems which would remove the chances of things going wrong tended to the general benefit of the community. He further submitted that the question of pecuniary terms was not competently before the Commissioners. The attempt of the Corporation to bring that in was an after-thought brought in after the difference had arisen and after the difference had been considered. The difference was constituted before any appeal was made to the Sheriff, and it was only that difference made to the Sheriff, and that difference only, which the Commissioners could determine. He demurred entirely to the view that that was done at the instance, or in the interests of the National Telephone Company. That had not been proved. If the Telephone Company had been at the back of the movement, he would have expected that the Telephone Company would have said to the Post Office: We applied for this underground system all over Glasgow, and you should do the same. Instead of that they had only a request by the Post Office for an underground service from one place to another. He submitted that the judgment of the Sheriff should be repeated, and consent given without conditions and terms.

Lord Stormonth-Darling said the Commissioners would take time to consider the question, and the decision would either be communicated in writing to the parties, or it might be delivered in Court before July 20th.

Holliday v. National Telephone Company.

The Court of Appeal on July 17th gave judgment in favour of a Mr. Holliday, who had brought an action for damages for personal injury against the National Telephone Company. Mr. Holliday was injured by the explosion of a benzoline lamp which scattered molten solder over him as he was passing a spot in Clapham where telephone wires were being laid down. In the City of London Court he was awarded damages, but in the Queen's Bench Division judgment went against him. The decision of the County Court was now restored.

PARLIAMENTARY COMMITTEES.

Bradford Tramways and Improvement Bill.

This Bill, which is promoted by the Corporation of Bradford, and which was originally opposed by the Corporation of Leeds, and the local authorities of Baildon and Shipley, and by other parties, and the object of which, amongst other things, is to construct effective tramways between Bradford and Leeds, and to secure the regulation of Baildon Moor, was down for hearing before a Committee of the House of Lords, presided over by Earl Egerton, on the 11th inst.

The opposition was, however, withdrawn, by agreement between the parties, and it was subsequently stated that the Bill would come before the Committee of the Earl of Morley (Chairman of Committees of the House of Lords) as an unopposed measure.

Salford Corporation Bill.

On July 12th the Police and Sanitary Committee of the House of Commons (presided over by Sir Stafford Northcote) considered the Salford Corporation Bill. This measure is a small omnibus Bill dealing with police and sanitary powers in general, and it also provides for powers in connection with the working of the tramways which are shortly to be acquired by the Salford Corporation and urban districts adjoining from the Manchester and District Carriage and Tramways Company. The Bill was opposed by the Manchester Ship Canal Company, the Lancashire and Yorkshire and the London and North-Western Railway Companies, and the Swinton and Pendlebury Urban District Councils.

Mr. Fitzgerald, in opening the case for the promoters, said that the lease of the tramways granted to the Manchester Carriage and Tramways Company would expire in 1901, and the Corporation intended, on the expiration of the lease, to work the trams themselves and convert them into electrical trams. Under the present Bill they took power to reconstruct the entire system. The opposition of the railway companies was as to certain lands which it was proposed to acquire in the vicinity of Exchange and Victoria stations, and they also desired that protection should be given them where the tramways crossed their bridges. The Swinton and Pendlebury Councils had arrived at an agreement with the Corporation as to the working of the trams, and they wished that agreement to be scheduled to the Bill. The Corporation did not object to this in principle, but difficulties were found to have arisen in Parliamentary practice. As to the Ship Canal Company's opposition, Mr. Fitzgerald pointed out that the company claimed that they would have to adjust their bridge in Trafford Road to such a nicety, and to take such care in accommodating the tramways, that the Corporation ought to pay for the necessary works and the signalling that would be required. The Corporation, on the other hand, said that they originally owned the whole of the rights of the road, and that the canal interfered with them, not they with it. He offered to pay the initial cost of the signalling apparatus, but the Canal Company must work it.

Evidence in support of the Corporation's case was led, and

Mr. Pember, Q.C., addressed the Committee on behalf of the Swinton and Pendlebury Councils, and the Committee intimated that they thought the agreement should be scheduled in the Bill.

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The opposition of the Ship Canal was not finished when the Committee adjourned.

On the following day the first matter which came up for consideration by the Committee was the question of the bridge of the company over the canal at Trafford Road. The Corporation proposes to carry its tramway across this bridge, and the Ship Canal Company objected, unless all responsibility for the working of it was assumed by the Corporation. The latter offered to pay for the neces ary works to make the bridge suitable for carrying electric tramways, provided that the company would work and maintain the semaphores. The Committee thought this was a reasonable offer, and inserted a clause providing that the Corporation should pay for erecting the signalling apparatus, and that after it was erected the company should maintain it. Evidence was then taken on behalf of the London and North-Western Railway Company regarding the compulsory acquisition of land, and the Committee again adjourned.

BUSINESS NOTICES, &c.

The Electrical Company, Limited.—We understand that the Electrical Company, Limited, of 122—124, Charing Cross Road, W.C., has just filed its balance sheet, which shows results beyond all expectations. After writing off the stock considerably, and writing off the patents, fixtures, plant, &c., to 1s., the net profits amount to over £4,000. The directors, in view of these favourable results, recently resolved that the company should undertake large installations, particularly for transmission of power plants, of which they have several up to 500 H.P. in hand already, and for this reason the capital has been increased to £50,000. The Electrical Company, as is well known, is affiliated to the Allgemeine Elektricitäts-Gesellschaft of Berlin, the character and extent of whose work is very familiar to English electrical engineers, and the Electrical Company claims that no plant can be too large for it to take in hand. It has been further resolved that the company's electrolier department shall be removed to other premises, and the available space be converted into technical departments, drawing offices, &c., to facilitate the working out of the larger schemes which are anticipated, with the greatest rapidity. With an excellent staff of first-class engineers, the company is convinced that its business will increase on the same enormous scale as during the last two years. We have received from the company a large illustration of the interior of the immense works of the Allgemeine at Berlin, also a reference list of various dynamos and motors made by the company, a list of theatre installations carried out by them, and several other excellently illustrated catalogues in which the German company's manufactures are shown, among the photographs being views of some of the large lighting, power, and traction plants executed by them, including a list of three-phase transmission of power plants. The Electrical Company is already making considerable headway, for we understand that it has now over 4,000 H.P. running in the United Kingdom. The company has our wishes for success in its new development.

The Copper Market in June.—Messrs. H. R. Merton and Co.'s circular for the month ending June 30th, shows that during June the supplies of copper have been equal to 17,925 tons, while the deliveries have reached 19,077 tons. The corresponding figures for June, 1898, were 19,145 and 18,833 tons respectively. The decrease in supplies, as compared with June 12 months ago, extends to shipments from Spain, Portugal, Chili, Australia, and miscellaneous countries; only the American shipments to Europe show an increase. In view of the large number of mines which have been floated as companies during the last 12 months, and the influx of new capital into the copper mining industry, this non-expansion of supplies from countries other than America is disappointing, for, as pointed out in our previous reports, it is to these countries we must look for the increased supply which will prove fatal to the influence of the Amalgamated Copper Company. The excess of deliveries over supplies has resulted in a decrease of stocks by 1,152 tons during June, and the stock of copper on June 30th stood at 29,004 tons. The prices of G.M.B.'s have not fluctuated much during June, the values at the different dates being as follows:—

May 31st, £76 15s. June 15th, £75 10s. June 30th, £76 15s.

The relative prices of copper and aluminium, for conductors of equal length and equal sectional resistance are now represented by:—

$$\frac{8{\cdot}93 \times 8{\cdot}57 \times 59}{2{\cdot}68 \times 14{\cdot}5 \times 100} = \frac{4{,}508}{3{,}886} = \frac{116}{100}$$

There has been a decided lull in the flotation of new mining companies during June, and the prospectus of only one company has come under our notice. This is the Ray Copper Mines, Limited, capital £250,000, £50,000 of which is to be reserved as working capital. This company has been formed to acquire 52 mining claims, and a reduction plant at Mineral Creek, Arizona. The locality is 45 miles from the South Pacific Railway. 190,000 tons of ore, averaging 5½ per cent. of copper, are in sight, and developments of the properties are expected to increase this to 2,000,000 tons. The plant at Mineral Creek is equal to the treatment of 75 tons ore per day. The Globe Minerals Exploration Company are the vendors, and are re-selling for £210,000, payable £95,000 in cash, and £115,000 in shares. In view of the large number of new companies floated in London during the first half of this year, the following remarks, which appeared in the issue of the *Engineering and Mining Journal*, of New York, for April 15th, 1899, are of interest, and emphasise the need for caution on the part of investors. We have more than once drawn attention in these reports to this aspect of the recent activity in the copper mining market, but the *Engineering and Mining Journal*, of course, speaks with special information concerning American mines:—

> Just at present the rapid increase in the price of copper and in the prevalling boom in copper shares, in the Boston and in the foreign markets have made copper stocks a favourite investment, and especially attractive to buyers of mining shares; and the copper vein is being worked accordingly. It is not possible to go at length into all the statements of the prospectuses and advertisements which crowd our desks. These all have a certain family resemblance; references to the prosperity and heavy dividends of the Calumet & Hecla, the United Verde, and a few other noted copper companies, constitute the bulk of the document, followed by a very little vague information—or misinformation—about the special company in question, and often by claims which, to the mining men, are so evidently ridiculous as to establish their falsity without further investigation. But these documents are not intended for the man who knows anything of mining; they are for that section of the public which is not informed, and the less that readers know, the better for the purposes of those who write and issue the documents. A favourite plan is to avoid all accurate description of the property itself, and to base its claims upon its neighbourhood to some well-known mine, which, it is assumed, will assure the value of the new property.
>
> We have hardly space here to give a list of all the companies of doubtful value, which are now before the public; but it may be well to mention a few conspicuous instances, and to refer to a few prospectuses which need criticism, to say the least. Perhaps the most conspicuous offender in the list is the Spenazuma Gold Mining and Milling Company, of Arizona, which, we are informed, is disposing of stock through its agents among Connecticut farmers, in the towns along the Hudson River, and in other places, which are not likely to contain parties having information about mines.
>
> Just at present, Arizona seems to be a favourite ground for these wild-cat companies, and especially for that class which are trading on the reputation of established mines. One conspicuous offender of this class is the Copper King, of Arizona, which has advertised extensively and has scattered prospectuses and circulars all over the country. The company is trading on its similarity in name and the neighbourhood of its claims to the Copper Queen Mine, although the owners of that and other properties had long ago prospected the district thoroughly, and would certainly have taken up any claims of value had they existed there. This company not only trades on the similarity of names, but illustrates its circulars with views of the extensive buildings of the Copper Queen, thus attempting a deliberate fraud upon the readers.
>
> We find other instances of trading on name and proximity, without going outside of Arizona, and although in these cases we have not been able as yet to make the necessary investigation to prove their worthlessness, they are at least destitute of all proven or developed values, and at the very best offer to the buyers of their stock gambles of the wildest kind. There is also the presumption that the neighbouring companies which are operating on a large scale would not leave valuable properties which they could have easily secured for themselves at the slight expense of locating and a little exploration and assessment work. In this class, we have the Arizona Copper Syndicate, which has claims at Clifton near the property of the well-known Arizona Copper Company; and a whole group—the United Verde, Jun., the United Verde Extension and the Val Verde—whose only distinction is that they are near W. A. Clark's well-known United Verde mines.

Mercantile Publishing Syndicate, Limited, v. The Western Union Telegraph Company, and the International Cable Directory Company.—On Monday, last week, in the Queen's Bench Division of the High Court of Justice, the cases of the Mercantile Publishing Syndicate, Limited, *v.* the Western Union Telegraph Company, and the same *v.* the International Cable Directory Company and another, came on for hearing before Mr. Justice Ridley. In these actions, Mr. Scrutton and Mr. Josephs appeared for the plaintiffs, who are the registered proprietors of a work entitled "The Broomhill's Comprehensive Cipher Code." Mr. English Harrison, Q.C., and Mr. A. J. Walter represented defendants in both cases. Mr. Scrutton, in opening the first case, said that in each of them the cause of action was the alleged infringement of a telegraph code, of which the plaintiffs held the copyright. Plaintiffs alleged that their copyright had been infringed by a code called the "Western Union Telegraph Code," ostensibly printed and published and imported into England by the International Cable Directory Company, whose agents in England, Messrs. Lilley & Tall, were the defendants in the second action. In each case the allegations in defence were that the book complained of was not an infringement of that of plaintiffs. In answer to his Lordship, Mr. English Harrison, Q.C., said he had reasons for objecting to the two cases being taken together, but the decision in one case would bind the other. Mr. Scrutton then put in the certificate of registration of the plaintiffs' code, which he said was *primâ facie* evidence of their copyright under statute, and the main question his Lordship would have to ascertain was whether the Western Union book was an infringement of plaintiffs. The learned Counsel quoted from decided cases, with a view to showing the application of law to the action in question, and then at some length Mr. Scrutton pointed out the similarity between the defendants' book and that of his clients, the plaintiffs. Their work, he said, was the result of 16 years experience, but the compiler of the defendants' code said he only took nine months in its preparation. At first he used plaintiffs' book sparingly, but it appeared that when he got near the end of his work he "lifted" from the plaintiffs' code in large batches, mistakes and all, and upon that counsel asked his Lordship for an injunction against the defendants. At the end of Mr. Scrutton's address, in the course of which he compared the works in dispute, Mr. English Harrison, Q.C., said that the code complained of was made in America under the superintendence of one gentleman, who had the aid of a number of others. It would appear from his learned friend's opening that one or other of those assistants had copied part of the plaintiffs' code. On behalf of the Western Union Telegraph Company, counsel intimated that he submitted to an injunction, and there were other terms which he need not mention, but which included the usual penalty. As regarded the other defendants, they had always denied that they had ever dealt with the books at all. They had, however, been presented with one book, and some other people had been handed copies and asked to sell them for their own profit, but not in connection with

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the second defendant company. He (Mr. English Harrison) was afraid that there had been a technical infringement, and, therefore, he had to submit to an injunction. His Lordship made an order accordingly.

Electrical Wares Exported.

Week ending July 12th, 1898.

		Value
Adelaide	.. ..	£142
Amsterdam	.. ..	125
Antwerp	.. ..	10
Bahia. Teleg. mat.	.. ..	50
Bombay	.. ..	8
Boulogne	.. ..	90
Buenos Ayres. Teleg. mat.	..	450
Cape Town	.. ..	165
Colombo	.. ..	210
Copenhagen. Teleg. cable	..	550
Demerara. Teleg. mat.	..	99
Durban	.. ..	20
East London	.. .. ..	188
Fremantle. Teleg. mat.	..	84
Gothenburg	.. .. ..	189
Hamburg	.. ..	60
Hiogo	.. ..	119
Hong Kong	.. ..	80
Liban	.. ..	50
Lisbon. Teleg. cable	.. ..	200
Melbourne. Teleg. mat.	..	29
Ostend	.. ..	80
Perth	.. ..	600
Port Elizabeth	.. .. ..	191
„ Teleg. mat.	..	500
Santander	.. ..	70
Shanghai. Teleg. mat.	..	300
Singapore. Teleg. mat.	..	22
Stockholm	.. ..	12
„ Teleg. mat.	..	215
Sydney	.. ..	775
Total	..	£5,718

Week ending July 11th, 1899.

		Value
Alexandria. Teleph. mat.		£32
Amsterdam	.. ..	181
Barcelona	.. ..	14
Barranquilla. Teleg. mat.	..	111
Bilbao. Teleg. mat.	.. ..	145
Bombay. Teleph. mat.	..	127
Boston (U.S.A.). Teleg. apps.	..	2,796
Boulogne	.. ..	90
Buenos Ayres	.. .. ..	70
„ „ Teleg. wire	..	560
Calcutta	.. ..	382
Cape Town	.. ..	176
Christiania	.. ..	13
Copenhagen	.. .. ..	17
Delagoa Bay	.. .. ..	13
Demerara	.. ..	15
„ Teleg. mat.	.. ..	123
Durban	.. ..	388
„ Elect. cable	.. ..	1,482
„ Teleg. mat.	.. ..	1,857
East London	.. .. ..	213
Fremantle	.. ..	18
Gothenburg	.. .. ..	23
Hamburg. Teleg. mat.	.. ..	600
Helsingfors	.. ..	89
Hobart. Teleg. cable	.. ..	130
Kertch. Teleg. cable	.. ..	3,000
Las Palmas	.. ..	14
Madras	.. ..	15
Mauritius	.. ..	15
Melbourne	.. ..	77
„ Teleg. mat.	.. ..	555
New York	.. ..	12
Odessa	.. ..	75
Ostend	.. ..	20
Perth	.. ..	13
Port Elizabeth	.. .. ..	120
Rangoon	.. ..	85
Rotterdam	.. ..	108
„ Teleg. mat.	.. ..	117
Shanghai	.. ..	2,188
Singapore	.. ..	115
„ Teleg. cable	.. ..	18,000
St. Petersburg. Teleg. wire	..	110
Stockholm	.. ..	86
Sydney	.. ..	796
„ Teleg. cable	.. ..	570
Tientsin	.. ..	65
Wellington	.. ..	191
Yokohama. Elec. cable	..	138
Total	..	£35,490

Foreign Goods Transhipped.

Antwerp. Elec. mchny... Value £80

Electrical Wares Exported.

Week ending July 19th, 1898.

		Value
Alexandria. Teleg. mat.		£12,551
Amsterdam	.. ..	155
Bahia Blanca. Teleg. mat.	..	288
Bangkok	.. ..	13
Barcelona	.. ..	400
Bilbao	.. ..	20
Bombay	.. ..	13
Bordeaux	.. ..	22
Boulogne	.. ..	141
Buenos Ayres	.. .. ..	61
Calcutta	.. ..	42
Cape Town	.. ..	1,152
Copenhagen. Teleg. cable	..	49
Durban	.. ..	195
„ Teleph. mat.	.. ..	40
Fremantle. Teleg. mat.	..	211
Gothenburg. Teleg. mat.	..	181
Halifax. Teleg. mat.	.. ..	138
Hamburg. Teleg. mat.	.. ..	86
Hong Kong	.. .. ..	21
Lisbon. Teleg. mat.	.. ..	96
Mackay	.. ..	4,200
Malta	.. ..	10
Marseilles	.. ..	81
North Atlantic. Teleg. cable.	..	11,400
Port Elizabeth	.. .. ..	181
Rio Janeiro	.. ..	19
Santander	.. ..	450
St. Petersburg	.. .. ..	61
„ Teleg. cable	..	156
Singapore. Telephone	.. ..	22
Stockholm. Teleg. cable	..	2,014
Sydney	.. ..	1,878
Trinidad	.. ..	33
Wellington	.. ..	139
Total	..	£35,978

Week ending July 18th, 1899.

		Value
Amsterdam	.. ..	£20
Boulogne	.. ..	1,000
Brussels	.. ..	90
Buenos Ayres	.. .. ..	1,426
„ „ Elec cable	..	900
„ „ Teleg. wire	..	264
Calcutta	.. ..	268
Cape Town	.. ..	690
Christiania	.. ..	61
Colombo	.. ..	218
Copenhagen	.. .. ..	80
Durban	.. ..	277
East London	.. .. ..	517
„ „ Teleg. mat.	..	1,076
Gothenburg	.. .. ..	40
Hamburg	.. ..	110
Hong Kong	.. .. ..	595
King George's Sound	.. ..	67
Leghorn	.. ..	52
Lyttleton	.. ..	60
Malta	.. ..	195
Marseilles	.. ..	86
Mauritius	.. ..	27
Ostend	.. ..	20
Port Elizabeth	.. .. ..	355
Rio Janeiro. 105 tons teleg. wire (value not declared)	..	—
Shanghai. 26 tons old teleg. wire (value not declared)	..	—
Singapore	.. ..	40
„ Teleg. stores	.. ..	40
St. Petersburg. Teleg. cable mat.		235
Stockholm	.. ..	9
Sydney	.. ..	28
„ Teleg. cable	.. ..	668
Total	..	£9,454

Foreign Goods Transhipped.

Odessa .. .. .. Value £17

Cowper-Coles Magnetic Scale Collector.—The removal of mill scale from forgings and plates has always been a matter of considerable difficulty, the scale in many cases being $\frac{1}{32}$-inch in thickness. The usual practice is to place the iron in a solution containing one part of hydrochloric or sulphuric acid, to 10 parts of water for from half an hour to 24 hours. The Admiralty specify that all steel steam pipes, boiler and collector tubes, and all plates for boilers, are to be pickled in a solution consisting of 19 parts of water and 1 of hydrochloric acid until the black oxide and scale formed during the process of manufacture is completely removed. The amount of acid consumed in the pickling of close annealed sheets, such as are used for roofing purposes, varies from 3 cwt. to 7 cwt. of muriatic acid per ton of sheets; if sulphuric acid is used, considerably less is required. Muriatic acid is used in preference to sulphuric by a large number of manufacturers, because it is cheaper bulk for bulk, and also because it acts less quickly on the skin of the metal, and consequently has less tendency to eat it away. In Worcestershire alone about 1,000 carboys of acid corresponding to some 27,000 gallons of waste pickle have to be

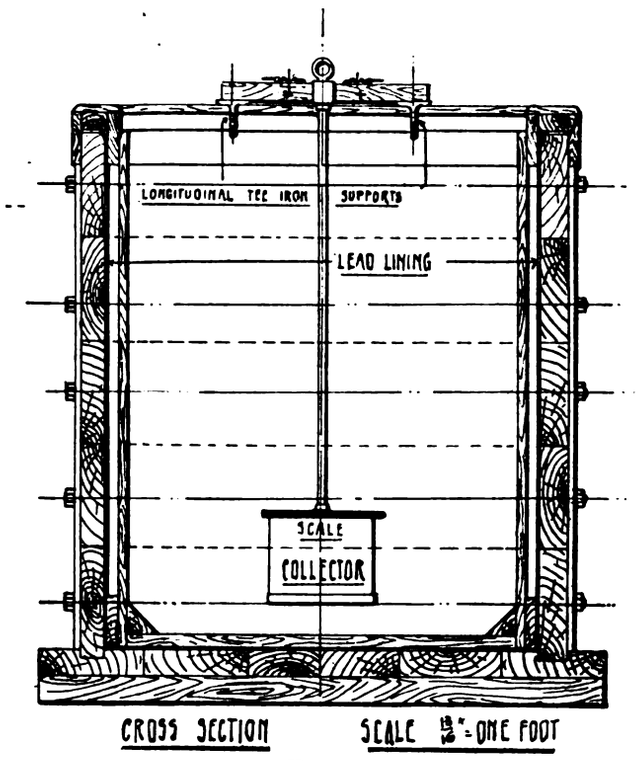

Fig. 1.

got rid of weekly. During the process of pickling large quantities of magnetic oxide and scale become detached from the plates, which if allowed to remain in the pickle to be further acted on by the acid, form a serious source of loss. The present invention has

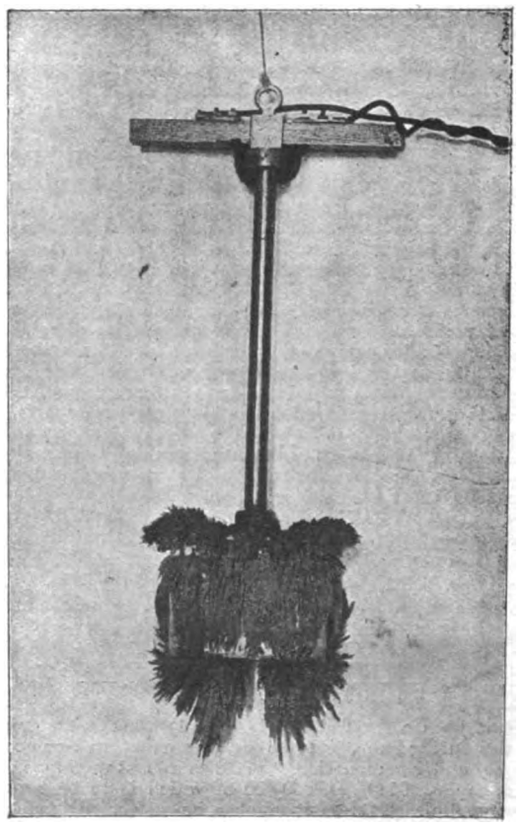

Fig. 2.

for its object the prevention or diminution of this loss, which is accomplished by means of the apparatus shown in fig. 1, which gives a sectional elevation of a lead-lined pickling tank, with a

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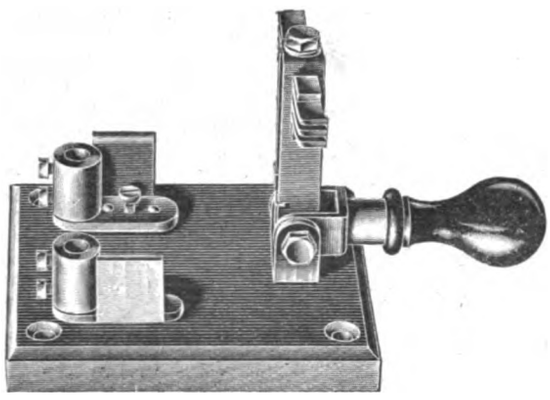
scale collector placed in position. The scale collector is placed in any convenient position in the tank, and connected by means of terminals A A to a depositing or electric lighting dynamo, the current required to work it being about 10 amperes when an E.M.F. of 6 volts is employed. In the case of large baths two or more collectors can be employed, or only one may be used, this being moved about to different parts of the bath at suitable intervals. From time to time the scale collector is taken out, and the adhering scale removed, either by breaking the circuit, or by means of a suitable brush or scraper. Fig. 2 is taken from a photograph of the apparatus after it has been dipped in iron filings; it will be noticed that the electro-magnet has consequent poles, this method of connecting up having been adopted with the object of distributing the field as much as possible. The following are the advantages claimed for the adoption of the Cowper-Coles patent scale collector:—(1) A great saving of acid is effected. (2) The apparatus is attached without any difficulty to any ordinary lead-lined pickling vat, and does not require skilled labour to look after it. (3) All the magnetic oxide or scale on the plate is collected almost as soon as it leaves the iron or steel, instead of being allowed to remain in the solution and be acted on by the acid as at present. (4) In large works, where a considerable quantity of acid is used per week, a great economy will be effected, as considerably less acid is required, and consequently there is less spent pickle to be got rid of.

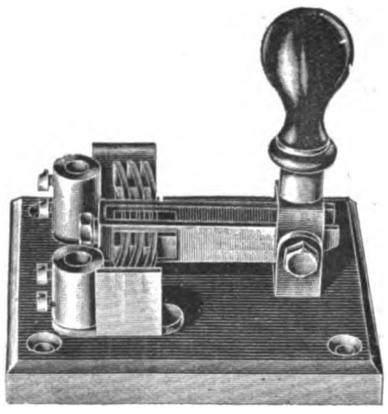
Rossell's Smoke Preventer.—Bituminous coal cannot be burned smokelessly except in furnaces arranged so that the products of combustion sweep over the surface of the fire, and become thoroughly mingled with a proportion of fresh air, admitted preferably at the door. When thus mixed it is essential that the gases be at a sufficient temperature to ignite, that they have space in which to burn freely, and be not unduly cooled down. The devices for admitting air are numerous, and a new one is being introduced by Messrs. Rossell & Co., of Sheffield. It is based on the admission of air for a short period after each fresh charge of fuel. This air is required by the hydro-carbon gases which are distilled off each fresh charge, and it is necessary that air admission should cease gradually as the gas supply becomes exhausted. The apparatus consists of a number of louvres in the door of the furnace. Each louvre carries a central bulb, and these bulbs rest one upon another in such a way that pressure on the lowest will raise all and open the louvres. In opening the furnace door the requisite upward pressure is supplied by means of a bell crank and a bracket, which presses on the bell crank lever and opens the louvres and raises an oil cataract or dash-pot piston. Closing the furnace door sets free the louvres to fall, but they only do so slowly under the cataract action, which is controllable by means of a cock in the bye-pass. We used a similar device many years ago; the same effect may also be obtained by means of a clock-work arrangement, actuated by a chain and by the weight of the louvres themselves. There is no necessity to reproduce the tests which accompany the description of this device in the *Engineer*. The principle is a good one, which if carefully worked will produce smokeless combustion, and will sometimes do so at an actual economy of fuel. While air is being admitted above the fire, less air enters below and the fire is checked. Smoke prevention is thus apt to cause less steam to be made, and this is its chief disadvantage, only to be remedied by forced or assisted draught; this requires specially adapted devices to admit air which must be in parallel with the under-grate draught.

Feed Water Heater.—A novel feed heater has been introduced by Messrs. McPhail & Simpson, in which the feed to the boiler is allowed to fall in a divided shower through the steam space of a vertical egg-ended vessel, and then over a series of trays which serve to separate out lime salts. The idea on which this auxiliary feed heater is based is that of securing that the boiler feed, no matter how it may first be heated by an economiser or by other means, shall be exposed to steam at full boiler pressure, in order that it may finally pass into the boiler at full temperature. A boiler thus fed has simply to supply the latent heat of evaporation. The idea is sound enough, though here we would speak a word of caution against the neglect of ordinary economical methods of feed heating, as by the use of a coil, or the flue heater, or economiser. These methods are not to be considered antiquated. It might be supposed they were, from the neglect with which they have been so often treated. There are still far too many places where the feed is run dead cold into the boiler without even the apology of running an exhaust coil through the water tank, or using such an appliance as the Berryman heater. Once we were employed in an electrical station where there was an economiser. The feed went cold into the boilers and the economiser was shut off. One of the young electrical engineers in charge said that the economiser was useless, and did not pay for using; Mr. X. had therefore ordered it to be disconnected, the said Mr. X. being the consulting engineer, who ought to have known better. This new apparatus of McPhail & Simpson's has its place, but not in every station. It seems to us to have been made to sell in deference to the new fashion of live steam feed heating, which has been carried to an absurd excess by men of the class who are throwing away sufficient exhaust steam to boil all their feed. Very much of the recent steam practice of this country has been carried out in a most careless and uneconomical manner, and upon most degenerate lines, while at the same time the complications introduced have been serious and uncalled for, and have not resulted in corresponding economies. What with non-condensing engines, and cold feeds and wasteful auxiliaries, we much fear that the adoption of so much American practice has not been an unmixed blessing.

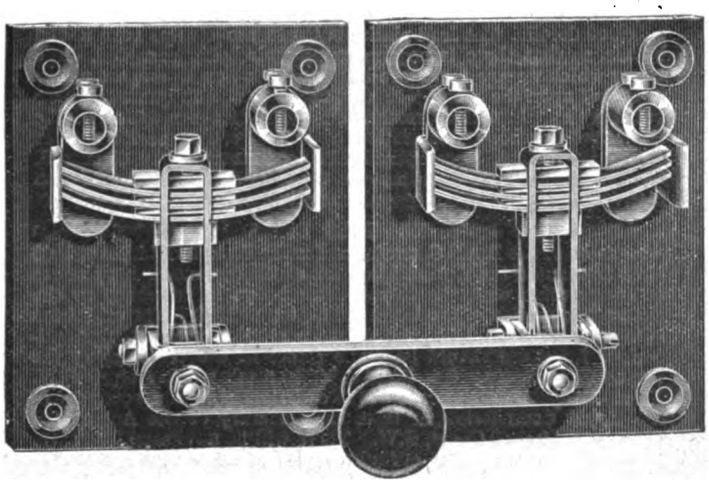
High Pressure Switch.—We illustrate below a new high pressure main switch, which is being sold by Messrs. Hill, Gifkins & Co., of Victoria Street, S.W. It is claimed to have an extremely long and wide break, and has been passed by a large number of high pressure supply companies. It is also being used



extensively for tramway and other similar undertakings. Among the other improvements are the easy replacement of the bridge pieces, and the adjustment of the same by the screw at the top. There are only three sizes up to, say, 100 amperes, the intermediate



sizes being obtained by the addition of extra laminations at the cost of a few pence each, each lamination being arranged for 5 amperes according to size of switch. There is a slot in the U piece which permits of the mechanical centering of the bridge



pieces between the contacts. The switch is made up entirely of stampings so that it is economical in price. There are hollow terminals and double binding screws which are found in practice to efficiently clip the cable without sweating thimbles into the sockets.

Lyall's Water-Tube Boiler.—This is a combination boiler. With the shell of a tubular boiler is the combustion chamber of a marine boiler with flat stayed surfaces, and below is a furnace, the roof of which is made of water tubes expanded into back and front headers and specially arranged, as it seems to us, to prevent good combustion. A large combustion chamber is placed between

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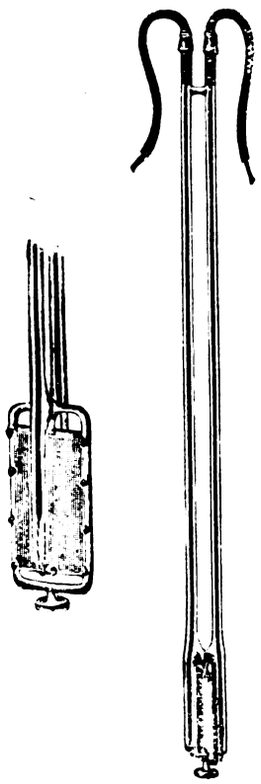
the water-tubes and the fire-tubes. We do not doubt the claim made for good circulation, but we do not see any special virtue in this boiler. It has too much complication; and we do not agree that the water-tubes are so few that they will not chill off the gases too quickly. We think they very probably will do just this. It preserves too many of the structural faults of old boilers, while introducing some of the worst features of the new types of boiler. The boiler would be improved by removing the water-tubes altogether, and using simply a firebrick furnace, but it would then be an underfired cylindrical boiler, and those blessed words, "water-tube," would be absent.

Bastian Meter—New Type.—A few days ago we examined the new type of meter which has been adopted by the Bastian Meter Company, and of which we give a detail view showing the improvements. The conductors are not sealed into the bulb at the bottom of the vessel containing the electrolyte, as used to be the case, but are brought down inside the vessel in glass tubes; the latter are fastened together by glass cross-pieces to form a stiff frame, which is supported by a rubber stopper. The conductors consist of stout leaden wires, which are sealed into the upper part of the tubes with pitch, and are joined to the platinum



foil electrodes with short lengths of platinum wire, as seen in the enlarged detail. The lead-platinum joints are always surrounded by air, so that there is no danger of their being corroded. The meter which we saw is, we are informed, the first 2½ ampere meter to be put upon the market in this country, and is quoted at two guineas net. It will be remembered that at the meeting of the Municipal Electrical Association at Bristol the excessive cost of electricity meters, as compared with gas meters, was discussed. Mr. Bastian's meter, however, goes far to bridge the gulf, and with free wiring should help to popularise electric lighting.

Automobiles at the 1900 Paris Exhibition.—The committee of the Royal Commission for the Paris Exhibition of 1900 have nominated the Automobile Club as the consulting body to act in co-operation with the Royal Commission in reference to the automobile section of the Paris Exhibition of 1900. The exhibition is to open on April 15th, and to close on November 5th. Applications for space should be made direct to the secretary of the Royal Commission, St. Stephen's House, Westminster, S.W. Forms of application may be obtained from either the secretary of the Royal Commission, or from the secretary of the Automobile Club, 4, Whitehall Court, S.W. There will be no charge for space. In order to secure that adequate space shall be reserved for the display of the automobiles of British firms, it is requested that those firms who are not at present in a position to apply to the Royal Commission for space, should inform the secretary of the Automobile Club about what superficial area they are likely to require for their exhibits.

Two-Rate Meter.—An ingenious device, intended to supersede the usual combination of demand indicator and supply meter, is being introduced by Messrs. Chamberlain & Hookham. The apparatus consists of their ordinary meter modified by the addition of a second counting train and dial; either train may be driven by the mechanism, but not both at once. The action of the apparatus is as follows:—When a small current is flowing, the lower counting train is in gear; but when the current exceeds a certain predetermined value, the upper train is thrown into gear by means of an electro-magnet in series with the main current, and the record is made on the upper dial. A pointer indicates the dial upon which the record is being made at any time. It is pointed out that the apparatus not only effects the same object as the demand indicator, but greatly reduces the burden of book-keeping, which is very heavy on the present system; further, the first cost is less, as the meter costs but little more than the ordinary form. While the result is not precisely the same as that of the demand indicator system, the disadvantage of the latter—viz., that an accidental heavy current for a short time taxes the consumer on the whole of his meter record—is eliminated, with a consequent diminution of complaints and discontent on the part of the consumer.

Outings.—The annual outing of Messrs. Marryatt and Place, of Hatton Garden and Shepherd's Bush, took place on Saturday, the 15th, when the employés and friends, numbering between 40 and 50, journeyed by G.W.R. to Staines, where the steam launch *Windsor Castle* awaited them to convey them to Windsor. Arrived there, lunch was served in first-class style at the White Hart Hotel, and afterwards the party proceeded to Cookham and then returned to Maidenhead, where dinner was served at the White Horse Hotel. After the usual toasts the health of "The Firm" was proposed and enthusiastically drunk, Mr. Marryatt responding. The toast of "The visitors" was also responded to in a neat speech. Then came the toast of "Sweethearts and Wives," which was drunk with great acclamation and responded to in a very witty and humorous speech by a visitor. This was most appropriate, as Mr. Marryatt (the head of the firm), is very shortly to be married, and he made this the occasion of his wedding dinner to the employés, kindly defraying all expenses. After dinner a concert was held, and various members of the firm added greatly to the enjoyment of the company, Mr. Place and Mr. Ralph, works manager, giving some exceptionally good songs. After a most enjoyable day the party returned to London, arriving about 11.30 p.m.

W. T. Burbey & Co.—The employés of this firm held their annual beanfeast on Saturday last. Special carriages conveyed the party by rail to Tonbridge, where a most enjoyable day was spent, chiefly in boating on the river Medway. Dinner was well provided for at the Castle Hotel. The toast of "Health and Success to the Firm" was proposed by Mr. Jones, to which Mr. Burbey responded. Other toasts followed, and the speeches throughout fully indicated the unity and interest existing between the masters and men.

Provisional Orders.—The Bill confirming a provisional order granted by the Board of Trade to the Urban Electric Supply Company, in respect of the Urban District of Newton Abbot, the other day proved compliance with the Standing Orders, and was sent by the examiner for second reading in the House of Lords. The Bill has passed through the Lower House.

Official notice has been given of the withdrawal of the opposition which was threatened in the House of Lords to the passing of the Bill promoted by the Brompton and Piccadilly Circus Railway Company, which has already passed the House of Commons.

The Bill to confirm the Walker Urban District Council's electric lighting provisional order received the Royal assent on Friday, the 14th inst.

The Trolley Car and Municipal Street Sanitary Departments.—Though we believe that the greatest service which electricity can render to city life will be that due to the increased facilities for cheap and rapid transport from the city to the suburbs, the general adoption of electric traction in place of horse traction is likely to be followed by other surprising changes. We learn on good authority that in Boston the trolley system is being used for the distribution of merchandise, coal, &c., by night; that in Sheffield they possess, or are about to possess, a trolley car equipped with brushes for street sweeping; and that in Baltimore the street sprinkling is effected by means of an electric road sprinkler. It only remains for some genius to invent an electric dust cart, for the whole service of the street scavenging departments of our larger cities to be performed automatically by the street trolley car.

Bankruptcy Proceedings, &c.—The public examination of Edward L. Joseph, electrical engineer, of the Northampton Works, Northampton Grove, Canonbury, was held at the London Bankruptcy Court on the 13th inst. before Mr. Registrar Hope. The debtor applied to pass upon accounts showing liabilities £7,618 9s. 1d., and assets consisting of 4,293 shares in Williamson and Joseph, Limited, and a book debt of £5,634 16s. that he claims from the same company. Questioned by Mr. G. W. Chapman, official receiver, the debtor stated that having acted as manager to Messrs. Appleton, Burbey & Williamson, he was, in August, 1891, admitted as a partner. He introduced no capital, but his father advanced to the firm £1,600, which loan was repaid two or three years afterwards. As a partner he was entitled to a percentage of the turnover, which came out at about £5 0 a year, but he only drew out £3 0 per annum because the profits were not sufficient to permit the arrangement to be carried through. Mr. Appleton retired from the firm in 1893, and Mr. Burbey followed suit in the following year. Witness and Mr. Williamson continued the business until 1896, when the latter retired, and Williamson and Joseph, Limited, was formed to take over the concern. A balance sheet then made out showed that the trading for the previous year had resulted in a considerable loss, but there remained a capital of £9,052. Witness undertook to pay half that sum to Mr. Williamson for his share in the concern, and that now formed the greater part of his (debtor's) present liabilities. The nominal capital of Williamson & Joseph, Limited, was £10,000 in shares, and £5,500 in debentures of £500 each. As vendor witness was to receive £4,526 in cash by quarterly instalments of £100

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each, and 4,993 fully paid shares. The shares were duly allotted, but he only received three of the £100 instalments. He handed over that £300 to Mr. Williamson, who devoted it to the discharge of liabilities of the old firm. The property transferred to the company was the same as that which appeared in the balance sheet at the value of £9,052, nothing being put down for the goodwill. The company removed the business from Sard's Rents, Bermondsey, to Canonbury in September, 1898, where in April last a receiver was appointed on behalf of the debenture holders. Witness had acted as manager for the company at a salary of £8 a week, but had only drawn at the rate of £300 a year and he was still employed in the same capacity by the Receiver. He obtained an option for the lease of Northampton Works on behalf of the company, and that option had been charged to secure a debt of £600 owing by the company but guaranteed by himself. He entirely attributed his appearance at the Court to the failure of the company and its consequent inability to discharge liabilities that he had guaranteed. It was a fact that he posse-sed no assets outside the company, and that his only prospect of paying the guarantees was its success. In reply to a solicitor appearing for the trustee and creditors, the debtor said a resolution was passed on May 29th last for the company to be wound up voluntarily. Although he personally held a large proportion of the shares, he did not vote upon the resolution, which was moved by independent shareholders. A petition for a compulsory winding up order had been previously lodged in the High Court, but it was not in consequence of the presentation of that petition that the resolution for voluntary liquidation was passed. Witness had opposed the claims of Mr. Edwards and Mr. Hall. In the case of the first named creditor a judgment was obtained in the absence of witness, although notice was given him that the action would not be proceeded with on that day. There had been a loss on the company's trading, but he could not possibly state the amount. (Q.) Why was the resolution to wind up the company decided upon? (A.) Simply because the company could not pay its debts. (Q.) Now, sir, was there *any* reason for winding up the company? (A) Certainly; otherwise I presume it would not have been done. (Q.) I suggest that *you* wound up the company in order to get rid of your own debts? (A.) Certainly not. The company had been sued by some of its trade creditors. In reply to further questions the witness stated that the company received £3,000 as compensation from the London County Council. That money was devoted to paying off loans. Mr. Leggatt Rubenstein attended for the debtor, who was allowed to pass.

At the Liverpool Bankruptcy Court, on July 13th, before Mr. Registrar Cooper, the public examination was taken of Benjamin Wild and John Henry Clarke, who carried on business in partnership at the Atlas Works, Virginia Street, Southport, under the style of "Wild, Rothwell & Co.," as general and electrical engineers. Mr. Nathan Yates, chartered accountant, Bolton, who has been appointed trustee, was present, and Mr. T. H. Williams, solicitor, Southport, represented the debtors. The statement of affairs shows liabilities £2,509, and assets estimated at £770 net. The examination was adjourned to August 10th.

A statement has been issued by the Official Receiver (Mr. J. Arthur Binns) to the creditors of Arthur Blackburn, of Marriott Street, Dewsbury, and James Walker, of 88, Dale Street, Batley Carr, carrying on business in partnership as electrical and mechanical engineers at Upper Lane Mills, Cleckheaton, under the style of Blackburn, Walker & Co. The liabilities are expected to rank at £217, and the assets are estimated to produce £79. The debtors, who commenced business in 1893, attribute their insolvency to losses on contracts and to want of capital.

Liquidation.—Williamson & Joseph, Limited.—A meeting of creditors of this company was held on Tuesday the 18th inst., at the Guildhall Tavern, Gresham Street, London. It was convened by Mr. Stephen P. Child, the liquidator of the company, who presented a statement of affairs, and who suggested that the meeting if it saw fit, should appoint a committee of creditors to co-operate with him in liquidating the affairs of the company. After some opposition from a solicitor, said to represent the petitioning creditor, and who desired to see appointed a co-liquidator with Mr. Child, a committee was nominated consisting of Messrs. Woodall (Mackintyre & Co., Limited, Burslem); F. Espir, Pinchbeck (Marriott's, Limited), the legal representative of Messrs. Wheatley Kirk, Price & Goulty, and the legal representative of Mr. E. L. Joseph. The proceedings then terminated.

Aron Meter.—The Board of Trade in the *London Gazette* of July 14th announces its approval of the Aron (alternating current) meter for use on two and three-phase systems, and specifies the mode of fixing and connecting the meter.

Catalogues, Lists, &c.—Messrs. Schattner & Co., of Timberhill, Norwich, send us an illustrated pamphlet describing the Long-Schattner prepayment meter, already well known to our readers.

An interesting catalogue comes to hand from the Wheeler Condenser and Engineering Company, of Queen Victoria Street. Some general observations on auxiliary devices for increasing steam engine economy are followed by notes and sketches describing Wheeler's double and single tube surface condensers, light weight jet and surface condensers, the Volz patent combined surface condenser and feed water heater, the Barnard water-cooling tower, Wheeler's feed water heater and combined reheater and receiver. The illustrations are excellent.

From Messrs. W. F. Dennis & Co., of Billiter Street, E.C., we have received a catalogue dealing with he products and manufactures of Messrs. Felten & Guilleau of Mülheim-on-Rhine. Some good pictures are given of the firm's various manufactures, including telegraph, telephone, and electric light cables, wire goods, chains, &c.

The Knecht Bros. Company, of Cincinnati, Ohio, send us a leaflet of their patent friction sensitive drill.

We have received a list of electrically-driven and other fans from Messrs. John Gibbs & Son, Liverpool; the special feature of these fans is the method of securing the blades by means of a double boss locking with flanges on the blades, so that the latter cannot possibly be thrown out. A neat motor-starting switch is also shown, which is designed to render accidental damage to the motor an impossibility.

Messrs. Paterson & Cooper's most recent catalogue, which we have received, shows voltmeters and ammeters at prices ranging from £2 upwards, of various types—gravity, permanent magnet, spring control, &c.—and Cardew voltmeters, and includes a useful reference table and price list of cables and wires.

The Maire Paint Company has sent us particulars of the Maire indestructible roof preserver, which, it is stated, is *not* a paint, and contains no oil.

Messrs. J. Beardshaw & Son, Limited, of Cannon Street, E.C., and Sheffield, have issued a new list of Sheffield steel and other goods, including engineers' and contractors' tools, agricultural implements, circular saws, profile tool steel. A handy telegraph code is given.

Messrs. Marryat & Place, of Hatton Garden, send us an illustrated price list of their "M.P." switches, switchboards, &c., for electric light and power.

We have received lists from Messrs. Johnson & Phillips, who have acquired the English patent rights of the Hartmann & Braun hot wire instruments for direct and alternating current, and are manufacturing them at their Charlton works. As is well known, in these instruments a short wire of platinum-silver alloy carries the current, and the elongation of this wire is transmitted to a pointer pivoted in jewels through a simple magnifying device. A zero adjustment is provided, and magnetic damping. The new patent "J. & P." supply meter is also illustrated; this is constructed on the integrating principle, combining a time-keeping mechanism with an amperemeter or wattmeter, as the case may be, and recording the product of these factors on the dials.

New Resistance Material.—During the past few days Messrs. Veritys have had at their showrooms in King Street, Covent Garden, some samples of the new resistance material which is being exploited by the Electric Resistance and Heating Company, Limited, whose prospectus is now before the public. As far as one could see the material is calculated to simplify the construction and regulation of a great number of electric appliances used for traction, lighting, cooking, and other purposes. Resistances made of this material cost less than present forms and occupy considerably less space. The composition is quite plastic, tough, and durable, so that it is very suitable for cooking utensils; and for heating rooms it is capable of being treated with a view to ornament.

New Resistance Switches.—We have received from Messrs. Mayes & Spikins, Hove, an account of their patent Phœnix motor controllers and arc lamp resistances. No wire is used in these, the substitute being powdered graphite, and every switch is practically indestructible, being capable of carrying four times its normal current without injury. The motor controller may be had with automatic maximum and minimum cut-outs, and is arranged either for regulating or for starting only; the price is extremely moderate—a most important feature, for our English motor starters, as a rule, have a tendency to be terribly dear.

Shipowners' Technical Code Book.—We have received from Messrs. Charles Barker & Sons, of Birchin Lane, a copy of this book which has been compiled by Mr. Walter Phillips to meet the requirements of shipowners and their captains. It is of course mainly nautical, but includes a Glossary of Terms used in electricity with code words and numbers. This list will probably be found useful in shipping circles, though it is marred by a number of misprints and includes a few items that are obsolete.

Trade Announcements.—We are informed that Mr. G. H. Gibson, formerly a member of Binko & Co., of Leadenhall Street, and subsequently a director of Messrs. Binko, Ridsdale & Co., Limited, has joined the firm of Messrs. Nunn, Ridsdale & Co., of Shadwell, wholesale ship chandlers and nautical and other lamp manufacturers, that firm having acquired the business of Messrs. Ridsdale & Co., of the Minories. He has no connection with any other firm or business.

The General Electric Company, Limited, announces that it is now in a position to supply the dry cells used for the De Dion motor cycle, both singly and in sets with rubber cases.

We are informed that Messrs. Gent & Co. have removed their London office from Maiden Lane to 25, Laurence Pountney Lane, E.C., where an increased stock will be carried, under the management of Mr. H. M. Harris.

ELECTRIC LIGHTING NOTES.

Alva.—At the monthly meeting of the Burgh Commissioners, held on 10th inst., it was stated that the Electric Light Committee had decided that the time had not yet arrived when they should take up the question of lighting the burgh with electricity.

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Ambleside.—The District Council has entered into an agreement with the Windermere and District Electricity Supply Company for the supply of electrical energy at 3d. per unit, while the Council will lay the mains and re-sell at 7d. per unit.

Barrow.—The Corporation electricity works is to be officially started on the 27th inst.

Bermondsey.—At a meeting on Monday, the Electric Lighting Committee recommended the Vestry to engage Messrs. Kincaid, Waller & Manville to advise the Vestry in the matter of the electricity works and refuse destructor, at a fee of 5 per cent. on the amount of the contracts. A long and unseemly discussion followed, but eventually the recommendation was unanimously adopted.

Berwick.—At a meeting of the Sanitary Authority on July 11th, the clerk intimated that he had received two letters, one from Edmundsons' Electricity Corporation, Limited, and the other from the Electric Power Distribution Company, giving notice that they intended to apply for provisional orders during the Parliamentary session of 1900 to introduce the electric light into Berwick. The question of lighting the town with electric light was referred to the Lighting and Works Committees, which were also empowered to get the advice of an electrical engineer on the subject.

Brechin.—A letter was read at the Police Commission meeting on July 11th from Edmundson's Electricity Corporation, Limited, asking the Commission to transfer the provisional order for electric lighting in the burgh to the Angus Electric Light Company, in terms of the agreement between the Commission and Edmundson's, Limited. The letter was remitted to the Electric Light Committee.

Bristol.—The Local Government Board has given its sanction to a loan of £41,650 in connection with the extension now about to be undertaken.

Broughty Ferry.—A committee of the Broughty Ferry Burgh Commissioners, on July 10th, considered a letter from Edmundson's Electricity Corporation, Limited, on behalf of the Urban Electric Supply Company, Limited, notifying the company's intention to apply for a provisional order for the burgh, and offering special facilities to purchase. The committee resolved to oppose the application, and to apply on its own account, and inquiries were set on foot as to a suitable engineer, who might draw up a report on the subject.

Camberwell.—The Vestry considered the report of Major Cardew, R.E., on the question of purchasing the electric lighting undertaking of the County of London and Brush Provincial Electric Lighting Company, at a meeting on July 12th. The report stated that the Vestry would have to pay 13s per cent. on the amount of the capital account, as well as a sum equal to 5 per cent. dividend for one year; in addition, the Vestry would have to erect a generating station, make house connections, &c. The total capital expenditure was estimated at £140,000. It was resolved that the supply of electricity should be in the hands of the local authority, that the Electric Lighting Company should be informed of the above resolution and be asked whether they would assist the Vestry by giving particulars of the work already done, and that the offer of the English Industrials, Limited, to lease or take over the cables, be not entertained at present.

Cardiff.—The Town Council has approved the recommendation of the Lighting Committee that one of the fitters in the electricity works be given a month's trial as electrician.

Charlton Kings.—The Cheltenham Corporation has informed the District Council of its intention to apply this year for a provisional order for supplying the district or parts of the district with electric light. The consent of the Council was given to the proposed extension, subject to such conditions as the Council might hereafter prescribe.

Chislehurst.—The Chislehurst Parish Council has abandoned the proposal to light the streets with electricity.

Coatbridge.—At a meeting of the Town Council on July 12th, Councillor Lavell moved that a committee be appointed to negotiate with the Scottish House-to House Electricity Company as to the terms on which they would be prepared to sell their Coatbridge undertaking, with a view to its being acquired by the Council in the interest of the community. The matter was remitted to the Fire and Lighting Committee to make inquiries.

Colne.—It was decided to give effect to the Colne Electric Light Order, 1897, with the view of supplying electricity within the borough.

Continental Notes.—GERMANY.—A large central station is about to be established at Thörl; water-power is to be utilised, about 4,000 HP, it is said, being available. The establishment of a central electric lighting station in the town of Bommern has just been decided upon.

FRANCE.—A company has just been formed in Paris with a capital of £8,000 to be known as La Compagnie Francaise d'Exploitation des Lampes Electriques à Arc (Systéme Hegner). The question of electrically lighting the harbour of Cherbourg is under consideration.

AUSTRIA.—At the end of May last the central stations of the Oesttereichische Gesellschaft of Vienna were supplying electric power equivalent to 120,442 hectowatts, as compared with 114,600 hectowatts a year ago.

RUSSIA.—The "Volta" is the name of a new company which has just been formed at Reval, with a capital of 1,500,000 roubles, to carry on an electrical engineering business.

Derry.—A special meeting of the Corporation was held on 10th inst. to consider a report from Mr. Christie, electrical engineer to the Glasgow Corporation, on the offer of the British Thomson-Houston Company, London, to take over the public and private lighting of the city and establish a system of electric trams, which the company would work. The report stated that the Corporation would be quite capable of working a system of public and private electric lighting, and should not hand its interests over to any company. It was resolved that the report be printed for the benefit of the Council.

Devonport.—The Corporation has received an offer from the Devonport and District (Electric) Tramways Company to take over the Corporation's electric lighting order. The offer, the terms of which have not been stated, was not entertained.

Dorchester.—At a meeting of the Town Council last week a letter was read from Edmundson's Electricity Corporation, Limited (writing on behalf of the Urban Electric Supply Company, Limited), notifying their intention to apply to the Board of Trade for a provisional order for supplying the borough with electric light. If the Council assented to the application being made, the company undertook to insert special clauses in the order giving the Council option to purchase the undertaking at a much earlier period than was provided for in the Electric Lighting Act. The letter was referred to the General Purposes Committee.

Dundee.—A deputation from the Town Council visited Blackpool last week for the purpose of inspecting the electric light and tramway installation.

East Barnet Valley.—At a meeting of the District Council on 4th inst. a letter was read from the North Metropolitan Electrical Power Distribution Company, Limited, stating that application was intended to be made by them on or before December 21st next for a provisional order to supply electrical energy for public or private purposes within the urban district of East Barnet Valley. It was decided to write to the Board of Trade, intimating that the Council objected to the proposed scheme.

Edmonton.—The District Council has received notice from the North Metropolitan Electric Power Company of its intention to apply for a provisional order, and has decided to apply for an order itself.

Epsom.—The District Council, on the advice of its engineer, Mr. Hawtayne, has decided to apply for power to borrow £16,100 in order to carry out its provisional order.

Gosport.—The Electrical Power Distribution Company has intimated to the District Council that it has made an application to the Board of Trade for a provisional order authorising it to light the district of Gosport and Alverstoke by means of electricity.

Govan.—At a meeting of the Commissioners on July 10th it was decided to apply to the Secretary for Scotland for power to borrow £50,000 for electrical purposes under the Govan Burgh Provisional Order.

Hammersmith.—At a meeting of the Vestry on July 19th it was stated that the London County Council was prepared to advance to the Vestry £30,000, part of a loan of £69,000, to meet the cost of extending the electric lighting installation, such sum to be repaid by instalments extending over 42 years, and to bear interest at the rate of 3 per cent. per annum. The Vestry resolved to accept the loan on the said terms, and to form a sinking fund for the purpose of any renewals of machinery, &c, which might be needed during the currency of the loan. At the same meeting the Vestry decided to oppose the application of the District Electrical Supply Company, Limited, for a provisional order to supply electricity in the parish.

Hereford.—The County Council is considering the question of installing the electric light in the Hereford County and City Asylum, at an estimated cost of about £6,000.

Hove.—The Hove Electric Lighting Company, Limited, announces that an important reduction in the prices charged to consumers of the electric light will be made on January 1st, 1900.

Hoylake.—The District Council has adopted an electric lighting scheme drawn up by Mr. T. L. Miller, on the alternating current system, at an estimated cost of £26,000.

Hythe.—A letter was received by the District Council last week from Mr. F. Hall, of Folkestone, notifying that he intended, on behalf of the Folkestone Electricity Supply Company, to make application for a provisional order to supply the town of Hythe with electricity. The Council decided to ascertain the best terms of Mr. Hall for the supply of electricity, and to approach the South-Eastern Railway Company to find out whether it was prepared to move in the matter.

Yeadon.—At a meeting of the District Council on July 17th, Mr. Reuben Yeadon presiding, a letter was read giving formal notice on behalf of Messrs. Greenwood & Batley, Leeds, of their intention to apply, on behalf of a company they propose to form, for an electric lighting order for the area of the urban district of Yeadon and probably some other adjoining areas. It was resolved that the provisional order obtained by the Council in 1894 should be put into operation, and that an expert be engaged to advise them as to the best method to adopt.

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Inverness.—The Town Council on July 11th decided to adopt steam-power for the electricity works, instead of water-power, in accordance with a report drawn up by Mr. Craven on the subject. The matter is to be actively pushed forward at once.

Lanark.—The Town Council has instructed the Street Committee to consider and report on the matter of having the streets lit by electricity.

Leek.—The District Council has received notice from the Electrical Power Distribution Company of its intention to apply to Parliament next session for power to supply electricity within the urban district of Leek. It was decided to inform the company that the Council would oppose the application.

Leicester.—The electric lighting of the extensive chemical factory of Messrs. J. Richardson & Co., Limited, of Leicester, has been placed in the hands of Messrs. Ellis & Ward, of Birmingham.

Llanrwst.—The District Council has had before it the question of public electric lighting. Tenders were submitted for street lighting during the ensuing year from the local electricity supply company and from the Holyhead and North Wales Gas and Water Company. Subject to a contract for three or five years, the electric company offered, under stated conditions, to supply the light for 25s. per lamp per annum. The gas company offered to supply gas at 4s. 9d. per 1,000 feet net, and emphasised the importance of adopting the incandescent burners, which, it was alleged, were being extensively used by large corporations in preference to electric light, even where the electric light was the property of the corporation. The electricity company's tender was accepted for 25s. per lamp.

Lowestoft.—The Local Government Board has granted the application of the Town Council for a loan of £30,000 for the purposes of electric lighting.

Maidstone.—The Maidstone Urban District Council has adopted the scheme put before it by Messrs. Stevens & Barker for lighting the streets with electricity, and application is to be made to the Local Government Board for sanction to borrow the money necessary to carry out the work.

Mersey Docks.—The Docks and Harbour Board has resolved to provide electric lights at the Union Dock and at the Herculaneum and Herculaneum Branch Docks, with the necessary additional plant, at an estimated cost of £1,000.

Montrose.—At a meeting of the Town Council, a letter was read from the Angus Electric Light and Power Company, informing the Council that the specifications for the lighting station were now in draft, and asking the Council to appoint one of their number as an *ex officio* director of the Edmundsons Electricity Corporation in terms of the agreement between that company and the town. The Dean of Guild Hall was appointed a director.

Morecambe.—The District Council has decided to carry out considerable extensions to meet the growing demand for electrical energy, at an estimated cost of £22,403, and will apply for the sanction of the Local Government Board to borrow the sum named. The electrical engineer is to advertise for tenders for an economiser and sub-station.

Newcastle.—The Tyneside Electric Power Company has been formed locally for the purpose of supplying electric energy in all the following localities:—Blaydon-on-Tyne, Wickham, Felling, Hebburn, Ryton, Willington Quay, Gosforth, Wallsend, Walker, Newburn, Benwell and Fenham, Seghill, Cramlington, Bedlingtonshire, Westslade, Jarrow-on-Tyne, Gateshead-on-Tyne, Boldon Colliery, Boldon, Monkton, Longbenton, Tynemouth, and South Shields. By working on this extensive scale it is anticipated that the Tyneside Company will be in a position to remuneratively supply electric power at much lower rates than have hitherto been found practicable. The original capital of the company is £100,000, divided into 10,000 shares of £10 each. The secretary is Mr. James Patterson, whose office is at 38, Granger Street West.

Nuneaton.—The directors of the Nuneaton Electric Light Company have accepted the offer of the District Council to purchase the works at £5,000, and a town's meeting has been called to consider the question.

Partick.—Several of the Commissioners have received a deputation from the ratepayers with regard to the electric lighting of the burgh, and the feeling has been expressed in the various wards and by the people generally that the electric lighting scheme should be proceeded with.

Penzance.—The Town Council has decided to hold a special meeting to consider the propriety of applying for a provisional order under the Electric Lighting Acts.

Radcliffe.—The District Council has applied to the Local Government Board for sanction to borrow £16,000 for purposes of electric lighting, and the Local Government Board has directed an inquiry into the subject.

Radcliffe.—The Local Government Board has fixed 18th inst. for an inquiry into an application by the Radcliffe District Council for sanction to borrow £16,000 for purposes of electric lighting, Colonel J. T. Marsh, R.E., being the inspector appointed to hold the inquiry.

Reigate.—A Local Government inquiry was held on July 13th into the application by the Corporation for sanction to raise a loan of £25,000 for electric lighting purposes.

Retford.—The Corporation is seeking a provisional order for the supply of electric light to the borough.

Ripley.—The question of establishing electricity works at Ripley is under the consideration of the Council.

Rochester and Chatham.—The Electrical Power Distribution Company, Limited, has sent notices to both the Rochester and Chatham corporate bodies that application is to be made by it to the Board of Trade for a provisional order authorising the company to supply electrical energy for public and private purposes within the two districts.

Runcorn.—The Royal Assent has been given to the Bill confirming the Runcorn electric lighting provisional order. The order was referred to the Highways and Buildings Committee, with instructions to prepare a scheme in accordance with the order, and report to the Council.

Sheffield.—A 600-KW. inductor alternator is being erected at the electricity works by the Brush Electrical Engineering Company, Loughborough, and the engine house is to be extended so as to contain a Ferranti alternating steam generator of 1,700 H P.

Slough.—Messrs. Laing, Wharton & Down have, through their solicitors, notified the Slough Urban District Council of their intention to apply for a provisional order for parishes and places within their district.

Southend.—A company is being formed by Mr. A. H. Gibbings, city electrical engineer of Bradford, with a capital of £50,000, to take over the Corporation's provisional order.

Southend-on-Sea.—The Town Council last week considered a detailed report from the Electric Lighting Committee, recommending that the Corporation's powers should be transferred to Mr. Gibbings, city electrical engineer of Bradford. The principal terms proposed are that Mr. Gibbings should supply electrical energy to the whole of the town for 1½d. per unit, and lay down the mains within 18 months. The discussion was adjourned.

Stroud.—The District Council is considering the question of establishing an electricity works in the district.

Sunderland.—The Town Council has adopted the recommendation of the Lighting Committee that the electricity works should be extended at a cost of £40,000.

Swanage.—The District Council has received a letter from the Camborne Electricity Supply Company, stating that it was their intention to apply to the Board of Trade for a provisional order for the supply of electricity for private and public purposes in the Swanage district. The clerk was instructed to obtain information about this company, and report to the committee.

Tavistock.—The District Council has deferred the question of obtaining a provisional order for six months.

Teignmouth.—The Parliamentary agent's accounts relative to the passage of the District Council's electric lighting provisional order for Teignmouth amounted to £258 15s. The clerk was requested to have it taxed.

Walker.—At a special meeting of the District Council on July 14th, a report was presented by the Electric Lighting Committee, which stated that the cost of the Council's Electric Lighting Bill was in all £1,936 10s. 2d. Answering a question by one of the members, the clerk said that had it not been for the opposition of the gas company, the Bill could have been obtained for £400, thus making an expenditure of between £1,500 and £1,600 unnecessarily incurred. The expenses of the members of the Council in London only amounted to £80. The report was unanimously adopted.

Walthamstow.—Colonel J. T. Marsh held a Local Government inquiry at the Town Hall on the 11th inst., into the application of the District Council to borrow £5,200 for wiring and fitting 6,600 8-C.P. lamps to private houses. Replying to the inspector, the clerk said that as the result of the recent canvass they had promises equal to 79,000 8-C.P. lamps. It was the usual course to enter into an agreement with the Free Wiring Company, but the Council preferred doing the work themselves. There was no opposition, but the inspector said the Local Government Board had only granted one similar application in all England.

Wellingborough.—The District Council has received notices of intention to apply for provisional orders from the Electrical Power Distribution Company, Limited, and the Municipal

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Supply Company, Limited. After discussion it was decided to consent to the application of the Electrical Power Distribution Company, subject to a satisfactory agreement being arrived at between the Council and the company.

Windsor.—A letter was read last week from the solicitor to the Windsor Electrical Installation Company, asking for the District Council's permission to the extension of the company's powers to light Clewer with electricity. It was decided to postpone the matter for a month.

Woking.—At a meeting of the Sanitary and Lighting Committee of the District Council last week notice was received of the intention of the Woking Electric Supply Company, Limited, to apply on or before November 1st, 1899, to the Board of Trade for a provisional order under the Electric Lighting Acts, 1882 to 1890. The matter was referred to the Council, which instructed the Finance Committee to prepare a report on the same.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—After a lengthy discussion the Town Council adopted the recommendation of the Lighting and Tramways Committee—that the salary of Mr. J. A. Bell, the electrical engineer, should be increased to £300 per annum.

Bardsley.—A collision occurred on the 15th inst. between an electric car and a lurry. The latter was thrown to the side of the road, while the front of the car, which was stated to have been running up hill at a speed of "several miles an hour" (!) was badly damaged. The car was full of passengers, but no one was seriously injured.

Bedford.—The Town Council on July 12th received a petition from a number of ratepayers urging the Council to construct a system of electric tramways in the borough and to Kempston. It was resolved that the Electricity Committee should report on a scheme, and that a provisional order should be obtained. At the same meeting it was decided to apply for a loan of £41,000 to extend the electricity supply undertaking, so as to render it available for the whole of the public and private lighting of the town.

Bexhill-on-Sea.—The House of Commons Committee has rejected the Bill for the construction of an electric tramway from Bexhill to Hastings, which received the assent of the House of Lords some two months ago.

Bristol.—The electric tramway extension to Arno's Vale was inspected on July 11th by Major Cardew, the Board of Trade inspecting officer. After inspecting the track Major Cardew visited the St. George power station, where the current will be generated till the company's central power station at Counterslip is completed. The inspector made a number of elaborate tests, at the conclusion of which he said he was perfectly satisfied with everything he had seen, and he gave the company authority to open the line for public traffic forthwith. The company had the whole of the new cars and staff ready in waiting at the Staple Hill depôt; these were telegraphed for at five o'clock, and before six o'clock the horse cars on the new electric tram section had disappeared, and the lines were being worked by the electric cars. The total length of line electrically operated now amounts to 10 miles. There still remains a length of 20 miles of route to be equipped, and the whole capital expenditure will amount to about £400,000. The work is proceeding rapidly, and it is anticipated that the permanent way will be finished by April next year. The feeder cables are being laid in conduits, the makers guaranteeing them to remain in good order for 10 years, if laid in this way. At the same time new car sheds and the large generating station at Counterslip are in course of construction, and every effort is being made to complete the work within a twelvemonth.

Although there are complaints that the centre poles, which the Tramway Company was compelled by the Corporation to use in Victoria Street, impede the traffic, the company will be obliged to reconstruct the lines near the Colston Avenue to suit centre poles, instead of span wires and side poles as intended.

Colne.—At a meeting of the Town Council on 5th inst., in regard to the Nelson, Colne, and Trawden Light Railway, it was stated that the opposition to the project of the Lancashire and Yorkshire Light Railway Company had been withdrawn, so that in all probability the order would now be made.

Continental Notes.—Italy.—An electric tramway is to be constructed between the railway station and the town of Chieti.

Spain.—Application has been made for a concession for a projected electric tramway between Sarria and the Montana de Vallvidrera.

Darwen.—A deputation from the Corporation visited the Glasgow tramways on July 12th, and inspected the generating station and car works.

Germany.—The American Consul at Düsseldorf has, after the fashion of his kind, lately been reporting upon the progress of electric traction in Germany, and an abstract of his report has been published in that enterprising trade journal, *Sell's Commercial Intelligence*. From this abstract we learn that all the more important German cities are now provided with suburban electric lines, and that horse traction in the central portions of these cities is being gradually displaced. As a typical instance of the network of electric lines surrounding the larger towns he takes Düsseldorf, which possesses four completed suburban lines:—Düsseldorf to Crefeld, about 12 miles; Düsseldorf to Rattigen, about eight miles; Düsseldorf to Benrath, about six miles; Düsseldorf to Kaiserwerth, about five miles. Were London as well equipped as Düsseldorf it would possess at least 100 suburban electric lines, and one of the great city problems of the moment would be in a fair way towards solution. Could not the L.C.C. spend with advantage more of its superfluous energy upon study of this aspect of the "over-crowding" problem?

Halifax.—The electrical engineer to the Corporation (Mr. Street) has presented to the Council a lengthy and exhaustive report in regard to the future requirements of the municipality, under the altered conditions since the construction of the tramways. He says that as to whether the present alternating system of supply of electricity is still suitable, under the altered conditions of working since the operations of the tramways, the question depends mainly on the extent the Council proposes to extend the tramway system. He says:—

"For the purposes of lighting alone the superiority of alternating current supply or direct current supply is a matter of personal opinion, based on experience, and seeing how large a number of central stations of either system are in successful operation in this country, it cannot be said that either the one or the other is unsuitable, the only moot point is—which is the easier to work? The question in general was decided when your central station was built some years ago, and from the geographical conditions existent in Halifax, preference was undoubtedly given to what was then the more suitable system. Recently, however, conditions have altered to such an extent that the present is a very proper time for the reconsideration of the question. Among recent improvements, the introduction of a good high voltage lamp ranks first. This has removed the great disadvantage under which direct current systems had been working, *i.e.*, cost of distribution, which has been reduced 50 per cent.; of course it has also favourably affected alternating current stations, but in a lesser degree. Plant and switch gear have also improved, and for cables several reliable substitutes for rubber have been brought out. Accumulators also have made big strides towards perfection, from which, however, they are still a long way. These improvements have all tended to bring the direct current system more into favour. But if ever a reliable battery is brought out which will store electricity in the same proportion as gas is at present stored in your gas-holders, it will of necessity be for direct current, for it is a physical impossibility to store up alternating current. In many cases now, an engineer, when deciding on the system to be employed, would consider direct current more suitable, when a few years ago the alternating current alone could have been used. The question before the Committee is this: Are you justified in now changing over part of the system from alternating to direct current, seeing conditions have so materially altered during the last few years? But, at the outset, a serious difficulty is apparent. Five-sixths of the present lamps installed are within a radius of 500 yards from Cheapside. Consequently, if this area is changed over to direct current, three-fourths of our present plant, viz, the two large 600-H.P. alternators, would be useless for lighting purposes. They could, however, be re-arranged so as to work as tramway power generators. If an extended tramway service is brought forward, there will of necessity be required several sub-stations several miles out of Halifax, and these must be supplied with power by means of polyphase distribution with polyphase generators in the central station in Foundry Street, for this is the only method of working long distance tramways, and the committee would have to purchase an outfit. As an alternative, I would lay before you the following scheme:—You are aware that at present electricity for lighting is generated at high pressure, 2,000 volts, at Foundry Street, and transformed, by means of transformers fixed at suitable points in the town, to a low pressure, 200 volts, which goes to the lamps. Houses outside the area supplied have, in nearly all cases, small transformers fixed in their basements. It is suggested that the area should be supplied with direct current, which does not need transformers, and would result in releasing all these large transformers for other work in more distant parts of the town. The network of cables which ran through the district shown was laid down with ample margin for an increasing demand, but progress has been so rapid that these cables will soon be loaded up, which will necessitate either extra cables and extra sub-stations, or doubling the pressure on the mains, and thus doubling their capacity and altering all the lamps. This overloading will have to be dealt with within the next two or three years, and could be very well done at the present instance. So the committee have now to decide if they will (1) convert the two 600-horse-power alternators, at an estimated cost of £1,000 each, into tramway power generators, and put down new plant for lighting the centre of the town; (2) change the standard pressure from 100 to 200 volts, thereby doubling the capacity of the low tension network; and (3) relay these cables in bitumen, thereby more than doubling their life. As before mentioned, these last two matters will have to be met, even if the alternating system is proceeded with, and new alternators must be bought at once. If the system were changed, and new direct current machines obtained, these could be used either for tramway or lighting work. But whatever your decision, I wish to impress upon the committee a most vital point with regard to central stations, a point which cannot be too strongly emphasised, and it is that, to

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secure good and successful running, all future machinery should be alike as near as possible, in size and make, for 'uniformity of plant' is an axiom which cannot be carried to excess. Do not, if you have an odd corner in your station, buy an odd plant to fit in; it is a policy which will be regretted sooner or later; you could erect a building for £4,000, which would hold £150,000 worth of plant, and if this plant is uniform, the cost and time of repairs are reduced to a minimum, while the appearance of the station is vastly improved. I need hardly point out what a profitable source of income could be obtained by combining a tramway and lighting station in outside districts, worked by multiphase motors from Foundry Street, and in my opinion the deciding of the question on which this report is based should depend on what decision (*re* tramways) the committee are able to come to with these districts. I consider it advisable to lay before you the necessary expenditure which will occur during the next three years to meet the rapidly increasing demand, and supposing the alternating current supply is proceeded with. Out of the five existing sub-stations, four are very much overloaded, and the transformers must be increased, and feeders doubled. The feeders which supply the outlying districts are at present all joined to one trunk main, and should now be split up into sections and two extra trunk mains laid between George Street and the works. The cost of this will be as follows:—Alternator switchboard, £200; six feeder panels at £45, £270; six pairs feeders, at £140, £840; 20 kw. transformers, at £53, £1,060; fittings and wire at sub-stations, £130; pipes for feeders, and laying same, £420; total, £2,920. This will suffice for only three years. If the direct current system were adopted the amount of copper to be laid from the works to the existing sub-stations, in order to supply our existing lamps, plus the number allowed for its estimate No. 1, and with a very large margin, would be 42,500 lbs., at 9d. per lb., £1,594; (2) cost of conduits and insulation material, and laying same, £800; (2*a*) switches at sub-stations, £60: total, £2,454. These mains will carry 1,000 amperes to each sub-station, or four times what we are already supplying, and if the standard pressure be doubled, then these feeders will carry enough current to meet the demands in the centre of the town, even if nearly every house has the electric light. I may again say that even if the alternating supply is proceeded with, the cables laid in the streets, shown on map, will soon be overloaded, and either new sub-stations should be built or new feeder cables run to relieve them, or the pressure doubled. In the case of either system the cost to us would be the same, for we should have to exchange all the lamps in the district, of which there are about 16,000. (3) 16,000 lamps at 10d. each, £666. We could retail a lot of these lamps to consumers in the outskirts of the town at 6d. each. There are about 16 private alternating current arc lamps in the town; these would have to be changed to direct current ones where possible, but the old ones would be used for public lighting in the outside districts. Also the few small alternating motors could be let on hire. The proposed change to direct current would release transformers and switchboard fittings at present fixed in the Town Hall, George Street, Markets, Wards End, and Woolshops sub-stations, to the value of about (4) £1,200, all of which could be in time used up in the small but rapidly increasing sub-stations in outside districts. You will notice that the difference of cost of sub-station fittings, &c., for alternating current and direct current is £1,200 and £60 respectively. See estimates, Nos. 4 and 2*a*. So that, bearing in mind that engines and dynamos for supplying alternating current cost practically the same as those for direct current of equal power, the necessary immediate outlay, not allowing for engines and dynamos, will be estimate No. 1 (alternating) for three years, £2,920; estimate No. 2 (district current), £2,454; switchboards at works, boosters and balancer, £700; total, £3,154, less estimate No. (4), £1,200; leaving, £1,954; plus estimate No. 3, £666; total, £2,620. I have only added estimate No. 3 to the direct current scheme, as it is absolutely necessary to this scheme, but could be dispensed with for a time in the alternating current scheme. The direct current trunk mains are practically unperishable. I am assuming that our large battery will be of great use to us in this scheme, which is fortunate, as it is already too small for tramway work, except as a balancer, owing to the rapid growth of the tramway system. It will not be much good to take the top peak of the lighting load, though it could help. I may here say that the prime cost, efficiency, and up-keep of an engine and dynamo would be less than that of a battery, though a battery in some cases is invaluable. With regard to a question raised by a member as to reserve plant required in a station, if the standard unit in a station is 800 H.P., there must always be an 800 H.P. set in reserve. If there are enough lamps connected to fill up either one H.P. set or 10 800-H.P. set, the reserve plant is always the same, viz., one 800-H.P. set. Our small tramway sets will soon be of little use, owing to the increase of the tramway system, but these could be used for the varying lighting loads; and, of course, if the committee adopt the direct current, their new machines could be used for lighting or tramway work. The question of the low tension network of mains is a very important one. In this case it is proposed to double the pressure between the outer wires and earth the inner. The makers, while they think the mains should stand this, would not guarantee it. Personally, I do not think there is much risk at present, and if there were a breakdown it would not be a serious matter. But bearing in mind that the life of a rubber cable is by no means long, say, eight years, it would be a good plan to re-lay the existing mains in the district shown on the map, bedding them in bitumen. They will then be practically unperishable, and though I estimate the cost to be £1,400, including labour, &c., I consider the money will be well spent. In conclusion, I may say I have made this report with great diffidence, not wishing, so soon after my appointment as your electrical adviser, to make changes of so revolutionary a character as this report sets forth, but I cannot help admitting, and my opinion is shared by men of the highest standing in the electrical profession, that in a few years' time no new single phase alternating current stations will be laid down, and signs are not wanting of a tendency to convert these stations before they get too large. Undoubtedly the station of the future will be a large polyphase generating station, with direct current distributing stations containing rotary converters, the former being placed in a position for the easy handling of coal and with a good water supply near, and your Foundry Street station is most admirably situate for both these. And as the demand for light in Halifax increases, the direct current supply will gradually extend and absorb the districts that are at present fed with alternating current, and eventually sub-stations equipped with polyphase machines driven by polyphase motors, actuated by the polyphase generators in Foundry Street, will be erected in some part of Skircoat, Highroad Well, and Ovenden, which will supply the districts near each." The recommendation of the Gasworks and Electricity Committee was approved that part of the centre of the town be supplied with direct current, and machines which can be used for either lighting or tramway purposes.

Halifax.—A special meeting of the Town Council was held on July 12 h, when the recommendations of the Tramways Committee—that powers be obtained to construct electric tramways on nine specified routes, at an estimated cost of £160,000, or about £8,000 per mile—were adopted. Further, the Council added four routes which had been rejected by the Committee! It was stated that the whole system would be completed within five years.

Laxey-Ramsey.—On July 13th, Messrs. T. Fisher, J. Cowle and R. Corlett, arbitrators appointed by the Governor, sat at the Court House, Douglas, to assess the value of certain lands acquired by the Isle of Man Tramways and Electric Power Company, Limited. The matter was adjourned.

Leeds-Yeadon.—The Joint Tramway Committee appointed by the District Councils of Yeadon, Rawdon, and Horsforth, met at Rawdon on 14th inst., and formulated a scheme of tramways from the Leeds city boundary at Kirkstall to Yeadon, which is to be submitted to three private firms, to see how far they are prepared to carry it out.

Liverpool.—At a meeting of the Tramways Committee on July 14th it was stated that great loss and inconvenience had been caused by the failure of the contractors to deliver the electric cars, of which only five out of 20 had been received. There are altogether 80 cars on order. The engineers were asked to report on three proposed new routes.

London County Council.—The Council on July 18th decided to instruct the Parliamentary Committee to seek powers in the next session to authorise the Council to adopt on the tramways the conduit, trolley, or surface contact system of electric traction.

A New Tramway System.—Mr. A. F. Stevenson sends us a description of a new electric tramway system, which he terms a combination of the underground conduit and surface contact methods. He effects the combination by enclosing a simple mechanically operated surface contact in a small conduit, and claims to get a system which is sightly, safe, and inexpensive. It is known as the Heyl-Dia electric tramway, and the patents are the property of the English Industrials, Limited, of Manchester. In this system the conduit, which is only 6 inches deep and 3½ inches wide, is formed by riveting a stout angle iron of special shape on the flange of one of the ordinary rails, the space between the rail and the angle iron being the conduit. The slot of the conduit is ⅜ inch wide. At intervals of 24 feet contact boxes are let into the angle iron, which are operated by a flexible plough, 26 feet long, stayed from each end of the car truck. The contact box consists of a watertight cast-steel chamber (6 inches × 6 inches × 5½ inches) in which is pivoted a horizontal switch arm. One end of the switch arm, which is fitted with a small trolley, projects into the conduit through a flexible diaphragm of leather, rubber, or other suitable material. The other end of the switch arm lies midway between two contacts, which are in connection with the feeding cable. The body of the plough consists of a steel strip 26 feet long and 2½ inches deep, to which is attached, by insulating blocks, a conducting strip of phosphor bronze, which extends the whole length of the plough. The *modus operandi* is as follows:—The contact strip, coming into contact with the trolley at the end of the switch, knocks it over till the other end engages with one of the contacts in the box. Electrical connection is thereby established between the feeding cable and the contact strip, which again is in connection with the motors, &c., on the car. After the car has passed, the switch arm is brought back to the insulated position by a spring. If the car is travelling in the other direction the arm goes over to the opposite contact. One of the main features claimed for this system is its high insulation. The only point at which a leakage can take place is the contact under each car. The rest of the conduit is dead. At first sight it might seem that there was considerable danger of the strip coming into contact with the walls of the conduit, but we are given to understand that this is prevented by the plough body, which would come against the sides of the slot long before that happened. The stays and guide wheels keep the plough in a vertical position and also in the middle of the conduit. Sump holes are let into the conduit about every 100 yards, the conduit being cleaned out by attaching a scraper to the plough of a car.

Plymouth.—The "Three Towns," Plymouth, Devonport and East Stonehouse, had an opportunity recently of buying out the company which owns and works the horse tramways which connect the towns, and of equipping the service for electric traction. They did not do it because of local jealousies respecting the division of the anticipated profits. Now the company are themselves prepared to undertake the work of bringing the service up to date, and

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in harmony with the municipal tramways in other parts of the towns. Unfortunately there seems to be serious danger of this scheme being also wrecked. The East Stonehouse District Council declines to discuss it, and as the District Council holds the key of the situation, the two Corporations of Plymouth and Devonport are practically helpless in the matter. If East Stonehouse continues obdurate, it is likely to be swallowed up by one of its bigger neighbours; but when Plymouth tried this remedy for these domestic differences a few years ago the Local Government Board would not consent.

The Board of Trade has sanctioned the loan, for which the Plymouth Corporation recently applied, for the purpose of extending electric traction in the borough. The Prince Rock section of the electric tramway will, it is expected, be opened this month. The application of the system to the Compton line will commence as soon as certain street improvement works are sufficiently advanced to give the necessary road space.

Rhymney.—The directors of the Rhymney Railway have decided to equip their new works at Caerphilly in the most modern manner. Electricity will be adopted for the transmission of power as well as for lighting purposes. A complete system of electric lighting will be installed, and electrical motors will be used throughout for driving the machines in the fitting shops and carpenters' shop. The lifting and walking cranes will also be worked by means of electrical motors. The dynamos and motors will be manufactured by Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne, and the whole of the erecting and fitting up will be carried out by Messrs. J. B. Saunders & Co., electrical engineers, Cardiff.

Rothesay.—A special meeting of the Council is to be held to consider the proposal for the purchase of the Rothesay Tramways Company by the British Electric Traction Company. Notice of motion has been given that the Town Council take over the tramways.

Ryde.—The Town Council has decided to support the proposed light electric railway scheme to Sea View.

St. Helens.—The electric tramways were inspected by Major Cardew, on behalf of the Board of Trade on July 19th, with satisfactory results.

Seven of the contracts for the important extensions in view have already been let, and the work of relaying the tramways has been commenced.

Stourbridge.—At a special meeting on July 11th, the Council authorised the Tramway Committee to make the necessary arrangements with the British Electric Traction Company as to the details of the carrying of the tramway up High Street, as authorised by the Dudley and District Light Railways Order.

Washington, U.S.A.—A plan is being considered by the Post Office Department for the introduction of automobile mail waggons in place of the horse-drawn vehicles now employed for collecting mail matter in the business section of the city. An electric vehicle, it is said, could easily be adapted for the work, and in addition to carrying storage batteries for its own power, an electric automatic cancelling machine could be placed in the waggon, providing better facilities for postmarking letters than the present method of hand cancellation. At present several clerks are employed on the mail collection waggons for cancelling and postmarking letters, and with the introduction of the automatic machines, which are used in the city post office, a considerable saving of time and labour would be effected. It is urged that the automobile could be charged from the electric plant of the post office building, and that better time and service would be the result in the collection of mail matter.

Worcester.—The report of Messrs. Kincaid, Waller and Manville, the experts appointed to advise the Corporation as to the advisability of acquiring the present system of tramways and converting them for the use of electric traction, has been placed before the Streets and Electricity Committee. The engineers estimate the cost of acquiring, extending, and equipping for electric traction the present tramways at £72,000, and the working, in their opinion, after meeting all charges, would result in a net profit to the city of £2,834 per annum. They advise that steps should be immediately taken to oppose the proposals of the tramway company to obtain powers to retain possession of the tramways.

TELEGRAPH AND TELEPHONE NOTES.

Edinburgh.—The directors of the Chamber of Commerce have forwarded to Sir Lewis M'Iver, M.P., for presentation to the House of Commons, a petition against the Telephone Bill. The petition says that the directors cannot regard the Bill as amended by the Standing Committee on Trade as being in any way a solution of the difficulties which the system existing in the country presents, and that they are of opinion that the true solution of the whole question lies in the nationalisation of the telephones.

Royal Electric Bells.—It is reported that the National Electric Company, of Milford (Connecticut), has made a contract to furnish Windsor Castle with electric bells and fire alarms, in competition with 50 English, French, and American concerns. When this order has been carried out, all the Queen's residences are to be fitted up in the same way. And by the same firm may we ask?

Government and the Telephones.—A basis of agreement has been arrived at between the Government and the National Telephone Company on the one point left by the Grand Committee on the Telephones Bill; this is as to the terms of intercommunication between the subscribers of the new and the old exchanges. It appears that the new exchanges will have free communication with the old ones when they have secured half the telephone users in an area of competition, and in the meantime the new exchange will pay to the old one a fee of 1d. a call. It is also pointed out that the free communication, when it is reached, will of course benefit the old company as well as the new exchanges, as it will be reciprocal.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa ...	April 4th, 1898 ...	...
Jamaica-Colon	July 1st, 1899 ...	...
Bonny-Cameroun	May 29th, 1899 ...	...
Latakia-Cyprus	June 21st, 1899 ...	...
Para-Maranham	April 10th, 1899 ...	...
Landlines.		
Communication between Salonika and Monastir ...	March 23rd, 1899 ...	...
Communication with Swakopmund	July 11th, 1899 ...	...
Moulmein-Bangkok... ...	July 18th, 1899 ...	...

Wireless Telegraphy from Balloons.—The Austrian military balloon section on July 11th made some interesting experiments, in which for the first time it was attempted to communicate between two balloons on the Marconi system of telegraphing without wires. One station was fixed to the car of a captive balloon, while the second was placed in a free aerostat. Notwithstanding the fact that, on account of the movement of both cars, the apparatus could not be fixed with the same accuracy as in a stationary position, despatches were exchanged with satisfactory results for some considerable time. Occasionally the signals were not clear, and some interruptions also occurred, but, on the whole, the outcome of the experiments was such that the military balloon detachment has resolved further to study and perfect the system.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barcarrota, Spain.—July 31st. The municipal authorities of Barcarrota (Badajos province) are inviting tenders until the 31st inst. for the concession for the electric lighting of the town during a period of 10 years. Particulars may be obtained from, and tenders be sent to, El Secretario del Ayuntamiento de Barcarrota (Badajos).

Battersea.—August 31st. The Vestry wants tenders for an overhead travelling crane (hand or electric), and batteries for the electricity works. See "Official Notices" July 7th.

Belfast.—July 31st. The Harbour Commissioners are prepared to receive tenders for the conversion of a 2-ton jib crane from steam to electric power. See "Official Notices" this week.

Birkdale.—August 19th. The Urban District Council invites tenders for the transfer of its electric lighting powers.

Denbigh.—The North Wales Counties Lunatic Asylum Committee wants tenders for the supply of engines, dynamos, switchboard, injector, piping, and foundations, also wiring of buildings for electric lighting. See "Official Notices" July 7th.

Edinburgh.—July 31st. The Council wants tenders for coal measuring gear and extensions to shafting, &c., for driving mechanical stokers. See "Official Notices" July 14th.

Glasgow.—July 22nd. The Corporation wants tenders for boilers, steam engines (main and auxiliary), three-phase generators, continuous current generators, rotary converters, boosters, and static transformers, surface condensers, feed pumps, circulating pumps, and air pumps, all for the electric traction scheme. See our "Official Notices" June 23rd.

Glasgow.—July 22nd. The Corporation wants tenders for 80 electric tramcar bodies to sample and drawing. See "Official Notices" June 23rd.

Glasgow.—July 31st. The Corporation wants tenders for the supply of concentric and single lead-covered main cables. See our "Official Notices" July 14th.

Glasgow.—August 2nd. The Corporation wants offers for the electric work required in connection with its fire alarm and A B C telegraph systems. Specifications, &c., from the chief officer of the Fire Brigade, College Street.

(*Continued on page* 110.)

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ST. HELENS CORPORATION ELECTRICITY WORKS AND TRAMWAYS.

The Corporation of St. Helens made its *début* as an electrical undertaker nearly three years ago, when a provisional order was obtained by the Gas Committee, and a generating station was put down to the specifications of Mr. Robert Hammond on the alternating current system, with transformers in street boxes; we published a description of the plant in our issue of January 22nd, 1897. The alternators were two in number, one of 120 KW., and one of 25 KW. output; but the demand rapidly increased, so that last year there were 6,000 lamps connected, the plant was fully loaded, and there was no stand-by—but, we are pleased to add, neither was there a breakdown.

Instead of extending the alternating system, the Corporation, having in view the desirability of electric traction, and the fact that the tramway lines were their own property, instructed the late Dr. Hopkinson to draw up a scheme for a combined lighting and traction works on the direct current system. Dr. Hopkinson's report was adopted, and after Major Cardew had held an inquiry, the Board of Trade on April 27th, 1898, sanctioned a loan of £25,000 to carry out the work of constructing and equipping the tramway and generating station.

On the lamented death of Dr. Hopkinson, the resident electrical engineer, Mr. J. S. Highfield, was appointed electrical engineer to the Corporation. Since then the work has been rapidly pushed forward, and on July 5th the members of the Town Council made a trial run over the section of the line which has been completed, with entire satisfaction.

The works are situated on a large vacant space at Boundary Road, and share with Ashton the distinction of combining electric light and power supply with electric traction and refuse destruction; further, almost the whole of the plant and equipment is of English manufacture—a most healthy symptom of progress.

The buildings were erected by Messrs. John Rothwell and Sons, St. Helens, and comprise general offices, engine and boiler houses, destructor works, and car sheds.

The boiler house is situated immediately behind the engine room, while the economiser is conveniently placed in a shed adjoining the boiler house. The boilers, of which at present two have been installed, are of the Lancashire type, 30 feet long × 8 feet diameter, and are worked at a pressure of 160 lbs. per square inch; they were made by Messrs. Yates & Thom, who supplied almost the whole of the steam generating and distributing apparatus. The stop valves, isolation valves, and high and low water alarms, are of Hopkinson's make; the dead-weight safety valves are by Turnbull, the gauges and blow-off cocks by Dewrance.

Immediately behind each boiler is a superheater, made by

Fig. 1.—General View of Engine Room; Booster-Balancer in Foreground.

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Messrs. Musgrave & Sons, Limited, Bolton, and capable of giving a superheat of 120° F. This apparatus consists of a tube plate bolted to a cast-iron box, in which are placed an outlet and inlet for the steam; tubed into the plate are a number of solid drawn steel pipes, arranged in a U form, which are placed in the down take at the back of each boiler. Each superheater is fitted with a safety valve and two drains and thermometer pockets. After passing through the superheater the gases flow under the centre of the boiler, returning by the sides and away to the economiser.

The superheater adds only about 1 foot to the length of the boiler space, and is so constructed that after breaking two joints it can be bodily lifted from its setting (fig. 2); to facilitate this operation, a light girder is provided over the superheaters, on which a trolley runs to support the lifting tackle. The weight of the apparatus is about 2 tons.

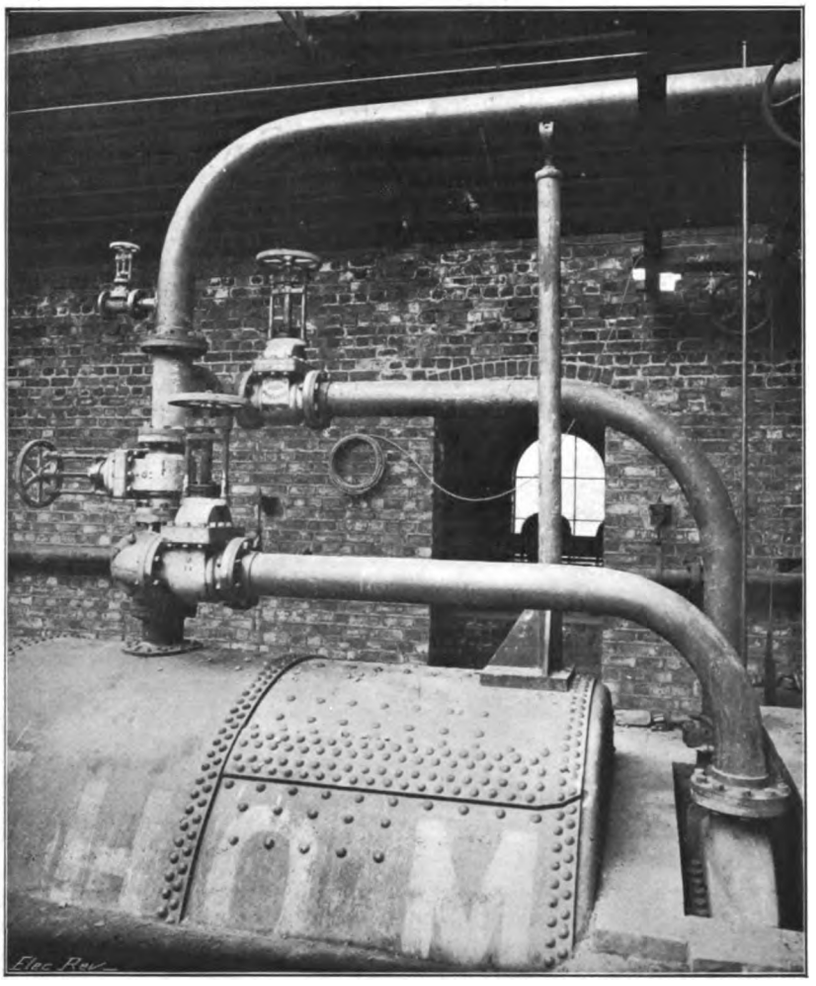

Fig 2.—Arrangement of Superheater and Steam Pipes.

The economiser, of Green's manufacture, consists of 240 9-feet tubes; the scrapers are driven by a small Lundell motor. The usual bye-pass flue is provided.

There are two steam feed pumps, of Green's double ram fly-wheel type, each capable of delivering 12,000 lbs. of water per hour, either direct or through the economiser. The steam pipes to the pumps are in duplicate, while the feed pipes form a ring. A tell-tale pressure gauge is fixed on the feed pipe leading to the economiser, to record the maximum pressure at which the pumps are worked. An injector is provided as a stand-by, made by Messrs. White, of Salford; this injector is self-starting, and is controlled by a single valve, which also acts as a regulator.

We noted with approval that the steam range consisted of a single main to the larger engine sets; there is, however, a duplicate steam supply to the small sets, the pipes for which are so arranged that they may be supplied—(1) from the main boilers, (2) from the destructor boilers only. The object of this is partly in order to obtain an exact knowledge of the value of the destructor as a steam producer. A valve is also provided, by means of which the destructor steam can be admitted direct into the main steam pipes, if desired.

The Lancaster steam traps are used all over, and the pipe joints are made with Taylor's packing rings; the pipes are lagged with plastic cork, supplied by Messrs. Lonsdale Bros., Blackburn.

The condensing and cooling plant consists of a Wheeler surface condenser, mounted on the steam-driven air and circulating pumps, and a Klein's patent cooling tower. The condenser is of the Wheeler standard Admiralty pattern, with a condensing surface of 850 square feet. The tubes are of brass, solid drawn with one end thickened; this is screwed into one of the gun-metal tube plates, while the plain end is held in the other tube plate with the usual screwed ferrule and corset lace packing. The air and circulating pumps have pistons 10 inches in diameter, the steam piston is 8 inches in diameter, and the stroke of all three is 12 inches; the pumps are of the horizontal type, and are very compactly arranged. The condenser is capable of condensing 8,000 lbs. of steam per hour. As the condenser is situated in a chamber beneath the floor of the engine room, it could not be photographed.

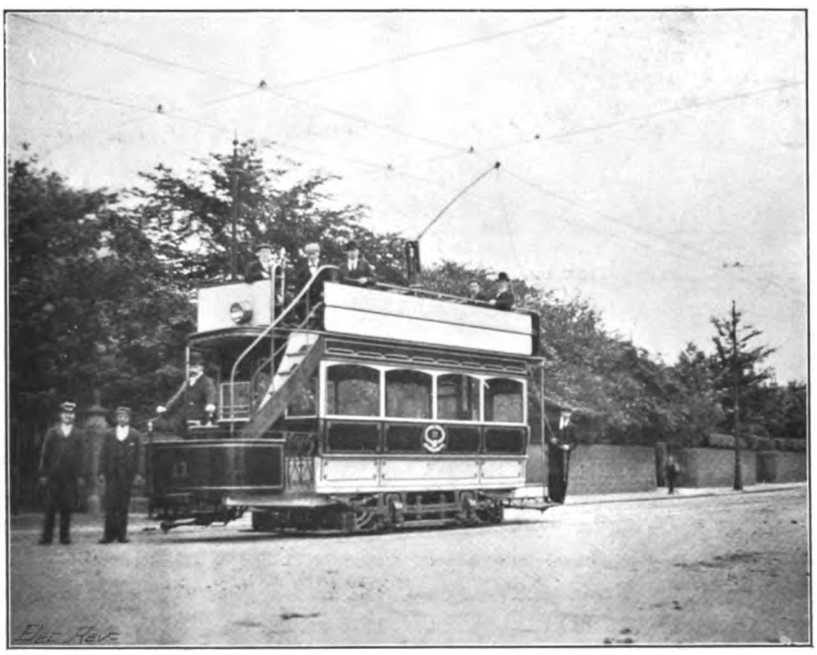

Fig. 3.—Car on Line.

The cooler, which was manufactured by the Klein Engineering Company, Limited, Manchester, is designed after the chimney principle, producing a natural draught without waste of power, and occupying a very small area of ground (fig. 5); there are no moving parts. The tower is carried to a height of 50 feet to prevent nuisance from the vapour which escapes from the top, but the cooling stack inside the tower is only

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20 feet high; this is the maximum height to which the water must be lifted. In order to use the condensed steam for feed water, the steam is passed through a Klein

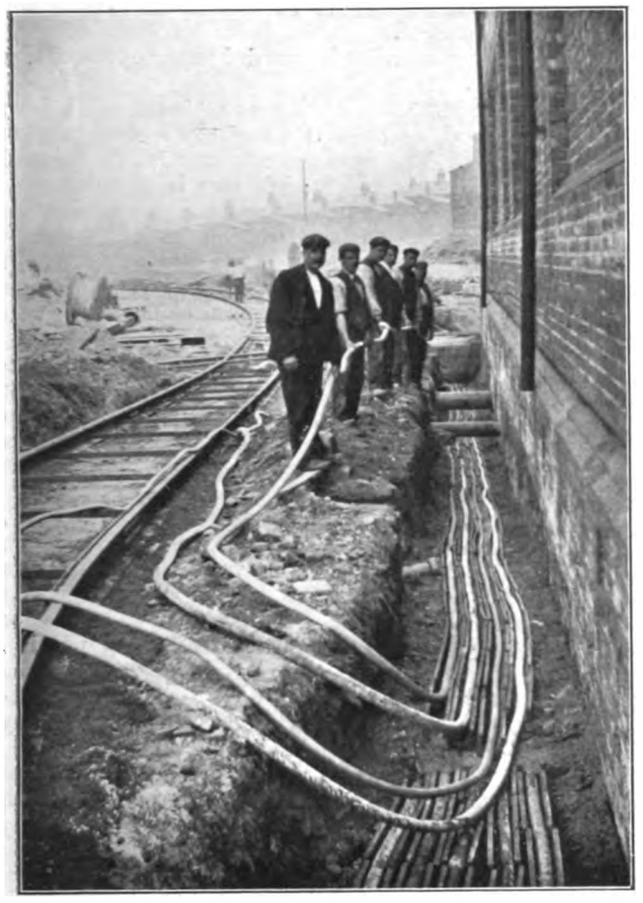

Fig. 4.—Laying the Feeders.

oil separator on its way to the condenser; this works on the principle of changing the direction and velocity of the steam, and so throwing out the oil, which is collected in the bottom of the separator. The water from the condenser is led direct to the hot well, from which it is drawn by the feed pumps.

There is an automatic relief valve to give free exhaust to the atmosphere if, from any cause, the vacuum should fail.

The chimney stack is 200 feet high, and about 6 feet in diameter at the top; it is lined for part of its height with fire-brick.

The generating plant at present comprises four coupled sets, each of which consists of a Willans & Robinson three-crank compound engine coupled to a Mather and Platt four-pole shunt-wound dynamo. The two larger engines are of the 3 P type, running at 360 revolutions per minute, and provided both with throttle governors and with automatic expansion gear. Between the engine and the dynamo is an extremely massive fly-wheel, of which we give a cross-section (fig. 6), and which weighs over 8 tons; the diameter of this fly-wheel is 5 feet, width 2 feet 2 inches, and it is arranged so as to form part of the rigid coupling between engine and dynamo.

The output of each engine is 310 I.H.P. at full load; the steam consumption specified was 16¼ lbs. per I.H.P.-hour, but under test the value was found to be 15½ lbs. condensing. The engines are capable of carrying an emergency load 25 per cent. greater than the normal full load, and by reason of the combination of throttle and expansion governing are able to maintain a high efficiency under wide variations of load.

The larger dynamos are rated at 195 KW., the maximum current being 390 amperes, while the pressure can be varied from 450 to 575 volts. The yokes are of cast-steel, and are separate from the bedplate, which is of the open type; the faces of the pole-pieces are laminated. The armature core is carried on a spider, allowing of ample internal ventilation. The armature is wound with two layers of solid bars laid in deep slots, which are partially closed at the periphery; wooden keys, driven into the slots over the bars, hold the latter in place. The winding is of the drum type, with cylinder end-connections, carried on an extension of the spider. The commutator lugs are slightly waved or corrugated, so as to be flexible. The brush-holders are carried on two complete rings, which are supported by the commutator-end bearing, and are simultaneously rotated by a screw feed; the brushes are of carbon. The bearings are provided with automatic ring lubrication, and in spite of the great weight of the fly-wheels, have never given any trouble by heating. The smaller sets are generally similar to the large ones, but the outputs are:—Engine 180 I.H.P. at 450 revolutions per minute (220 I.H.P. on emergency); dynamo 112·5 KW., 230 amperes at 450—575 volts. The engines are of the 3 O size, with fly-wheels weighing 4½ tons each.

The 10-ton travelling crane was made by Messrs. Higginbottom & Mannock, of Manchester, and is worked from platforms attached to the crane itself; the crane hook is mounted on ball bearings so as to swivel with ease.

A combined balancer and double booster forms an interesting feature of the engine room, and is well seen in our general view (fig. 1). This machine consists of two double-wound armatures coupled together, and having four commutators. The field magnets are both excited off the outers of the lighting mains, at about 470 volts; the balancer armature divides this into two circuits of 235 volts each, with a maximum load of 35 amperes, and runs at a speed of 625 revolutions per minute. The booster armature, which is driven by the balancer, is designed for a maximum current of 200 amperes, and generates a pressure of 40 volts

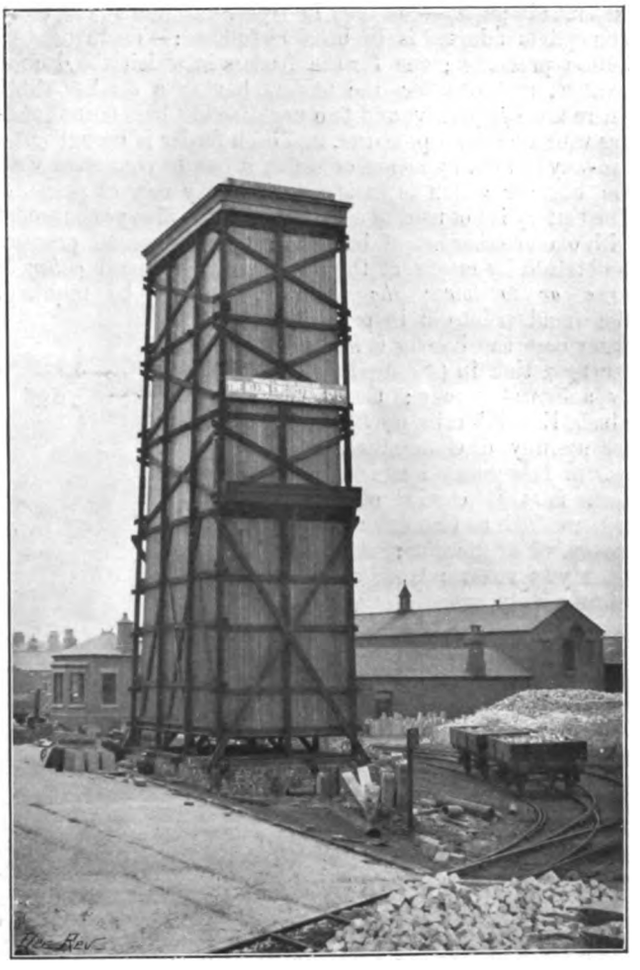

Fig. 5.—Cooling Tower.

in each circuit. The two windings can be put in parallel or in series, giving a "boost" of 40 volts with 400 amperes flowing, or 80 volts with 200 amperes, respectively. Moreover,

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the polarity may be reversed, so that the "boost" is up or down at pleasure. The combined over-all efficiency of the two machines, when the balancer is acting as a motor and driving the booster, is 80 per cent.

The engine room is ventilated by two Gibbs' electric fans, one at each end.

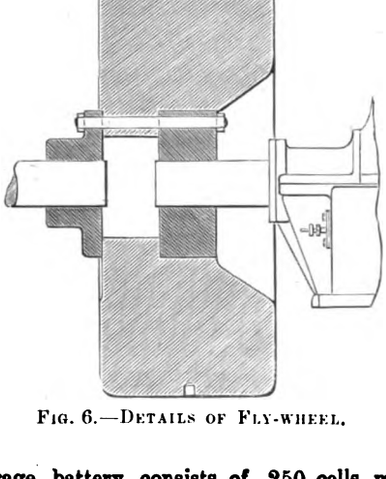


Fig. 6.—Details of Fly-wheel.

The storage battery consists of 250 cells made by the Chloride Electrical Storage Syndicate, Limited; each cell consists of 25 plates in a lead lined box, and will give 450 amperes for one hour without the terminal pressure falling below 1·85 volts during the passage of the current. A peculiar feature of the battery is that there are no regulating cells or switches; the battery is to be used *en bloc* at all times.

The most prominent feature of the switchboard is its extreme simplicity—not only in front, but also at the back. The system adopted is in brief as follows:—There are two station pressures; one for the feeders in which the drop is greatest, and one for the feeders having a smaller drop. There are two positive and two negative bus bars corresponding with these two pressures, and each feeder is brought to a two-way switch, by means of which it can be connected with the bus bar which is at the most nearly correct pressure. The battery is not used as a balancer, but is always connected with one or other set of bus bars; and the second pressure is obtained by means of the booster, which is used *either to raise or to lower the pressure*, as may be required. We would point out in passing, that in the latter case the booster is *motoring*, and that the reduction in pressure is not accompanied by a loss of power; this is true also of "back E.M.F." cells, provided that the latter are usefully discharged at proper intervals, but in how many instances where they are used is this carried out? We commend this method to the notice of engineers as a means of regulation; it has been applied already in electric traction, where a separate booster may sometimes with advantage be provided for each feeder, but we do not recollect any instance where the system has been employed for electric lighting in this way.

The control of the booster is effected by means of a regulating resistance in the field-magnet circuit (excited from the bus bars) and a small reversing switch in the same circuit; in order to change from boosting up to boosting down, the field current is first reduced to a very low value by means of the resistance; the reversing switch is then thrown over, reversing the polarity of the magnets and consequently the direction of the booster E.M.F., and the field current adjusted to give the proper boost. This controlling gear could be covered by a single page of foolscap!

The performance of the battery is recorded by a special Aron watt-hour meter, which is provided with two dials; on one of these the energy input is registered, on the other the output. As the battery is never joined to the middle wire except when the load is very small, the meter error due to want of balance is trifling; moreover, the whole of the lamps and motors used in the works can be thrown on either side of the system by means of a two-way switch, and as there is a considerable load of this kind, a valuable aid to balancing is in this way obtained.

An Aron watt-hour meter is provided to record the output of each machine.

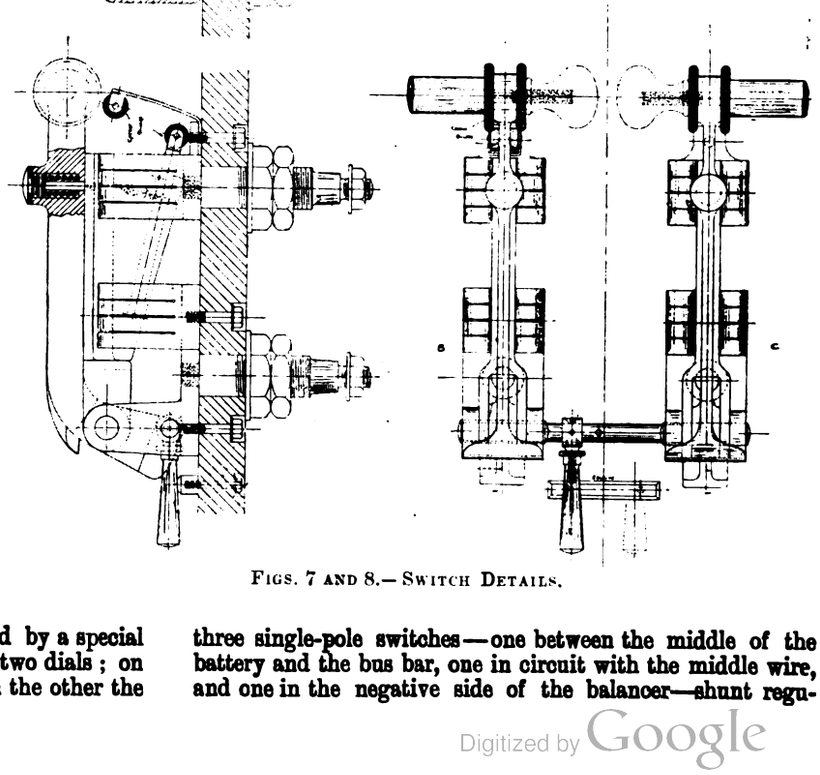
We cannot describe the lighting switchboard apart from the traction board, as there is necessarily a close relation between the two. The dynamos are intended to be used indifferently on either system; but each is provided with two double-pole switches which are interlocked, so that when a dynamo is coupled to the traction mains it cannot possibly be simultaneously thrown on the lighting mains, and *vice versâ*. We give in figs. 7 and 8 detail views of these main switches, which it will be seen are of the knife type with quick break and carbon break.

Considered more in detail, the lighting switchboard consists of six panels of white marble, arranged on a gallery at one end of the engine room; from the gallery a door opens direct to the top of the boilers, so that the gallery forms a central point from which practically the whole works can be readily supervised and controlled.

The first panel on the left hand is the battery panel, bearing the booster shunt regulator and reversing switch already mentioned, a main circuit reversing switch, a series parallel switch for putting the two booster windings in series or in parallel, a double-pole switch and fuse for the battery, single-pole switch in the battery positive, and a double-pole switch to put the battery in series with the booster. The instruments on this panel are:—Battery voltmeter (600 volts), booster voltmeter (120 volts), and a battery ammeter (450 amperes), which reads both ways.

The next two panels are for the positives, and are fitted with two large horizontal bus bars on the front. Each feeder is joined through an ammeter shunt to a two-way switch connected with the two bars, so that the feeder can be thrown on either bar; the battery and dynamo leads are joined to five vertical bars on the back of the board, which can be connected with either of the bus bars by means of screw plugs. The instruments are two voltmeters (500 and 250 volts), and two feeder ammeters (450 amperes); space is left for four more feeders, and two more dynamos. There is also a vertical bar for the balancer at the back of the board.

The fourth panel is fitted with the middle wire bus bar,



Figs. 7 and 8.—Switch Details.

three single-pole switches—one between the middle of the battery and the bus bar, one in circuit with the middle wire, and one in the negative side of the balancer—shunt regu-

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lator for the balancer field, and balancer starting switch. There is an ammeter (250 amperes) reading both ways, in the middle wire, and a voltmeter (250 volts). Space is left for practically as much more apparatus as is already fitted. The two remaining panels are almost identical with panels 2 and 3.

The traction switchboard consists of eight panels (two spare), of which the first is the usual Board of Trade panel, fitted with recording ammeter and voltmeter; the second the line panel, and the remainder dynamo panels. The line panel is divided into positive and negative portions; the former is fitted with two single-pole feeder switches and ammeters (550 amperes); the latter carries two bus bars, one for the dynamo terminals, the other for line connections (rail return). A main switch and ammeter (750 amperes) are also on this panel; the whole return current passes through these and through a Chamberlain & Hookham ampere-hour meter fixed beneath the gallery.

Each of the dynamo panels is fitted with ammeter (550 amperes), voltmeter (450—650 volts), "Ajax" lightning arrester, I.T.E. circuit breaker, shunt regulator, and the interlocking double-pole switches for lighting and traction already referred to.

When an additional dynamo is to be thrown on the bus bars, a differentially wound voltmeter is used, one coil of which is connected with the in-coming machine, the other with the bus bars. The dynamo field is adjusted until the voltmeter reading is zero; the main switch may then be closed without affecting the bus bar pressure.

The ammeters and voltmeters mentioned above are all of the Weston type, except the recording instruments, which are of Messrs. Elliott Bros.' manufacture. Both the switchboards were manufactured by Messrs. Veritys, Limited, at their Aston works, and erected by the British Insulated Wire Company. The comparative scarcity of fuses is a noticeable feature of the boards—a praiseworthy feature in our opinion.

The back of the board is almost as clear as the front; all the cables are laid up in racks and coloured blue or red according to their polarity, and they are coupled to bars near the bottom of the board, so that there are no straggling cables or wires to interfere with its accessibility and simplicity.

There are two smaller switchboards, also of Messrs. Veritys' make, one for the motor circuits, the other for the lamps about the works.

The public lighting is effected by 44 of Messrs. P. R. Jackson's arc lamps, run 11 in series off the 460-volt distributing mains; 33 of these lamps are carried on combination trolley poles, the remainder on special arc lamp poles. Each pole is also provided with two glow lamps, which are substituted for the arcs at midnight.

The private lighting supply is carried out by means of a three-wire network with the usual disconnecting boxes, the declared pressure of supply being 230 volts.

The whole of the mains were supplied and laid by the British Insulated Wire Company, and are of their single-core paper-insulated, lead-covered type, laid in stoneware troughs filled up with compound (See fig. 4.) There are three feeders of two single cables, 0·75, 0·5, and 0·5 square inch in cross-section respectively, the total length being 4 miles of cable. The three-wire distributors consist of about 18 miles of cable, the sections of the outers chiefly used being 0·2, 0·15, and 0·1 square inch.

The Corporation shows great energy in popularising the electricity supply; motors are let out on hire, as well as cooking and heating apparatus, while service connections are made free of charge. A small rent is charged for meters. An agreement has been entered into with Messrs. F. W. Smith & Co., of Southport and Manchester, for carrying out free wiring on two systems:—

(1) Wiring absolutely free; rent of ¾d. per Board of Trade unit (reduced to ½d. after the consumption reaches 12 units per 8 C.P. lamp per annum); purchase after three years if desired by consumer.

(2) Ten per cent. of cost paid down, the rest spread over four or five years.

Mr. Highfield has also drawn up a standard specification for house wiring which is at the disposal of intending consumers; the Corporation invites tenders and assigns the contract on behalf of the consumer, receiving 5 per cent. on the cost of the installation to cover expenses. This system has become most popular; no less than 2,000 lamps have been connected since April last by this method. It has been decided to use the old alternating plant for supplying Sutton and other outlying districts, and to supply all the lamps in St. Helens on the direct current system from the combined works at Boundary Road. The dayload of the districts supplied with alternating current will also be carried by the above works; for this purpose a motor-alternator will be put down at the alternating current station, and will be connected with the direct current works by a feeder.

The tramway belongs to the Corporation, which is responsible for its maintenance in good running order, and which provides all the plant and material required for its equipment; the actual conduct of the traffic is leased to the new St. Helens and District Tramways Company, Limited, for a term of 21 years; the company provides the rolling stock and pays a rent for the lines, which increases from £2,400 per annum at the start to £3,500 per annum in the last four years of the lease. The Corporation supplies electrical energy to the tramway company at a charge of 2d. per unit for the first 400,000 units, with a sliding scale by which the charge is reduced to 1d. per unit when the supply reaches 800,000 units per annum.

The total length of line at present equipped is about 7 miles, but an extension of 12 miles is about to be undertaken, and is to be completed within one year—which will be a very busy twelvemonth for the engineers!

The route of the line is from Prescot through St. Helens to Haydock, and from St. Helens to Salton, Denton's Green and Rainhill. There is a stiff gradient at Cropper's Hill which the steam cars could only ascend with a running start, but the electric cars ascend the slope, fully loaded, without difficulty.

The streets in the town are for the most part old and narrow, but a large part of the line lies in the open country and interurban districts.

The track was laid by the Corporation on a concrete foundation, with steel rails made by the Leeds Steel Works Company, Limited, and weighing 100 lbs. per yard. The intermediate pavement consists of granite setts. The crucible cast-steel points and crossings, steel tie bars, &c., were made by Messrs. Askham Brothers & Wilson, Limited, who also carried out a large quantity of special work at the car depôt. At a bridge over the canal special cast-steel rails were employed, as the depth available was insufficient for the ordinary rails. The points are of Marshall's patent automatic type. The rail joints are bonded with two Crown bonds under the fish plates, each bond having a cross-section equal to No. 0000 B. and S.

The poles and bracket arms are of lap-welded steel, neatly designed and manufactured by Messrs. John Spencer, Wednesbury. The overhead work consists chiefly of side bracket construction, but at some parts of the line, where the road is very broad, span wires are employed; some of the bracket arms are as much as 16 feet in length.

The whole of the overhead construction was carried out by the British Insulated Wire Company, Limited, Prescot, under the general supervision, and to the plans, of Mr. Highfield. The line material was manufactured by the Electric Tramways Equipment Company, Birmingham, with "Verus" insulation.

There is a battery sub-station on the Prescot road, about three miles from the works. The battery consists of 250 cells of the Chloride type, with an output of 150 amperes for one hour; a booster, made by the General Electric Company, Manchester, is placed in the same station, with an output of 40 amperes at 150 volts, or 80 amperes at 75 volts, at a maximum speed of 1,040 r.p.m. The field magnet is excited from the 500-volt mains, and the pressure is regulated by hand.

Thanks to the efficient bonding and to the battery sub-station, the drop in the rails is well within the Board of Trade limit, even when a number of cars are bunched at the end of the line.

The trolley wire is double throughout, 0·325 inch diameter, and is divided into sections about half a mile in length, by Aetna section insulators; it is supplied by feeders which are led into switch-pillars of the Blackwell type, one to each section. The following feeders have been laid:—Two trolley wire feeders 0·75 and 0·5 square inch cross-section; and an overhead feeder 0·4 inch diameter to the sub-station. The telephone and pilot wires are of bare copper, carried on insulators on the top of the trolley poles.

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All these cables were made and laid by the British Insulated Wire Company, and are of their usual type, laid on their patent "solid" system.

There are at present eight cars in use, but the number will shortly be increased. The car bodies were made by the Brush Electrical Engineering Company, Limited, and are of the double-deck type (fig. 3), capable of seating 53 passengers. Peckham trucks are used, with a wheel-base of 6 feet gauge, 4 feet 8½ inches; each truck is equipped with two G.E. 52 motors. The car complete weighs about 7 tons unloaded. The trolleys are of the straight under-running type, with detachable heads, and were made by Messrs. Blackwell & Co. The controllers are the General Electric Company's K 10 pattern, with emergency stop. The whole of the above machinery and equipment was supplied by the British Insulated Wire Company, and erected under the supervision of their engineers.

The refuse destructor installation, which constitutes an important part of the scheme, is being carried out by Messrs. Beaman & Deas, Limited, Westminster. The installation consists of two pairs of Beaman & Deas destructor cells, each pair having a combustion chamber common to both cells. Each pair of cells is provided with one large Babcock & Wilcox water-tube boiler; and in order to utilise to the fullest possible extent the heat value of the gases from the destructor cells, a Green's economiser is also being provided. In accordance with the designers' usual practice, the cells will be worked by forced draught produced by a high pressure fan, which at the same time draws off the foul air from the pail sheds.

A special feature in connection with this installation will be the arrangements that are being made to elevate the refuse to the charging platform. Owing to the peculiarities of the site, it was found to be impossible to arrange for the usual inclined approach; specially designed bucket elevators are therefore being supplied, one set to each pair of cells, by which the refuse will be raised to the necessary height and delivered into a storage hopper opening immediately above the charging doors of the cells. The elevators and the fan for forced draught will be driven by two 12-H P. motors; the scrapers of the economisers will also be driven by a small motor. Whilst only two pairs of cells and two boilers are at present installed, all arrangements are made for the addition of a third set at any time. The two pairs are more than sufficient for present needs, if worked continuously; the provision for the third set is made not merely in view of the natural development of the town, but also in order that, if desired, the destruction of the refuse may be concentrated in less than a 24 hours' day, with a view to utilising the power available more completely.

In conclusion, we wish to record our indebtedness to Mr. J. S. Highfield, electrical engineer to the Corporation, for his invaluable assistance in preparing this account; and to Mr. E. M. Hollingworth, chief assistant engineer, who furnished us with several excellent photographs, from which we have selected views of the car and feeder trench, and of the cooling tower. We have also to express our thanks to the various contractors who forwarded to us particulars of their work.

CONTRACTS OPEN.

(*Continued from page* 104.)

Hastings.—July 25th. The Corporation wants tenders for the supplying and laying of high and low tension cables. See "Official Notices" July 14th.

Madrid.—The Ministerio de Marina is inviting tenders until 31st inst. for an electric light installation for the floating naval school.

Malmo.—September 1st. The Gas Works' directors want tenders for the erection of electricity works for the city. Particulars on application to the clerk of the Gas Works (deposit 12s).

Salford.—August 8th. The Corporation wants tenders for eight 750-kw. continuous current steam dynamos for electric lighting and traction. See "Official Notices" July 7th.

Sunderland.—July 24th. The Corporation wants tenders for the reconstruction and electrical equipment of the tramways: (*a*) permanent way, (*b*) overhead construction, (*c*) car bodies and trucks. See "Official Notices" July 7th.

Sunderland.—July 28th. The Corporation wants tenders for the supply of five Lancashire or Galloway boilers and two fuel economisers. See "Official Notices" this week.

The War Office.—The Secretary of State for War announces that tenders for various articles, including electrical instruments, will probably be invited from time to time during the next 12 months. Manufacturers who may wish to be applied to when tenders are required, should address Mr. A. Major, Director of Army Contracts, War Office, stating the particular articles they manufacture, and the names of at least two well-known firms or public bodies who have purchased from them, and are in a position to certify as to the quality of their productions.

CLOSED.

Chatham.—The Corporation has accepted the tender of the Edison & Swan Company, Limited, for the fitting up of the town hall and offices with electricity.

Crewe.—The Council has accepted the following tenders:—Mr. J. Matthews, Nantwich, chimney stack, engine house and front of boilers, £6,085 17s; Messrs. Mather & Platt, Limited, Manchester, engines and dynamos, £5,130; Messrs. Yates & Thom, Blackburn, boilers, £3,230; W. T. Henley's Telegraph Works Company, Limited, London, for conductors, &c., £6,921 12s. 7d.; and other tenders of smaller amounts.

Hackney.—The Vestry has accepted the tender sent in by the British Insulated Wire Company, Limited, for electric cables, trenching, troughing, joint boxes, and jointing and house services, for the sum of £60,000.

NOTES.

Lord Kelvin's Resignation.—At a meeting of the Glasgow University Court held on July 13th, Principal Story presiding, a petition for leave to retire from the Chair of Natural Philosophy was presented from Lord Kelvin. The Court granted the leave asked, and accepted Lord Kelvin's resignation with deep regret. A remit was made to the Principal to prepare a minute to be signed by all the members of the Court, expressing their sense of the great loss that the University is now to sustain. Lord Kelvin has occupied the chair for 53 years. We hear that Lord Kelvin has joined the board of directors of the British Aluminium Company, Limited.

Obituary.—F. C. Webb.—On Wednesday Dr. G. D. Thomas, Coroner for Central London, held an inquiry at Hampstead into the circumstances attending the death of Mr. Fredk. Chas. Webb, aged 70 years, lately residing at Agincourt Road, Hampstead, who fell, or threw himself from a second-floor window at the Hampstead Home Hospital on Saturday evening last. He entered the hospital at the end of last month for the purpose of undergoing an operation which was successfully performed, and he seemed to be progressing favourably. He, however, took a very desponding and exaggerated view of his condition, and became much depressed in consequence. He was the author of various scientific papers, and from 1853 till 1877, Mr. Webb took a leading part in all things connected with cable making, laying and testing. He was made a knight officer of the Imperial Order of the Rose by the late Emperor of Brazil in 1874. Mr. Webb had for many years practically retired from his profession, but his early labours in connection with submarine telegraphy are too well known to need recapitulation here. In 1884 he was enrolled by the Council of the Institution of Civil Engineers as a life member in consideration of the services rendered by him to the Institution. To his brother, Mr. F. H. Webb, the genial ex-secretary of the Institution of Electrical Engineers, and to his other relatives, we offer our sincere sympathy.

We regret to hear from Mr. Lord, of Messrs. Lord and Shand, electrical engineers, Plymouth, that his partner, Mr. E. B. Shand, died of heart disease, on 18th inst., at the age of 28 years.

Marriage.—On July 6th, at Hoar Cross, Mr. S. A. Walker and Miss A. M. Mosedale. The bridegroom is one of the firm of Walker Bros., electrical engineers, Old Square, Birmingham, while the bride is the second daughter of the late W. Mosedale, of Lower Hoar Cross.

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Electric Tramway and Lighting Stations.—At a May meeting of the Electrical Association of New South Wales, Mr. P. B. Elwell, M.I.E.E., M.I.C.E., read a paper on "The Utilisation of Electric Energy from an Intermittent Source":—

The paper particularly dealt with the practicability of utilising the surplus power obtained from the working of electric tramways for lighting and other purposes. This question had been prominently brought forward in connection with a huge power station now in course of erection in New York, primarily to supply energy for the tramways. It was contended that, in round numbers, 66 per cent. of energy of the generating plant was available for other purposes. On all tramways the plant is taxed to its utmost at certain hours every day. In order to equalise matters and obviate the wear and tear incident to the slowing down or stoppage of the machinery, the New York Company determined to enter another field—that of supplying light, heat, and power. It was recognised by the company that with crowds of people to carry on the trams at one time of the day and none at the rest it would not pay to attempt to fill all requirements, unless the surplus power could be disposed of. They therefore arranged to establish 21 sub-stations in various parts of the city, from which light, heat, and power will be supplied for commercial purposes. This sale of the by-products of electric stations was expected to result in a reduction of 50 per cent. in the prices to be charged to the consumers. The example of New York in this matter was urged by Mr. Elwell as one to be seriously considered in connection with the electric tramlines in Sydney. It would be easy to select good positions in close proximity to the tramline for sub-stations to distribute electricity in the immediate neighbourhood. As the tramway feeders were calculated to carry the maximum load without excessive loss, and generally at a low current density, it followed that these feeders might well be used for the supply of the surplus electricity to sub-stations. This would give a quantity of electrical energy equal to that actually used for the operation of the tramway, available for supply to sub-stations in the best business centres, without any additional capital outlay, either at the power station or in feeders. The most economical size of sub-stations, and their equipment, were exhaustively considered. Storage batteries would have to be used, and as the potential on the tramway varied about 10 per cent. in ordinary operation, and one side was earthed, it followed that if the energy were to be mainly used for lighting, some method of transformation and regulation must be adopted. This could be done either by charging batteries alternately, cutting them off the discharge circuit for the purpose, or by means of a rotatory transformer between the tramway feeders and the batteries, together with an automatic regulator for the discharge. The capital cost of a typical sub-station furnished with three batteries, would be about £14,000, and the annual cost of maintenance £2,200. The best method of supplying the power from the sub-station to the purchaser would be to measure the electricity as delivered from the batteries to his sub-station bus bars. It had been found that on the average electric lighting undertakings in the United Kingdom some £70 per kilowatt was expended in distribution. If only one quarter of that sum could be saved by the sub-station system, the entire capital cost of the sub-stations with the storage batteries would be more than covered, and the cost per unit very materially reduced. A general discussion followed.

Correction.—We regret that, through an unfortunate misapprehension, in our account of the Oldham and Ashton tramways last week, we ascribed the electric brake to the Westinghouse Company. The brake actually in use is of the Thomson-Houston magnetic type, of which 16 more are to be supplied by the British Thomson-Houston Company to the tramway company, as well as eight complete cars. Five of the latter will have K 10 controllers with emergency stops, while the remaining three are to be equipped with magnetic brakes, and are to be delivered within three weeks.

Automobiles at the B.A. Meeting.—A show of automobiles is to be held at Dover between September 18th and 21st next, simultaneously with a meeting of the British Association then taking place there. The meeting at Dover will be especially noteworthy, as it is held in conjunction with that of the French Society taking place at Boulogne, and an interchange of visits is already arranged for. The object of the show is primarily to provide an interesting display and to benefit the motor car industry. A small charge for space will be made, and prizes will be awarded to successful exhibitors. Full particulars may be obtained from the secretary, F. E. Beeton, Esq., Park Street, Dover.

Cricket.—Johnson & Phillips' Cables C.C. *v.* The D.P. Battery Company. This match was played on Saturday last at Blackheath, and resulted in a win for the former by 109 to 27.

Lord Kelvin's Successor.—There will be keen competition for the Chair of Natural Philosophy at Glasgow University, rendered vacant by the retirement of Lord Kelvin. According to the *Westminster Gazette*, canvassing on behalf of candidates has already begun. The salary of the post is £1,000 a year, with a large and beautiful house adjoining the University, fitted with all modern telephonic and other electrical conveniences by its late distinguished occupant. Lord Kelvin will reside at Netherhall, Largs, his beautiful country seat.

Appointments Vacant.—The Bradford Corporation wants a departmental electrical engineer. See "Official Notices" this week.

The City and Guilds of London Institute wants three assistants in the electrical engineering department of the Central Technical College. See "Official Notices" this week.

The Salford Corporation wants a first-class cable jointer. See "Official Notices" this week.

The Corporation of Bootle require the services of an electrical engineer.

The Electrical Engineers R.E. Volunteers.—The first detachment of this corps has finished its annual training at Plymouth. It has put in some interesting work in connection with projectors for search lighting and running plant to supply same, and some very useful work was done in submarine mine work. The next detachment will go to Portsmouth for eight days commencing July 29th, and may possibly take part in the Naval Manœuvres.

Personal.—Mr. H. E. Yerbery, A.I.E.E., late assistant electrical engineer of the Bristol Tramways, has been appointed assistant electrical engineer on the Sheffield Corporation Tramways.

Mr. C. A. L. Prussmann, chief assistant electrical engineer for the Bradford Corporation, has been appointed clerk of works at the Doncaster electricity works.

The Institution of Junior Engineers.—On Thursday next, July 27th, at 3 p.m., the Institution will visit Messrs. Edw. Cook & Co.'s East London Soap Works, Bow.

Lightning at Play.—Electra—not the Chancery Lane goddess—has been playing strange pranks in Newcastle. We hear that "a thunderbolt—a bright ball of fire" was seen to fall, and in one case a flash of lightning "entered through the window, and the electricity played about the wires attached to a telephone on the table, eventually disappearing in a corner." We are persuaded that this must be the corner in copper of which we have heard rumours.

Manchester Moving.—Our leader of this week refers to an important development in the electrical industry, and we hear rumours of yet another. It is said that a big combine is in progress to be launched in a very few weeks, the names mentioned being those of Messrs. P. R. Jackson and Co., of Salford, and the Ganz Company. Manchester is also credited with still further developments on the part of a powerful company not a hundred miles from Salford.

NEW COMPANIES REGISTERED.

Anglo-Spanish Electricity Company, Limited (62,655).—This company was registered on June 21st, with a capital of £100 in £1 shares, to carry on the business of electricians, suppliers of electricity, &c. The first subscribers (each with one share) are:—A. Lucas, Melbourne, Brampton Road, Bexley Heath, clerk; H. F. Wreford, 47, Nicholl Road, Harlesden, Middlesex, incorporated accountant; C. F. A. Spashett, Lansdowne, Hillfield Road, West Hampstead, N.W., registrar; J. H. McCashin, 73, Webb's Road, Clapham Junction, S.W., clerk; H. P. Hetherington, 17, Powis Square, W., clerk; W. H. Ostertag, 38, Church Road, Richmond, clerk; and J. A. Marrot, 30, South Eaton Place, S.W., gentleman. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; no qualification; remuneration, £1,000 per annum divisible.

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Sharpe & Co., Limited (62,699).—This company was registered on June 23rd, with a capital of £2,500 in £1 shares, to acquire and carry on the business of sanitary, gas, hot water, electrical and general engineers, smiths, &c., now carried on by Sharpe and Co., at 22, 24, and 26, Strand Street, Grimsby, Lincolnshire, and to enter into an agreement with the said vendors. The first subscribers (each with one share) are:—John H King, 163, Freeman Street, Grimsby, foreman plumber; William Cooper, 114, Welholme Road, Grimsby, foreman; T. Bell, Redshaw, 33, Tarburg Street, Grimsby, plumber; William C. Sharpe, George Street, Louth, Lincolnshire, sanitary engineer; John C. Store, Cedar House, Abbey Park Road, Grimsby, accountant; Anne E. Sharpe, Belvoir, Grantham; and Ada Sharpe, 12, George Street, Louth. The number of directors, the names of the first, and their remuneration, are to be determined by the company. Registered office, 26, Strand Street, Great Grimsby.

Llanrwst Electricity Supply Company, Limited (62,720).—This company was registered on June 26th, with a capital of £5,000 in £1 shares, to acquire and carry on the business of electrical and mechanical engineers and suppliers of electricity for the purposes of light and power now carried on at Llanrwst, Denbigh, by G. F. McInnes and G. R. Peers as "The Llanrwst Electricity Supply Company." The first subscribers (each with one share) are:—C. F. McInnes, Carrington Terrace, Llanrwst, electrical engineer; J. E. Humphreys, Llanrwst, solicitor; J. E. Jones, furniture warehouse, Llanrwst, general dealer; Mrs. A. McInnes, 4, Carrington Terrace, Llanrwst; J. O. Thomas, 14, Watling Street, Llanrwst, accountant; Mrs. G. S. L. Thomas, 14, Watling Street, Llanrwst; and J. W. Owen, Llysmedyg, Llanrwst, surgeon. Registered without articles of association. Registered office, 14, Watling Street, Llanrwst, Denbigh.

Theatroscope Syndicate, Limited (62,764).—This company was registered on June 28th, with a capital of £25,000 in £1 shares, to acquire, own, and work the British, Colonial, and French rights in respect of an invention for projecting on to screens animated scenes in colours, to enter into an agreement with the Société Internationale d'Etudes Industrielles, and to carry on business as electricians, caterers for public entertainments, &c. The subscribers (each with one share) are:—H. E Taylor, 28, Finsbury Pavement, E.C., mining engineer; A. Clippingdale, 17, Honley Road, Catford, S.E., gentleman; W. H. Taylor, 78, Allison Road, Harringay, N., engineer; H. W. Green, Stock Exchange, E.C., gentleman; W. G. Blakeman, 57, Moorgate Street, E.C., chartered accountant; W. H. Chantry, 57, Moorgate Street., E.C., chartered accountant; W. D. Clippingdale, 17, Honley Road, Catford, S.E., engineer. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; remuneration, 10 per cent. of the net profits divided between them. Registered office, 28, Finsbury Pavement, E.C.

Woodhouse and Baillie Riviera Electricity Company, Limited (62,791).—This company was registered on June 29th, with a capital of £50,000 in £1 shares (16,000 first preference and 20,000 second preference), to enter into an agreement with C. H. E. Woodhouse and G. H. Baillie, and to carry on the business of electricians, mechanical, electrical and general engineers, suppliers of electricity and other agencies for the purposes of light, power and otherwise, manufacturers of and dealers in electrical machinery and apparatus, &c. The first subscribers (each with one second preference share) are:—Claude H. C. Woodhouse, 7, Charlwood Road, Putney, S.W., electrical engineer; Ernest W. Shevens, 59, Cressingham Road, Lewisham, Kent, clerk; William H. Milne, 70, Forthbridge Road, Clapham, S.W., clerk; William T. Parkes, White House, Elstree, Herts, clerk; Francis J. Pepper, The Elms, Willesden Green, N.W., clerk; George Forrest, 28-9, Chancery Lane, W.C., accountant; and John A. Parkes, 93-4, Chancery Lane, W.C., solicitor. The number of directors is not to be less than three nor more than seven; the first are Claude H. C. Woodhouse, Glanville H. Baillie, and Arthur M. Hanbury; qualification, £500; remuneration as fixed by the company. Registered office, 28, Queen Street, E.C.

Tayside Electric and Gas Light Company, Limited (4,308).—This company was registered at Edinburgh on June 24th, with a capital of £25,000 in £1 shares, to acquire the business of the Newport Gas Company, and to carry on the business of manufacturers and suppliers of gas and electricity, for heat, light, or power. The first subscribers (each with one share) are:—Walter Corbet, Acton Regnald, Shrewsbury, land proprietor; Henry Wedderburn, Berkhill Cupar, Fife, land proprietor; Andrew Leitch, Netherlea, Newport, Fife, shipowner; James Lowson, Kilnburn, Newport, Fife, retired merchant; James Orr, Newport, Fife, land agent; Thomas Winton, Newport, Fife, wood merchant; and Alexander Stewart, Wormit, Fife, builder. The number of directors is not to be less than five nor more than nine; the subscribers are to appoint the first; qualification, 100 shares; remuneration as fixed by the company. Registered office, 9, Ward Road, Dundee.

Telepantograph Syndicate, Limited (62,843).—This company was registered on July 3rd, with a capital of £10,000 in £10 shares, to enter into an agreement with R. Greville-Williams and to carry on any business directly or indirectly connected with the supply and employment of electricity, and in particular to establish and maintain a system of telepantographic exchanges and telepantographic communication. The first subscribers (each with one share) are:—George Kemp, 71, Portland Place, W., M.P.; E. Tootal Broadhurst, 56, Oxford Street, Manchester, manufacturer; Rupert Greville-Williams, Simpson Hill House, Heywood, chemist and electrician; W. H. A. Gaddum, 7, South Street, Manchester, merchant; James G. Groves, Regent Road, Bravery, Salford, brewer; C. H. Scott, Ackers Street, Manchester, merchant; and C. Tattersall, Oakdale, Altrincham, merchant. The first directors (to number not less than three nor more than seven) are to be nominated by the subscribers; qualification, £500; remuneration as the company may decide.

CITY NOTES.

The Elmore Amalgamations.

Extraordinary meetings of the four Elmore companies were held on Monday last at the Cannon Street Hotel for the purpose of confirming the resolutions passed on June 29th for the voluntary winding up of the concerns and the appointment of Mr. James Shurmer, of Hunslet, Leeds, as the liquidator for the purposes of such winding up. Mr. A. S. Elmore presided over the meeting of Elmore's Patent Copper Depositing Company, Limited, Mr. F. Elmore over that of Elmore's Wire Manufacturing Company, Limited, Mr. J. T. Cooper over that of Elmore's American and Canadian Patent Copper Depositing Company, Limited, and Mr. F. L. Rawson was the chairman at the Elmore's Foreign and Colonial Patent Copper Depositing Company, Limited. In the case of the first three companies the resolutions were formally moved and carried without any discussion, but considerable discussion ensued with regard to the resolution affecting the last-named company—the Elmore's Foreign and Colonial Patent Copper Depositing Company, Limited.

The Chairman (Mr. Rawson), in moving the confirmation of the resolution, which was in these terms:—"That the company be wound up voluntarily, subject to the company receiving £48,000 in fully paid-up shares in Elmore's Trust, Limited, or such lesser number as the committee appointed at this meeting may consider fit, and failing agreement the question of the amount is to be submitted to arbitration"—said that at the last meeting it was left to a committee which was then appointed, to settle whether they would accept the 33,000 shares that were offered or go to arbitration, or whether any other amount should be accepted. Ultimately the committee agreed that the foreign company should receive 45,000 fully-paid shares in the Trust Company, so settling the questions in dispute between the Foreign Elmore Company and those who were specially interested in the formation of the new company. The second matter that was left for the committee to consider was as to the division of the 45,000 shares among the shareholders. According to the articles of association, each founder's share would be entitled to the same amount as each priority share received. By the articles each priority share was entitled to receive back by dividend and bonus 100 per cent. out of the profits before the founders' shares received anything. The priority shares had received back £5 each—that was to say, the full amount of their shares, and those holding priority shares argued that they were entitled to receive another £5 before the founders' shares received anything, but that contention was not strictly accurate, because they were to receive their money out of profits. In order to enable them to receive anything, it would have been necessary to show that the capital of the company, consisting of 15,000 priority shares of £5 each and 9,000 founders' shares of £5 each, was intact. It was impossible to show that, and therefore it was a very great question whether the priority shares would have been entitled to receive anything at all, even if the company had remained in existence. The argument of the founders was that they had never received one penny; that the priority shares had received £5 each, and that therefore, in the distribution they were entitled to something more than the priority shareholders. A good many of the priority shareholders argued that they had bought their shares at £10 and £11, and that it was not they who had received a bonus of £5, but their predecessors, and that consequently the founders' shares were not entitled to anything more than they were. The founders' shareholder's reply to that was that some of them had paid £19 each for their shares. A committee was appointed consisting of Mr. Busch, Mr. Foster and Mr. Freeman, representing the priority shareholders, and Mr. Holmes, Mr. A. S. Elmore and Mr. Hewitt represented the holders of founders' shares, and Mr. Bennett, who held both classes of shares was added to the committee, so that in the event of a division of opinion arising he should practically settle what should be done. The result of that meeting was that Mr. Busch practically led the opposition on behalf of the priority shareholders, and he was very strongly of opinion that they should have had something extra given to them, and ultimately it remained with Mr. Bennett to say what the distribution should be. That gentleman came to the opinion that in the best interests of the company the division of the shares should remain exactly as the legal position left it—that was to say, that each founder's share should receive the same amount as each priority share. He (Mr. Rawson) thought that the committee who had acted now for nearly two years in assisting the board to arrive at a settlement with those who had been interested in forming the new company, should receive some small remuneration for their services. That had not been asked for, and, in fact, some of the committee had said that they did not think they were entitled to anything, as they had given their time freely. He, however, thought that that was a mistaken view, and even if it was only a small amount, he believed in giving the committee something for the hard work they had done for the shareholders. Taking the view that 48,000 shares was the proper amount to be received, he did not

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believe they would have been able to have got the 45,000 which had now been settled on, had it not been for the work of the committee in insisting upon a fair proportion of the assets coming to the foreign company.

Mr. Shurmer seconded the resolution.

Major Phillips expressed himself dissatisfied with the way in which it was proposed to distribute the 45,000 shares. In his opinion, the founders' shares ought not to receive anything at all and the priority shares ought to receive the full amount, and unless some more equitable form of distribution could be arranged he should feel bound to vote against the resolution.

The Chairman said there might be something in Major Phillips's contention if the vendors held a very large amount of the founders' shares. At the present time not more than 1,500 out of the lot were held by the vendors, and they also held a considerable number of priority shares which they had bought.

Mr. G. H. Busch (chairman of the committee) said they had been informed by the directors that the committee had succeeded in increasing the selling price of their assets to the Elmore Trust to £45,000 in shares from the £33,000 originally offered. They did not think it worth while to go to arbitration for the sake of insisting upon the extra £3,000, as the difference would be so very small to each individual shareholder. As to the division of the £45,000 among the founders and priority shareholders, the decision was come to that they should be divided *pro rata*, giving each shareholder £1 17s. 6d. for every old share he held, be it priority or founders. Personally, he held that the priority shareholders ought to have had the preferences, and he fought hard to obtain £31,500 for the priority shareholders and £13,500 for the founders. Mr. Bennett, however, advocated the division *pro rata*, and some other members of the committee unable to attend intimated to Mr. Rawson before the meeting that they should be satisfied with that arrangement. They understood, too, from the chairman, that another large priority shareholder had expressed his consent. What made him (Mr. Busch) finally give way was that the articles of association having, strangely enough, not provided for any preference as to capital for the priority shares, the legal aspect would, in all probability, be in favour of a division *pro rata*. Therefore, even if his suggestion had been carried, some of the founder shareholders might have gone to law about the matter, and thereby created delay and expense. The only other point the committee had to decide on was with reference to the liquidator, and they had decided to recommend that Mr. Cartwright should be appointed instead of Mr. Shurmer. In conclusion, Mr. Busch said he hoped that the new undertaking would meet with every success.

Mr. Ellis said he was of opinion that the committee ought not to have decided as to the way the 45,000 shares should be distributed, and he thought they had rather gone beyond their power in making the arrangement.

In reply to Major Phillips, the Chairman said he was not aware whether the vendors were willing to forego the founders' shares which they still held.

Mr. Patchard said that, as an original holder both of founders' and priority shares, he considered that the division was a very fair one.

After some discussion the resolution was carried.

The Chairman then proposed Mr. Shurmer as the liquidator, remarking that that gentleman was willing to act free of all expense.

Mr. Cooper seconded.

Mr. Ellis said he thought it was agreed at the last meeting that they should have an independent liquidator, and he would certainly prefer to see Mr. Cartwright, for he knew all about the Elmore Companies, and was thoroughly honest and able in every respect.

Mr. Busch said that although they had no personal feeling against Mr. Shurmer, as the general meeting wanted an independent liquidator, he thought the directors ought to yield.

After some discussion, Mr. Shurmer's appointment was carried by nine votes to five.

On the motion of the Chairman, it was agreed to vote the committee 50 guineas for their work. A vote of thanks to the chairman for presiding terminated the proceedings.

Electric Construction Company, Limited.

Sir Daniel Cooper presided on July 13th, at Winchester House, at the sixth annual general meeting of the shareholders of the above-named company.

The Chairman, in moving the adoption of the report, pointed out that the gross manufacturing profits for the year ended May 31st last amounted to £48,544, showing an increase of £2,698 over those of last year, and including the balance brought forward there was now £21,393 of profits to appropriate. Of this sum the board proposed to apply £16,952 in paying the dividend of 7 per cent. on the preferred and a dividend of 6 per cent. on the ordinary shares, and to add £3,000 to the general reserve fund, making the amount at the credit of this account £20,000. The reserve fund was intended to meet any exceptional loss, which, in spite of careful management, would sometimes arise, and also to provide for any unexpected loss in realising the company's securities. He did not look for any call on this fund, which strengthened the position of the company, and gave confidence in its future. The business of the company and the out-turn of their factories continued to make satisfactory progress, and the excellence of their manufactures had been fully maintained. During the year they had, besides largely increasing the output of standard machines, successfully installed some of the largest dynamos of their kind in this country. The electric equipment of the City and South London Railway extension on which they were now engaged would, they hoped, demonstrate that their company were at least as well qualified as their American rivals to provide such installations. It must, however, be confessed that some cause for disappointment had been given to a few of the company's customers by some unavoidable delay in executing their orders, caused, partly by novelty in the designs, and partly by pressure of work. To prevent the latter, a considerable addition was being made to their workshops, and larger tools and appliances were being provided to cope more advantageously with the large machines now coming generally into use. The board had not been eager to enlarge the works, but the growth of the business and the prospects of great development in the use of electrical power had satisfied them of the expediency of this step. Besides enabling the company to execute orders promptly, these additions would tend to economy in cost of production, as their fixed standing charges would be spread over a larger output. The directors expected that the extensions would be completed and in full working order before another year had elapsed, and the company's factories would then be the largest and the best equipped, especially for the construction of large machines, of any in this country. Some additional capital might then be necessary, but the board would, perhaps, be able to arrange for it without any further issue of shares. The shareholders would probably recollect that at the last general meeting he mentioned that the directors contemplated making an offer to them of part of the company's holding in shares of the Electrical Power Storage Company, Limited. The proposal was submitted to them in last October, and nearly half of the shares offered were applied for and allotted to shareholders. The board might again submit the unallotted balance, and if these shares were taken up, it might be unnecessary to issue any more of the company's own shares, or, if so, only to a very limited extent. All their first and second 6 per cent. debentures had been converted into 4 per cent. debenture stock, and a large portion of floating debt into redeemable 4½ per cent. second debenture stock. The whole expenses of this conversion had been written off, and in addition to the important reduction of interest already experienced, there would be a further saving in the coming year. The compensation for injuries paid to workmen during the year had not exceeded £20, although the company were none more liberal in their treatment of those who had suffered than was provided by the Act. Their relations with their employés were also thoroughly harmonious. The men had for some years been paid an annual bonus on their wages, and the board intended that this bonus should bear a fixed proportion to the dividend paid on the ordinary shares. It was thus to the men's pecuniary advantage to co-operate heartily in working for the success of the business. The shareholders would, he felt sure, agree that this was a sound and an enlightened policy in the management of such works as the company's, and he believed that it was bearing fruit in a steady growth of confidence on both sides, and of cordial co-operation among all the company's employés. During the present management the position of the company had been strengthened every year both within and without. There was before them an enormous development in the use of electric power, involving, of course, a corresponding demand for the company's manufactures. With the extensions they would have factories capable of increasing largely the output of their standard manufactures as well as of producing the largest machines that could practically be required, and they were steadily building up a business that would, he hoped, not only prove profitable, but also permanent and a credit to everyone concerned.

Mr. James Wm. Barclay (deputy chairman) seconded the motion, and it was carried unanimously.

The retiring directors, Sir H. C. Mance and Mr. P. E. Beachcroft, and the auditors, Messrs. James Merton & Co., were re-elected, and the proceedings terminated with a vote of thanks to the chairman.

Electrical Power Storage Company, Limited.

The tenth ordinary general meeting was held on July 13th at the offices, Great Winchester Street.

Mr. J. Irving Courtenay, who presided, stated that after paying debenture interest and adding a substantial amount to the contingent fund, a net profit of £4,532 remained, which, with the sum brought forward, made a total of £4,889 available for distribution. The directors, therefore, recommended a similar dividend to that which had been paid for the last six years—namely, 5 per cent.—leaving £554 to be carried forward. To meet the demand for E.P.S. storage batteries, which had during the past year very considerably increased, new buildings had been erected at a cost of about £1,500, while over £1,600 had been expended in providing plant. Their work came near to what was designated a dangerous trade, and the board had therefore to comply with the wishes of the Home Office in the matter of precautions for the health of the workmen. The result of the year's work might be deemed satisfactory, as not only had severe competition to be faced, but prices of all raw material, and especially of lead, had shown a considerable upward tendency. The directors were obliged to increase their prices 10 per cent., but little of the accruing benefit came into the past financial year. In order to compete for some contracts it was necessary to enter into agreements for the upkeep of the battery for periods varying from five to 15 years. This was, he thought, prejudicial to the industry generally, besides fostering unfair competition, as it enabled certain persons, by offering a low maintenance rate, to secure contracts. When the time came for the maintenance contracts to be carried out and renewals made, the customer frequently found that the guarantors had in the meantime ceased to exist. The policy of their company had always been to enter into maintenance contracts at rates which might reasonably be expected to cover the risks. The directors had started, in addition to the reserve fund, a special contingent fund, for the purpose of making further provision against this class of liability. Such a reserve added greatly to the strength of the com-

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pany, and he could not help thinking that engineers, electric companies, and committees of local authorities generally would in time find that the only safe way to deal with contracts of this description was to satisfy themselves that the parties giving these maintenance guarantees had adequate reserves to meet the risks. Among the company's larger work completed during the past year he might specially mention that they had installed a traction battery for the Liverpool Corporation, had extended the batteries for the Birmingham Electric Supply Company, and had erected one for the Metropolitan Electric Supply Company; and, in addition, they had erected batteries at Colchester, Morecambe, Belfast, and Leith for the various lighting authorities. Among important contracts in hand might be mentioned one with the Metropolitan Electric Supply Company for their station at Willesden, and also batteries for the Gloucester, Bradford, Doncaster, and Bury St. Edmunds Corporations, and for the London County Council's works at Crossness. The contract for the supply of batteries to the London Electrical Cab Company had now been completed, and the batteries were doing well. The company had devoted a great deal of attention to the problem of constructing a battery capable of providing heavy currents for lighting and traction work in central stations, and in this respect they had been singularly successful. The board had decided that the company should take part in the Exhibition to be held next year in Paris, where they proposed to show some of the latest types of the company's manufactures, special attention being given to traction types of cells, for which the directors believed that there was a considerable market opening on the Continent. He concluded by moving a resolution for the adoption of the report and the payment of the dividend recommended.

Sir Daniel Cooper seconded the motion, which was carried unanimously.

Eastern Telegraph Company, Limited.

The report for the half-year ended March 31st, according to the *Times*, states that the revenue amounted to £493,504, from which are deducted £122,561 for ordinary expenses and £34,520 for expenditure relating to repairs and renewals of cables, &c., during the half-year. After providing £4,333 for depreciation of spare cable and £7,413 for income-tax, there remains a balance added to £35,447 brought from the preceding half-year of £360,122. An interim dividend of 1½ per cent. on the ordinary stock has been paid, the directors have placed £10,000 to reserve fund for maintenance ships, £5,050 to the reserve in connection with removal of head office, £2,000 to the reserve fund for insurance of goods in transit, and £100,000 to the general reserve fund. They now recommend a final dividend on the ordinary stock for the year of 1½ per cent. and a bonus of 2 per cent., amounting together to £133,000, both payable on the 20th inst., free of tax, and making a total distribution of 7 per cent. for the year. A balance of £3,536 is carried forward. The revenue includes £25,112 dividends for the half-year upon the company's investments in other telegraph companies. The British Government having announced that it was prepared to co-operate with the Governments of Australasia and Canada in the laying of a Government cable across the Pacific Ocean, the directors of this and the Eastern Extension Telegraph Company considered it necessary in the interests of the proprietors to protest against the British Government entering into active competition with private enterprise, and pledging the public credit of the country for such a purpose. Accordingly a deputation from the two companies waited upon the Chancellor of the Exchequer and the Secretary of State for the Colonies, in order to express the companies' very grave objections to so serious an attack upon private interests. The directors consider that should the laying of the Pacific cable be decided upon, it should be worked and maintained by private enterprise, and not by Government agency. The convention with the French Government for a landline through France to Marseilles terminated in March last, and the new cable from this country to Gibraltar, Malta, and Egypt, referred to at the last meeting, was completed on January 23rd. The direct telegraph communication with Egypt and the Far East, as well as South Africa, has thereby been materially strengthened. The cost of the Malta-Alexandria section has been charged against the general reserve fund.

West African Telegraph Company.

The directors' report for the year ended December 31st, 1898, presented to the meeting held at Winchester House, E.C., yesterday, reads as follows:—"The directors submit the accounts and balance-sheet of the company for the 12 months ended December 31st, 1898. The company's revenue for that period amounted to £65,522 15s., against which £21,526 16s. 6d., is charged for ordinary expenses, and £17,717 18s. 7d. for expenditure relating to repairs of cables, &c. After providing £522 17s. 4d. for income-tax and £175 13s. 2d. for revaluation of currency assets, there remains a balance of £25,579 9s. 5d., to which is added £372 12s. 6d. brought from the preceding year, making a total available balance of £25,952 1s. 11d. From this balance there has been deducted £9,439 10s. 1d. for interest on debentures, and £14,333 6s. 8d. for sinking fund, leaving a balance of £2,179 5s. 2d., which it is proposed to carry forward to next year. The revenue for the year under review includes a further sum of £12,000 in respect of subsidy due from the French Government, but which has not yet been paid. As will be seen from page 9 of the accounts, this arrear, together with the sums withheld in previous years, now amounts to £44,415. The director who retires by rotation is Sir Henry C. Mance, C.I.E., M.Inst.C.E., who, being eligible, offers himself for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., also retire, and offer themselves for re-election."

The British Aluminium Company, Limited.

Mr. Wallace, Q.C. (chairman) presided on Tuesday at the Westminster Palace Hotel over the fourth ordinary general meeting of the shareholders of the above company, and, in moving the adoption of the report, said they had hoped to have met earlier, but they had had the question before them of raising further capital and consolidating the debentures. It had always been their endeavour to keep the preference capital and the ordinary shares at their original amount, and thus to provide new capital they had decided to increase the debentures. To do that they had had to get a fresh valuation of their capital. He had previously explained to them the various operations they carried on in their factories, and he need only tell them on the present occasion that the work was going on satisfactorily. They had reduced the cost of their product, and from experiments they had made they hoped still further to decrease it. What would interest them most was the demand for their product, and that was going on slowly but surely. Taking the supply of aluminium for the world since 1889 it had increased eight times, and with regard to the company's sales in England since 1885 it had increased six times. They would thus see that the demand was increasing, but not so rapidly as they had the right to expect. During the last six months of the year compared with the corresponding six months the sales had increased 48½ per cent., which was very good. The Government of the country had given them little assistance. They had given them trial orders, but not such orders as, in comparison with the orders given by other Governments, they had the right to expect. No doubt they would give more when the trials were complete. In Germany the army was practically equipped with aluminium utensils, and in the German ships of war almost all the internal fittings were of aluminium. Of course, there was much more done for them in the Naval Department of the country than in the War Department, but still not as much as they expected. With regard to the general trade of the country, he told them last year that they had been interfered with because of the strike, and now they were being affected because of the full state of the country's workshops. Thus the shareholders must be patient. A good deal had been said with regard to the action of sea water upon aluminium, but those reports had been very much exaggerated. He was not at liberty to say anything about the *Shamrock*, but he could say of the *Defender*, that although she had lain in dock for 4½ years, she had not deteriorated. With regard to the use of aluminium for electrical purposes, that was going on very fast in America, but not so fast in that country as they would like. Lord Kelvin had spoken highly of aluminium, and at the present price of copper, aluminium was much cheaper for transmitting electricity over telegraph and telephone wires. Experiments were being made in that direction by the Government, and being much lighter than copper it did not require so many poles. The chairman referred to the satisfactory arrangement made with the Acetylene Illuminating Company to take over the manufacture of the product at Foyers on terms beneficial to the company. In conclusion, he welcomed the co-operation of Lord Kelvin on the board.

Lord Kelvin seconded the motion, and said they did not know how far aluminum could be protected by paint, but they had great hope in that direction with respect to the building of ships. He thought there was a good future before the company.

Replying to a shareholder, the Chairman said they had only paid six months' interest on the preference shares, but they would pay the balance when they found they had sufficient money in hand to spare it. When they got their fresh debentures they would not be paying much more interest than they did now.

The report was adopted, and at a subsequent meeting alterations in the articles of association were agreed to.

The Bristol Tramways and Carriage Company.

The directors at their meeting on July 19th, declared an interim dividend to June 30th last at 7 per cent. per annum, payable on August 5th. The total receipts of the company for the half-year were £72,396 14s. 9d., against £67,246 16s. 10d., an increase of £5,149 17s. 11d. over the corresponding period last year, whilst the number of passengers carried was 11,408,683, against 10,680,379, an increase of 728,304. The interest on debenture stock and interim dividend of 7 per cent. per annum absorbs £19,489 2s. 5d., against £13,189 9s. 4d. in the corresponding period last year, when the dividend was 6 per cent. per annum.

Telegraph Construction and Maintenance Company.

The half-yearly general meeting of the shareholders of this company was held on Tuesday at the offices, 38, Old Broad Street, Sir Robt. G. W. Herbert presiding.

In proposing the adoption of the report, the Chairman said he was pleased to be able to state that the affairs of the company continued in a satisfactory condition. That being the half-yearly meeting, there were no accounts to be presented, but he was pleased to be able to tell them that their factories were in excellent working condition, and had been kept well employed throughout the six months. Their ships were in very good order, but they had not been engaged to the same extent as in the previous half-year, because the work which they had been doing had been in a great measure that of supplying various companies and governments with reserves of cables and in effecting repairs which had not required their larger ships to go to sea for any lengthened period. They had been able to provide for the payment of the usual interim dividend of 5 per cent., and they were hopeful for the future, as the works were well employed, and already some progress had been made towards completing a satisfactory dividend when the year's accounts closed.

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Replying to Mr. Crowe (a shareholder) the Chairman said that the question of the proposed cable by the Azores to America was still under negotiation, and no definite conclusion had yet been arrived at. It was true that the Germans were not in a position to carry out large cable-laying enterprises without help from this country, and it was not improbable, therefore, that a stipulation might be made that wire and other materials of German make should be employed in the manufacture of a cable which their company or some other company might construct for the German Government. He did not think that would be an unreasonable arrangement, but at present he could not say anything definite on the subject.

The meeting then terminated.

The Direct United States Cable Company, Limited.

The report of the directors for the six months ended June 30th, 1899, will be presented at the forty-fourth ordinary general meeting of the company, to be held at Winchester House (Hall No. 174) 50, Old Broad Street, in the City of London, on Tuesday, July 25th, 1899, at 2 o'clock p.m. The directors in their usual statement of accounts state that the half-year's revenue, after deducting out-payments amounted to £51,951 8s. 2d. as compared with £52,232 12s. 1d. for the corresponding period of 1898, showing a difference of £281 3s. 11d. against the half-year under review, which must be considered satisfactory, having regard to the exceptional increase in the revenue during the spring of last year owing to the Spanish-American war. The working and other expenses for the same period, including income-tax, but exclusive of cost of repairs of cables, amounted to £20,411 8s. 1d., leaving a balance of £31,540 0s. 1d. as the net profit, making with £5,920 16s. 8d. brought forward from the previous half-year a total of £37,460 16s. 9d. For the corresponding period of 1898 the working expenses and other payments amounted to £21,685 12s. 6d. Three quarterly interim dividends of 3s. each per share, amounting to £27,319 10s., have been declared and paid during the financial year, and a final dividend of 3s. per share is now proposed, together with a bonus of 2s. per share, making with the three interim dividends 3½ per cent. for the year, or a total distribution of £42,497. After transferring £10,000 to the reserve fund account, the balance of £3,176 16s. 9d. on the revenue account is proposed to be carried forward. The reserve fund account has been debited with £2,603 13s. for cost of cable repairs, and after being credited with interest, realised profit, and sum transferred from revenue account, the balance of the reserve fund, taking the investments at cost price, now amounts to £382,365 19s. 6d. Pursuant to the provisions of the articles of association two of the directors, viz., E. M. Underdown, Esq., Q.C., and Sir James Pender, Bart., M.P., retire by rotation, and, being eligible, offer themselves for re-election. Messrs. Deloitte, Dever, Griffiths & Co., and Messrs. J. & J. Sawyer and Co., the auditors, retire pursuant to the articles of association, and offer themselves for re-election.

Jandus Arc Lamp and Electric Company, Limited.

The annual meeting was held at 46, Brown Street, Manchester, on July 11th, Mr. E. N. Galloway, chairman of the directors, presiding. The report, which was unanimously adopted, recommended a dividend of 40 per cent. for the year ended April 30th last, payable free of income-tax, and that £1,000 be written off patents account. This is the third year in succession in which the company has paid 40 per cent. The report contains a schedule of 23 companies and firms which have now recognised the "Jandus" patent and accepted licenses. The company is at present fitting up extensive new works in Holloway, London, which will enable the directors to deal with the rapidly-increasing business. Mr. Thomas A. Earle, Manchester, and Mr. Bernard Drake, London, the retiring directors, were unanimously re-elected.

City Electric Lighting.

The City Corporation has received the following letter from the City of London Electric Lighting Company, Limited:—

"1 and 2, Great Winchester Street, London, E.C.
"Manager and Secretary's Office,
"*July 17th*, 1899.

"To the Town Clerk, Guildhall, E.C.

"Sir,—My directors had before them at their meeting to-day the correspondence which has passed recently between the respective solicitors of the Corporation and the company, from which it appears that the Streets Committee will not meet my directors to discuss the position, but have expressed themselves as being willing to consider any proposals my board may deem it desirable to submit in writing. I am instructed by my board to submit the following proposals:—

"I.—As to a reduction in the price of electricity, conditional on the Charing Cross and Strand Company's Bill being rejected, and an amending Act (as below) being passed:—

"1. The company to apply for an Act, supported by the Corporation, to relieve the company of the obligations imposed by the Act of 1893 as to depreciation and reserve funds, imposing in lieu thereof no larger obligations than are imposed on other companies who have to keep their accounts in the form required by the Board of Trade.

"2. Agree that the company may use the same plant and mains for public and private lighting.

"3. The company will, if the Corporation wish, give up the lighting of the side streets.

"4. (*a*) The Corporation not to oppose the present or future applications to the Board of Trade for continuous current;

"(*b*) and to consent to the alteration of the standard pressure to 200 volts.

"5. The company to reduce their prices to those set forth in the Charing Cross order on the passing of the amending Act above referred to.

"6. In all other respects the existing Acts and contracts to remain in force, and the contracts alleged to be null and void to be 'set up' again with above modifications.

"II.—As regards purchase—My board are prepared at the present time to negotiate for the sale of the whole of the company's undertaking to the Corporation upon the basis of the Corporation issuing to the company such an amount of Corporation stock as will produce an annual income of £75,000. I am to point out that the net revenue derivable by the Corporation from the company's undertaking should be at least £120,000, made up as follows:—

Net revenue for 1898 as per published accounts	£95,779
Interest on deposits, investments, &c.	3,406
Add savings in administration, &c., which would not fall upon the Corporation	7,000
	£106,179
Add increase of revenue for 1899, by reason of the greater number of lamps connected, estimated to be at least	14,000
	£120,179

"This calculation is made on an average charge of 6 22 l. per unit.

"A purchase on this footing would give the Corporation an immediate profit of £45,000 per annum, which might be applied either in reduction of price to the consumer or in relief of the rates.

"The sale to the Corporation would include the entire assets of the company, subject to liabilities incurred for additional plant, &c.

"I am directed to forward a copy of this letter to each member of the Corporation.—I am, &c.,

"J. Cecil Bull, Manager and Secretary."

Prospectuses.

Kidderminster and District Electric Lighting and Traction Company, Limited.

A company has been formed, having the above title, for the purpose of acquiring all the issued shares of the Kidderminster and Stourport Electric Tramway Company (except 120 shares held by the directors), and of taking over the electric lighting order granted to the Corporation of Kidderminster. The old company was formed in 1896, with a capital of £60,000, but has not the necessary statutory powers to undertake the supply of electrical energy. The tramway is about 4½ miles long, and is electrically equipped on the overhead system; there are nine cars in regular work. The area of supply under the provisional order includes the whole of the municipal borough of Kidderminster. The tramway company pays the British Electric Traction Company £56,000 for the undertaking as it stands, as well as the costs incurred by the latter company in promoting the new company. The authorised capital is £100,000, divided into 5,000 5 per cent. cumulative preference shares and 5,000 ordinary shares of £10 each. The present issue comprises 3,000 5 per cent. cumulative preference shares. The list opened July 18th and closes to-day. The secretary is Mr. H. S. Hodgson; offices, Denington House, Norfolk Street, Strand, W.C.

The Horsfall Destructor Company, Limited.

This company is formed to acquire the business of the Horsfall Furnace Syndicate, Limited, carried on in Leeds, including the well-known Horsfall Refuse Destructor and the Loidis Forced Draught Boiler Furnace.

It is explained that the main object of the issue (announced in our other columns) is to obtain further working capital, and it is intended to acquire or establish suitable works, in order to cope with the large increase of business.

The company will purchase from the syndicate all its patents, covering the United Kingdom, France, Belgium, Germany, Italy, Switzerland, Russia, Austria, Hungary, United States, New South Wales, Victoria, New Zealand, Straits Settlement, and Hong Kong, the benefit of all its current contracts, and the whole of its assets, privileges, and rights, for £60,000, payable as to £20,000 in cash, £30,000 in fully paid ordinary shares of the company, and £10,000 either in cash or shares, at the option of the directors of the company. The capital is to be £100,000 in £1 shares, of which the vendor company takes as part of its purchase price, £30,000, and the balance of £70,000 is offered for subscription. Extracts from full reports (to be seen at the offices of the company's London solicitors) are published, and are from Lord Kelvin and Dr. Archibald Barr, Mr. Charles Estcourt, Sir Alexander Binnie and Dr. Shirley Murphy, engineer and medical officer respectively to the London County Council, and from Herr Andreas Meyer, chief engineer to the municipality of Hamburg, all speaking well of the destructor, and when we add that the contracts in hand with Corporations and other Public Authorities amount to nearly £88,000, and that additional orders to the tune of £50,000 are expected to be secured shortly, it will be seen what a promising opportunity for investment the above company presents.

Thames Iron Works, Shipbuilding and Engineering Company, Limited.

In our business columns this week will be found the prospectus of the Thames Iron Works, Shipbuilding, and Engineering Company, Limited. This company has been formed to take over the business

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of the Thames Iron Works and Shipbuilding Company, Limited, together with the old-established engineering works of Messrs John Penn & Sons, Limited, of Greenwich and Deptford, which was recently acquired by the vendor company. Besides having built, or in course of building, 32 warships, &c., for the British Admiralty, the vendor company has built 60 other large vessels, many of them armour-clad, the total tonnage amounting to over 330,000 tons; while Messrs. John Penn & Sons have engined vessels for the British and other Governments with a total of 377,900 H.P. Such figures need no comment.

The authorised capital is £600,000 in £1 shares, of which 300,000 are ordinary shares and the remainder 5 per cent. cumulative preference shares. The purchase price is £750,000, payable as to £300,000 in ordinary shares, and as to the balance in cash; the present issue is 300,000 preference shares, and £200,000 4 per cent. irredeemable first mortgage debentures, at par, in 2,000 debentures of £100 each. The list closes on or before Wednesday, July 26th.

Electric Resistance and Heating Company, Limited.

This company is formed to acquire the patent rights for a new electric resistance for all countries with the exception of Austria-Hungary and the Balkan States, to re-sell, manufacture, and grant licenses, and for the other purposes mentioned in the memorandum of association. The patents are for the manufacture of a composition for use as a resistance in order to regulate the amount of current supplied to electric appliances The directors have consulted Mr. James Swinburne, M.I.C.E., Vice-President Inst.E.E., as to the material, who states that "the material, which is clay and blacklead, can be worked up and manufactured cheaply," and "can be made of various specific resistances." The total price to be paid by the company for the whole of the above-described patents and rights, including 100,000 kronen in fully-paid shares of the Rheostat Company of Hungary, has been fixed by the vendors, the Construction and Investment Company, Limited, at the sum of £95,000, of which £35,000 will be paid in fully-paid shares, as above stated, £27,500 in cash or shares at the option of the company, and £32,500 in cash, leaving £25,000 in shares to provide working capital. Out of the purchase price the vendors have to pay for the patents, rights, and shares above mentioned, the sum of £55,000, as to £20,000 in cash, and as to £35,000 in fully-paid shares, and also have to pay all expenses, including brokerage, but excluding legal fees and costs connected with the formation and flotation of the company and the issue of its share capital up to and including allotment.

The share capital is £120,000, in 120,000 shares of £1 each, of which 35,000 are taken as fully paid in part payment for the patents, the present issue being 85,000 shares of £1 each, at par. The list closes on July 25th. For other particulars see our business columns.

City and South London Railway Company.—The accounts for the half-year ended June 30th show a balance, after providing for the debenture interest and dividend on the preference shares, sufficient to allow the payment of a dividend on the consolidated ordinary stock at the rate of 2¼ per cent. per annum, carrying forward £1,107. The dividend for the corresponding period last year was at the rate of 2¼ per cent. per annum, with £1,005 forward.

Edison and Swan United Electric Light Company, Limited.—The directors recommend a dividend for the six months ended June 30th at the rate of 6 per cent. per annum on the "A" share capital, making, with the interim dividend, 6 per cent. for the entire year.

Eastern Telegraph Company, Limited.—The half-yearly ordinary general meeting of the above company was held yesterday at Winchester House, when the report of the directors was received and adopted. A report of the proceedings will appear in our next issue.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending July 15th, 1899, were £913 18s. 2d.; receipts for three days ending July 16th, 1898, £323 12s. 5d.; aggregate, July 1st, 1899 to date, £1,962 8s. 9d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending July 14th, 1899, were £3,579 5s. 4d.; corresponding period 1898, £3,126 1s. 1d.; increase, £458 4s. 3d.

The City and South London Railway Company.—The receipts for the week ending July 16th, 1899, were £861: week ending July 17th, 1898. £927; decrease, £66. Total receipts for half-year, 1899, £2,878; total receipts corresponding period, 1898, £2,828; increase, £50. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending July 8th, 1899, were £219 10s. 2d.; week ending July 9th, 1898, £201 2s. 11d.; increase, £18 7s. 3d. Total receipts to date, 1899, £4,151 8s. 8d.; corresponding period, 1898, £3,540 3s. 10d.; increase, £911 4s. 11d. Miles of track open week ending July 8th, 1899, 3; week ending July 9th, 1898, 3. Car miles run week ending July 8th, 1899, 4,510; week ending July 9th, 1898, 3,741. Number of cars, week ending July 8th, 1899, 11; week ending July 9th, 1898, 10. The receipts for the week ending July 15th, 1899, were £258 15s. 8d.; week ending July 15th, 1898, £226 0s. 7d.; increase, £32 15s. 1d. Total receipts to date, 1899, £4,710 4s. 4d.; corresponding period, 1898, £3,766 4s. 5d.; increase, £943 19s. 11d. Miles of track open week ending July 15th, 1899, 3; week ending July 15th, 1898, 3. Car miles run week ending July 15th, 1899, 4,722; week ending July 15th, 1898, £3,968. Number of cars, week ending July 15th, 1899, 11; week ending July 15th, 1898, 10.

The Dublin United Tramways Company.—The receipts for the week ending Friday, July 14th, 1899, were as follows:—D. U. T. Co., horse cars, £2,044 13s. 9d.; ditto, electric cars, £1,216 7s. 8d.; D. S. D. Co., electric cars, £1,022 16s. 6d.; total, £4,283 17s. 6d.; corresponding week last year—D. U. T. Co., horse cars, £2 849 6s. 10d.; ditto, electric cars, £685 4s. 8d. D. S. D. Co., electric cars, £1,028 12s. 5d.; total, £4,563 3s. 11d.; increase, £279 6s. 5d. Aggregate to date, £8 689 12s. 4d.; aggregate to date last year, £9,040 2s.; decrease to date, £400 9s. 8d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 11 miles electrically, and 31 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending July 16th, 1899, amounted to £1,593; corresponding week last year £1,691; decrease, £98.

The South Staffordshire Tramways Company.—The receipts for week ending July 14th, 1899, were £676 2s. 8d.; aggregate receipts for 28 weeks, £17,880 0s. 11d.; week ending July 15th, 1898, £667 7s. 8d.; aggregate receipts for 28 weeks, £17,117 11s. 11d.

STOCKS AND SHARES.

Wednesday Evening.

There has been an inclination on the Stock Exchange this week to read the South African news as more favourable to peace, and the telegraph market has steadied itself in the hope of a speedy solution of the Transvaal question. Should the Gordian Knot be cut, there may be a very sharp rise in some of these securities, but we look rather for a long period of unrest before the final basis of compromise arranged, and holders of telegraph securities must look for jumpy markets. The new Pacific cable, too, is edging its way to the front. So far as the Eastern Company's Ordinary stock is concerned, the price has been maintained by reason of the directors' excellent report. The two deputations to Sir Michael Hicks-Beach seem to have counteracted each other in the eyes of the market, although it is feared that the company will have to lower its rates to India in the near future.

Eastern Extensions are a weak market, and the report is awaited with some anxiety. Wireless Telegraphy shares are also dull, and the price has relapsed to 5¼ middle. The Direct United States Cable dividend and bonus are regarded as being very satisfactory. The City and South London Railway dividend, at the rate of 2¼ per cent. for the year, is fairly good, and is about what the Stock Exchange looked for. There was, accordingly, no movement in the price when the dividend was announced on Tuesday afternoon. A slight increase in the carry-forward is the only change since this time last year. Central London descriptions display no vivacity, and a small selling order was sufficient to knock 5s. off the price of the Preferred half-shares. Waterloo and City stock marks no alteration. It is satisfactory to note that the Brompton and Piccadilly Circus Railway will not have to face the opposition that was at one time threatened by the House of Lords, and the company seems at length to have a plain course to run over.

Electric lighting shares exhibit but little change on the week, what alterations there are being mostly downward. In the present temper of the market the quotations that are sent out officially must be regarded as somewhat nominal, nor must sellers be disappointed if their orders are executed at the lowest figure marked, since there is very little support being accorded to the list of electric lighting shares. The Metropolitan Companies' shares are all in a weak state; in fact, the only hard quotation in the list is that for Westminsters, which have risen ½ during the week. City of London shares went from bad to worse, nor did the company's latest circular have much effect in brightening the price. The document is regarded with very mixed feelings, and in some quarters the opinion is expressed that it adds nothing to the company's dignity.

The two classes of the Metropolitan Electric Supply's Ordinary shares are now quoted at the same price.

Dividends and rumours of dividends are the order of the day, and the Edison & Swan has again succeeded in declaring 6 per cent. on its "A" capital, which makes 6 per cent. for the year. The yield on the partly-paid shares at to-day's price works out to over 7 per cent. The Debenture stock has relapsed, last week's rise having brought in several sellers. The manufacturing department is quiet, the changes marked being principally on account of the deduction of dividend. Callender's Cable Construction are better. A new comer in this section is an issue of 6 per cent. Preference shares of the British Westinghouse Electric and Manufacturing Company. As a speculative investment, the shares appear to merit some attention, and a small premium has been established in the market, although very few shares have changed hands up to the present.

British Electric Tractions have been rather sold by people who are disappointed at the rebuffs which have lately fallen to the company's lot, but, as we have pointed out in a previous issue, these must be expected to come occasionally. Buenos Ayres and Belgrano keep firm at 4⅜, and Anglo-Argentines are a mere shade below this price. Imperial Tramways at 25 and Potteries Electric Traction are both exceedingly firm, and New General Tractions remain at 4.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, July 12th.	Closing Quotation, July 19th.	Business done during week ended July 19th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	61 — 64	61 — 64	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	112 —113	112 —113	112⅞	112½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	13¼— 13⅜	13¼— 13⅜	13⅜	13⅜
205,151	Brasilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	15 5/16	15
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	108 —112	108 —112	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2¼— 3	2¼— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105⅝	105¼
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,981	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½%	3½%	11½— 12	11½— 12	11⅛	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	150 —155	150 —155	153½	150
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	100 —104	99 —103	99⅞	99¾
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104	101 —104	...	...
1,433,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	115 —120	115 —120	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14⅝— 15¼	14½— 15 xd	15	14½
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —100	99 —100	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
330,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	116 —121	116 —121	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	103 —106	103 —106	103	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	4 %	...	...	102 —105%	102 —105%	102	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	5⅛%	10¾— 11¼	10¾— 11¼	11 3/16	10¾
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15 — 15½	15 — 15½	15 7/16	15
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	30½	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	49	48
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5⅛%	6 %	6 %	5⅛— 5⅜	5⅛— 5⅜	5¼	5⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12½— 13½	12½— 13½	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12½— 13½	12½— 13½	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5⅜	5¼— 5⅜	5 5/16	5¼
1,339,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	99 —102	99 —102	100½	99
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	105 —108	103 —106	...	...
11,889	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	7⅝	...
3,331	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	5 — 5½	4⅜— 5¼xd	4⅞	...
151,738£	Do. do. 5 % Debs.	Stock	...	...	...	103 —106	103 —106	105½	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	100 —103	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	101 —104	101 —104	...	...
389,521	Western and Brasilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	105	...
38,321	West India and Panama Telegraph	10	1 %	2%	...	1¼— 1½	1¼— 1½	1 7/16	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10⅝	10½— 10⅝	10⅝	10¼
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	103 —106	103 —106	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	9½— 10½	9½— 10½	10	9⅝
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8½	8½	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	112 —114	112 —114	113	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	13 — 15	12 — 14	14	12⅞
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 15	13 — 15	14½	14⅛
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	128 —128	123 —128	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 11½	11 — 11½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	14 — 15	13½— 14½	14	13⅝
220,000	Do. 4½% Deb. Stock, Prov. Certs (£60% to be paid) Rd.	...	...	...	...	52 — 54	52 — 54	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5½— 5⅝	5½— 6	5 13/16	5⅝
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	7½— 8½	8½— 9½	7 15/16	7⅝
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	8½— 9½	8½— 9½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	3 1/16	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 7	6⅝	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	16 — 17	15½— 16½	...	...
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	15½— 16½	15½— 16½	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	116 —118	118 —120	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½— 16½	15½— 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	16½— 17½	16½— 17½	17¼	16⅝
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	10	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	4⅛— 4⅜	4⅛— 4⅜	4¼	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14 — 15	14½— 15½	14⅞	...

* Subject to Founder's Shares.
† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
‖ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation July 12th.	Closing Quotation July 19th.	Business done during week ended July 19th, 1899. Highest	Lowest
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3¼— 3⅜	3¼— 3⅜	3½	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	18 — 19	18 — 19	...	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	14¼— 14⅜	14¼— 14⅜	14⅜	...
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	13⅜— 14¼	13⅜— 14¼	13 15/16	13⅞
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	129⅜	129
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅜— 2	1⅜— 2	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2⅛— 2⅜	2⅛— 2⅜	2¼	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	101	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½%	15 %	14 — 15	14½— 15½	15	14⅜
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10½— 11	10½— 11	10⅜	...
178,303	Do. do. do. £8 paid	10	...	...	...	8½— 9	8½— 9	8 11/16	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	3 — 3⅛	2⅜— 3¼	3¼	3⅛
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	5¼— 5⅜	5¼— 5⅜	...	...
630,000£	City and South London Railway	Stock	1 1/16 %	1⅞%	2⅛%	67 — 69	67 — 69	68½	68
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £5 pd.	10	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	4 — 4⅛	3½— 4	3 15/16	3⅜
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛%	6 %	...	2 — 2⅛	2 — 2⅛	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛%	6 %	...	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	97 — 99	95 — 97	96½	96
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2¼	2⅛
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3⅛	3 — 3⅛	3¼	3 1/16
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	101 —104 xd	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ⅞	⅝— ⅞	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13 xd	12⅜	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	24½— 25½	24½— 25½	25¼	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	19 — 21	19 — 21	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	...	112 —115	111 —114	111	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21½— 22½	21 — 22 xd	21⅞	21½
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	101 —105	101 —105	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅝%	3½%	3½%	8⅜— 8⅝	8½— 8⅜	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	14 — 14½	14 — 14½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	38 — 42	37 — 41 xd	...	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	104½	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9⅜	9¼— 9⅜	9 11/16	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅜— 6¼	5⅜— 6¼	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	104 —107	104 —107	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

***Birmingham Electric Supply, Ordinary £5 (fully paid) 10½.**
British Aluminium, Ordinary, 10¼—11½; 7 % Pref., 11¼—12½ nom.
House-to-House, 4½% Debentures of £100, 103—107.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7⅞—8¼. Debentures, 103—106. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, ⅜—½.
Smithfield Market Electric, 3—4 nom.
***T. Parker, £10 (fully paid), 19 xd.**

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, July 19th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	22/-	22/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	57/-	57/-	..
a Ammonia, Muriate (crystal) .. per ton	£26	£26	..
a „ „ .. .. per ton	£24	£24	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£26 5	£27	15/- dec.
a Lead, Nitrate .. .. .. per ton	£28 10	£28 10	..
a „ White Sugar .. .. per ton	£31	£31	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	8½d.	8½d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6 5	5/- dec.
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5 0	£5 0	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	2¼d.	2¼d.	..
METALS, &c.			
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£70 to £145	£70 to £145	..
c Brass (rolled metal 9" to 12") basis per lb.	8½d.	8½d.	..
c „ Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c „ Wire, basis .. .. per lb.	8½ d.	8½d.	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d
e

METALS, &c. (*continued*).	This week.	Last week.	Increase or Decrease.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£86	£2 inc.
g „ Wire (basis price) .. per lb.	10½d.	10½d.	..
g „ Sheet .. .. .. per ton	£88	£86	£2 inc.
g „ Rod .. .. .. per ton	£88	£86	£2 inc.
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/0½ to 4/1½	4/0½ to 4/1½	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	72/1½	70/6	1/7½ inc.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£11 5	£10 12 6	12/6 inc.
g Lead, English Ingot .. .. per ton	£14 10	£14 7 6	2/6 inc.
g „ Sheet .. .. per ton	£15 7 6	£15 7 6	..
l Mica (uncut slabs 8" long) .. per lb.	From 8/-	From 3/-	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 6 6	£8 5	1/6 inc.
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd strip & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£135	£126 10	£8 10 inc.
g „ foil .. .. per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/9	1/7	2d. inc.
p White Anti-friction Metals—			
"White Ant" brand .. per ton	£40 to £67	£40 to £67	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	..
j „ Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j „ Hemp, 3 ply 10 lbs. .. per lb.	3½d.	3½d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£12	£12	..
j „ Manila, 24 thread .. per ton	£32 10	£32 10	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£30	£30	..

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
l Messrs. Sanders, Wake & Co.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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ACCUMULATORS FOR AUTOMOBILES.

WRITING on the subject of automobiles in the *Revue de Physique et Chimie*, M. L. Inman premises that the automobile is undoubtedly one of the foremost subjects of the day, and the subject of the accumulators must of necessity be equally of interest. He treats only of accumulators, not of primary batteries, which are out of the question, being too feeble in power, and furnishing energy at too high a rate. Their recharging would also be often impracticable.

So far does the accumulator hold the field, that M. Hospitalier has proposed the term accumobile, and M. Inman adopts it straightway.

The improvements of the past 15 years have rendered the accumobile practicable. Reverting to the year 1881, the best accumulator of that time was the Faure, which had a specific capacity of 39 ampere-hours, and a specific current of ·35 ampere, per kilogramme of total weight. This gives 7·5 watt-hours per kg., and ·65 watt per kg. for the energy and the specific power. In 1883 the Faure-Sellon-Volckmar gave 12 watt-hours per kg. at the rate of ·6 watt per kg., and 8·5 watt-hours per kg. at the rate of 2 watts.

Constantly growing, the figures now obtained are:—

30 watt-hours per kg. of total weight at 1·5 watt per kg.
25 " " " 5·0 "
20 " " " 10·0 "

for the Fulmen accumulator of 1897 type. The specific power, at the same time, is able momentarily to attain 20 to 25 watts per kg.

Theoretically it is known that 1 ampere-hour requires 3·86 grammes of lead and 4·46 of lead oxide, a total weight of 8·32 of active material. In practice a complete utilisation of the active matter is unattained, electrolytic action being incomplete and the active material being of considerable thickness. Further, the sulphate and oxide of lead cause the electromotive force to diminish as the internal resistance increases. Under the very best conditions, a coefficient of utilisation of ·5 or ·6 is obtained, especially when the *régime* is light and the thickness of active material is small. Thus a minimum of 15 grammes of active matter must be counted upon per ampere-hour. In the lightest plates with lead grids it is found that the active matter will hardly exceed 65 per cent. of the total weight of the plates.

The minimum weight of plates per ampere-hour will thus be $\frac{15}{\cdot 65} =$ 23 grammes, of which the specific capacity at a maximum will be $\frac{1000}{23} = 43$ ampere-hours per kg.

Adopting 1·5 as the accessory coefficient, including liquid, cell, and connections, the lightest plates will produce cells having a total weight 23 × 1·5 = 35 grammes per ampere-hour, bringing the specific capacity and energy to 28 ampere-hours per kg., and 54 watt-hours per kg. of total weight. These figures have still to be attained, and it is very difficult to secure them industrially with lead accumulators, because of the economic questions that arise. The duration of plates is a prime factor, and it has not sufficed to augment the specific energy of accumulators in order to render the accumobile a practical success. Diminished cost of maintenance has also been necessary with a view to comparison with other systems—horses, oil motors. Otherwise, the advantages of electricity are incontestable, its safety, absence of noise, vibration, heat, and smell, as well as in simplicity of handling.

Taking actual results furnished by accumulators, it is necessary to assume the battery as 30 to 40 per cent. of total weight of vehicle, say, 350 kg. The specific energy will be at 25 watt-hours per kg., 350 × 25 = 8,750 watt-hours. The recent meeting of the French Automobile Club has shown the results as follows for different vehicles:—Total weight of vehicles, 1,090 to 1,802 kg.; energy consumed at the terminals of the charging generator for a run of 60 km., 8·78 to 13·26 kw.-hours; consumption in watt-hours per ton-km., 134 to 105 at the generator, and about three-fourths to two-thirds this amount on the vehicle itself. Speed from 13·8 to 19·9 km. per hour, the mean consumption on a course in Paris being about 118 watt-hours per ton-km., as shown on a course of 75 km. at a speed of 15 km. per hour. The small length of possible run per charge limits the use of accumobiles to a certain radius from a charging station. Special types of cell constructed for vehicular traffic are reviewed. All the vehicles in the meeting referred to had Fulmen accumulators, distinguished by their great power and specific energy. Their plates are made up of two grids of cellular structure in antimony lead applied one against another, and presenting rectangular cells to receive the active material. These plates measure 18·5 cm. × 9·5 cm. × 0·4 cm. in thickness, and have 24 cells.

A test made by M. Hospitalier has determined their weights as follows:—

Plate	135 grammes	+	135 grammes	−
Active material	340 "	+	255 "	−
Total ...	475 "	positive	390 "	negative

The plates of the size named above are made up in six types of cell measuring 30 cm. × 11 cm. × from 8 to 18 cm., containing from 3·7 kg. to 9 kg. of plates. The total weight of an element is 5·3 to 12·8 kg. The capacity in ampere-hours is 70 to 175 for a discharge in five hours, and the energy in watt-hours 133 to 333, the specific capacity in ampere-hours per kg. being 13·5, the current in amperes 2·7, the energy in watt-hours 25, and the power in watts 5·1

The Society for the Electrical Treatment of Metals has an accumu- once economical and durable. The negatives are of paste by the reduction of lead chloride. The positives are of Planté type made up of little fluted bands of lead specially arranged and united. The active surface is considerable, the electrolyte circulates easily, and deformation from progressive peroxidation is not found to take place. The output is large. The specific energy given by each plate is as follows:—

28 watt-hours per kg. at 2 watts per kg. of electrodes.
26·5 " " 3 " " "
25 " " 4 " " "
22·5 " " 6 " " "
20·5 " " 8 " " "
19 " " 10 " " "

An ordinary cell comprises 13 plates, 6 positive 7 negative. They are 11 cm. by 21 cm. high. Each element measures 17 cm. long, 12·5 wide, and 28 high, and weighs 17 kg., of which 8·4 are positive and 3·6 are negative plates. Special precautions are taken in their mountings. The plates are carried by a bracket of ebonite of suitable form and are separated by perforated corrugated ebonite plates. Plates of the same polarity are soldered to a lead bar carried by two bars resting on the edges of the cell. A 13-plate cell discharged in 3½ hours has the following output, &c.:—

Normal current in amperes	38
Specific " " per kg. of plates ...	3·2
" " " " total	2·2
Capacity in ampere-hours	132
" " per kg. of plates	11
" " " total	7·7
Normal power in watts	70
Specific " " per kg. of plates	5·8
" " " " total	4·1
Energy in watt-hours	250
Specific energy in watt-hours per kg. of plates ...	20·8
" " " total	14·7

For specially high specific energy the Society has established a type, of which the positives are pasted, and exceed by 30 per cent. the previous type for discharge periods of 5 hours and under.

In the Palvis accumulator the active material is lead powder or granules without oxide. This powder is produced by means of a jet of compressed air blown on a fine stream of melted lead, after the manner of slag wool. The resulting powder is mixed with powdered pumice stone of special preparation, mixed with water and compressed into the plates with great pressure.

The cells are of ambroin, and the plates are separated by ebonite sheets, corrugated and perforated. The ordinary type is made up of seven plates, three positive, four negative. They are 19 cm. long and 15 cm. high. Each cell measures 10 cm. by 21 cm. by 25 cm. high, and weighs 16 kg., of which 7·5 are positive and 4·1 kg. negative.

The figures of output are:—

Normal current in amperes	30
Specific " " per kg. of plates ...	2·5
" " " total	1·9
Capacity in ampere-hours	150
" " per kg. of plates	12·8
" " " total	9·3
Normal power in watts	58·5
Specific " " per kg. of plates	5·0
" " " " total	3·6
Energy in watt-hours	292
Specific energy in watt-hours per kg. of plates ...	25
" " " total	18

In the Pisca cell the active matter is embedded in a honeycombed plate. Thin plates are at once less durable, but of greater specific capacity. Pisca plates are 3 to 4 mm. thick, the positives being a trifle thicker. The cells are of semi-hardened India-rubber, with separators in one piece, and have covers which completely prevent the acid from spilling. The cells are made with 9, 11, 13, 15, and 17 plates, an 11-plate cell having plates 20 cm. square. The cell has a length of 22 cm. × 11 cm. × 33·5 cm. high; it weighs 18 kg., the plates weighing 13·7 kg. With different rates of discharge, the capacity of an element is as below:—

Utilisable capacity. Ampere-hours.	Discharge in amperes.	Duration in hours.
107·5	71·6	1·5
116	38·6	3
138	23	6

The constants of each element for a three hours' rate of discharge are:—

Normal current in amperes	38·6
Specific " " per kg. of plates ...	2·8
" " " " total	2·1
Capacity in ampere-hours	116
" " per kg. of plates	8·5
" " " " total	6·5
Normal power in watts	78·3
Specific " per kg. of plates	5·3
" " " total	4·1
Energy in watt-hours	220·0
Specific " per kg. of plates	16·0
" " " total	12·2

The accumulators of Valls et Cie., specially devised for automobilism, are of three types, normal, light, and extra light. The negative plates are of soft lead with very small cells in which the active material is solidly imprisoned, thus providing a large surface of contact between the material and its support. All three types have positive plates of soft lead of a shape to compensate for the loss of capacity due to the fall of the active matter by the gradual formation of the support. For the lighter types the negative plates are the

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same in form. The positives, of the normal type, have a form similar to those with fixed post, with central piece and branching grooves arranged in chequer form and stiffened by horizontal and vertical bands. To prevent the fall of the active matter each plate is covered by a plate of perforated ebonite, and the separators are ebonite, also the cells and covers.

The three types have the following leading characteristics:—

	Normal.	Light.	Very light.
Number of plates	23	19	13
„ positives ...	11	9	6
Length of plates in cm. ...	14 5	14 5	14 5
Height „ „ ...	„	„	„
Length of cell	16	16	16
Breadth „	14·5	10·5	7 5
Height „	22	22	22
Weight of one positive plate	0·650	0·400	0 400
„ „ negative „	0 400	0 400	0 400
„ total of plates ...	11 95	7 6	5·2
„ „ cell ...	15 95	11 4	8 0
Duration of discharge ...	5 hours.	6 hours.	5½ hours.

Normal current in amperes ...	25	20	15·6
Specific current in amperes per kg. of plates	2 1	2 6	3·0
Specific current in amperes per kg. total	1 6	1·75	1 9
Capacity in ampere-hours... ...	125	120	85
Capacity in ampere-hours per kg. of plates	10 4	15·8	16 3
Capacity in ampere-hours per kg. total	8 0	10 5	10·6
Normal power in watts	48	38	29 6
Specific power in watts per kg. of plates	4	5	5 7
Specific power in watts per kg. total	3	3·3	3 6
Energy in watt-hours	240	228	163
Specific energy in watt-hours per kg. of plates	20	30	31 3
Specific energy in watt-hours per kg. total	15	20	20·4

In the Blot accumulator both plates are of the Planté type with large surface of active material and a thickness of a few hundredths of a mm. only. Hence the coefficient of utilisation is large. The plates are of antimony lead. The Blot Company make special types to give a specific capacity of 12 ampere-hours per kg. of plates at a rate of discharge of four hours. The author concludes that makers of accumulators, having regard to the durability of the plates, do not care to exceed a mean of 15 watt-hours per kg. Counting one-third of the total weight of a car to be accumulators, the distance run by one charge will be 40 to 50 kilometres. The Automobile Club has organised for April next another set of trials of international character. The points in view are:—Duration of the elements; industrial output; ratio between energy furnished and delivered; operation; weight and capacity ratio of accumulators. The conditions are those under which automobiles are called upon to work. The trials, which will last six months, will enable the fixing of the limits of the economical performance of accumulators and their practical usage.

THE MUNICIPAL ELECTRICAL ASSOCIATION.

CONDENSERS FOR ELECTRIC LIGHT AND POWER STATIONS.

By J. F. C. Snell, A.M.I.C.E., M.I.E.E., M.I.M.E.
Borough Electrical Engineer, Sunderland.

A good deal of labour is expended in obtaining an extra one per centum of efficiency of electrical plant, and it is anomalous to find so many electrical stations, which are among the most modern in equipment of all generating centres of power, exhausting steam into atmosphere, and thereby reducing the efficiency of the steam plant wholesale. When one considers the fundamental equation $\frac{T-T_1}{T-T_2}$ which gives the increase of efficiency obtained by a condensing engine over and above that of the same engine working with an atmospheric exhaust, it seems that in the most difficult of cases, *i.e.*, where circulating water has to be purchased, and the station site is limited in extent, it is financially unsound, and also unsound engineering to ignore the claims of the condenser. Take a simple example of an engine working with a chest pressure of 135 lbs. absolute, and with 6 lbs. back pressure in the exhaust, and compare the results with those obtained from the same engine having the same initial pressure, but exhausting into a 25-inch or 26-inch vacuum, or against a vapour pressure of 3 lbs. absolute, what increase of efficiency results? The temperature of steam at 135 lbs. absolute = 350° F., and that of 21 lbs. absolute = 231° F., and that of 3 lbs. absolute = 127°.

The theoretical efficiency of the engine working with a condenser would be $\frac{350-127}{350-231} = 1{\cdot}87$ times greater than the same engine working to atmosphere. In the classical papers of the late Mr. Willans, published in the *Proceedings of the Institution of Civil Engineers*, Vol. xiv., 1893, curves and results were shown of trials of throttle-governed engines in which the condensing curve (which is a straight line in this case) is much below that of the non-condensing curve, and the initial quantity of steam to overcome friction being very much less, and the constant increment per H.P. being the same in both cases, the two lines are parallel, showing that the value of condensation of steam increases with a decrease of load, a very valuable fact in view of the variable load of an electric light station and the present tendency towards large units of power. It is a pity that the valuable tables given weekly in *Lightning* do not give a column showing whether a station is condensing its steam or exhausting to atmosphere, for the former must have the advantage in coal consumption. Of course this is not all gain, a certain debit having to be made for the auxiliary machinery required to drive air or circulating pumps, or both, which auxiliary power amounts to some 2 or 3 per cent. of the whole.

There are other considerations which should induce one to adopt condensers, such as the nuisance which is caused sometimes from the exhaust steam blowing about and becoming condensed and falling as a greasy rain; or, again, the atmospheric vibration which is frequently caused by an exhaust pipe. A saving is effected in less cleaning of boilers; the hot well water can be used for feed, and only a small amount of make-up water is required. Other advantages could also be brought forward.

The locality must needs affect the type of condenser adopted. If a natural source of circulating water is not available, can ground space be obtained for artificially cooling the water?

This and other considerations must settle the question.

Condensers may be classed broadly into two kinds:—

1. Those in which the circulating water is always separated from the exhaust steam.
2. Those in which the circulating water is mixed with the exhaust steam.

The first class contains the surface condenser and the evaporative condenser.

The second class contains the old jet condenser and the more modern ejector condenser.

Surface Condensers.

In the author's opinion there can be no inducement to adopt any other class of condenser if plenty of circulating water can be had. If not, artificial cooling arrangements should be adopted. If economy of circulating water is necessary, this system is very good, and though it does not approach the simplicity and excellence of surface condensing plant supplied from liberal and natural sources of cooling water, yet it appears to the author to be the next best system. In the *Railway World*, of February, 1899, a case is cited of the Madrid power house, where, after a 12 hours' full load run, the temperature of the tank from which the circulating water was drawn had not increased. The water, after passing through the condensers, is in that case made to fall over a series of metal sheets contained within a tower through which a circulation of air is forced by fans.

The advantage of surface condensers is, that the condensed steam can be returned to a hot well, and after passing through a carefully arranged oil filter, can be used again as boiler feed. It is true that both air and circulating pumps are required, and in the case of cooling towers, fans as well; also that this type requires a larger percentage of auxiliary power than other types. It is also more costly in outlay, but eventually, and especially in hard water districts, it will probably be found better to instal than a type in which condensed steam and circulating water are mixed together. The principle of using the heat units of the hot well water, instead of wasting them as well as the latent heat units taken away by the circulating water, is one that must be right.

The author has recently been obliged to go into the question of extensions at Sunderland, where every available foot of ground on the existing site will be taken up as soon as the extensions are completed, and the only alternative of exhausting to atmosphere (for which the station was originally designed) is the adoption of artificial means of cooling the circulating water, or the use of condensers of the evaporative type. The author has decided to adopt self-contained surface condensers, one to each pair of 500-H.P. steam dynamos, and a cooling tower with fan draught for top loads or special climatic conditions. Sunderland water is very hard indeed (about 25° Clark's scale), and, as considerations of space have made it imperative to adopt marine boilers, it is more necessary to use the condensed steam again as feed. The price of the condensing plant, steam driven, including cooling towers and all pipe work, will be about £2 5s. per E.H.P. installed.

In large stations it will certainly be best to have each engine completely equipped with surface condenser, air and circulating pump, even if the pumps be separately driven. Simplicity of design is most essential, and any system allowing for changing over from one condenser to another, or many, will in the end introduce unnecessary complexity of design. Each engine, condenser and pumps and atmospheric by-pass uptake should be separate. By having the condenser close to the L.P. cylinder, a gain in vacuum in the cylinder results. There is less work for the air pump, and there are less joints on the exhaust to be maintained.

Should the condenser be a portion of the engine and the pumps

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driven from it, or should they be independent of it? The author understands that even in some modern marine practice, the condenser is being made independent of the main engine, and the pumps are separately driven. The present tendency of electrical men—writing from a station engineer's standpoint only—is towards high speed, This in itself practically disallows the pumps being driven from the main engine; again, it is convenient and economical to have the condenser below the engine room floor instead of taking up unnecessary space. A good drainage is thus given to the low pressure cylinder, and though not all-important, a gain in the appearance of the station. The engines can also be worked to atmosphere more readily.

In stations of small dimensions where the price of a separate condenser for each small unit would be prohibitive, it becomes necessary to have a common exhaust pipe, and perhaps several condensers connected thereto. This is not to be desired, as the more valves and complications, the more chances of losing the vacuum, and that perhaps at a critical moment, when a drop in pressure over the whole system might result.

The question whether the condensers are to be separate, or built up with the engines, therefore depends much on the type of engine itself. To sum up, the author is of opinion that high speed or moderately high speed engines, with separate condensers to each, driven by a motor or auxiliary engine, and with the condensing plant below ground, and a separate atmospheric by-pass, commends itself as the most reasonable and simplest design.

The systems of cooling circulating water will be dealt with later in the paper.

Surface condensers, including air and circulating pumps, cost approximately £1·6 per E.H.P. if steam driven, or £3·75 per E.H.P. if motor driven. They take up approximately 0·03 square feet per horse-power. The cooling surface in the best practice is 2 square feet per horse-power, and the weight of circulating water should not be less than 25 times the weight of steam condensed, and more if the surrounding temperature and temperature of circulating water be high.

The importance of having brass tube plates, with the tubes ferruled into the plate, plenty of air pump volume (usually taken at $\frac{1}{7}$th the L.P. volume), brass liners, brass buckets, and phosphor bronze air pump rods, scarcely needs pointing out. A type of air pump now much in favour is that known as Edwards's, which does away with foot and bucket valves, and therefore reduces to a minimum a chief source of trouble in air pumps. The head or delivery valves of course remain, but another advantage is that these can be renewed from a side door without stopping the pump. India-rubber valves are of no use with oily water, as they waste and rot so quickly. Munts metal sheets, or vulcanised fibre valves are found best in practice. It is best to let the air pump have an easy discharge to the hot well, as if much head of water be allowed on the delivery side, trouble results in getting rid of the air and the vacuum is consequently impaired.

The barrels, buckets, and valves of the feed pump should also be of brass, as the hot well temperature will be some 130° or 140° F.

In a recent description of a surface condenser with motor driven air and circulating pumps for Glasgow, the curves show a modulus of 66 per cent., that is, $\frac{\text{Pump H.P.}}{\text{Elec. H.P.}}$. These sets are each to care for 15,000 lbs. of steam, or at 22 lbs. per E.H.P., say, about 700 E.H.P., and have each a surface of 1,250 square feet, that is, 1·78 square feet per E.H.P. The air pump took 13 H.P. at full load, and I have calculated out the circulating pump at 7, or a total of 20 H.P. of auxiliary plant for a 700 H.P. engine, *i.e.*, slightly under 3 per cent., a usual figure. The air-pump motor runs at 800 revolutions per minute, and the pump at 150 revolutions, a rather high rate for an air pump; the 7-inch centrifugal pumps deal with 1,000 gallons per minute against a 10-foot head, and run at 530 revolutions per minute.

Evaporative Condensers.

The next type of condenser which keeps condensed steam separate from the circulating water is one which has sprung up only recently, and is still in rather an experimental stage. At least little has been written on the matter excepting, as far as I know, a paper before the Institution of Civil Engineers, by Mr. Henry Davey, in 1896, one before the Institution of Junior Engineers by Mr. Fraser, and an admirable paper recently read before the Institution of Mechanical Engineers by Mr. Oldham. The author has had experience with three types of evaporative condensers. The principle is, of course, the passage of a film of water over tubes arranged either horizontally or vertically, which by evaporation carries off the latent heat of the steam contained within the pipes. In some cases the pipes are enclosed within a casing and the cooling is aided by forced draught obtained by means of a separately driven fan. It is claimed that the amount of circulating water evaporated is less than the amount of feed water, but of course this is obtained only by means of a considerable amount of air cooling. The condensers can be, and usually are, fixed on the roof of the engine house. The average vacuum obtained is from 18" to 22", and air pump and circulating pump are both required, but the work done by the circulating pump is small, being that due to the height of the condenser itself. The objection to this type, in the author's opinion, is the fact that the condenser is some distance from the engine, and on account of the benefit of wind draught and ground space occupied, it is placed on the roof, and natural drainage of the exhaust is impossible, and the vaccum in those with which the author had to deal, at any rate, has not been nearly so good as that obtained with a surface condenser. So far as his experience with this class of condenser goes, the vertical arrangement of tubes is better than a horizontal construction. Various means have been devised to keep the water spread over the tubes, so as to use every inch of cooling surface:—tape, spiral guides, troughs at intervals, and other devices. The amount of cooling surface per E.H.P. is found to be about 2·75 square feet, as against 1·75 to 2 square feet for a surface condenser. The air pump should be larger, on account of the large amount of exhaust pipe usual in such cases, and so arranged as to drain the exhaust pipe at its lowest level. The circulating pump is very much smaller than in the case of a surface condenser, being only required to circulate something like one-twelfth of the amount of water.

There is a well-known type of evaporative condenser at Kensington Court, which is frequently used as an air condenser only, being in its present situation impossible to circulate water, owing to the proximity of important residential buildings, and the fear of creating a nuisance. This type of condenser for congested districts must of necessity be a valuable one, and next to surface condensers, in the author's opinion, will prove to be the best when more developed.

A case is cited in Mr. Oldham's recent paper read before the Institution of Mechanical Engineers, of an evaporative condenser connected to two Willans engines of 350 H.P. This condenser was 140 feet away from the engines, and the distance from the engines to the condenser and thence to the air pumps was 350 feet. These engines could run at 100 H.P. without any cooling water, the condenser simply acting as an air condenser. It, therefore, seems that only sufficient tube area is necessary to enable this type of condenser to be used without employing any circulating water at all.

The auxiliary H.P. required for driving the pumps is about 2 per cent., and the circulating water necessary may be taken at 1½ times the steam condensed.

Another case is cited of a Theisen plant dealing with 3,000 H.P. These condensers are supplied with a 12-inch fan, and the auxiliary plant requires only 16 H.P. for the centrifugal pump and fans, and 15 H.P. for the air pump, or 1·03 per cent. only of the total power. The cost of an average evaporative condenser may be taken at £1·8, with motor-driven auxiliaries, including air pump, circulating pump, and fans, and the area taken up about 0·15 square foot per E.H.P.

The make-up water of either of the above-mentioned types of condenser can be, if necessary, in hard water districts, treated by a softener or by an evaporator, since so small a quantity is required.

Ejector Condensers.

The next type to consider is the ejector, which the author thinks ranks third on the list. He does not, however, like it so much as the other types because of the intermixture of circulating water and steam and consequent loss of a hot feed. Thus one of the two great advantages of condensation is lost. This is, however, a very neat and a very cheap condenser, occupying very little room. The principle, of course, is the supplying to a specially-shaped vessel a stream of water under good head or pressure passing through the inner sides of a series of cones around the outside of which the exhaust steam circulates. The *vis viva* of the falling water, with the added energy due to the differences between atmospheric pressure and vacuum in condenser, carries away the combined steam, air and water. No air pump is therefore necessary, but a circulating pump similar in size to that used with a surface condenser is required, *i.e.*, circulating water about 25 times the weight of steam condensed. At two stations with which the author was connected the engines exhausted into a common pipe to which several ejectors were fixed, varying in size. The author does not like this, but considers that a separate ejector to each engine, as arranged by Mr. Wordingham, at Manchester, is by far the best. There is one important point in connection with this type; it is necessary to seal the delivery from the condensers with water. In cases of failure of the head of circulating water, the vacuum might cause the water seal to rise in the pipes and so to the engine, causing some little trouble (if a new cylinder or a blown off low pressure cover may be classed as such!) To prevent this, non return valves or syphon bends are always fitted. An automatic atmospheric exhaust valve is also, of course, always added. For neatness and cheapness this type is to be strongly recommended. Unfortunately it has that, to him, great objection: the inability to return the condensed steam as feed water to the boilers. The cost of this condenser is as low as £0·9 per E.H.P., including the circulating pumps to raise the water to sufficient head, usually not less than 25 feet, for the purpose of supplying the condensers. The author suggests an interlocking arrangement, so that the water may not be shut off before the engine has been shut down, as non-return valves do not always act.

Jet Condensers.

The last type here mentioned was the first to be adopted, viz., the old jet condenser. In this case the air pump has to be large enough not only to clear away the condensed steam and air, but also the whole of the injection water, no circulating pump being necessary except it be for re-cooling. The amount of power required to drive the air pump is 2 per cent. of the total engine output, and the cost is £0·88 per E.H.P. This may be dismissed at once by saying that this type is effete so far as electric power stations are concerned.

Circulating Water.

As to those cases in which no natural source, such as river, sea or canal, is at hand from which water for circulation is obtainable, there are many ways for dealing with the cooling of water; amongst them being the cooling ponds, cooling sheets as at St. Pancras, and by spraying over a pond such as is extant at Croydon and Newcastle, and is being adopted at Cheltenham and elsewhere; also towers as at Brighton, the Central London, and as the author intends adopting at Sunderland.

There is usually no warrant for adopting cooling ponds, the cooling area required to equate the increase from the steam being so great, and ground being, as a rule, far too valuable.

A simple method was adopted at St. Pancras, consisting of a series of corrugated iron sheets over which the water was allowed to trickle. This system, however, requires such a very large cooling area, and the wind pressure on the exposed area is sometimes so great as to

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make an adequate system too bulky to be practicable. Of course, a large reservoir was in connection with this, the cooling going on throughout the 24 hours, and the temperature of the water rising considerably at times of full load, which was reduced to normal temperature during the hours of light load.

The system of spraying through specially constructed hydraulic nozzles over a large reservoir is very successful, but unfortunately this, too, requires a large ground space, though in inland provincial stations it would be a most excellent method. The ground space is about 24 square feet, and the price about £0·9 per H.P.

The author's opinion is that towers, with an artificial air draught, offer the most ready method of dealing with this important matter. Towers do not take up much room, the ground space per 1,000 H P. being only 100 square feet, the vapour is taken away from a good height, and the amount of auxiliary power required for driving the fan is only 0·8 per cent. The ground space is about 0·15 square feet, and the cost £1·05 per H.P.

Allusion has been made to the necessity of brass-ended pumps for condensing plant. There is one other point, viz. the elimination of oil from the hot well water, which must be effected before the water is fed into the boilers. In most engines nowadays, such as Belliss, Allen, or other high speed marine types, very little oil need be used; in fact, the engines at Sunderland of the former type are run almost without any oil in the cylinders, and at the last inspection the cylinders were in splendid condition, and showed no signs of wear. Almost all enclosed engines are now constructed with outside glands on the cylinders, and with lantern glands with drains returning to the crank chamber.

By this means oil is not now sucked up from the crank chamber into the low pressure cylinder, and the amount of oil present is therefore very small. There are several filters on the market now which profess to deal with the oil in water, and no doubt do so to a great degree, but it is a different matter to eliminate oil which becomes saponified and so intimately mixed with the water. A careful selection of the oil, or the replacement of cylinder oil by graphite, for example, will minimise this trouble.

The author disclaims any novelty in this paper, and has merely laid the same before the Association as a nucleus for discussion, which, it is hoped, will be beneficial to us all.

The weight of steam per E.H.P. is taken at 20 lbs. throughout.

ELECTRICAL MOTOR CARRIAGES.

A few days ago we paid a visit to the exhibition of motor cars and motor cycles at the Agricultural Hall, Islington. There was an abundance of steam, gas, and oil vehicles, and also a very fair collection of electrical carriages, or "electromobiles" as our American namesake has ruled that they shall henceforth be called. Let it not be thought that we propose to abide by the ruling of our contemporary in the matter. We are inclined to think that far too much space has been devoted by our contemporaries, particularly in America, to a consideration of the question of whether a motor car shall be called a motor car or something else. "Electromobile" may be all right for some vehicles, but "immobile" would be a more accurate definition for others, and when a motor car has come to a sudden standstill, we have heard an even shorter word used. There is greater need for serious discussion as to improvements in the method of pro-

Fig. 1.

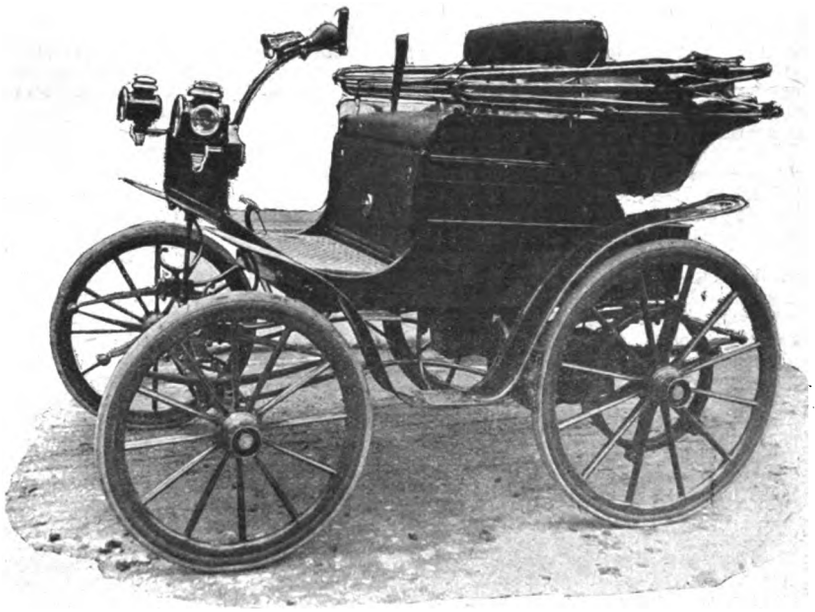

Fig. 2.

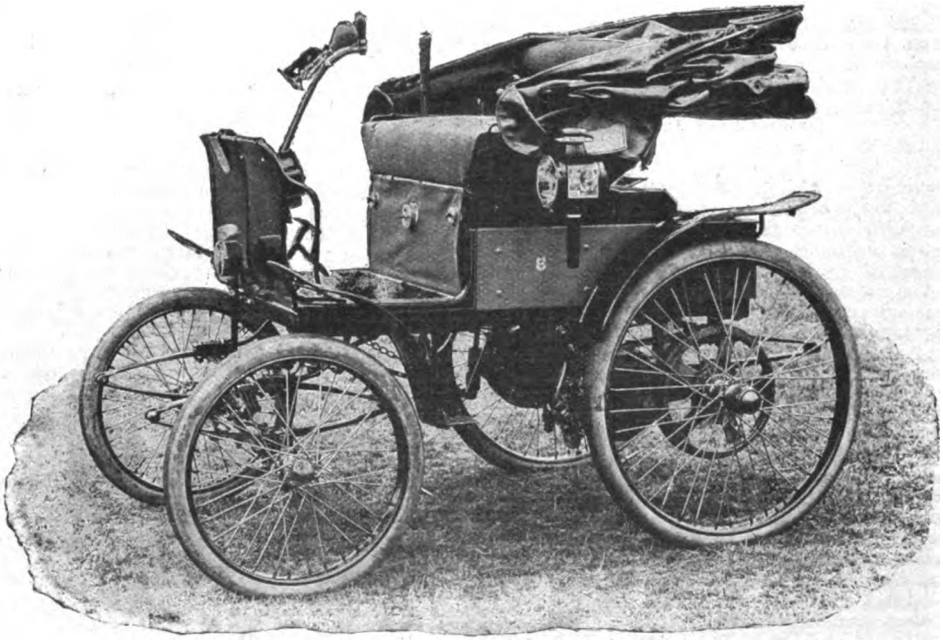

Fig. 3.

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pulsion, the design of the carriage, and so on, than for squabbling as to whether "John" having been duly christened shall be known as "Jack," or "Richard" as "Dick." So far as the Agricultural Hall show is concerned, we were certainly struck with the improvement which is being made in the design of horseless carriages, particularly in those propelled electrically. Some of them are now quite passable without the noble steeds which were essential to give the earlier designs a decent finish.

An arena was specially arranged for conducting trials, and some runs in progress during our visit demonstrated how easily and excellently the motor car may be controlled, how noiselessly and smoothly the electrical vehicle can glide along as compared with the continuous thumping, &c., &c., of the other classes of cars. We regret we are not in a position to pass an opinion upon the performances of the artistes who contributed to the musical part of the arrangements, for the management had wisely or unwisely erected the concert stand in the centre of the arena. Motor cars dodged to and fro around the stand seeing how near they could go to it without touching it, and one may well imagine that music either vocal or instrumental accompanied with the musical humming and bussing and growling of the motor cars, as they described their respective circles around it; the blowing of shrill whistles and the hideous warning notes given out by the respective drivers, was somewhat weird, to say the least of it. It was a mixture of good things which did not altogether suit our ultra-refined taste.

But to turn to exhibits more within our province, the Crowdus Accumulator Company, also Messrs. Le Carbone, had exhibits of their sundry specialities. Messrs. Shippey Bros. showed models of the Riker carriage motor, the Paragon motor and various accessories for electrical motor cars.

Mr. Carl Oppermann, of Clerkenwell, exhibited a patent electric Victoria car of very neat design, and which was conspicuous for its smooth and noiseless running. The accumulators are carried in a strong case which is readily detachable, underneath the body, and being suspended on steel springs they are not detrimentally affected by vibrations caused by unevenness of the roads. These accumulators when fully charged will furnish sufficient energy or current to propel the carriage about 40 miles at about 8 miles an hour. The electric motor (made specially by Mr. Oppermann) is claimed to be light and efficient. This is carried in a suitable steel frame suspended under the seat, and drives, by means of a special silent gear, an intermediate shaft furnished with a differential gear enabling the carriage to turn corners with the utmost facility; at the ends of this shaft are two specially designed silent working chain pinions, which transmit the power by means of chains to a suitable chain wheel bolted on to the inner side of the hind road wheels. The actual weight of the complete Victoria is 28 cwt., of which the accumulators weigh 12 cwt. We understand that this system is protected under home and foreign patents.

The Joel Electric Carriage Motor and Battery Syndicate, Limited, had on view a specimen of Joel's new patent underframe fitted with electric motor cars, all ready for the carriage maker to fix to the body of the motor car. Messrs. Joel make the underframe and motor part according to the requirements of the motor car which is being built at the carriage works.

Undoubtedly the most striking electrical exhibit was that of the Electrical Undertakings, Limited, of Camden Town, N.W. This Company had on exhibition some specimens of the cars made by them under the Leitner patents, including the four-wheeled electric buggy, which acquitted itself so excellently in a recent contest, both in hill climbing and in long distance trials. The vehicle has this year made a record run to Brighton and back, and a note on this subject recently appeared in our "Traction Notes."

The weight of this buggy (which we illustrate) is about 15 cwt., the batteries being about 400 lbs. weight, and the capacity about 10,000 watt-hours at 15 amperes rate, corresponding to 8 to 10 miles an hour. Distances of from 50 to 70 miles have been run on average roads on a single charge at about 10 miles an hour; six speeds forward, two speeds back. Zero or stop puts on brakes. Its minimum speed is about two miles an hour; the maximum speed being 30 miles an hour. The speeds are not materially increased going down hill, as the carriage checks itself automatically and charges back. There are two 2-H.P. motors, working up to 4 H.P. each, making a total of 8 H.P. Two varieties of the above carriage are built, one (smaller) running about 30 miles and built on cycle principles with motor working up to 4 H.P., the other (larger, ampler, and more comfortable) going up to 80 miles at great speeds and of still greater hill-climbing powers, and motors working up to 10 H.P. Fig. 1 shows this buggy without hood and fig. 2 with hood. Another very similar car is shown in fig. 3.

THE VOLTA CENTENARY.

Congress of Telegraphists at Como.

[FROM OUR SPECIAL COMMISSIONER.]

(*Continued from page* 6.)

The International Congress of Telegraphists which took place at Como was conceived and carried out in the most sumptuous style. The objects of the Congress, as set forth in the convening circulars, were as follows:—"To discuss, from an international point of view, questions relating to the professional interests of telegraphists, and the practical service of telegraphy." The Congress was to be a part of a series of celebrations in Italy in honour of the centenary of the discovery of the voltaic pile. An international subscription was made for the purpose of laying at the foot of the statue of Volta in his birthplace, Como, a bronze crown as a tribute from telegraphists of all nations. The "Committee of Honour" was presided over by the Italian Minister of Posts and Telegraphs, and was under the direct sanction of the Government. The municipalities of Milan, Como, Bologna, Florence, Rome, and Bellagio also took part in the organisation, and extended invitations to the Congressists to visit their various towns. Success was thus assured.

England was represented by one delegate and five Congressists. The delegate was Mr. C. H. Garland, of the Central Telegraph Office, who was also President of the English Volta Sub-committee, and the five Congressists were as follows:—Mr. G. S. Lacey, Assistant Superintendent Foreign Branch C.T.O.; Mr. Bazeley, Superintendent Telegraphs, Cardiff; Mr. Smith, Telegraphist, Edinburgh; Mr. J. Cameron, jun., Telegraphist, Glasgow, and Mr. J. Gennings, who attended as Editor of the *Telegraph Chronicle*. The Postmaster-General kindly granted special leave to the representatives for a fortnight, and subsequently, at the request of the President of the Congress, extended this leave for a further five days, to permit the representatives to follow the programme to the end.

The proceedings commenced on Tuesday, May 30th, at Milan, where a reception was held at 9.30 p.m. in the *foyer* of La Scala Theatre. The mayor and municipal officers of Milan were present and received the visitors, who numbered over 200. They included representatives from practically the whole civilised world. Japan, South America (Argentina), and North America (U.S.) each sent representatives, whilst France and Germany sent over 30 each.

On Wednesday, May 31st, the representatives proceeded to Como, where they were received by the municipality, the whole town being decorated and the inhabitants *en fête*. The Congress was formally opened at 3 p.m. by the Minister of Posts and Telegraphs, the Marquis of San Giuliano. We live, he said, in an epoch in which sentiments still have a country, but ideas have no country. We are all patriots in heart, and cosmopolitan in spirit. A century had passed since Volta had, for the first time, produced a constant current of electricity, and he claimed that all the developments of that century had sprung directly from the discovery. The constant peaceful intercourse thus made possible between nations tended to dissipate national prejudices, to soften national antipathies, and to set up friendly relations between all the nations of the earth. The speaking was continued by the Mayor of Como, Signor Cadenazzi, Signor Colombi, of the Organising Committee, and the following chiefs of delegations: Mr. C. H. Garland (England), M. Amiot (France), Sig. Alimenti (Rome), Sig. Pieri (Milan), Mighetta (Naples), and König (Austria).

The Congress having been thus inaugurated, the delegates dispersed, to meet again at 6.30 at the Grand Hotel Plinius, where a banquet was given in their honour, at which the Minister presided. Some 300 guests were present. In the evening the whole town was brilliantly illuminated in honour of the Congress.

On Thursday, June 1st, the international tribute to Volta was unveiled. It consisted of a heavy bronze tablet, fixed to the base of the statue in the Piazza Volta. To the lower portion of the tablet was attached a large bronze wreath. On the tablet were inscribed the following words:—

OMAGGIO
DEI TELEGRAFISTI D'OGNI NAZIONE
NEL PRIMO CENTENARIO
DELL' INVENZIONE DELLA PILA
MDCCCXCIX.

The oration was delivered by M. Baudot, honorary president of the French delegation, who is the inventor of the multiplex type printing telegraph, which bears his name. Speeches were also made by chiefs of the foreign delegations and the Mayor of Como. A sonnet, composed by M. Leonce Depont, Professor of Poetry at the French Academy, was recited by M. Rozet, and the delegates then marched bare-

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headed past the statue. Large crowds witnessed the ceremony.

At half-past 1 o'clock the Congress opened under the presidency of M. Amiot, of the French delegation. Signor Colombi, of the Organising Committee (Milan), and M. Foret, of the French delegation (Paris), read papers on the International Exchange of Staff. The papers dealt with the advantages which would be derived from some system of exchange of staff which would familiarise the telegraphists of one country with the language and methods of the other countries, and facilitate international working. The Congress expressed its sense of the importance and utility of such a system by registering its unanimous opinion in its favour. An interesting paper on the importance of a knowledge of foreign languages by telegraphists was read by M. Stricker (Schaffhouse). Signor Brambilla, of the Organising Committee, read a *résumé* of a lengthy paper submitted by Mr. J. Nicolson, of Buenos Ayres, on "Telegraphic Signs in Combination with the Vocabulary of an Agreed Language." The author set forth a system of signs which, in many respects, resembled the Morse signs, and were based upon the same principles. He claimed, however, to have introduced some improvements upon the older alphabet. The system has already been noticed in many quarters. The Congress thanked Signor Brambilla for the trouble he had taken in the preparation of the *résumé*. Congress then adjourned until the following day.

In the evening the La Scala (Milan) Company and orchestra gave a special performance of "Verdi's *Otello* in the Theatre Social," at Como. The whole of the delegates and Congressists were present.

On Friday, June 2nd, an excursion was made to the tomb of Volta at Camnago, and the representatives were received afterwards at lunch by the Abbe Guanella at "La Binda."

The Congress re-assembled at 2 o'clock under the presidency of Senor Olmi, of the Argentine Republic. M. Longuet, of the French delegation (Paris), and Signor Spagnolo, of the Roman delegation, read lengthy papers on the question of Sunday rest. The Congress agreed that so far as was consistent with public convenience, Sunday labour should be restricted, and that the rights of the staff to Sunday rest should be recognised by an allowance in time or money for all Sunday work performed. Signor Colombi, of the Committee of Organisation (Milan), and M. Prevot, of the French delegation (Paris), read papers dealing with the necessity of offering some recompense for exceptional professional ability in order to encourage a healthy emulation among operators, which would improve the efficiency of international telegraph service. The papers were well received, and Congress registered its opinion in favour of such an encouragement being offered, the form to depend on national exigencies. Mr. C. H. Garland, of the English delegation (C.T.O., London), read a paper on "Pension Systems." He set forth the conditions under which pensions were granted in England and in Holland, France, Germany, &c., and made a comparison of the underlying principles. At his request, Congress expressed its opinion that the State should accept some responsibility for the widows and children of officers dying in active service, and that pension systems should contain some provision for this end. Mr. Garland moved an instruction to the Permanent Commission charged to carry out the wishes of the Congress to collect and publish in the international organ the details of the pension systems in every State for the purpose of setting up comparisons, and to form the basis of work in the directions previously indicated. Congress unanimously adopted the English delegate's proposition.

Signor Colombi, of the Organising Committee (Milan), read a paper on the "Facilitation of Travelling for Telegraphists who profit by their Annual Leave to Travel in Foreign Countries for Purposes of Study." It was suggested that efforts should be made, with the aid of the various administrations, to obtain for travelling telegraphists reduced fares and assistance of companionship in the countries they visited. Congress expressed itself strongly in favour of such work, which was left in the hands of the Permanent Commission. Congress then adjourned for the day.

In the evening the Società Générale Impregati Civili (General Association of Civil Employés) gave a reception at their headquarters, Via Unione, 10. The Congressists attended in good numbers, and a very pleasant evening was spent.

On Saturday, June 3rd, Congress re-assembled at 8 a.m., under the presidency of Cavalier G. Angelini, of Rome, Mr. C. H. Garland, London, being elected vice-president. Signor Brambilla, of the Committee of Organisation (Milan), and Signor Perisi, of the Neapolitan delegation, read papers on the question of the institution of an international journal for telegraphists. M. Amiot, of the French delegation, suggested that the further question of the election of the Permanent Commission should be taken with this question. Congress agreed, and M. Amiot then proposed that the Roman sub-committee should form the Permanent Commission, and that the journal *Pro Congresso* should be altered and continued as an international organ. Congress agreed. M. Amiot then invited the Congress to sit in Paris next year on the occasion of the Great Exhibition. The invitation was accepted with acclamation.

M. Amiot, chief of the French delegation, read a lengthy "*exposè* on the State of Professional Associations in France." Cavaliere Angelini, on behalf of the Roman Committee, thanked the Congress for appointing them as the Permanent Commission, and declared the first International Congress to be closed. Votes of thanks to the Minister, presidents and other officers, and Organising Committee concluded the business. The proceedings throughout were conducted in French.

The delegates were taken by special boat to Bellagio, where they were entertained at lunch by the municipalities of Como and Bellagio. Some 400 guests sat down, and speeches were made by the Mayors of Como and Bellagio, and the chiefs of the foreign delegations. Returning to Como, a presentation was made to the mayor in the Town Hall. The presentation took the form of a gold medal commemorative of the visit of the Congress to Como, and each chief of foreign delegations presented a copy of the National *Cocarde*, which had been worn during the Congress. The delegates then proceeded to Milan, where a fresh series of functions commenced.

(To be continued.)

THE INSTALLATION OF STEAM BOILERS.

IV.

No part of a flat-ended cylindrical boiler is so important as the end plates. Strictly speaking, the ends of a cylindrical boiler should be hemispherical and of less thickness than the shell, but practical considerations demand flat ends, the chief argument in favour of these being, perhaps, the difficulty of attaching the furnace tubes to ends other than flat. The end plates must therefore be considered as flat stayed surfaces. The stress upon the end of a boiler is obviously found by multiplying the area of the circle of the shell by the pressure per unit of area, less the product of the pressure by the circular areas occupied by the furnace tubes. Thus in a boiler of 8 feet diameter at 150 lbs. pressure the furnace tubes have an outer diameter of about 40 inches, and the load is about 317 tons. This is carried on the three circumferential seams of rivets. At the front end these have diameters at the rivet-holes of about 101 inches and 42 inches, or a total of 580 inches. The tension is thus nearly 1 ton per 2 inches of circumference. As the shell angle iron ring will have two rows of rivets there is a riveted circumference of about 900 inches, or 1 ton to each 3 inches. This is equal to about 1,500 lbs. on each rivet. But gusset stays are added to take up part of this stress. These stays require very careful design, and have only attained to their present state by a process of evolution and survival. Originally the rivets of the angle irons that attached the gusset stays to the end plates were brought very close to the ring of rivets that attached the furnace tubes. Observation showed that severe corrosion very usually developed round the furnace angle irons, and in the root of the angle iron, and also in the end plate, at the lower ends of the gusset angle irons. Such corrosion was worst at the points opposite the gussets. When this cause was recognised it became usual to cut out one or two of the

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lower rivets of the gusset angle irons. Then it became usual to leave this space when constructing. A distance of 6 inches was fixed upon; this became 7 inches, then 9 inches, and now it is 10 inches. The reason for this "breathing space," as it is termed, is that when at work the furnace tubes arch up and press outwards against the end plates. This produces a bending that is most severe at points where thicknesses stop, as at the edge of an angle iron.

The Manchester Steam Users' Association adopt the system of design as shown in fig. 5. A 10-inch circle is drawn

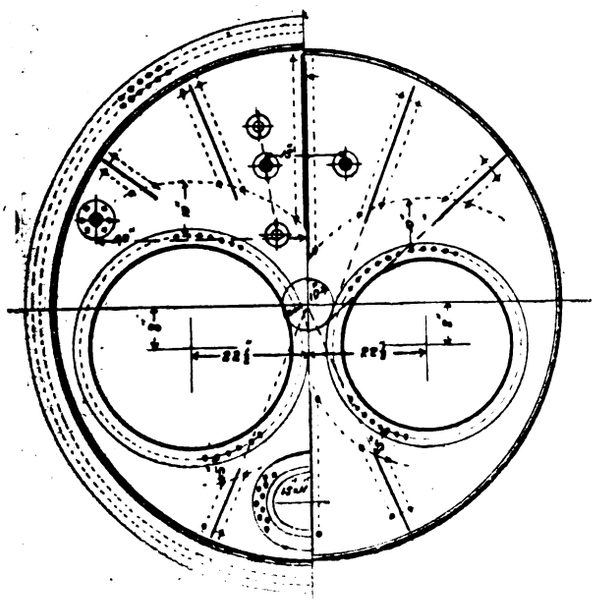
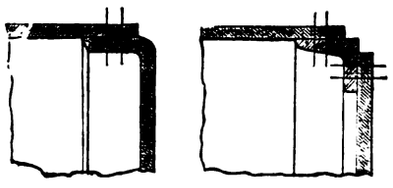


FIG. 5

about the centre of the boiler. The central and outer gussets at the front end are drawn radially, and the intermediate gussets tangentially to this circle. At the back end the middle gusset alone is central, the remainder being all tangential. About the centre of the furnace tubes at a radius of 10 inches more than the radius of the ring of rivets of the furnace angle irons, circles are struck on which are placed the lowest rivets of the gusset stays. Partly for giving access to the bottom of the shell, but also partly for giving elasticity to the end plate, the furnace tubes at the back end are about 6 inches smaller in diameter than the furnaces, and the back end plate is either flanged inside the shell as in fig 6, or attached by an inside angle iron as in fig. 7.

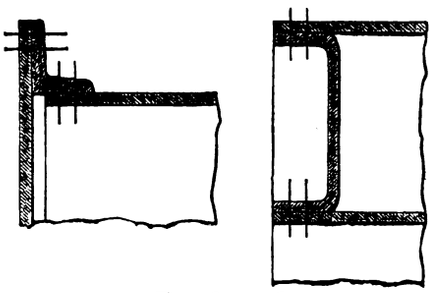


FIGS. 6 AND 7.

The front end plate, however, must be attached by an external angle iron as in fig. 8, otherwise there would not be room for the furnace angle irons inside the boiler. The rivets are double, and the front end plate of a boiler is, therefore, very much larger than the inside or nominal diameter of the shell. The end plate may, however, be flanged outwards and inserted within the shell as in fig. 9, the holes for the furnace tubes being also outwardly flanged This dispenses with the rings of angle iron, and saves the space they require, and possibly it may help to prevent grooving. This construction may be seen in a boiler at the electric station at Coventry. Obviously such a construction is favourable to the machine riveting of these important ring seams.

All gussets are held both to the shell, and to the end plates by, and between, two angles, and are tightly nipped by properly-formed rivets, not by bits of bent bar iron. No work of this type should be permitted, as the gussets are exposed to the most severe stress towards their inclined or inner edges, they should be so cut that these edges nowhere fall within a distance of, say, 2 inches of the straight line joining the outer rivets of the angle irons on the other edges, as in fig. 10. This prevents undue tearing stress on the edge of the gusset.

The modern tendency is to dispense with longitudinal bolt stays in Lancashire boilers. When applied they should be at most 15 inches apart. They will then come between



FIGS 8 AND 9.

the central and outer gussets. They require to hang slack and their effect in restraining movement of the end plates ought not to be externally visible. They should be slung by hooks from small brackets riveted to the crown of the boiler. They are, however, very little employed, as stress cannot well be apportioned to them, and the furnace tubes are supposed to be amply sufficient to take care of the two halves of the boiler should a failure occur in the ring seams. The disastrous explosions of plain cylindrical boilers that arise from tearing of the ring seams do not occur with Lancashire boilers. In these boilers seam rips

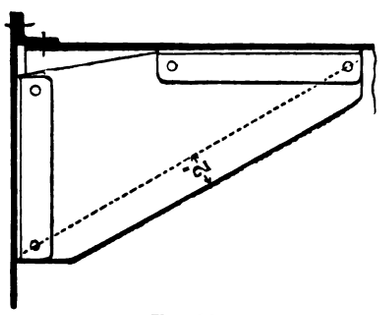


FIG. 10.

occur usually on the shell bottom where the longitudinal bolt stays do not help, and these rips are harmless and merely let out the boiler contents, the furnace tubes meanwhile holding the boiler ends together. Mention has been made of the suspension of any bolt stays from small brackets. Various small brackets are employed inside a boiler for suspending scum troughs, feed pipes, or anti-priming pipes. All such brackets require to be strongly riveted to the shell. No studs are permissible.

The duty of the gusset stays is thus to hold the end plates reasonably flat and yet not unduly rigid. As we have already pointed out, the space of 10 inches is left to give elasticity, and this wide unstayed surface seems to offer an example of a flat unstayed area, capable of standing a pressure in excess of anticipations. Yet even with the 10-inch breathing space there is quite enough rigidity. No extension is allowed by flat gussets. Hence our suggestion that possibly an advantage might be found from the employment of more or less corrugated gussets that would yield slightly and permit of some movement of the plate above the lowest rivets of the gusset angle irons. We believe some such practice could be experimentally determined, and that it would prove beneficial and conduce to longevity. With regard to the system of construction shown in fig. 9, it may be remarked that the large diameter of modern boilers renders it somewhat difficult to fire such high furnaces. In a 7-foot boiler the front end plate is only about 8 feet diameter.

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The furnace centre is about 3 feet 4½ inches above the floor plate. In an 8-foot boiler the furnace centre will be fully 3 feet 10 inches above the floor plate. The construction shown in fig. 9 reduces this height by nearly 6 inches, and may prove very convenient at times. While on the subject of end plates, it may be named that the glass water gauges are usually fixed as shown on the left side of fig 5, slightly inclined from each other, the lower fittings being placed 12 inches apart and about 13½ inches above the boiler centre line. This brings them about level with the ring of rivets of the furnace attachment. An ordinary length apart is 21 inches vertically. Both the bolt stays and the glass gauge fittings are indicated in fig. 5, as also is the feed inlet block which is riveted to the front end plate and studded to receive the feed valve. In an 8-foot boiler the feed inlet is about 16½ or 17 inches above the centre line of the boiler, and as near to the side of the shell as will permit the internal flange pipe to lie comfortably, this internal pipe being slung from brackets as above described. If a scum trough is supplied, and this is a useful adjunct, its place is on the opposite side of the front end plate from the feed inlet in identically the same position. The longitudinal bolt stays, if applied, are to be held to the end plates by a deep nut and washer inside and out, the diameter of the bolt thread being about 2 inches and the washers being very little larger than the nuts, or, say, 5 inches. Large washers are a mistake, causing much rigidity. The spacing of gusset stays is such that their centre lines come 22½ inches apart at a distance of 48 inches from the boiler centre. It would, perhaps, be better to state the angle in degrees, and to place the stays to the nearest half-inch. Thus an angle of 13½° worked to the nearest half-inch gives a spacing of 19½, 21, and 22½ inches in boilers of 7 feet, 7½ feet, and 8 feet respectively, and similarly for the gussets below the tubes an angle of 15° will give spacings of about 17½ inches, 19 inches, and 20½ inches in the three sizes named. If front end plates be designed upon the foregoing lines it will be found that they represent a system of compromise between more or less antagonistic forces, and that the general proportions cannot be far departed from with advantage. They are no one man's ideas, but the composite experience of 40 years of many observers. Upon the front end plate there is also fixed a double ended water level pointer extending close up to each water gauge glass. It is placed 10 inches above the furnace crown to mark the approved working level of the water.

(To be continued.)

INSTALLATION ESTIMATES.

Amount of Illumination.

No definite rules can be laid down with regard to the amount of illumination required for a given area. The show windows to a shop, for example, may be said to require 1½ candle-power per square foot of surface, on the average, but everything depends on the kind of goods which have to be displayed. Jewellery might require four or five times as much light.

For factories, again, it is difficult to lay down fixed rules; ordinary work rooms may have 1 C.P. for 10 square feet to 8 C.P. for 10 square feet, according to how close the operatives are placed together, whilst on floors which are mainly occupied by machinery, the best method is to allow one or more lights per machine, according to its size, and not to reckon by floor space.

The following table may be useful as a rough guide:—

	C.P. for 10 square feet.
Shops without show windows	6
Stores and small warehouses	2½
Private offices	2
General offices (where there are many clerks)	2½
Anterooms	1½
Drawing rooms (private house)	5
Dining rooms	3½
Bedrooms	2
Kitchens	1½
Subsidiary rooms	1

For an hotel the lighting would be:—

	C.P. for 10 sq. ft.
Drawing room	6
Dining room	10
Best bedrooms	4
Small bedrooms	3
Corridors	1½
Entrance hall	2½
Office	2
Kitchens	1½
Subsidiary rooms	1

Cost and Weight of Generating Plant.

It is frequently necessary to estimate the price of an electrical installation at a moment's notice, and as it is a

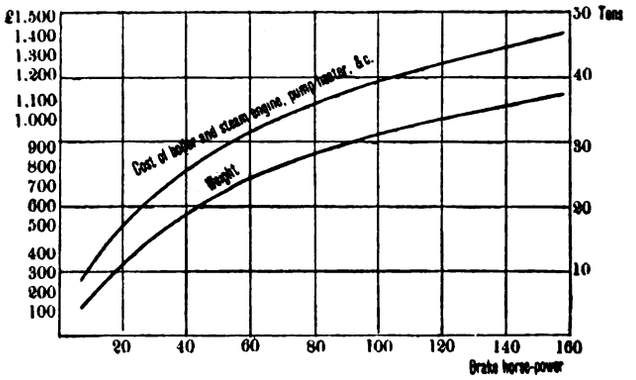

Fig. 1.

moral impossibility to carry the prices in one's head the accompanying curves and tables may prove useful. As a check against estimates built up in detail in the usual way the writer has found them helpful.

Fig. 1 gives the price and weight of a steam engine and boiler working at 120 lbs. pressure non-condensing. The price curve includes feed pump, injector, feed heater, steam exhaust feed and drain piping, and handrailing. It is

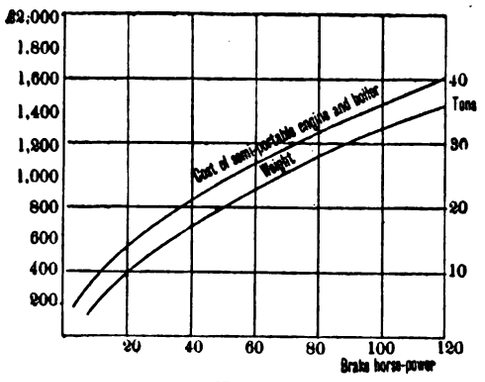

Fig. 2.

assumed that the engine is of the moderate speed open vertical type and that it is situated close alongside the boiler.

Fig. 2 gives the price and weight of semi-portable engine and boiler, including the usual accessories of such a self-contained plant with wrought-iron chimney, the whole being mounted on wheels in the smaller sizes. Such plants as these are frequently used for temporary work.

The prices of engines alone vary very considerably, more especially those of the high speed enclosed type which are usually coupled direct to the dynamos. For installations such as we are now considering, however, the engine may very well be of the moderate speed open type driving the dynamo by belt. Such engines, for example, as are made by Marshalls, Robey, Clench, Ruston Proctor, and others. These engines are especially suitable for foreign and colonial work because they are understandable by the ordinary mechanic and being made in large quantities the parts are

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easily and cheaply obtained. The curves shown in fig. 3 are of such ordinary cheap non-condensing engines suitable for belt driving.

Fig. 4 gives curves for a gas engine plant, including water tank, gas bag, piping to tank, say, 8 feet distance, and extra fly-wheel to give steadiness in running.

The price of an oil engine (see fig. 5) is just about the same as a gas engine, in fact, many makers use the same

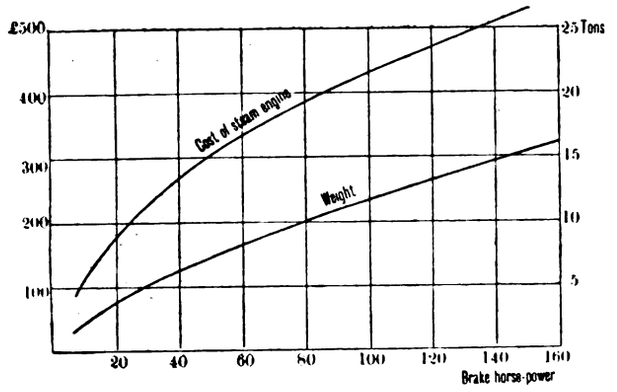

Fig. 3.

castings for the two engines, merely altering the valve gear. They are not, however, made in such large sizes. The prices given in the curve include water tank, piping, and extra fly-wheel.

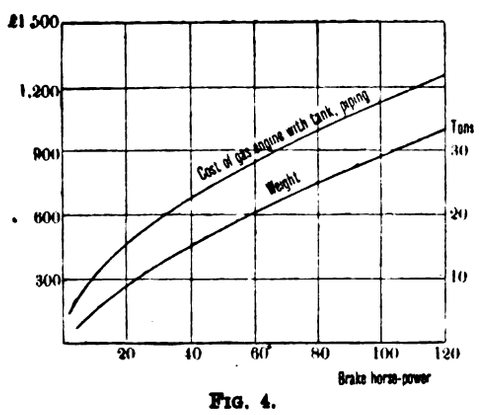

Fig. 4.

In all the above prices of engines, &c., the necessary foundation bolts are included, and weight curves include for packing cases.

In fixing the size of generating plant it is desirable to know how many lamps are likely to be burning at one time,

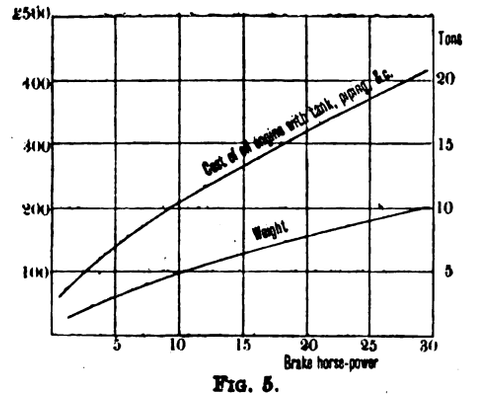

Fig. 5.

and also, assuming that the installation is successful, whether an increase of plant is contemplated, and, if so, to what extent. With this knowledge it is then possible to so adjust the size of the generating units that they fit in with the extensions and only one set of spares is required.

(To be continued.)

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

13,694. "Method of ventilating and keeping dry the wires and insulation of telephone, telegraph, or electrical conductors." F. F. Bennett and A. W. Thomas. Dated July 3rd.

13,719. "Improvements in tubular masts for wireless telegraphy and other purposes." J. A. Fleming. Dated July 3rd.

13,731. "Improvements in electric accumulators or storage batteries." G. V. Lagarde. Dated July 3rd.

13,732. "Improvements in electrical storage batteries." C. E. Lee. Dated July 3rd. (Complete.)

13,738. "Improvements in apparatus for exciting alternating current dynamos." C. D. Abel. (La Société Anonyme pour la Transmission de la Force par L'electricite, France.) Dated July 3rd.

13,773. "Improvements in electric traction." S. P. Thompson and M. Walker. Dated July 4th.

13,802. "Improvements in multi-rate electric meters." The British Thomson-Houston Company, Limited. (E. Thomson and F. P. Cox, United States.) Dated July 4th. (Complete.)

13,804. "Improvements in and connected with electric motors." P. M. Justice. (The Emerson Electric Manufacturing Company, United States.) Dated July 4th. (Complete.)

13,819. "Improvements in automatic magnetic circuit breakers." C. E. Starr. Dated July 4th. (Complete.)

13,836. "Elastic and permeable electrodes for storage batteries." L. Tobiansky. Dated July 4th. (Complete.)

13,846. "Improvements in and relating to the manufacture of a composition from Rhea fibre applicable for electric insulation and other purposes." W. J. Cordner. Dated July 4th.

13,849. "Improvements in electric incandescent lamps." J. Atherton. Dated July 4th. (Complete.)

13,860. "Improvements in the method of distributing electric light." W. G. Inglefield. Dated July 5th.

13,907. "Improvements in the manufacture of primary batteries." C. H. Elliot and E. J. Fumber. Dated July 6th.

13,928. "Improvements in dynamo-electric machines." E. E. Brown. Dated July 6th.

13,930. "Improvements in magneto electric generators." F. Bryan. Dated July 6th.

13,939. "Improvements in or connected with street, road, or similar electric railways." J. Milnes. Dated July 6th.

13,940. "Improvements in or connected with electric alarms for clocks, also applicable to doors, windows and the like." J. Worrall. Dated July 6th.

13,955. "Improvements in apparatus or devices for giving electrical time alarms." W. Hausmann and H. Ritter. Dated July 6th. (Complete.)

13,980. "Improvements in apparatus for the electrical working of railway points and signals." Siemens Brothers & Co., Limited. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated July 6th. (Complete.)

13,981. "Improvements in electricity meters for measuring rotary phase currents." Siemens Brothers & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated July 6th. (Complete.)

13,991. "Improvements in or relating to monophase electric motors." W. P. Thompson. (E. Cantonio, Italy.) Dated July 6th.

13,994. "An improved key switch for electrical circuits, particularly adapted for incandescent lamp sockets." Veritys, Limited, and W. R. Riding. Dated July 6th.

13,995. "Improvements in and relating to the carbon feeding mechanism of electric arc lamps." Veritys, Limited, and W. R. Riding. Dated July 6th.

13,996. "Improvements in electric arc lamps." Veritys, Limited, and W. R. Riding. Dated July 6th.

14,010. "Improvements in means for use in the production of radiation and light by electricity." J. Swinburne and C. H. Stearn. Dated July 6th.

14,026. "A locking device for electric incandescent lamps and holders." W. J. Martin. Dated July 7th.

14,038. "Means for constructing a heliopile and for utilising solar rays and other energy for the purpose of generating, transmitting, storing, and using thermo-electricity." R. H. Dunn and S. S. Bromhead. Dated July 7th.

14,104. "Improvements in trolley heads for electric tramways." G. H. Nisbett. Dated July 8th.

14,105. "Improvements in electric generators or motors." B. Draper. Dated July 8th.

14,140. "Improvements in or relating to electric motors." P. R. Jackson and Co., Limited, and J. S. Lewis. Dated July 8th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

28,865. "Improvements in controllers for motors and brakes of electric cars." A. Grossman. Dated December 7th, 1897. Motor road vehicles.—In electric motor cars one handle is employed to apply the brakes, and to control the motor switch or rheostat. The brake spindle has loosely mounted upon it the crank handle. The upper end of the socket on the said shaft has ratchet teeth cut on it, with which teeth on the handle gear, so that when turned in one direction, the handle rotates the shaft, while it is free to rotate in the other direction without the shaft. The shaft of the switch or rheostat has loosely mounted on it a sprocket-wheel, geared to another loosely-mounted on the brake spindle. By means of a lever the crank handle can be locked to an internal gear made in one with the brake spindle sprocket-wheel so that the latter is rotated in either direction with the handle. The sprocket-wheel on the switch shaft has on its upper face a half-clutch engaging with a similar one on a plate keyed to the switch shaft and provided with a tail engaging with stops. When not locked to the handle, the wheel on the brake spindle is prevented from rotating by a clutch carried on a spring plate, and in a similar way the plate is held by a spring plate in gear with the wheel, so that when the tail is in engagement with a stop the said wheel can rotate without the plate. 15 claims.

22,851. "Improvements in instruments for measuring continuous currents." W. P. Thompson. (O. B. Shallenberger, United States.) Dated October 5th, 1897.

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Relates to current meters.—A coil conveying current, is movable about a spindle on an iron ring between which and a co-axial similar ring a magnetic field is formed, the rings being fixed on blocks attached to the ends of a permanent magnet or magnets. The coil is balanced by another coil which may be a closed conducting circuit to damp the movements of the spindle, or may also convey the current; in the latter case both coils are wound on conducting frames to effect damping. Current is conveyed to the coil by two spiral phosphor-bronze springs carried by insulators on the spindle and connected to stationary arms. The coil carries a pointer over a scale. The rings are made with gaps to permit the placing of the coils on them, the gaps being afterwards filled up with magnetic material, or each ring may consist of two semi-circular pieces. The rings may be nearly surrounded by an iron ring secured adjustably between three screws; this ring shields the magnetic field from outside influences, and also serves as a means for adjusting its uniformity, and the proportionality of the deflections, through a large angle. 2 claims.

22,852. "Improvements in phase adjusting and regulating methods, and means for alternating current apparatus." R. Belfield. (E. M. Tingley and O. B. Shallenberger, United States.) Dated October 5th, 1897. Electric phase adjusting apparatus.—A current exactly in quadrature or other desired phase-relation to the current in a given circuit, is derived from the latter for use in a measuring instrument or otherwise. In one arrangement the main current flows in coils and the derived current in a coil which is connected in series with an inductance between the mains; the derived current is adjusted to quadrature by connecting a non-inductive resistance in parallel with the coil. In another arrangement, the main current flows in a transformer with an adjustable magnetic circuit, the secondary of which supplies the coils, while the coils are connected without the resistance. In a third arrangement, the coils carry the main current, but the coil is supplied from the secondary of a transformer having two primaries connected in parallel between the mains; one primary is in series with an inductance, and the other with an adjustable non-inductive resistance or a condenser. The provisional specification described a modification of the arrangement having an inductance connected in parallel with the main current coils. 4 claims.

22,878. "Improved fusible cut-out for electric lighting and the like." J. Pesohek. Dated October 7th, 1897. A tin, lead, or other fusible strip or wire is placed on a strip of mica, asbestos, millboard, or other incombustible material, so that it is in electric contact with thin brass, copper, or other bands wrapped round the ends of the strip. A strip similar to the first one may be placed over the first strip or wire to protect it. These contacts are clamped in position by two screws, the latter of which makes contact with the main, while the former screws into a metal block to which the leads are clamped by screws. To prevent damage to the screws and blocks by sparking when the cut-out fuses, shields are provided, preferably by bending the strips. These shields may be formed of some metal or alloy incapable of maintaining an arc. 4 claims.

23,097. "Electric conductor or cable." G. H. Nisbett. Dated October 8th, 1897. Air-space cables with paper or similar insulation are formed by passing wires and paper through tapering formers so that the folds come together. The formed tubes are passed through an assembling guide, and are twisted into a long-pitched spiral. The machinery employed consists of stationary reels and formers, the twist being imparted by rotating the take-up drum. The take-up motion is imparted to the drum by bevel and worm gearing. The provisional specification refers to a machine in which the twist is imparted by rotating the frame carrying the feed reels. An extra thickness or thicknesses may be placed between the folds. (Grant of patent opposed.) 2 claims.

23,260. "Improvements in automatic magnet circuit breakers." W. M. Scott. Dated October 9th, 1897. (Date applied for under Patents, &c., Act, 1883, Section 103, March 17th, 1897, being date of application in United States.) Relates to an automatic electro-magnetic switch or cut-out which operates upon either a predetermined maximum or a predetermined minimum flow of current. The magnets may be energised by the current to be controlled or by a controlling current. The switch arm is carried by arms pivoted near the bottom, and forced upwards by springs being provided for checking the movement. The contact-arm is held, when in engagement with the fixed contacts, by a latch engaging with a cam-plate pivoted. A second cam-plate is also pivoted, and is slotted to receive a pin carried by the first cam-plate. The resetting handle has a plug on the contact-arm, is pivoted, and carries a pin to set the cam-plate when the handle is fully raised. Two electro-magnets are arranged in connection with the circuits. When the currents exceeds a predetermined limit, the movable part of the core of the magnet is raised, lifting the pin and so releasing the catch. When the current falls below the limit, the part of the magnet falls, pulling down the pin and operating a lever the other end of which engages with the cam lever. The lowest position of the core is adjusted by the nut, and the action of the core is adjusted by limiting the distance that it may be drawn within the coils, or by means of an adjustable core moving in the fixed core. Instead of two magnets a differentially-wound magnet may be employed. Carbon contacts are arranged for taking the sparks. 8 claims.

23,267. "Improvements in apparatus for the electro-deposition of one metal on another." J. E. Bryant. Dated October 11th, 1897. Electro-deposition.—Relates to apparatus for depositing one metal upon another. It consists of a cylinder or barrel one end of which can be removed and closed by screws, is supported on axles and rotated by a driving pulley. The shaft to which one terminal is attached, passes through an insulating tube surrounded by a metal tube forming one axle, which itself passes through a stuffing box. The inner end of the shaft is bent upwards and then inwards, and supports by adjustable rods the horizontal anode plate of the same metal as is to be deposited. The opposite shaft is connected to the other terminal, and similarly passes through an insulating tube, a metal tube, and a stuffing box. It is connected to a metal disc from which copper strips pass along one end and the sides of the barrel to make contact with the articles to be coated. The barrel may be perforated and mounted within another vessel containing the electrolyte. The anode may be a cylinder, a polygonal prism, or a longitudinal section of either of these, instead of the plate shown. 4 claims.

23,352. "Improvements in the manufacture of electrodes for electrolytic processes." A. Zimmerman. (The Chemische Fabrik auf Action vormals, E. Schering, Germany.) Dated October 11th, 1897. Electrodes are formed by coating glass, porcelain, mica, enamel, stoneware, or other similar material with an alloy composed of gold, platinum, silver, or other noble metal, and a small quantity of bismuth, or other metal which reduces the melting point of the noble metal, and enables it to be burnt in at a lower temperature. The metallic coating formed may be strengthened by electrolytic or galvanic deposits of the noble metals. 2 claims.

23,416. "Improvements in dynamos." J. Liddle. (E. W. Farnham, United States.) Dated October 12th, 1897. Relates to a magneto-electric machine, suitable for use upon a bicycle or other vehicle, for supplying an electric lamp or other electric signalling apparatus. The parts are contained within a cylindrical casing mounted rotatably on a fixed spindle, and driven by the tyre of one of the wheels. The field magnets and the armature are supported by a frame secured to the shaft, and motion is communicated to the armature from the casing by means of pulleys over which passes a cord. One end of the armature winding is connected to an insulated stud, upon which bears a brush in connection with a leading-wire; the other end is connected through the frame of the dynamo with the other leading wire. In one modification, the armature shaft is driven by an internally toothed gear wheel attached to the casing; in another, the armature and field magnets are arranged so that both rotate in opposite directions. 4 claims.

23,418. "Improvements in electromotors and dynamos." T. B. Murray and G. Johnston. Dated October 12th, 1897. Dynamos and motors, armatures, field-magnets.—An electromotor or dynamo is constructed with two armatures mounted on the same shaft, and each provided with one or more distinct windings, connected to their respective commutators. By varying the connection of the armature windings from series to parallel, or *vice versâ*, the speed of a motor may be varied. This may also be effected by varying the strength of the magnetic field. To obtain a sparkless commutation under such circumstances, a pair of smaller electro-magnets are arranged between the main magnets, the additional magnets being preferably energised by coils in circuit with the armatures. 1 claim.

23,470. "Improvements in electric incandescence lamps and apparatus or appliances in connection therewith." Dr. W. Nernst. Dated October 12th, 1897. Incandescent lamps, having incandescent bodies of magnesia or other oxides, are provided with resistant metal wires for heating such bodies to render them conducting. The incandescent body is fixed at the focus of a concave porcelain reflector containing a coiled platinum wire. When current is supplied to the wire, it heats the body until this conducts sufficiently to take current from a separate or parallel circuit. The supply of current to the wire may then be stopped, by hand, or by a cut-out operated by the current supplied to the body In a modified form the wire is wound in a refractory transparent cylinder, within which the incandescence body is fixed; or such enclosing cylinder may be dispensed with. In another modification, the cylinder is of porcelain, and either it or the incandescence body is supported by a spring and a core of a solenoid in circuit with the incandescence body, so that the heating cylinder is automatically withdrawn from the body when it conducts sufficiently. 6 claims.

24,130. "Improvements in mountings for the contact shoes of surface contact railways." The British Thomson-Houston Company, Limited. (W. B. Potter, United States.) Dated October 19th, 1897. Collectors. Shoes are carried by spring-controlled levers at each end of the vehicle. The lever is pivoted on a block mounted on a stiffened support depending from the axles. 4 claims.

24,150. "Improvements in electrodes for storage batteries." H. S. Lloyd. Dated October 19th, 1897. The plates or electrodes are made up of two or more layers of lead wires or strips with an intermediate perforated lead plate. The wires are preferably plaited together. The plate may be of material which will be dissolved or destroyed by the electrolyte. 2 claims.

24,155. "Improved joint box for electric cables." R. J. Hatton and W. T. Henley's Telegraph Works Company, Limited. Dated October 19th, 1897. Junction boxes for electric cables are formed of U shaped metal troughs in which the two ends are formed double, and rise only to the height of the middle of the cable, semi-circular recesses being left to receive the cable. The ends of the conductor are jointed before being placed in position. After being placed in position end pieces fitting round the cable and held by guides close the ends of the box. The pieces are separated by connecting webs and a space is filled with bituminous or other insulating material. A lid provided with a rib is secured by bolts. The external sockets are also filled with insulating material. 3 claims.

24,158. "Improved joint box for coupling underground and aerial electrical cables." R. J. Hatton and W. T. Henley's Telegraph Works Company, Limited. Dated October 19th, 1897. Junction boxes for connecting ground and aerial lines are formed of metal cases provided with lugs for attachment to posts or other supports. The bottom is perforated to receive the underground cable, and the insulators for the bare aerial lines. The cable is secured by packing and a gland, the several conductors being provided with connections for attachment to the ends of the bare conductors. The insulators are set by cement into the bottom of the box, and the conductors pass axially through them. The box is filled with paraffin wax or other insulating material, and the lid is bolted on. There is a dependent skirt round the box. 1 claim.

24,418. "Improvements in telegraphic transmitting instruments." G. Draper and W. Gaye. Dated October 21st, 1897. Transmitters for sending curb currents are arranged so that the duration of, and interval between, the signal and curb currents are independent of the time the key is held down. In one arrangement of the apparatus, the double keys are connected to cable and earth respectively, and their back contacts normally rest on a bridge connected to the middle point of the split battery. Each key is provided with a light spring extension which when raised makes contact with a bridge connected to a spring controlled pivoted lever. The front portions of the keys are insulated from the back portions, and are connected together so that either key will complete the local circuit through a magnet. The armature of the magnet carries a pointed lever which bears against a cam surface on the lever. The end of the lever plays between stops on two levers which are connected to the opposite poles of the line and curb batteries. The space between the stops is adjustable, and the frame carrying the levers can also be adjusted laterally so as to vary the duration and interval between the signal and curb currents. In modified arrangements of the circuits only one battery is employed, the opposite poles of which are connected to bridges, in one case the cable being connected to the lever. Condensers and resistances may also be employed. 8 claims.

24,421. "Improvements in systems for the transmission of electrical energy, and apparatus for use therein." H. H. Lake. (N. Tesla, United States.) Dated October 21st, 1897. Relates to a system for distributing electrical energy without the use of line conductors. The current from a generator is transformed into a current of excessively high pressure in the secondary of a transformer. One end of this secondary is connected to earth and also to the primary, and the other to a terminal which has a large surface, and which is maintained at a high elevation by a balloon, &c. The current flows through the rarefied air to a second terminal connected to the secondary of a transformer, in the primary of which are arranged the translators. The transformers preferably have two concentric coils, and the secondary should preferably be one quarter of a wave in length. 5 claims.

24,519. "Improvements in the construction of overhead lines of electric railways or tramways." P. Dawson. Dated October 22nd, 1897. Electric railways and tramways with overhead conductors, crossings and frogs for.—The underside has ribs, grooves, guards, to guide the trolley wheel; preferably the ribs are curved and a central guide is also used. The ribs, &c., are shaped so that the wheel runs on its flanges at the centre of the plate, or the plate may be inclined or otherwise arranged to guide the trolleys. The conductor wires are not cut, but are held in grooves on the top side of the plate by solders and by clamps and set screws. 7 claims.

24,521. "An improved frog for overhead conductors or trolleys of electric railways or tramways." P. Dawson. Dated October 22nd, 1897. Electric railways and tramways with overhead conductors. Conductors, movable frogs for. A part of the guiding ribs on the underside of the frog-plate is connected by a lever on its axis to a sliding bar which is normally held in one position by a spring. Trolleys which are to pass on to the branch line are provided with a projection which strikes the depending arm on a carriage sliding in the box on the frog plate. This carriage moves forward, and so operates the switch through the rod and then tilts when its roller comes opposite a slot in the top of the box so that the trolley can pass. A catch operated by a trigger lever holds the switch until the trolley has passed. Trolleys without projections pass on the main line, or the switch may be arranged to work for either direction. The main trolley wire is not cut, but is laid in a groove on the top side of the plate, and both it and the other wire are held by solders, clamps, and set-screws. 4 claims.

24,561. "Improvements in galvanic cells." A. Heil. Dated October 23rd, 1897. Primary and secondary batteries.—A primary battery consists of a zinc electrode and of a carbon electrode surrounded by equal parts by volume of graphite, manganese peroxide, and lead peroxide. The electrolyte consists of an aqueous solution of zinc sulphate, to which soda is added until the hydrated carbonate of zinc is precipitated in small flocks, which are maintained in suspension by forming the liquid into pulp by admixture with gypsum and sawdust or other absorbent materials. In the provisional specification, the use of the battery as a secondary battery is described, the electrolyte consisting of a solution of pure soda, and the zinc electrode being coated with zinc dust, while the carbon electrode is made as above described. 2 claims.

24,828. "Improvements in coin-freed mechanism applicable to gas, electricity, and like meters." S. Simpson. Dated October 26th, 1897. Gas meters, liquid meters, electricity, supplying.—Relates to the actuation and the price-charging arrangements. In one arrangement, after prepayment a segmental wheel is turned by a handle and drives a complete wheel in gear with it. Segmental wheels of various arcs can be put on the handle shaft laterally, or the set of wheels can be replaced by a pair of overlapping sectors. In another arrangement a cam on the handle shaft reciprocates a slide whence a variable ratchet feed is operated by a connecting rod. Coin action.—Normally the handle is prevented from being turned because a detent engages in a notch in a disc on the handle shaft, but when a coin has been put into a radial pocket in a drum it lifts the detent as the handle is turned through the small play allowed by the notch. In the second arrangement the slide contains the coin. Fraud preventing.—A cam prominence in the periphery of the disc holds the detent in the notch when the pocket registers with the insertion slot. 6 claims.

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THE

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THE TRIAL OF PATENT CASES.

THE necessity of having a special Court for the trial of patent actions has long been apparent, not only to patentees and alleged infringers, but to the public who advocate the cause of speedy justice. This subject formed the burden of a speech by Mr. John Corry Fell to the Society of Engineers early in the year. The Queen's Bench and Chancery Divisions of the High Court are from time to time engaged in discussing, at considerable length, the validity of complicated patents to the exclusion of other business with which the time of the judges might be occupied. While it is one of the chief sources of the law's delay, the practice of allowing patent actions to be heard in the ordinary way is prejudicial to the interests of those whose inventions are being called in question, for the judges, although they are often men of consummate ability in other respects, are not usually chosen on account of their proficiency in the law relating to patents.

A glance at the history of patent law will serve to show that the ordinary tribunals are unsatisfactory for the determination of the numerous questions which arise. The unfitness of a jury was strongly insisted upon by the most eminent legal and scientific witnesses before the Parliamentary Committees of 1851, 1865, 1871 and 1872. In an ordinary action at law the duties of a juror are confined to the consideration of matters of fact, the credibility of witnesses, or the assessment of damages, whereas in a patent action he might be called upon to determine the relative merits of opinions expressed by expert witnesses of the highest order of intellect. It is clear that in such cases the average juror must soon be out of his depth. This has been recognised for some time, so that the trial of a patent action by a jury is now very rare.

Lord Selborne, in the Patent Marine Inventions Company *v.* Chadburn (1873) L. R. 16 Eq., 447, referring to patent actions generally, said:—"It is to be observed that such cases almost always involve questions of law and fact, not only mixed, but mixed in such a way as makes the extrication of them extremely difficult; secondly, that very often much must depend upon the construction of documents, as to which a jury must take their direction entirely from the judge; thirdly, that much of the evidence, or that which is permitted to be given in evidence in such case, is argumentative, and relates to matters of opinion, so as to make it extremely hard for the judge himself to keep it under proper control; and lastly, that even the questions of fact are often, to a very great extent, questions of science, which, to say the least, are likely to be as well dreaded by a judge as by any jury."

Again, the judge who sits alone to decide a question as to the validity or infringement of a patent is beset with a series of difficulties. No matter how great his ability in grasping all the facts of the case, it is almost beyond his power to decide as to the soundness of the views which are expressed in his hearing by distinguished professors and experts, often chosen from the most important seats of learning in the kingdom. Recognising the difficulty which is experienced by the Court in deciding cases where some technical knowledge is required, it was provided by Section 56 of the Judicature Act, 1873, that the High Court, or Court of Appeal,

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might call in the aid of one or more assessors specially qualified, and try and hear the cause or matter wholly or partially with the assistance of such assessors. This, however, did not deprive either party of the right to insist upon a trial before a judge and jury (Sugg *v.* Silber, 1 Q.B.D., 362), and as a jury was found unsuitable in patent actions, a further change was made in the law by the Patents Designs and Trade Marks Act, 1883.

By Section 28 (1) of that Act it was provided that the hearing of actions or proceedings for infringement or revocation of a patent is to take place before a judge who may call in the aid of an assessor specially qualified, and the question whether there shall be a jury or not is left to the discretion of the judge. A jury is now hardly ever employed, and patent actions are usually heard in the first instance by a judge of the Chancery Division. The power to call in an expert as an assessor is never exercised, and seems to have fallen into abeyance.

The position of an assessor was alluded to in the judgment of the late Master of the Rolls in *The Beryl* (L. R. 9, P. D. 140):—"In the Court of Admiralty the application of the rules is to be made by a mixed tribunal. The tribunal which has to try the case is the judge himself, and the judgment is his and his alone. The assessors who assist the judge take no part in the judgment whatever; they are not responsible for it, and have nothing to do with it. . . . But nautical questions may arise in the course of the case with regard to particular facts of the case, and he is entitled to ask those questions in order to guide him in applying any general rule that may exist to the particular facts before him."

One very satisfactory solution of the difficulty is the appointment by the judge of some independent expert to experiment and make a report in accordance with directions furnished by the judge with the assent of both parties.

In the case of "Badische Amlin und Soda Fabrik *v.* Levinstein" (L. R. 24 Ch. D. 156), the plaintiffs, who were possessors of a patent for improvements in the production of colouring matters for dyeing and printing, sought to restrain the defendants from infringing their patent by making similar articles. A number of witnesses were called on both sides as to the manner in which four different chemical processes were worked, and when the defendant gave his evidence he objected to answer the questions put to him in cross-examination on the ground that they would disclose his secret. He was allowed to give his evidence *in camera*.

After a hearing which lasted 10 days, Pearson, J., stated that in consequence of the conflicting nature of the evidence and the consequent difficulty of deciding a scientific question of this nature, he should not give judgment without having the evidence of an independent expert witness, who would undertake to make such experiments as were necessary for the purpose of advising the Court.

Prof. Roscoe was thereupon appointed, with the consent of both parties, to conduct these experiments, and certain instructions were given to him by the Court. That the judge was satisfied with this arrangement appears from his judgment, in which he said:—"There was a great deal of conflicting evidence upon this subject, and the result of it was that I thought it desirable to get further evidence upon the subject from an independent scientific chemist, and both parties agreeing to Prof. Roscoe as being one of the most competent men in England to assist the Court, I directed, by an order that was made, that he should pursue this first example and report to me what the result was. Accordingly he did so, and I think the Court has reason to feel considerably indebted to Prof. Roscoe for the pains which he took in performing the experiment, and giving to the Court the advice which was wanted."

In the case of Gormully *v.* North British Rubber Company (14 T. L. R. 335), the Lord Chancellor expressed himself in no measured terms as to the unsatisfactory state of patent procedure.

He said:—"Having regard to the extravagant and extraordinary consumption of time which was involved in the determination of this case, witnesses of great eminence being called on both sides and evidence given which amounts in the book which I hold in my hand to 500 printed quarto pages, it is no wonder that, if a case so simple in its character is so protracted, there is what is called a 'block' in the courts of law. . . . . I think it is worthy of the consideration of those engaged in such cases to remember that the legislature has provided a tribunal for protracted scientific investigations, to which cases of this kind will have to be remitted, if this case is to be taken as an example.

"The question to be determined in this case by a court of law is a comparatively short one, but if professors on every subject under Heaven are to be brought to confront each other and give evidence on questions of this sort, it is quite manifest that the ordinary principles which guide courts of justice cannot be adhered to, and what is called the scientific part of the case will have to be remitted to a totally different tribunal."

The "tribunal provided by the legislature for protracted scientific investigations," to which his Lordship referred, was created by the Arbitration Act, but it does not seem to have been used to any extent.

By Section 14 of the Arbitration Act, 1889, if the cause or matter requires any scientific or local investigation which cannot in the opinion of the Court conveniently be made before a jury, or conducted by the Court through its other ordinary officers, the Judge may at any time refer the whole cause, or any question arising thereon, to be tried before a referee agreed upon by the parties or before an official referee. This power was exercised by the late Mr. Justice Hawkins, who referred a patent case to the Official Referee, and the Court of Appeal refused to disturb his decision.

If an additional Official Referee were appointed, who possessed a good knowledge of patent law, it is reasonable to suppose that some improvement might be effected in the present state of things. Having regard to the increasing number of patent actions, which involve difficult problems in electricity and chemistry, we agree with Mr. Fell in thinking that the time has come for the establishment of some tribunal, such, for instance, as "The Patent Designs and Trade Marks Division of the High Court of Justice," in which the law would be administered by judges trained for the particular purpose.

City Electric Lighting Competition.

The Committee of the House of Lords on Tuesday allowed the Charing Cross Bill to proceed. There are a few facts in this case which seem, however, to call for sympathy. It is not generally known that when the original contracts with the Corporation were settled, the special conditions insisted on by the Corporation with reference to depreciation and reserve funds were incorporated in a special Act of Parliament in 1893. These contracts also provide for the lighting of the main thoroughfares and minor streets at rates which were based on the actual works costs of the supply; when, therefore, the Corporation repudiated the contracts, they not only relieved themselves of the consideration which they had offered for the obligation, but left the City Company in a position of having to carry out not only the obligation in respect of the depreciation and reserve funds, but also the lighting of the main thoroughfares, for all the mains, lamp-posts, lamps, &c., had been purchased and provided by the City Company under the terms of the contracts. If, therefore, they were to cease supplying current to the lamps, it is quite clear that a capital outlay of no less than £120,000 would be thrown away. Under such conditions, competition with a company free to adopt any system of supply or method of generation, and unfettered by conditions as to depreciation and reserve funds and providing unremunerative capital for street lighting, becomes a mere handicap, the one redeeming point in the position of the established company being, that having worked up their undertaking so that no less than 400,000 lamps are connected, this will provide for the necessary returns to enable them to fight such unjust competition. The prospects of investors in such a competing supply—however much the established company may be handicapped—do not seem to be sufficiently favourable to warrant the issue of any glowing prospectus, and it is earnestly hoped that where Parliament has apparently failed to give justice, the public themselves may hesitate to embark capital in what seems in the light of present knowledge a fruitless enterprise.

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AMERICAN ELECTRO-MEDICAL APPARATUS.

For some time electro-medical treatment has been in much greater favour with the medical profession in the United States than in this country. As a natural consequence of this, the American electro-medical apparatus has reached a much more advanced stage of development. Medical men may satisfy themselves on this point by inspecting the very

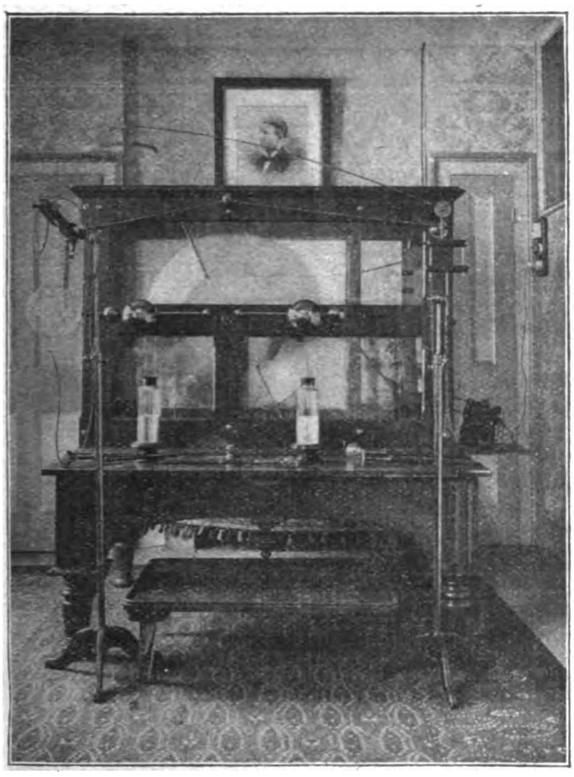

Fig. 1.

interesting collection of electric apparatus which is now been shown by Drs. Waite and Strong at 18, Pall Mall East. This apparatus has been made by the Waite & Bartlett Manufacturing Company, New York, and as we have had an opportunity of examining it, we are enabled to give the following short description of its design and working :—

One of the finest pieces of apparatus on view is a multiple plate influence machine. This machine is a modified form of the type of Holtz machine (fig. 1), with fixed supports for the inducing charges, but the modifications are of considerable importance. As is well known, the ordinary Holtz machine of this type is liable to reverse when overtaxed. This drawback alone completely unfits it for electro-medical use; for example, in the midst of an important examination with Röntgen rays excited by such a machine, it may reverse and extinguish the lamp at the most inconvenient moment. The reversal of the Holtz machine is principally due to the accumulation of a reverse charge opposite the inductor on the face of the glass plate next to the rotating plate. In the Waite and Bartlett machine this is effectually prevented, by fixing the paper inductors next the rotating plates. There being no glass between the inductors and the rotating plate, there is no possibility of an opposite charge accumulating to cause reversal. As a matter of fact, this machine does not reverse. The objection to this arrangement, which would occur to one at first sight, is that the spark length would be considerably reduced. But from their 30-inch plates a spark of 15 inches is obtained in favourable weather, and this is as much as can be expected from a first-class machine of any type.

The machine is beautifully made, and is enclosed in a glass case, 6 feet 6 inches long, 5 feet 8 inches high, and 3 feet 9 inches wide. In the same case is a small Voss machine which is used to charge the inductors of the large machine. The machine is driven by a $\frac{1}{8}$ H P. electromotor, and is capable of exciting a Röntgen tube sufficiently powerful for examining the thickest parts of the human body. The machine is fitted with convenient terminals for drawing brush discharges from the head and other parts of the body of a patient seated on an insulated stool. There are eight rotating plates each 30 inches in diameter and eight fixed plates of rectangular shape to support the paper inductors. The machine runs without noise. In cases where a shunt spark is necessary, the spark gap is enclosed in a vulcanite tube which acts as a perfect silencer. The absence of noise is a point of considerable importance in the case of nervous patients.

For the application of the induced current the Engleman faradic apparatus illustrated in fig. 2 appears to contain all the adjustments that are likely to be required in this form of electro-medical treatment. The interrupter consists of a disc of insulating material with several concentric circular rows of metallic contacts, any one of which can be brought under the contact spring. The disc is driven by an electromotor, and is fitted with a counting apparatus which rings a bell at the end of a fixed number of breaks. The frequency of the breaks can be varied from 1 to 100,000 or more, per minute. It is well known to medical men that, in the application of the faradic current, the frequency of the breaks is a matter of vital importance. A frequency which may cure one patient may be disastrous to another. The value of an adjustment by means of which any given frequency can always be reproduced is, therefore, self-evident. The intensity of the faradic currents is regulated by moving the coil on a fixed core. A special accessory with this apparatus is for the treatment of deafness. Ear tubes convey to the ears sound vibrations of a given frequency, and with every sound wave an electric impulse is passed through the nerves of the ear.

The Ranney cabinet (fig. 3) is a very complete apparatus for administering either the galvanic current or the faradic currrent. In the cupboard underneath are contained 44 cells of the Leclanché type. There is a milliampere meter for the galvanic current, and also a current controller for turning on the galvanic current gradually. By means of a German silver rheostat of 17,500 ohms the resistance of the patient can be measured. The patient is first placed in the battery circuit, and the deflection observed on the milliampere meter. The rheostat is then put in the circuit in place of the patient, and adjusted to give the same deflection. In the centre of

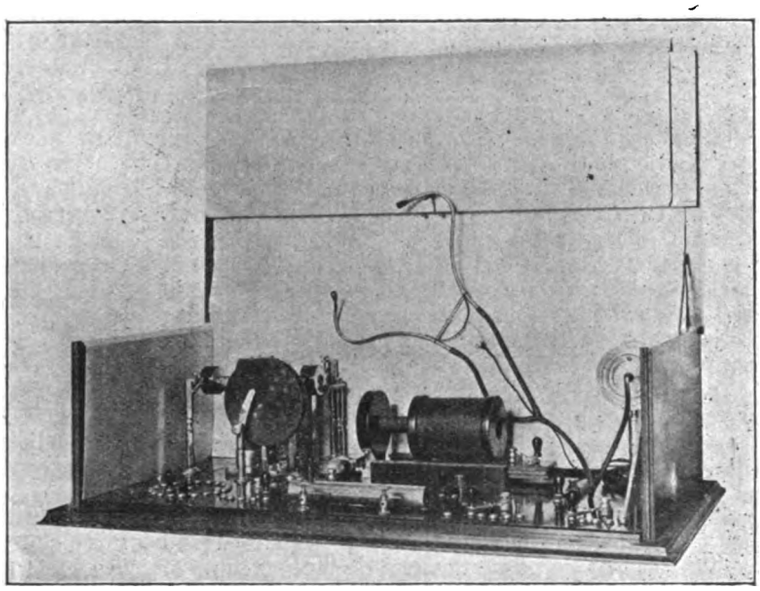

Fig. 2.

the top cabinet is a double cell selector, consisting of two movable radial arms which bear on a circle of studs connected to the cells. By means of this arrangement one or

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any number of cells can be selected anywhere from the battery. There is an automatic interrupter for the galvanic current, a pole changer for both currents, a De Watteville switch by which a galvanic current, a faradic current, or both combined, can be supplied to one set of binding posts. The faradic portion has three separate coils, one of which is 4,500 feet long; it has a fast and very slow vibrator, and also a key for giving a single impulse. There is a special arrangement for moving the secondary coil slowly over the primary. The various vibrators, after being adjusted, are selected by means of a switch. The size of the above cabinet is 22½ inches wide, 3 feet 7 inches long, and 5 feet 7 inches high.

Drs. Waite and Strong have also on view a small hand apparatus capable of producing galvanic or faradic currents. This contains a battery of 21 dry cells, a rheostat and double cell selector and a milliampere meter. The rheostat is arranged so that it is in series with either current. It has a micrometer adjustment so that the most sensitive do not

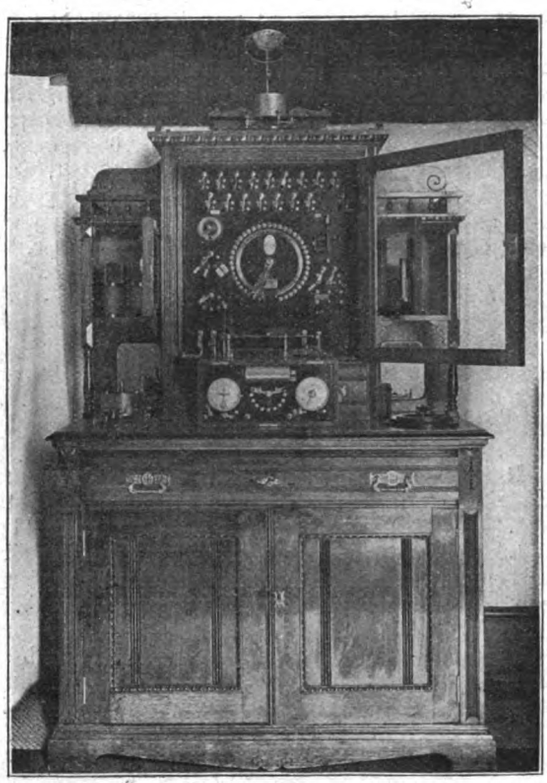

Fig. 3.

notice the gradual increase of the current. The double cell selector is arranged so that the cells can be turned on, one at a time, without interrupting the current, and yet it is impossible to leave the switch so that one cell can be short circuited. The moving contact of the switch is of oblong section and can be turned through a right angle, so that its longer or shorter dimension may be tangential to the circular path in which it moves. The longer dimension is capable of covering two adjacent battery terminals, whereas the shorter dimension cannot possibly cover more than one. When the switch is left at rest, it automatically takes up the position in which it can touch only one battery terminal; the ordinary sliding switch is liable to be carelessly left in a position in which one of the cells of the battery is short circuited, with the result that this cell is run down and becomes useless.

Another interesting little exhibit was a centrifugal apparatus driven by an electromotor for separating out and estimating the red corpuscles in blood. The specimen of blood to be tested is placed in a graduated glass tube, which is then fixed radially to a vertical axis, rapidly rotated by the electromotor. After a time the red corpuscles will all have accumulated at one end of the tube, and their percentage can be readily read off by means of the graduations on the tube. This invention, we believe, is due to Edison.

POPLAR ELECTRIC LIGHTING CONTRACT.

We notice that in the awarding of the contract for the engine house plant there appears to have been some political or other influence at work.

The original tenders for Section A, comprising engines, dynamos, switchboards, balancers, boosters, overhead traveller, steam exhaust and other piping, pumps, motors, spares, and engine room stores stood as follows:—

Crompton & Co., Limited, £15,840 (recommended).
Johnson & Phillips, with Willans engines, £16,149.
Mather & Platt, Limited, £16,200 (accepted).
Electric Construction Company, Limited, £16,834.
Johnson & Phillips, with Belliss engines, £17,644.
Siemens Bros. & Co., Limited, £18,050.
Voight & Lindsey, £18,238.

As all the tenders (with the exception of the highest) were from firms well known in the electrical engineering trade, it was only natural that the lowest—Messrs. Crompton and Co.—should be recommended for acceptance. At this point, however, certain trades union officials appear to have begun to exert influence on the members of the Council, and although the Chelmsford firm furnished a schedule of wages paid (which, in many cases, were higher than those fixed by the Amalgamated Society of Engineers), the contract has been transferred to Messrs. Mather & Platt, Limited. This latter firm appears to be favoured by the trades unions, because of the prominent part taken in establishing an eight-hour day for its workmen. It is somewhat doubtful, however, whether any better guarantee with regard to the labour clauses has been obtained from Messrs. Mather & Platt than other firms would have given. At any rate, there must of necessity be a good deal of sub-contracting, and it is extremely probable that certain sub-contractors will be employed who do not pay the standard rates of wages.

We are afraid that there is a great deal of bluff with regard to these wages and penalty clauses. When the tenders come before a Council to be settled, these questions come prominently forward because they form an easy means of vote catching. Afterwards, however, such matters are quietly dropped, and the members and officials are so anxious to get the electric lighting started during their term of office, that they are only too pleased to see the plant arrive, and do not ask as to the conditions under which it has been manufactured.

WESTINGHOUSE GAS ENGINES.

Last week we welcomed the stranger within our gates; to-day we welcome what he has brought to us, for on Wednesday last Mr. George Westinghouse exhibited specimens of the new gas engines, which we believe will form one of the staple manufactures of his English company.

The engines shown numbered five; three two-cylinder motors of 10, 25, and 50 H.P., connected by belts to dynamos, and two three-cylinder engines of 50 and 125 H.P., direct coupled. The chief claims put forward on behalf of the new engines, are better governing, better admixture of gas and air, regularity of explosion, and, therefore, practically no variation of speed, and we believe the Westinghouse engine is the first in which direct coupling has been employed.

The beautiful regularity of the driving was fully demonstrated by the voltmeter needle, which showed no fluctuations; indeed, to all intent and purpose, the dynamos might have been running from first-class perfectly regulated steam engines. The ignition was by electrical means, and the freedom from the usual noise occasioned by gas engines was quite remarkable, as were the ease and rapidity with which they are started. There is little doubt that from to-day a new era in the gas engine industry has commenced, and to America belongs the credit of making improvements so simple in their nature that the wonder is they remained so long undiscovered.

The Westinghouse gas engines are very different in construction from those of other makers, and they can be used with some advantages in place of steam engines for electric

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lighting, power, and other purposes, when a uniform speed is desirable or necessary.

To bring these engines to their present perfect form has required more than 10 years of patient investigation and experiment, the aim having been to develop a type of engine which could be built in sizes up to 1,500 H P.

It is interesting to note that the gas company at Long Branch, New Jersey, has ordered a Westinghouse gas engine of 280 H.P, direct connected to a generator, for supplying electric light to a public circuit. On the other hand, the Columbus Electric Company, of Columbus, Ohio, is adding to its plant a 650-H.P. and a 280-H.P. Westinghouse gas engine, each direct connected to Westinghouse electric generators.

With the Westinghouse engine and electric generator, operating at full load, we understand 1,000 cubic feet of illuminating gas will produce about 40 KW.-hours, which, at the retail London rate of 2s. 6d. per 1,000 cubic feet, amounts to ¾d. per KW.-hour, making, with an equal amount for attendance, maintenance, and depreciation, 1½d. per KW.-hour. The large sizes of Westinghouse gas engine show even a more favourable result.

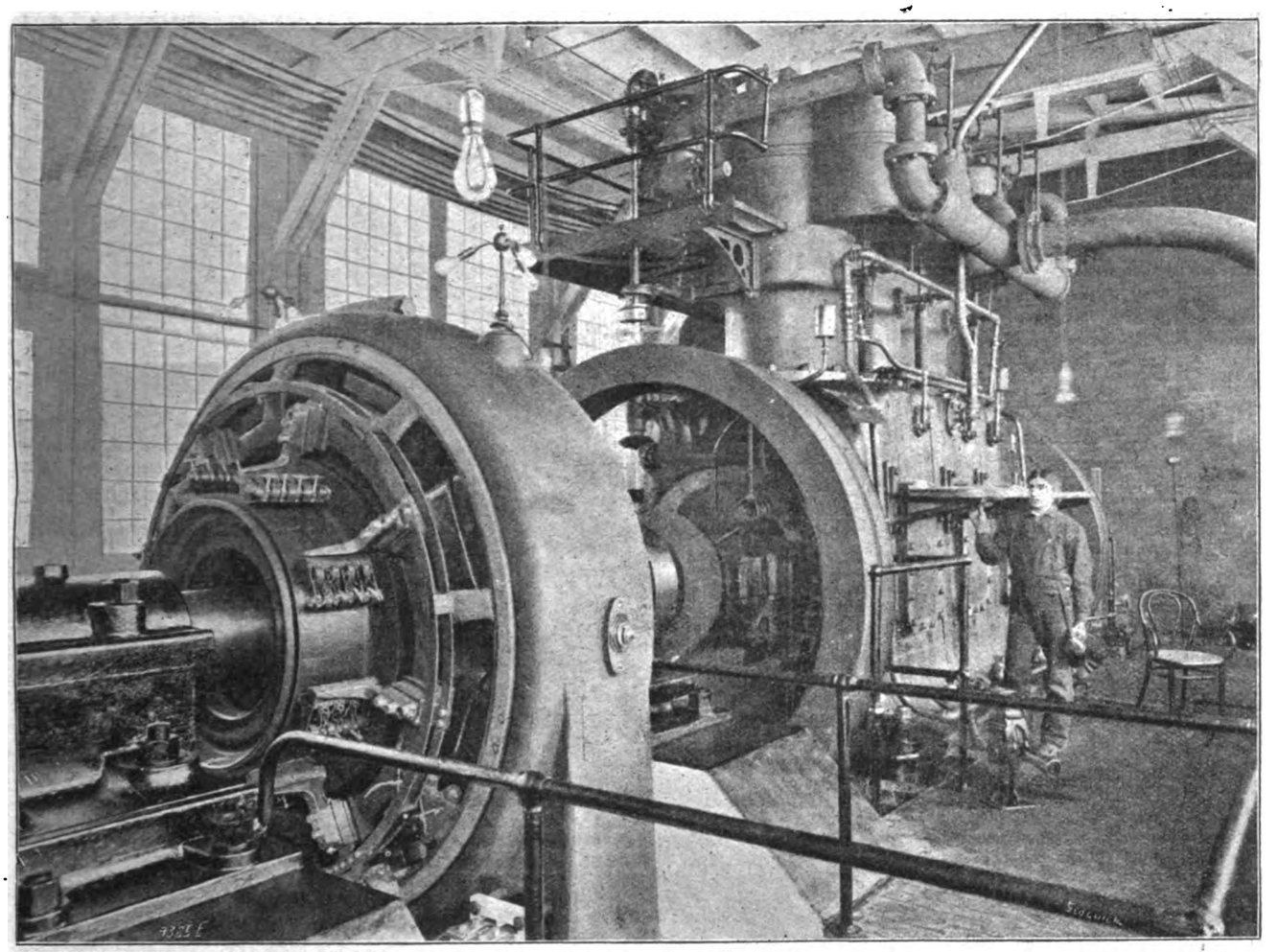
It is claimed that a Westinghouse engine and electric generator, even of moderate size, can be installed, ready for operation, at a cost, per 16-C P. light capacity, of less than half the capital required for a steam engine central station plant and its system of distribution.

At the present time projects for the electric equipment of London underground and street railways are under discussion. The use of gas engines for developing the electrical energy, with suitable pipes laid for conducting the gas, would, it is said, make the cheapest system to construct and operate. It should be quite within the scope of the operations of existing gas companies to erect special gas works, put down special pipes, and supply gas for the operation of large gas engines in connection with such lines, as well as with those now being built in London, and those in contemplation.

A further plan would be to place the gas engines and electric generators in a station corresponding to that now selected for steam engines, and to operate the gas engines by means of what is known as producer gas, requiring less than 1 lb. of coal per H P. developed. But for simplicity and certainty of operation, the Westinghouse Company considers the central station gas generating plant, with mains for carrying the gas to the engines, to be the most reliable and attractive plan, after a long consideration of the subject, and especially in view of the value of the by-products recovered in large gas plants.

The equipment of a short country railway line in Long Island, near New York, affords a striking instance of what can be accomplished by a Westinghouse gas engine. The line is 8 miles long, and rises 165 feet, with gradients running up to 1 in 22. It carries three cars in the summer and one only in the winter, so that for variability of load the conditions are about as severe as they can possibly be. A Westinghouse gas engine plant is used in the generating station. There is a battery (chloride) in parallel with the two Westinghouse dynamos. With a car mileage of 200 miles per day, the gas consumption is 46 cubic feet per car-mile, and the operating expenses, including wages of motor men and conductors, are 6½d. per car-mile. Gas is taken from the mains of the local company, which charges 3s. 9d. per 1,000 feet. The line is the property of the Long Island Railroad Company, to whom it is specially valuable, as it brings traffic to feed their main railway.

All gas engines, except the Westinghouse, are governed on the "hit-and-miss" principle. It will be readily understood why the "hit-and-miss" type of engine is not suitable where a uniform speed is required, and why it is that but few engines of this type are running in connection with dynamos for extensive electric lighting purposes.



Westinghouse 650-b.h.p. Three-Cylinder Gas Engine, Direct Connected to an Electric Generator. This is the largest Gas Engine ever made.

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The "hit-and-miss" gas engine must have heavy fly-wheels, and a heavy balance wheel is usually mounted on the jack-shaft, in order to obtain an approximately steady speed. Some outfits of this kind even have a small fly-wheel on the armature shaft. This arrangement takes up a great deal of floor space. The flapping of the engine belt, due to the irregular motion of the gas engine, together with the ordinary hissing sound from the two belts, makes the old-fashioned plant a very noisy one. The variation in the voltage on a 100-volt circuit is generally 3½ to 4 volts during the cycle. That is, when the engine takes in a few charges successively the voltage is steady and rising, but when the engine omits one or more charges, a momentary variation in speed is the result, and fluctuation is apparent in the lights.

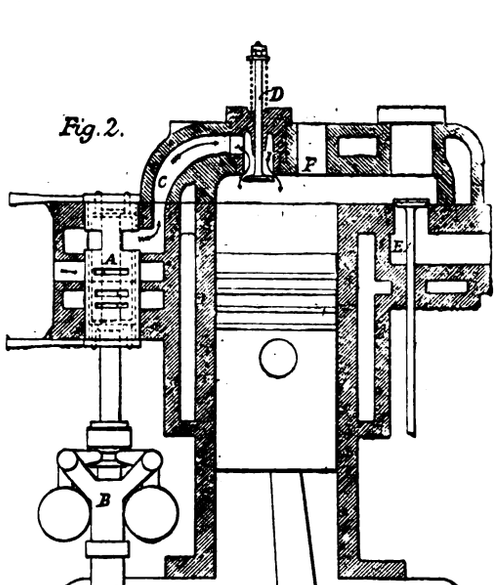
This introduction of extra belts, shafting and masses, causes quite a loss in power. The power absorbed by the two belts is approximately 7 per cent., and by the jack-shaft about 3 per cent., making a total of about 10 per cent. taken up by the extra machinery. Even with this auxiliary machinery, the speed of the dynamo is unstable, and the service unsatisfactory. The "hit-and-miss" type of engine is, therefore, limited to work where steady speed is not necessary or required.

Recent developments have proved that the Westinghouse engine is admirably adapted for electric lighting, as its economy is very high, and its speed regulation as good as that of a first-class steam engine, as we have before said. The electric business stimulated experiments in the direction of producing this gas engine, which is the only one that has yet been direct-connected to an electric generator. In contrast to the "hit-and-miss" type, Westinghouse gas engines have the armature on the crankshaft, direct-coupled, or directly belted, precisely as in the case of the steam engine.

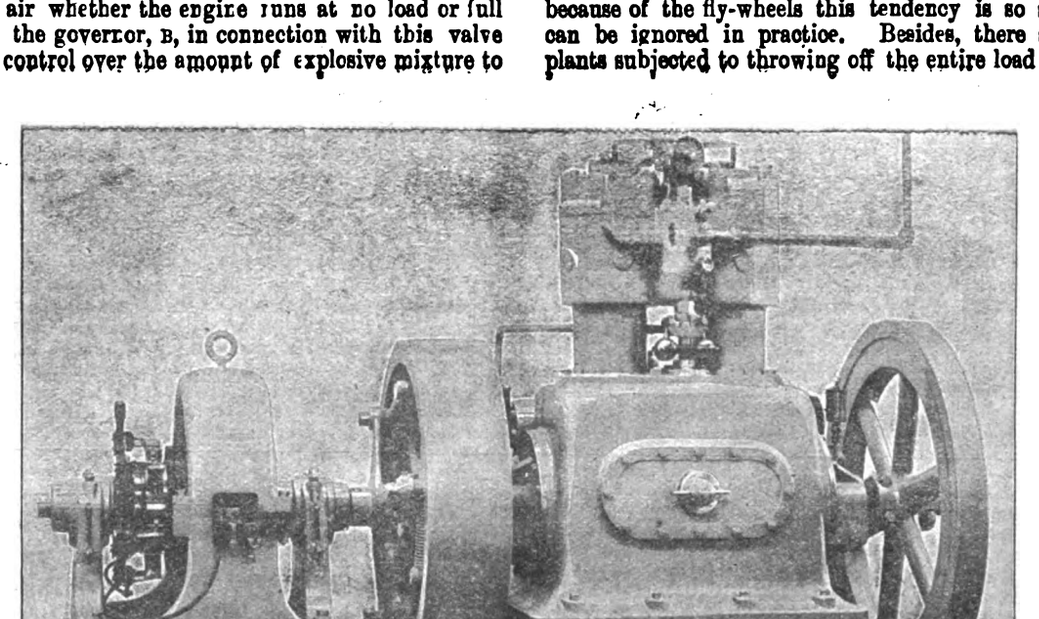
Figure 2 illustrates a gas engine cylinder and mixing valve of the Westinghouse type which proportions the charge in accordance with the load. The gas and air are mixed in the cylindrical mixing valve, A, in the proper proportions at which the valve is set. This ingenious device is in reality a proportional meter, and preserves the proportions between the gas and air whether the engine runs at no load or full load. Thus the governor, B, in connection with this valve has absolute control over the amount of explosive mixture to be taken into the cylinder through the channel, C, and inlet valve, D. The charges are ignited by an electric igniter, located at F. This igniter, which is fully patented, differs from all other igniters in the respect that it is duplex, and the bonnet covers two separate mechanisms. This construction makes it possible to change the connections of the wire from the battery to either set of terminals while the engine is running. If desired, both sets of terminals can be used at one time, thus insuring absolute certainty of ignition. This is often done in large electric station work.

This mode of governing is similar to that of the steam engine, and for picking up a heavy load it is even superior. As all charges are proportioned to the load, if the load is suddenly thrown off, there is one heavy charge, already

Fig. 2.



locked in, which cannot be removed, although the governor acts instantly; and there may be another under way which may be partially reduced by the action of the governor. This tends to speed up the engine a trifle above the normal, but because of the fly-wheels this tendency is so slight that it can be ignored in practice. Besides, there are very few plants subjected to throwing off the entire load at once.



Two-Cylinder Westinghouse Gas Engine, Direct Connected to an Electric Generator.

The gas consumption varies with the kind of gas used, and with the size of the engine, up to certain limits. The average performance of the Westinghouse gas engine, say, from 20 H P. upwards, is 10·5 to 12 cubic feet of natural gas per brake H.P.-hour. According to numerous tests with the Junker calorimeter, it has been found that the average heat value of natural gas is 1,000 British thermal units per cubic

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foot. That is, the engine requires 10,500 to 12,000 British thermal units for each brake H.P.-hour, giving a heat efficiency at the shaft $\frac{33,000 \times 60}{778 \times 10,500} = 24{\cdot}24$ per cent. and 21·21 per cent. respectively. These figures represent the every-day performance of the engines while in the hands of customers.

Some special Westinghouse gas engines have been built which have given much better results than those above-mentioned. A 125 brake H.P. gas engine gave the phenomenal economy of 9 cubic feet per brake H.P.-hour. This gives an efficiency at the shaft of $\frac{2,545}{9,000} = 28{\cdot}3$ per cent.

These are good results, but they are not as good as may be expected later on. It is firmly believed that the every-day performance of the Westinghouse gas engine will, within a short time, reach 33⅓ per cent.

A 65-H.P. Westinghouse gas engine, owned by the Consolidated Gas Company, of New York, and driving a No. 10 Sturtevant fan blower, made the following record on its first run:—

Hours run.	Hours shut down for.					Total hours shut down.
	Changing igniters.	Taking up bearing.	Painting.	Repairing blower gates.	Changing gas connections to works.	
3,058	26½	12½	179	5	7	230

Engine ran 93 per cent. of the time.

Engine shut down 7 per cent. of the time.

Shut down for causes due to engine less than 1¼ per cent. of the time.

Engine ran without stopping from 10 a.m. January 23rd to February 19th, which equals 638 hours, or 26 days and 14 hours.

On the second run it worked 1,000 hours without stopping, according to the latest report from the engineer in charge.

When Mr. Westinghouse commenced experiments in the gas engine field, he foresaw a large demand for the gas engine in electrical work. Experiments on a large scale were undertaken, both on compound and single-expansion engines. The work was hard and trying, as the obstacles to overcome were numerous, but the results have been gratifying. In the early part of the spring of 1898 an engine of 650 brake H.P. was completed in the works of the Westinghouse Machine Company at Pittsburg. One of the pictures shown illustrates this engine operating a direct current 500-volt "engine type" generator. This engine is of the three-cylinder type and has a speed of 150 revolutions per minute. After it was thoroughly tested, it was erected in the power house of the Westinghouse Electric and Manufacturing Company at Pittsburg, where it has ever since been running in regular commercial service of a severe character. The engine is direct connected to an electric generator, and runs in conjunction with one or two steam engines, according to the call on these units for electric currents. This engine is by far the largest gas engine in the world. But it will not long enjoy the distinction of being the largest. The Westinghouse Machine Company are now building a 1,500 brake H.P. gas engine. This is also of the three-cylinder type, and it is designed to run 100 revolutions per minute. Remarkable economy is expected from this engine, as every possible care is being taken to make it a model of modern gas engine engineering. It would not be surprising if this engine developed a brake H.P. for every 8½ cubic feet of natural gas consumed per hour, or 8,500 British thermal units per brake H.P.-hour. This would give a heat efficiency of $\frac{2,545}{8,500}$ = about 30 per cent. at the shaft. Gas engines of such efficiency in large units will undoubtedly compete successfully with the best steam engines. A gas engine of such size and efficiency will run day in and day out on less than 1 lb. of coal, burned in a good producer gas plant, per brake H.P.-hour. This includes banking of fires and similar losses. It would have to be a high grade steam engine and boiler plant that would regularly produce a brake H.P. for 2 lbs. of coal per brake H.P.-hour—twice the amount of fuel required by the gas engine under similar conditions. The gas engine is no longer limited to special power purposes. It can hold its own as a prime mover, and can be used for almost all purposes for which the steam engine can be used.

REVIEWS.

Management of Engineering Workshops. By Arthur H. Barker. Manchester: The Technical Publishing Company. 1899.

This is one of the many technical manuals by the same publishers, and it is fully up to the standard of its predecessors; it deals with a subject that is often a sealed book to engineers. The book is more especially designed for small workshops, though not for the smallest. As the author very properly observes, a small works has more reasons than a large works for falling behind. Founded, perhaps, by some vigorous man, it is kept moving by the energy of a single individual, and with his departure or death, the motive power is much reduced. Then in a small works which is running successfully there is usually to be found some man who knows everything. He can find every drawing, knows every pattern, and why and when it was made, and generally he is the one man to whom everything is referred. But it is dangerous to lock up in one case the whole of the drawing list and pattern register, and the chief draughtsman and manager, and some system ought to prevail even in small works which will permit of the death of a man or his departure without stopping the concern or causing serious loss. In a large works the individual is of less proportionate account, while there is bound to be a system, and a large works will run a long time without great ability at its head, by virtue of momentum. So far as management can be generalised, we think it has been in the book before us. One of the difficulties in management is the stores, and in a little shop it is difficult to run the stores in the same efficient manner that is the case in a larger workshop. The workmen themselves are the worst obstructives to proper management. If a workman is made to sign for any special tool out of stores, he thinks he is being badly treated; he is quite unable to realise the importance of system. But a stores is fully as important in a small as in a large works. There is no room to-day for shops where each man takes his own chisels to the smithy for dressing and proceeds to grind them. The author has clearly had opportunities of observing the inner working of the shop. His remarks on the hoarding and guarding of tools by individual workmen proves this. In the reviewer's own experience he has known one man to possess from one to two hundred cold chisels, and none of these were allowed to be handled by other men. In fact, he had himself something like 50 flat chisels in his own tool chest, so that the stock of chisels held by 20 or 30 men is liable to be very large. Properly managed, half a dozen per man would meet all contingencies even with out-workers.

The author's remarks on the timing of jobs for costing are good. On economy, too, he is good, especially in regard to the use of superior and costly steel for tools, whereby greatly increased output is rendered possible. Cheap steel cannot pay if it is of low quality, as it usually is. Here are the author's remarks on the means necessary to secure large output:—(1) Broad belts and high speed and fairly flat faced pulleys; (2) the best possible quality of tool kept flooded with lubricant, which should be properly laid on in pipes and circulated and filtered; (3) stiff and strong machines; (4) properly arranged and supported work.

From these few abstracts it will be seen that the book is something more than a book for the prime cost clerk. Its value is largely technical. There is little in it for the book-keeper. It deals rather with the subject in a way that other similarly entitled books do not touch or attempt, and should be in the hands of all managers who do not feel quite satisfied of their own perfection, as even for men of experience there is something to be here learned.

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Text-Book on Applied Mechanics. By Andrew Jamieson. Vols. I. and II. London: Griffin & Co. 1899.

The author's intention in these books has been to provide for the wants of second and third year students, a book on applied mechanics, to match his other works on the "Steam Engine" and on "Elementary Mechanics."

The general plan of the work may be said to be the describing of certain practical pieces or parts of machinery, and showing how and in what way the principles of mechanics are carried out in their working. It is exceedingly difficult to write a book for engineering students, because it is not easy to know the drift of the average student's mind. One of the chief faults in the books of professors is the lack of proportion which they show. Young students are particularly lacking in the sense of proportional importance of details, and the professors do not seem to give them much help. In the book before us we find this fault to less extent than usual, and also, so far as we note in going through more familiar figures in the pages before us, the figures of practice seem reasonable, and the author has made free but legitimate use of the tables of strength and sizes furnished by practical engineers. A few errors have, perhaps, crept in. We note one of small importance. The wheel teeth known as Gee's are not of recent introduction, but have been in use now many years, and we are only surprised there are not more of them.

The author cannot let slip the opportunity of referring to the Field engine, that combined steam and hot air contrivance on which so much has already been spent, and the importance of which, in the author's eyes, seems to your reviewer somewhat indicative of the professorial lack of idea of proportion above referred to. We hope the space he gives to the Field engine will not mislead his young readers. We feel inclined to forgive him his reference to the poundal in a book for engineers, because he really makes a good and brief explanation of the term, and does not fall into the usual professorial error of losing his temper over the coarse methods of engineers who employ for their approximate calculations the sufficiently approximate weight in place of the variable g—or ought we to say the invariable g?

Volume II. deals with a variety of subjects in a somewhat mixed manner, beginning with a chapter on motion and energy, illustrated by reference to the fly-wheel and the governor and centrifugal extractors, and passing then to graphic statics and the calculation of stresses in framed structures, and finally to hydraulics and hydraulic machinery, with practical illustrations from turbine work, and centrifugal pumps.

There are some merely pictorial illustrations, but these are fairly well chosen, as showing the forms which are taken by practical machines.

The work, on the whole, is one we are inclined to consider in a fairly favourable light, though it traverses ground already trodden hard, and it is difficult to see the need for so many books on mechanics.

Parents tell us that their boys at school are compelled to buy too great a variety of books, and there does seem to be some sort of tacit understanding as regards the use of books by different authors. Text-books for educational purposes ought to be few and standard.

CORRESPONDENCE.

Engine Tests.

I enclose you copy of the tests of some engines which I conducted at South Shields. You will perhaps remember that in my paper before the M.E.A. last year, I mentioned the tests of some engines which we had here previously. These tests, which I now send you, are the tests of similar engines, only double the power.

These engines were especially designed to be economical over a large variation of power, and you will find, I think, that they have fulfilled these conditions to a remarkable degree.

The governor on both the engines was not set exactly alike, for whereas engine 636 is most efficient at light loads, engine 634 is most efficient at the higher loads. The tests of 634 were taken first, and it was thought it would be better to alter the governor before 636 was tested, but you will see that there was not really much in it, because though there was a gain in one there was a loss in another.

I ought to mention that engine 634 had been running for some three months, whereas engine No. 636 had not been running more than a fortnight.

The contractors for the combined plant obtained a bonus on each plant of £100, as the contract provided that the steam consumption per kw.-hour should not exceed 25 lbs. of steam, and the contractors would receive £50 bonus for each complete pound below this consumption, the consumption to be the average of the consumption at full, three-quarter, and half loads. Trusting that this may be of interest to some of your readers.

Jos. A. Jeckell.

South Shields, *July 20th*, 1899.

South Shields 200 kw. Ferranti-McLaren.—Official Test.
Engine No. 636. Alternator No. 294.

Load.	20 % over.	Full.	¾	½	¼
Date	24 11 98	21 11 98	18 11 98	16 11 98	23/11/98
Time	2 hours	5 hours	5 hours	5 hours	4 hours
I.H.P.	363·25	315·45	259·68	172·59	122·82
kw.-hours	220·5	188	147	99	55·25
Revolutions	123·0	123·04	127·19	123·17	125·69
Water per I.H.P. ..	13·80 lbs.	13·26 lbs.	13·05 lbs.	13·41 lbs.	13·38 lbs.
" " E.H.P. ..	16·95 "	16·6 "	16·12 "	18·4 "	21·77 "
" " kw.-hour..	22·7 "	22·24 "	23·06 "	23·62 "	29·55 "
Combined efficiency..	91·4 %	79·88 %	75·8 %	76·6 %	60·4 %

Average water per kw.-hour at full, ¾, and ½ loads.

Full load ..	23·24 lbs.
¾ " ..	23·06 "
½ " ..	23·62 "
	3)68·92 lbs.
Average per kw.-hour =	22·97 lbs.

South Shields 200 kw. Ferranti-McLaren.—Official Test.
Engine No. 634. Alternator No. 282.

——	20% over.	Full.	¾	½	¼
Date	12/11/98	14/11/98	11/11/98	10/11/98	12/11/98
Time	2 hours	5 hours	6 hours	6 hours	4 hours
I.H.P.	375·55	322·45	255·5	176·3	104·64
kw.-hours	228·5	198·6	152	95·16	54·25
Revolutions	124·7	124·63	124·78	124·92	124·7
Water per I.H.P. ..	13·2 lbs.	13·06 lbs.	13·18 lbs.	13·87 lbs.	14·65 lbs.
" " E.H.P. ..	16·33 "	16·23 "	16·5 "	18·49 "	21·09 "
" " kw. ..	21·88 "	21·75 "	22·11 "	24·7 "	28·26 "
Combined efficiency	80·9%	80·5%	79·7%	74·3%	69·48%

Average water per kw. at full, ¾, and ½ loads.

Full load ..	21·75 lbs.
¾ " ..	22·11 "
½ " ..	24·7 "
	3)68·56 lbs.
Average per kw.-hour =	22·85 lbs.

The Electric Lighting of the City.

The evidence brought forward by the City of London Electric Lighting Company before the House of Commons Committee was mainly directed to show that this company had laid out capital on the faith of the contracts with the Corporation, and had therefore laid mains and made provision for the lighting of all thoroughfares and minor streets, courts, and alleys, and the action of the Corporation in repudiating these contracts looks uncommonly like a great injustice.

It seems strange that the Charing Cross Company have sufficient faith in the Corporation to arrange terms with them, for it is quite clear that as they have not hesitated to break their faith with this company, there is no guarantee that they may not find it to their interest to deal equally cavalierly with the Charing Cross Company. The whole thing seems to be one more instance of the fact that individual morality is quickly lost when hidden by the cloak of civic honours, and men do not hesitate to do things in a corporate capacity which they would never dream of in carrying on their own business.

I send you herewith a chart showing an analysis of the

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SUMMARY OF VARIOUS ELECTRIC SUPPLY COMPANIES' RESULTS COMPILED FROM PUBLISHED ACCOUNTS.

1898.

Name of company.	Lamps connected.		Highest load in kw.	Lamp factor allowing 10 per cent. loss at F.	Capacity of plant installed in kw.	Capital.	Capital cost per kw. installed.	Total B.T.U. sold.	Units sold per average lamp connected.	Yield per average lamp connected.	Capital cost per lamp installed at end of year.	Per cent. yield to capital.	Price obtained per unit.	Units per kw. of plant installed.	Value of load diagram. Aver. load / Max. load.
	Connected to Dec. 31st.	Average lamps connected.													
Charing Cross	134,236	120,889	2,176	43·8 %	3,120	£409,383	131	3,246,231	26·85	9/9	3 38	14 4 %	4·361	1,040	17·03
City of London without street lighting ...	355,825	323,595	7,809	59·25 %	11,660	1,244,754	106·7	5,837,317	18·04	9/4	3 84	12·15 %	6 22 %	500	8·53
Westminster	339,986	315,273	4,400	34 94 %	5,658	626,365	110	5,065,195	16·2	7/1	1·98	17 88 %	5 25 %	895	13·14
Metropolitan	430,000	395,000	6,868	43·1 %	8,265	993,761	120	6,845,066	17 3	7/5	2 31	16 07 %	5 17 %	828	11·38
City Company with Charing Cross lamp factor and similar load diagram.	355,825	323,595	5,761	43·8 %	8,040	918,168	114·2	8,688,525	26·85	6/3 7/5	2·59	12 15 % 14 4 %	2·80 3 32	1,080	17 03
City Company with Westminster lamp factor and similar load diagram.	355,825	323,595	4,615	34·9 %	6,441	735,562	114·2	5,242,239	16·2	5/0 7/4	2 03	12·15 % 17 88 %	3 71 5·45	814	13·14
Charing Cross Company with City Company's lamp factor and similar load diagram.	134,236	120,889	2,950	59·25 %	4,230	554,720	131	2,180,837	18 04	10/0 11/11	4·13	12·15 % 14 4 %	6 67 7·91	515	8·53
Westminster Company with City Company's lamp factor and similar load diagram.	339,986	315,273	7,445	59·25 %	9,572	1,052,920	110	5,687,524	18·04	8/1 11/11	3 34	12·15 % 17·88 %	5·4 7·91	594	8·53

COMPARISON OF ABOVE RESULTS.

ASSUMING SAME NUMBER OF LAMPS, SIMILAR CAPITAL COST PER KW. OF PLANT, GROSS YIELD OF 10 PER CENT. ON CAPITAL, AND SHOWING PRICE NECESSARY FOR 10 PER CENT. RETURN.

Name of company.	Lamps connected to Dec. 31st.	Average lamps connected.	Highest load in kw.	Lamp factor.	Capacity of plant installed in kw. 10 per cent. spare.	Capital.	Capital cost per kw. installed.	Total B.T.U. sold.	Units sold per average lamp connected.	Yield per average lamp connected.	Capital cost per lamp installed at end of year.	Per cent. yield to capital.	At price which must be charged to obtain 10 per cent. gross returns on capital.	Units per kw. of plant installed.	Value of load diagram. Aver. load / Max. load.
1897.															
Charing Cross district	100,000	84,163	1,277	34·4	1,419	£177,375	125	2,432,310	28·9	4/2½	1·77	10 %	1·75d.	1,714	21·9
City of London „	100,000	91,840	2,442	65·9	2,713	339,125	125	1,683,232	18·4	7/4	3·39	10 %	4·83d.	620	7 93
Westminster „	100,000	92,900	1,257	33·9	1,397	174,625	125	1,523,560	16·14	3/8	1·74	10 %	2·75	1,090	13·62
1898.															
Charing Cross district	100,000	90,053	1,618	43·8	1,798	197,780	110	2,418,923	26·85	4/4	1 97	10 %	1·96	1,345	17·03
City of London „	100,000	90,940	2,193	50·25	2,437	268,070	110	1,640,557	18·04	6/10	2 68	10 %	3·92	673	8 53
Westminster „	100,000	92,735	1,258	34 9	1,398	153 780	110	1,502,307	16·2	3/3	1·53	10 %	2 45	1,074	13·14
Metropolitan „	100,000	91,860	1,597	43·1	1,756	193,160	110	1,589,178	17 3	4/2	1 93	10 %	2 91	905	11·38

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working results of four companies, with certain deductions to be drawn therefrom, and I think they reveal many facts which ought to be placed before shareholders of these undertakings and intending investors in this absurd competition. The wicked waste of money in duplicating mains and plant cannot bring good to anyone; though, in the first instance, there is bound to be a considerable reduction to customers, the duration and extent of which will depend upon the length of the respective purses of the competitors.

It is, of course, obvious that having provided plant of 11,000 KW. with 3,000 KW. of plant coming in, say, 14,000 KW. altogether, the City Company cannot afford to allow a competitor to enter the field with new armour and unfettered by any pioneering expenditure, &c., without making a desperate struggle for existence. I shall not, therefore, be surprised, now that the House of Lords has allowed the Bill to pass, to find the rates cut down below a remunerative return, and if the public are tempted to invest money in the Charing Cross Company under such conditions, it seems deplorable that no guiding and helping hand should be extended to warn them of their fate.

The position of the Charing Cross Company is certainly rather peculiar at the present time. They came into existence and found they could only live by over running districts cultivated and pioneered by other companies. They have secured a lucrative return in their St. Martin's area, with considerable profits from the Strand area, and have lately commenced the foolish policy of further incursions, which has compelled them to expend large additional capital in the St. Giles district, which is at present unremunerative, and for which the prospects are very poor. They continually assert that they are competed with by the Metropolitan Company, but this is true only in theory, as the Metropolitan Company have not yet been in a position to fight them on their own ground; but as the new Holborn Street is now decided, the Sardinia Street works will be reconstructed, and with the help of the large modern works at Willesden there is a certainty of a warfare of rates which will surprise not only customers but possibly shareholders. The effect of this will be, that the Strand Company will no longer be able to rely upon their present lucrative districts to assist them in fighting the peculiar districts of the City, and it may confidently be expected that they will suffer, and bring discredit upon electrical enterprise as a safe investment for capital.

It is difficult to believe that a rate of 4d. per unit in the City is equivalent to 2d. per unit in the Strand area, but when it is considered that the City lighting calls for no less than 60 per cent. of the lamps connected to be in use at one and the same time, it is clear that very nearly double the plant is necessary for the City lighting to that required in the Strand district.

This peculiarity, of course, only affects the question of capital, and the return on this capital is seriously prejudiced by the peculiar conditions of the supply. The revenue from the lamps connected is practically negligible for the two summer quarters, and is confined to five days in the week for the winter six months. During this period the plant must always be ready for use, and sudden demands render economical working extremely difficult. The City Company have, therefore, large plant and little return. The gross yield in units per KW. of plant installed being, for the year 1898, 1,040 in the Charing Cross Company, and only 500 in the case of the City Company.

From these facts it is evident that a much broader view must be taken of the matter than is usually given to matters of this kind. It is not a question of a few decimals of the works costs or the relative merits of systems of supply; all that is required being some clear conception of the actual yield per KW. of plant.

Pray pardon the length of this letter, and if I have succeeded in securing your assistance in warning the public against recklessly squandering their money in a badly judged and unnecessary competition, I shall be more than satisfied if you can do anything to avoid such a disastrous complication of results.

Statistician.

P.S.—It has been stated that a reduced charge increases the yield, facts and proofs show otherwise. Cheaper supply will not alter hours of sunset, nor increase working hours in offices, &c. Published accounts show:—

	Year.	Units sold per lamp.	Hours each lamp used per day.		Price charged per unit.	Yield per lamp.	
			hrs.	min.		s.	d.
Charing Cross Company	1896	30·7	2	31	4·70d.	12	8
	1897	28·9	2	23	4·49d.	10	9
	1898	26·9	2	12	4·36d.	9	9
City Company	1897	18·4	1	30	7·36d.	11	2
	1898	17·9	1	28	6·24d.	9	3

Thunderstorms and Wireless Telegraphy.

On the evening of Friday, the 21st inst., at about 9.30 p.m., a severe thunderstorm appeared to be raging over Tor Bay; a number of flashes being visible, and distant thunder distinctly audible.

Experiments were made with a coherer consisting of five brass filings, which had been exposed to air for four days and nights, and an unexhausted tube.

When this was connected in series with a single quart Leclanché cell, a telephone receiver, and a galvanometer, a 50-foot vertical wire being used, most distinct readings were obtained; the galvanometer, which was not at all sensitive, often being deflected 80°.

A large number of readings were obtained when there were no visible flashes; but when a visible flash did occur, an instantaneous effect was shown in the instruments. This storm passed away about 11 p.m., after which time there were hardly any readings obtained for about half an hour.

Between 11.30 p.m. and midnight readings were again obtained, sometimes with distinct thunder, but with no visible lightning. From these readings it was calculated that the storm was 20 or 30 miles away when first observed, but this is not certain. As the intervals between the signals given by the instruments and the distant thunder were getting less, this was expected to be a fresh storm approaching, and as the wind was then S.S.W., it was looked for in that quarter.

At about midnight the readings were very marked. Just before 1 o'clock flashes were seen towards the S.W. It was then noticed that sounds were heard in the telephone receiver before the eye had time to appreciate the flash.

As this storm came nearer, the effects became rather weaker, a few of the brightest flashes taking no perceptible effect. The flashes then became so frequent that observations were stopped at about 1.30 p.m.

During these observations it was found that the earth connection was quite superfluous, but no results were obtained without a vertical wire.

No wings or extra capacities were used.

Similar results were obtained to-night with a vertical wire of 20 feet. The results, however, were far less constant, perhaps owing to the storm being partially overhead.

R. H. Martin.

Totnes, *July 22nd*, 1899.

Situations Vacant.

Having read the article headed "Situations Vacant" by "Trolley," I can thoroughly endorse his views.

I also am out of a berth through the failures of firms by whom I was engaged. I have had a first-class all-round experience in both light and heavy electrical engineering for 20 years. Have held posts of works manager and chief works electrician. Have designed dynamos, motors, &c., erected power transmission and lighting plant, &c., and hold first class testimonials. In spite of all this, although I have answered scores of advertisements, I rarely, if ever, receive the courtesy of a reply, or, if I do, find that they expect a "manager" for about 30s. per week or so.

I am debarred from taking a post in a central station, as the advertisements always state "must have had central station experience," notwithstanding the fact that many pupils who have learned their profession under me have succeeded in being admitted.

I recently replied to an advertisement with the usual result of no reply, and eventually discovered that the man for the post was actually chosen *before* the advertisement was sent for insertion; this only being done to delude the

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directors. It seems a matter of pure chance as to one's application being taken notice of or not.

If only there could be some qualifying examination by some such authority as the Institution of Electrical Engineers, giving diplomas or certificates as to one's actual knowledge and abilities, then the really competent man might stand a chance.

As matters are at present, unless one has either money or influence, actual knowledge and ability counts for little or nothing.

I am sure there are numerous employers who would be glad to know of able men, but for want of suitable means of coming into touch, such as an official bureau or the like, have to take their chance.

It is not always the one who gives the best reply to an advertisement who is the best man for the job.

Disheartened.

Electrolytic Recovery of Zinc.

Referring to the above-mentioned article and the letters that appeared in your issue of July 21st, I am glad Mr. Kershaw has quoted the extract from the *Times*, April 5th, as it gives one an opportunity of comparing his remarks with those from which he obtained his information. Of course, the locality where the trial took place is of secondary importance, except as it relates to the accuracy of Mr. Kershaw's statements.

Sherard Cowper-Coles.

PARLIAMENTARY COMMITTEES.

Charing Cross and Strand Electric Supply Company's Bill.

A Committee of the House of Lords, presided over by Lord Ribblesdale, commenced the consideration, on Monday, of the Bill promoted by the Charing Cross and Strand Electric Supply Company to confirm the provisional order granted by the Board of Trade giving the company power to supply electric light within the City of London. Mr. Pember, Q.C., Mr. Shiress Will, and the Hon. Sydney Holland, appeared for the Charing Cross Company; Mr. Pope, Q.C., Mr. Balfour Browne, and Mr. J. Roskill, were for the City of London Electric Lighting Company, who opposed the Bill; and the Corporation of the City of London, who also opposed the confirmation of the order, were represented by Mr. Littler, Q.C., Lord Robert Cecil, Q.C., and Mr. A. J. Walter.

Mr. Shiress Will opened the case for the Charing Cross Company, and said the contest had been fought twice before, and on each occasion the company he represented had been successful in the contest. Having gone over the chief points which arose at the inquiry held by Sir Courtenay Boyle at the Guildhall, he went on to trace the history of the Charing Cross Company, and showed that in each of the districts where they were now established there was competition. They were prepared to answer any criticism as to their position, character, activity, and energy. The average price which they charged over their areas was 4·36d. per unit as against 6·22d. per unit charged by the City of London Company. It was to the lowness of their charges, coupled with the admirable nature of their supply, that had resulted in their success. It was proposed in the provisional order to supply light in the City at a maximum of 5d. per unit, reducible to 4d., and to supply motive power at a maximum of 3d., reducible to 2d. per unit. Mr. Will proceeded to deal with the agreements entered into by the Corporation with the Pioneer City Company, and said that a great deal had arisen over the words in the agreement by which the Corporation undertook to grant a monopoly to the company, "so far as they are able to do so."

The Chairman: So far as they are able to do so. Is that limited by the first section of the Act of 1888?

Mr. Will: That is what it means.

Mr. Balfour Browne: We do not admit that for the company.

Mr. Will next dealt with the question of the illegality of the agreement entered into between the company and the Corporation.

Mr. Pope said Mr. Will should state that it was through no fault of the City of London Company that the agreements might be invalid. It was simply that an Act which governed the Commissioners of Sewers prevented them from entering into a contract with any one of their members, and it happened that Alderman Sir Joseph Savory was a shareholder in the company, and the question was whether that invalidated the whole contract.

Mr. Will: The whole thing is utterly immaterial to me, and I will tell you why.

The Chairman: If it is immaterial, I do not know why we should hear it.

Mr. Will said if the agreements were invalid there was an end of the matter. If, on the other hand, they were valid, then the hands of the Corporation were tied to their exclusive grant, and then the Public Act of 1888 came in, and that could not be over-ridden by any agreement between parties. Several matters were left over by Sir Courtenay Boyle for future settlement, and these matters, viz., the time of purchase, the site of the generating station, and other matters had since been settled by the Board of Trade.

The Chairman: Do I understand that your company and the Corporation have settled these matters between yourselves?

Mr. Will said it was very difficult to know what the City did mean, but in this matter the terms had been settled by the Board of Trade.

Lord Robt. Cecil: The City of London Corporation oppose the grant of the order.

Mr. Will was proceeding to read the evidence given by Sir Courtenay Boyle before the House of Commons Committee, but—

Mr. Pope objected, and said that Sir Courtenay Boyle was still alive, and could be called.

The Chairman: Yes, we will not have that, I am not very fond of that. We prefer to put our own questions.

Mr. Will next dealt with the petition of the Corporation, and said that the Board of Trade had now made over 500 provisional orders, and the one now granted to the Charing Cross Company was an order of the latest and most improved form. Going next into the petition of the City of London Electric Lighting Company, counsel contended that with respect to the reserve and depreciation accounts of the City Company they were in no worse position than the Charing Cross Company. As to the unique state of affairs stated to exist in the City of London with regard to the nature of the supply demanded, the Charing Cross Company was prepared to face the difficulties and supply at a lower price. His case was for competition, which they had in almost every district in London and which resulted in a better and cheaper service.

Mr. E. Seale (secretary of the Charing Cross Company) gave evidence as to the financial position of the company. They supplied 23 theatres out of 26 in the district, and also many Government buildings. Altogether they supplied 157,000 lamps in their district. They supplied on the continuous system, which was considered best for motive power. They supplied cheaper than any private company in London, and cheaper than any local authority except Shoreditch. He had no doubt but that if they got into the City, the low price they would charge would stimulate a demand.

Replying to the Chairman, Mr. Balfour Browne said that if the agreements were valid between the Corporation and the company, it cut off the City of London Corporation from being a possible competition with the City of London Company.

Lord Glenesk: The local authority is also debarred from buying one or the other company.

Mr. Balfour Browne: Not until 1914.

Mr. W. H. Patchell, engineer to the Charing Cross Electric Supply Company, said there had only been one case in which the company had had trouble with the local authorities in respect to the breaking up of streets. When his company applied for a competing order in the Strand district, they were met with entirely the same arguments with respect to the condition of the streets, but the difficulties were overcome.

The Chairman: You are going to charge 5d. per unit in the City?—Yes.

And you think you can make money out of it?—We do.

Mr. Balfour Browne pointed out that in the case where the company did not carry out the work, the Board of Trade could revoke the order, and the Corporation would buy the undertaking. If that was done the Corporation would take over the powers of the provisional order to companies.

Mr. Will having intimated that this would close his case, a discussion took place as to whether the company or the Corporation should go into their case.

The Committee decided that the Corporation should be heard first.

Mr. Littler, Q.C., then addressed the Committee for the Corporation, and said that no doubt they did use the words that they would allow no interference with the company as far as they lawfully might. They held that if they thought the company had forfeited its privileges, they had the right to set up competition. If the agreement was held to be valid, of course the City would be bound by it. If it was invalid the Corporation desired to be in a position to act as they thought best for the citizens, and to be in a position if they desired to step in themselves. If the Charing Cross Company came in, the Corporation did not know exactly where they would be. If there was to be competition the Corporation should have the opportunity of being the competitor, especially having regard to the condition of the streets. The decision in the other House was not one congenial to the City.

The Chairman: If the agreements are valid, is it in your mind to invite competition?

Mr. Littler: If the agreements are valid we shall be out of it, and it will be for this company to come again if they like.

Mr. Balfour Browne (for the company) said he would first call evidence.

Mr. Geo. Herring, a director of the City of London Electric Lighting Company, said the conditions of supply were different in the City than in any other district. Consequently, there had to be a large capital expenditure for the purpose of supplying for a very short period each day. He and his friends who subscribed a great deal of money only raised that money on the strength of the agreement with the Corporation to give a monopoly for 21 years.

The Chairman: Do I understand you to go so far as to say you considered yourselves monopolists for 21 years?—Yes, my lord.

Continuing, Witness said that to get that exclusive right the company had given valuable privileges to the City and the public were protected by the sliding scale. If the onerous conditions imposed by the Corporation with regard to reserve and depreciation funds were revoked the company would reduce the price charged to 5d. per unit.

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Mr. J. C. Bull, secretary of the City of London Electric Lighting Company, said the average dividend of the company had been 3·8 per cent. They had 8,000 customers and sold 5,800,000 units in 1898. With regard to the investment of the depreciation fund in gilt-edged securities, the opinion of Mr. Cripps, Q.C., had been taken on this matter since the House of Commons inquiry, and he had held that the company were quite right in so investing the fund.

The Committee adjourned.

The Committee resumed the consideration of the Bill on Tuesday, when Mr. F. Bailey, engineer of the City of London Electric Lighting Company, was called, and in answer to Mr. Roskill, produced charts showing the maximum demand for electricity in the City, and the daily load curves, showing the peculiarity of the demand in the City. Whereas in the City they had 60 per cent. of their lamps connected at the same time, in the West End there was, as a rule, little more than 33 per cent. connected. He explained the way in which the City was parcelled out into districts, so that the failure of supply in one district would not affect the others. Culverts had been laid in every street, so that now, when fresh customers were added, there was practically no disturbance of the streets. If they were relieved from the onerous condition of investing balances in gilt-edged securities they could supply electricity at 5d. per unit.

By Mr. Will: He did not think the Charing Cross Company fully realised the difficulties they would have to meet in the City. They could not have used batteries for storage because of their price until just recently. At present, the Metropolitan Electric Lighting Company had not actively competed with the Charing Cross Company in St. Giles and Holborn, but they would soon be able to do so, and then the Charing Cross Company would know what competition meant.

Re-examined by Mr. Balfour Browne: Batteries at one time were prohibitively expensive, now they were better and cheaper. They had applied to the Board of Trade to use the continuous current, and had it not been for the Corporation putting a spoke into their wheel, they would have had the continuous current in use now.

Replying to the Chairman, Mr. Will said the Charing Cross Company was quite prepared to insert a clause in a provisional order binding themselves absolutely not to combine in any way with another company in the City.

The Chairman (to witness): Is it a matter of fact, that if the Charing Cross Company came in, at all events up to 1914, they will have the best of the handicap to the extent that these onerous burdens with regard to the investment of the depreciation fund will not be imposed on them?—That is only one part of the burden.

But it is a very essential part of the handicap?—I think it is.

Mr. S. Morse, solicitor, who acted for the Pioneer Company in the negotiations with the City Corporation in respect of the agreements entered into, stated that in principle it was not the practice of the Board of Trade to dispense with the consent of the local authority.

The Chairman: Would you not infer that the Board of Trade had very strong reasons for dispensing with the consent of the local authority in this case?

Mr. Freeman, Q.C.: The inference is that the Board of Trade has made a mistake.

Mr. D. J. Ross, engineer for the Corporation of the City of London, was examined as to the state of the streets in the City, and said that in many of the principal streets it would be impossible to place any more pipes under the footways.

Lord Kelvin gave evidence as to the abnormally high peak existing in the City. A remunerative load could only be obtained during the winter months, and during the rest of the year he believed the supply was worked at a loss. Owing to the peculiar nature of the demand in the City it meant having double the quantity of machinery to that which would be sufficient in other districts, and this led to a large capital expenditure. In his opinion, if competition was allowed, it would be disastrous. The difficulties would only be increased by dividing the responsibility, and the public would be bound to suffer in the end. The inevitable end would be the buying up of the two companies by the Corporation at a greater price than they would have to buy the one company.

Cross-examined by Mr. Pember: He was against competition where competition was not for the benefit of the public. He believed that in the Strand it would have been better if one company had been allowed to go on. He thought the Corporation of the City ought to take up the whole undertaking now.

The Chairman asked Mr. Pember if the clause in the Charing Cross provisional order which provided for purchase by the local authority was a model clause.

Mr. Pember said it was, so far as regarded the possibilities of purchase, but it differed in respect to the period and conditions. Sir Courtenay Boyle only thought fit to give them a period of 14 years before the local authority would have the power of purchase, and that in consequence the City should give the 10 per cent. on the capital expenditure properly so found, and bring up the dividend to 4 per cent. during the interval.

The Chairman asked if that met the views of the City?

Lord Robt. Cecil said that if ever they got to the clauses generally speaking the clause would meet the wishes of the City.

Mr. Balfour Browne, Q.C., then addressed the Committee for the Corporation, and contended that the provisional order had been granted to a considerable extent under a misapprehension. He thought, with all respect to Sir Courtenay Boyle, that he had totally misread the report of Major Marindin. It was a mistake to say that competition was always a benefit to the consumers, and nothing could be put in that order which would prevent two companies agreeing to a certain price. When the Corporation invited tenders for the supply of electric light to the City it was too careful in the interests of the public. The City imposed conditions on the company, and the depreciation fund was being stored away for the benefit of the City. It was not fair, therefore, that another company should come in and be allowed to compete without having the same conditions imposed on them. What the City of London Company considered they had was a regulated monopoly, and that was only what every gas and water company had. If competition was allowed, the Corporation, at the end of 1914, would have to buy out two companies, and one set of plant must necessarily be useless to the public. The City Company felt that they had perfect security by means of the agreement with the Corporation, which stated that so far as they were able they would give them exclusive rights. Till the change of front by Sir Courtenay Boyle, the consent of the local authority had not been dispensed with. He submitted that his company was under serious disability, and that if the Charing Cross Company came in it would have an unfair advantage. The attitude taken up both by the Board of Trade and the Corporation, was very hard on his company. If the Corporation was not legally bound by the contracts, they were morally bound by them. They had had eight years' good service, and now wished to tear up the contracts. It would be a serious blow to all enterprise if contracts solemnly entered into were to be torn up.

At the conclusion of Mr. Balfour Browne's address the Committee conferred in private, and the chairman afterwards announced that the Committee were of opinion that the provisional order might proceed, but they would wish a clause inserted to be provided in every respect by the Lord Chairman of Committees to ensure competition and obviate combination pending the purchase by the local authority.

Some discussion took place between Mr. Pember and Lord Robert Cecil as to the wording of the clause, and it was agreed to insert words providing that the Charing Cross Company should neither directly nor indirectly associate themselves in any way, or for any purpose, with the City of London Company or any other company, except with the consent of the local authority and of Parliament.

At the suggestion of Lord Robert Cecil words were inserted in the provisional order prohibiting the Charing Cross Company from selling their undertaking in the City.

The other clauses of the Bill were then gone through.

Electric Light Provisional Orders.

The Electric Light Provisional Order (No. 17) relating to Carshalton, Gateshead, Merthyr Tydfil, and Newton Abbott should have come before Lord Ribbledale's House of Lords Committee on Thursday, but all opposition was withdrawn, and it accordingly went through.

South Staffordshire Tramway Bill.

The above Bill came on Wednesday before a House of Commons Committee, presided over by Mr. Seale Hayne, but as no opponents appeared it was struck out of the list, and will thus go forward as an unopposed measure.

Newcastle Tramways.

On Thursday a Committee of the House of Lords, under the chairmanship of Lord Ribbledale, considered the omnibus Bill, promoted by the Corporation of Newcastle-on-Tyne.

Mr. Pember, Q.C., in opening the case for the Corporation, said the Bill was a large one in bulk, but it contained a large amount of uncontroverted matter. Power was sought to lay down 20 miles of double line of tramways, a considerable portion of which would be the reconstruction of the existing tramways, and, further, to work the tramways by any system of mechanical traction including electricity. It was also proposed to light the street lamps by electricity generated in connection with the tramways, and to use electric current for the working of the quay cranes. It was in connection with the lighting and the use of the cranes that the opposition came in from the Electric Supply Company, but he asked the Committee to seriously consider, taking all things into consideration, that company which had a provisional order of the ordinary kind could not fairly be heard against the Corporation measure. All the petitions against the Bill had been withdrawn except that of the Electricity Supply Company. The opposition practically was on one point, viz., whether the company which had the ordinary provisional order for the supply of electricity within the borough of Newcastle were entitled to say that the Newcastle Corporation were not entitled to light their own lamps and work their own cranes.

Mr. Dickinson (for the company): We go beyond that.

Mr. Pember said if that was so he should object more strongly against the company having a *locus standi*. As a matter of fact, the Corporation had an Act empowering them to light the streets, and they could if they liked use gas and refuse to take a single unit of electricity. In 1890 licenses were granted under the Electric Lighting Acts to two companies—one called the District Company and the other the Supply Company, for which Mr. Pembroke Stephens and Mr. Dickinson appeared to-day. It was especially set out, however, by the Corporation at the time that this did not prevent them from granting any further licence, and that showed that no monopoly whatever was intended. It was intended by the Corporation to have the overhead system of electrical traction, and the standards would be used as lamp-posts.

Mr. Pembroke Stephens, Q.C., for the company, said they were empowered to supply electricity for all private and public purposes. His learned friend asked why, having got the power to generate electricity for tramway purposes, why should he not be allowed to go on and light, but, as a matter of fact, the Corporation had got no power whatever until that Bill was carried. Parliament

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was very strong on the point that local authorities should not compete out of the rates with a private company. In this case the Corporation laid down very stringent conditions on which his company was allowed to come into the borough. Having done that it was only fair play that they should be left alone during the term for which their licence lasted. His company had spent £100 000, and would spend £30,000, and as the licence was granted for a shorter term than usual, they should have the opportunity to recoup themselves. A more unfair attack upon a company doing their duty properly he had rarely heard. As far as he knew there was no precedent for taking away the rights of a statutory company in that way.

Mr. Pemberr pointed out that the Corporation only wanted power to supply themselves, and not to compete with the company.

After private conference the Chairman announced that the Committee were of opinion that the company had not established a right to a *locus*.

LONDON COUNTY COUNCIL.

The Council at the meeting on Tuesday decided to lend £10,000 to the Battersea Vestry for electric lighting purposes, and £11,185 to the St. Pancras Vestry, £20,810 to the Shoreditch Vestry, and £26,000 to the Islington Vestry for similar objects.

Telephone Competition.

The adjourned report of the Highways Committee was brought forward, recommending the Council to express the opinion that it was undesirable that, as regarded the area of the county of London, the existing license of the National Telephone Company should be extended for a further period beyond the year 1911, when the license would otherwise expire.

Mr. Beachcroft, as an amendment, moved that the Council welcomed the determination come to on the part of the Government to establish a telephone system for the London area, and trusted that it might result in arrangements whereby telephonic communication and effective competition might be instituted as between the service of the Post Office and that of the telephone company.

Lord Welby, chairman of the Council, ruled the amendment out of order.

Mr. Harris then proposed that the amendment should form a preface to the recommendation of the committee, but only 16 votes were recorded in favour of the proposal, and the committee's suggestion was then carried.

Electric Traction Experiments.

In a special report the Highways Committee stated that they had received the report of Prof. Kennedy, whose services were requisitioned to advise the Council on the subject of introducing mechanical traction on the tramways. The committee stated that they had decided to recommend the Council to make experiments with the conduit and the surface contact systems on portions of the lines between Westminster Bridge and Tooting, and that they had informed the Lambeth Vestry and the Wandsworth Board of Works, and had asked those authorities to give consent without requiring more definite information. Continuing, the committee said:—

"As we are advised that there is no considerable difference in cost between the two systems, the settlement of the question of the portions of the experimental line on which each is to be tried might, we think, be left for us to determine. The line which we propose shall be adapted for experiments with electrical traction is about six miles in length; and the estimated cost of reconstructing it for this purpose is £15,000 per mile of single line, including the cost of preparation of plans, supervision of works, removal of pipes, repaving and alteration of carriageways and footways where necessary, and other minor matters. The total cost of the reconstruction of the lines for electrical traction is therefore estimated at £180 000. We propose that, having regard to the fact that the projected work is of a very special character requiring the supervision of an expert in such matters, Mr. Kennedy shall prepare the necessary plans, and superintend the reconstruction of the tramways referred to; and the amount of the estimate will cover his charges for this work. We are in communication with him with the view of arranging terms for this, and also for his undertaking the same work in connection with the proposed new tramways and light railways, for the construction of which for electrical traction the Council may obtain powers next year, either by provisional order under the Tramways Act, 1870, or by orders of the Light Railway Commissioners under the Light Railways Act, 1898. As to this matter we propose to report at the next meeting of the Council, when we shall ask the Council to direct a special meeting to be called, in accordance with the Light Railways Act and the rules of the Board of Trade with reference to applications under the Act, in order that the Council may consider and decide whether an application shall be made to the Commissioners for an order authorising the construction of certain light railways within the county of London. As the Council will on August 1st adjourn for the autumn recess, we think it desirable that we should be authorised, in the event of the road authorities concurring, to make on behalf of the Council the necessary application to the Board of Trade for its license for the use of electrical traction on the experimental line. It also appears desirable that, in order that the works may not be delayed by the recess, we should be authorised to take all necessary measures for the preparation of the plans and specifications."

The Committee accordingly recommended the Council to approve an estimate for £180,000, and to authorise them to apply to the Board of Trade for the necessary license. The consideration of the question was, however, adjourned for a week.

Electric Tramway in Blackwall Tunnel.

Various schemes of tramway extensions were approved by the Council, but one proposing the construction of a line from the present terminus at Greenwich through the Blackwall tunnel to the tramways in the East India Dock Road led to an interesting discussion.

Mr. Crooks, chairman of the Bridges Committee, moved as an amendment that the Council should withhold its sanction to this particular scheme. Sir Alex. Binnie, the Council's engineer, was opposed to the project, and the Committee pointed out that in the event of the tramway being constructed and worked by electricity it would be extremely difficult to fix the cables to the roof of the tunnel owing to the fact that the concrete and tiles are only in parts 4½ inches thick, and to carry the overhead cables in the open approaches supports placed outside the footways would be required. The Committee also stated that if the conduit system of electric traction was used, there would have to be a groove between two iron plates placed in the centre of each line of rails. There would, therefore, be parallel lines of iron in the carriageway on which the horses would obtain no satisfactory foothold, and the result would be extremely detrimental to the general traffic.

Colonel Ford having seconded the amendment,

Mr. Baker said that the tramway was both practicable and desirable. It would be unwise to place the trolley in the tunnel, but there was ample room for the conduit, and from a financial point of view the 2¼ miles of line proposed to be built would earn not less than £8 000 per annum.

Other members having discussed the proposal, the amendment on a division was carried by 52 to 50 votes, the scheme therefore being rejected.

The Three-Phase System.

The Highways Committee reported the receipt of notice from the Kensington and Knightsbridge Electric Lighting Company of intention to lay mains along Kensington High Street, Kensington Road, Hyde Park Gate, and Kensington Gore. The works referred to in the notice are different to those previously carried out by the company. The company purposes to lay trunk mains for three-phase high tension currents, and for a system of supply which has not yet been approved by the Board of Trade. The Vestry of Kensington is about to repave High Street, and the conduits for the mains there should be laid while the road is open, but no other of the works referred to in the notice should be carried out until full particulars of them have been submitted to, and approved by, the Council, and the Board of Trade have approved the system of supply. The works specified in the notice, other than the conduits for Kensington High Street, should be formally disapproved for the present, and a recommendation made to this effect was adopted by the Council.

LEGAL.

The Glasgow Telephone Wayleaves.

In the High Court of Justiciary, on July 20th, Lord Stormonth-Darling gave judgment on behalf of the Railway and Canal Commissioners in the difference between the Postmaster-General and the Corporation of Glasgow, with reference to the laying of telephone wires under certain streets in the city.

His Lordship said: The Corporation of Glasgow, being dissatisfied with the decision of the Sheriff of Lanarkshire, dated April 22nd, 1899, on a difference between them and the Postmaster-General, have required, under Section 4 of the Telegraph Act of 1878, that the difference should be referred to us. The difference is this. By notice dated December 21st, 1898, the Postmaster-General required the Corporation, as the body having control over the streets of Glasgow, to give their consent to the placing of telegraph wires under certain streets in that city, and, by reply dated January 10th, 1899, the Corporation intimated that they were prepared to give the desired consent, but only on condition that such consent was not to be made applicable to the purposes of any private company or individual, whose application, if made direct to the Corporation, could be refused by the Corporation without right of appeal. There was another condition stated in the reply, but no question arises with respect to it. On February 17th the Postmaster-General intimated in writing that he objected to the condition which I have mentioned, and the difference thus came to be whether the condition ought to be attached to the consent of the Corporation or not. Now the real meaning of that condition was that the Postmaster-General admittedly proposed to allot certain of these underground lines (being those marked B in the schedule annexed to the notice) to the service of the National Telephone Company, for the purpose of connecting two of the exchanges of that company, and thereby affording access to the trunk telephone system of the Post Office. This he did in pursuance of the policy of the department under which the trunk telephone lines were taken over in April, 1896. A Treasury Minute of May 23rd, 1892 (which was laid before Parliament) had contained a general undertaking that, so far as practicable, the Post Office would provide underground wires at an agreed rent to connect together the exchanges of a telephone company within one and the same exchange area, so that municipal authorities might not have to complain of their streets being disturbed by competitive companies; and this general undertaking had been applied to the case of the National Telephone Company by Article 13 of an agreement between the Postmaster-General and them, dated March 25th, 1896. It is, therefore, vain to say that the

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action of the Postmaster-General in 1898 was dictated by any sudden or special favour for the National Telephone Company, or that he was thereby using for its private advantage powers entrusted to him for the public service. He was only carrying out an engagement which had been publicly announced some years before, and if it involved, as it probably did, some benefit to the company, it was none the less part and parcel of a general policy which was believed to be best in the public interest. It may be natural for the Corporation of Glasgow to feel aggrieved at the Telephone Company obtaining this advantage in an indirect way; for there had been, early in 1897, negotiations between them and the company which, if successful, would have led to the company acquiring extensive rights in the streets of Glasgow, and for that they were willing to pay a considerable sum. These negotiations came to nothing; and the argument for the Corporation is that the company should not now be allowed to acquire, through the medium of a public officer, privileges which were refused when applied for in its own name—at all events, that it should not get for nothing a substantial part of what it was formerly willing to pay for. The feeling may be natural, but that is the most that can be said for it. Ever since the Government took over the national telegraphs in 1869, it has been the policy of the Legislature to give the Postmaster-General a free hand in the extension of the telegraph system. He has powers and privileges which no company ever had, and practically he has never had to pay for laying wires under the streets of a town. The Corporation of Glasgow do not seek to attach any condition, pecuniary or otherwise, to the operations which he now proposes, so far as these are unconnected with the Telephone Company; but we must assume that, in providing certain facilities for that company, he is acting in the public interest just as much as when he lays down wires to be worked by his own staff. I think it would be our duty to make that assumption without evidence, but it is specially easy to make it when we find that the improvement of the service of a telephone company acts as a feeder to the trunk lines belonging to the Post Office itself, and is part of a coherent scheme for the development of telephones throughout the country. It seems to me, therefore, that the Corporation had no right to clog their consent with the condition that the Postmaster-General was not to exercise his undoubted right of permitting a private company or individual to use his wires. I reached that result independently of the decision by this Court in the Corporation of London case. There the Corporation did not put their argument so high as that the company should not be allowed to use the wires at all, but only that it should not be allowed to use them unless it provided a better service. It was held that that was a stipulation which the Corporation were not entitled to make, because it did not concern them as street authorities. Perhaps the same might be said of the contention that the company should not be entitled to use the wires on any terms. But I prefer to rest my judgment on the ground that the Corporation were not entitled to make it a condition of their consent that the Postmaster-General should not permit his wires to be used in a particular manner authorised by the law. The Corporation next maintained that if consent was to be given, it should be made subject to the condition that the Postmaster-General should pay as much, proportionately, as the National Telephone Company was willing to pay for permission to use the streets when it negotiated with the Corporation in 1897. In reply to this it was urged that the question of terms formed no part of the original "difference" between the parties, and could not now be entertained. I cannot assent to that view. I think it is clear that, by Section 3 of the Telegraph Act of 1878, "the authority by whom the difference is to be determined," be it the Sheriff or this Commission, may give their consent "either unconditionally or subject to such pecuniary or other terms, conditions, and stipulations as they may think just. Nor do I think that the word "pecuniary" can be held applicable only to the case of railway or canal proprietors or lessees. But I do not think that there are materials before us which would enable us to fix any pecuniary terms as obviously just. The terms suggested in the negotiations of 1897 were made with reference to a much larger, and in many respects quite different, scheme from that which is now proposed. It is impossible to find in these negotiations any guide to a payment which could be justly imposed for the use of the limited numbers of streets marked B in the schedule appended to the notice of December 21st, 1898. I am therefore of opinion that the Sheriff was right in giving his consent unconditionally, and I propose that we should follow the same course.

No order was pronounced as to expenses.

Clontarf Tramway.—Injunction Application.

On July 18th, before the Master of the Rolls, Mr. Blood, Q.C., with whom were Mr. Matheson, Q.C., and Mr. Chaytor (instructed by Messrs. Sutton & Co.), applied on behalf of Lord Ardilaun for an interlocutory injunction to restrain the Clontarf and Hill of Howth Tramroad Company until the hearing of the action, from taking any proceedings for the purpose of acquiring, under the compulsory powers given to them under their Act of 1898, any greater quantity of his lordship's land at St. Anne's, Clontarf, than was *bonâ fide* required for the construction of a single tramroad opposite his demesne. On May 18th last the matter came before the Court on an application to restrain the defendant company from constructing a double line of tramroad at this particular place, on the ground that the Act of Parliament only authorised the construction of a single line. His lordship then arrived at the conclusion that the defendant company were seeking to construct a double line of tramroad, and an injunction was granted to restrain them. No proceedings were pending at that time for the purpose of compulsorily acquiring lands, but steps were taken immediately afterwards to do so. When the arbitrator's inquiry was held it was discovered that the defendants were taking sufficient land for a double line of tramway. The plaintiff objected to the arbitration proceedings being continued unless the plans were amended, so as to limit them to ground for a single line. The arbitrator decided to go on, and Lord Ardilaun withdrew from the inquiry. Counsel submitted that there was no distinct evidence that the defendant company had in view the ultimate construction of a double line of tramway. The idea was that the new line would be of the same gauge as that of the Dublin United Tramway Company, so that the cars would be able to run continuously to Howth. Lord Ardilaun opposed the Bill in Parliament, with the result that a change was inserted for the protection of his interests, amongst the provisions of this clause being one that the tramline should pass outside and on the sea side of the plantation opposite the entrance to St. Anne's, and there was another provision that the main line might be constructed either entirely upon, or immediately alongside, the existing road. It was contended by counsel that the defendant company had got the power, if they desired, to construct the line along the public road, and if they did not do so they were bound to run it immediately along the side of the road. Lord Ardilaun's boundary wall flanked one side of the road, the boundary on the sea side being grass lands. The defendants had chosen to build their line on the grass portion, and the case put forward by the plaintiff was that the defendants had laid bare sufficient of this grass land for the construction of a double line; and that they had left an interval between the public roads and the excavations. The defendants claimed that they were entitled to a width of from 35 to 40 feet, while the plaintiff contended that for the construction of a single line, such as this, 14 feet was the outside width required.

Counsel then quoted from a number of affidavits of engineers, expressing their opinion that 14 feet would be quite sufficient to take for a single line. On behalf of the defendants affidavits were filed stating that a width of from 35 to 40 feet would be necessary for the purpose of such a line as this.

The Master of the Rolls suggested that the parties should avail themselves of the arbitration clause of the Act, as the question at issue was more a question for a competent engineer than for him.

Mr. Blood said he was quite ready to go to arbitration on the matter.

Mr. Wright, Q.C., opened the case for the defendant company. He said it was a misfortune for the company that they had to deal with a person like Ardilaun. He certainly had given this company as much trouble as any person possibly could. The value of the land was out of the case. The whole amount the defendants were taking was valued at £35 or £40, and it had not been shown either by affidavit or argument that Lord Ardilaun would in the slightest degree be damnified by their taking this land. How could the taking of 20 feet along the foreshore injure him? There were others to be considered besides Lord Ardilaun; there were the defendants and also the public. This particular portion of the line was not on the public road; it was on a strip of land on the sea side. Lord Ardilaun had insisted that where it ran in front of his demesne for a distance of close on a mile there should be no stopping places, and the defendants submitted that it was absolutely essential, having regard to curves and other matters, and for the purpose of avoiding accidents, that there should be a considerable margin of land over and above what would ordinarily be required. Counsel denied that this land had been taken for any sinister or collateral purpose. They might have been a little too liberal in taking a foot or two too much, but he defied the plaintiff to point out in what way he had been injured by it. If the defendants had erred, it was on the side of caution and to ensure the efficiency and safety of the line. Counsel submitted that the present application was unnecessary, was untenable, and should be dismissed with costs.

Mr. Matheson having replied on behalf of the plaintiff,

The Master of the Rolls, in delivering judgment, said he regretted that the present proceedings had been taken. If the plaintiff had any rights he had an opportunity of having them decided under the seventh section of the Act in a way much more satisfactory than by the present proceedings, namely, by arbitration. There was no doubt that if a railway company or a tramway company under the guise of their Act of Parliament proceeded to take lands which were not *bonâ fide* wanted for the purpose of their railway or tramway, but which they wanted for different purposes not sanctioned by the Act, in that case the Court would interfere. There were many cases in which that had been done. When Lord Ardilaun brought his first action for an injunction to restrain the company from constructing a double line opposite his place he was entirely within his rights. That injunction was granted. It was not now contended that that injunction had been violated. But the present proceedings were founded upon this—that, although there was no second rail, there was conclusive proof of a sinister object in taking more land than was necessary for a single line, and that therefore there was an intention on the part of the company to make a double line some time or other. If so, this application had been misconceived on that basis. There had been nothing done to violate the injunction, and if at any future time anything should be done to violate it the plaintiff had his remedy. He (the Master of the Rolls) was not going to decide between the engineers as to the number of feet required at this particular place for a single line. He refused the motion. He reserved the question of costs.

Hampstead Electric Supply Company.

In the Queen's Bench Division of the High Court of Justice, on Friday, the 21st inst., Mr. Justice Ridley had before him an interpleader matter, on the application of Mr. John Morris Catten for relief

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against claims by Mr. Geo. Shenton and others. The question at issue related to a large number of shares in the Hampstead Electric Supply Company, against which Mr. Shenton and others held commission notes. The parties desired instructions as to how the shares should be distributed against the commission notes, there not being a sufficient number of shares to satisfy the notes.

Mr. Adam Walker appeared for Mr. Shenton, Mr. Beydall Houghton for Mr. Waldron, and Mr. P. Rose-Innes for Mr. Catten, the applicant.

Counsel for the applicant said that the latter held 11,000 shares in the company in his hands, and so far as a division was concerned, he was quite willing to abide by the directions of the Court, but he asked that it should be stated that those who did not appear were barred.

His Lordship said that would be so.

In the result, an order of the Court was made barring all who did not appear, and the claims of those who had appeared were then mutually agreed upon, it being further arranged that the matter should be further mentioned before the terms of arrangement became a judgment of the Court.

Electric Construction Company, Limited, v. Imperial Tramways Company, Limited.

This action was mentioned on July 20th by Mr. A. J. Walter to Mr. Justice Cozens-Hardy in the Chancery Division of the High Court of Justice. The plaintiffs claim an injunction to restrain the defendants, of Clare Street House, Bristol, from infringing their patent, No. 9,527, of 1885, for improvements in motors for electric railways, an inquiry as to damages or an account of profits, and delivery up or destruction of the infringing machines. Plaintiffs contend that defendants had at Middlesborough, Stockton, and Thornaby, continuously used electric tramcars constructed in infringement of their patent. This the defendants deny, and submit that the patent of the plaintiffs is invalid. Counsel said that the patent sued upon was just expiring. The case was a very heavy one, and counsel on both sides were agreed that it should stand over the long vacation. Mr. Justice Cozens-Hardy consented, and stated that the case would keep its place in the list.

A Point in the Workmen's Compensation Act.

At Marylebone County Court on Tuesday, before Deputy Judge Fitzroy Cowper, an engineers' fitter, Francis Anthony Noah, living at 322, King's Road, Chelsea, London, S.W., claimed damages, under the new Workmen's Compensation Act, against the Safety Concentric Wiring Company, Connaught Mansions, 34, Victoria Street, Westminster, with respect to personal injuries sustained by the applicant while in the respondents' employ.

The applicant stated that he had been employed by the respondent firm to assist in the installation of the electric light at the Great Central Railway Station, Marylebone. While working on a scaffold one morning he stepped back to allow another workman to pass, when something gave way, and he fell to the ground, sustaining serious injuries. The present action was brought in respect of this accident.

Mr. Linden Bell, counsel for the respondents, explained that his clients had sub-contracted for the execution of work at the station, and he also drew attention to a clause in the Workmen's Compensation Act, which lays down that a sub-contractor shall not be liable for an accident upon a building, under circumstances similar to those now before the Court, although the contractor proper might be liable.

His Honour agreed with the learned counsel's contention that his clients were not liable, and non-suited the action.

Electric Light Advertisements.

The Universal Electric Advertising Syndicate, of 2, St. Peter's Church Walk, Nottingham, was summoned at Marlborough Street Police Court on July 25th by the County Council for erecting at 3, Oxford Street, a structure which projected beyond the general building line, contrary to the provisions of the Building Act. The structure complained of was an electric light advertisement erected in front of the fourth storey of the building. It contained about 1,000 electric lights, worked from inside, which formed into groups and made the letters of the advertisement.

Mr. Denman adjourned the further hearing of the case for a month.

Professor Dewar Threatened.

Charles Bombergbr, 54, an instrument maker, of Swiss nationality, living at 42, King's Cross Road, was charged on 25th inst. on a warrant before Mr. Denman at Marlborough Street Police Court with using certain threats towards Prof. James Dewar, of the Royal Institution, Albemarle Street, whereby that gentleman went in fear of his life or some bodily injury.

Prof. Dewar said that on June 5th he received one of the two letters now produced, written in German, and last week the second one arrived. In consequence of the contents of the letters he went in fear of the writer of them. He had never seen or heard of the prisoner before. Having consulted a gentleman of high authority in mental diseases he was advised to proceed against the prisoner, who appeared to be a danger to the community.

The letters having been read, the accused was remanded.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending July 26th, 1898.		Week ending July 25th, 1899	
Boulogne	Value £80	Alexandria	Value £29
Buenos Ayres. Teleg. mat. ..	324	,, Teleg. mat. ..	64
Cape Town	191	Amsterdam	100
,, Teleg. mat. ..	385	Bangkok	28
Christiania. Teleg. mat. ..	120	Bilbao	45
Colombo	70	Boca. Teleg. mat.	712
Copenhagen.	127	Bombay. Teleg. mat.	96
Durban	500	Boulogne	62
Hong Kong	342	Bremen	189
Korsor. Sub. cable	1,105	Buenos Ayres	299
Lyttleton	161	,, ,, Teleg. mat. ..	269
Malta	124	Calcutta	99
Melbourne. Teleg. mat. ..	750	Cape Town	187
Naples	34	Colombo	747
Ostend	12	Durban	74
Paris	30	East London	12
Penang	21	Gibraltar	35
Port Chalmers	46	Hamburg	117
Port Elizabeth	942	Jersey and Guernsey	60
Rio Janeiro	77	Odessa. Teleg. mat.	60
Santos	25	Ostend	10
,, Teleg. mat.	27	Port Elizabeth	897
St. Michael's. Teleg. cable ..	15	Port Said	593
St. Petersburg	585	Rouen	420
,, Teleg. mat. ..	70	Sydney	221
Shanghai	65	,, Teleg. mat.	400
Singapore. Teleg. mat. ..	72	Wellington	32
Sydney	1,019	Yokohama. Teleg. mat. ..	150
Tonku	368		
Zara. Teleg. cable	1,206		
Total ..	£8,877	Total ..	£5,507

Foreign Goods Transhipped.

Malaga	Value £151	Brisbane. Teleph. appa.	Value £900
Rio Janeiro	903	Gothenburg. Teleph. appa. ..	90
		Port Elizabeth. Telephones ..	25
Total ..	£1,054	Total ..	£1,015

Auction.—There will be a sale of lathes, drilling machines, and other workshop tools and electrical stock on August 2nd, at 46, White Post Lane, Hackney Wick, N.E. For details see our business columns.

Bankruptcy Proceedings.—A sitting of the London Bankruptcy Court was held last week before Mr. Registrar Hope for the public examination of J. E. Evered, described as of Museum Chambers, Bloomsbury, and Camden Town. The accounts filed under the proceedings show total liabilities £9,033 (unsecured £7,633), and assets £1 18s. 7d. In the course of his evidence the debtor stated that in July, 1898, he was appointed as commercial agent to the Electrical Undertakings Company. He had no practical knowledge of electricity, but had previously been interested in a motor cab business. In the following November, he was appointed to the post of superintendent of the factory at a monthly salary of £20, to be subsequently increased to £40. Then in February last he was summarily dismissed from office, the order for his suspension coming over from America by cable, and no reason being given for the step. Witness also stated that he had lost £444 by Stock Exchange speculations, and a further £468 by betting. The examination was ordered to be concluded.

At the Carey Street offices of the Board of Trade on Monday, meetings were held under the compulsory winding-up order made against the Chitty Dynamo and Motor Company, Limited. Mr. Winearls, Assistant Official Receiver, reported that the company was formed in December, 1895, to acquire letters patent granted to Mr. Henry Chitty, in respect of special methods of construction of dynamo-electric machines. The nominal capital was £200,000, and the purchase price was £56,000, payable as to £11,000 in cash, and the balance in fully paid shares. In response to a prospectus, subscriptions to the amount of £5,540 were received, and the directors went to allotment. Premises were taken at Willesden Junction, and work was commenced in June or July, 1898. The company received £19 in respect of work, and a motor had been supplied at an invoice price of £40. The failure of the company was ascribed to insufficiency of working capital. The accounts showed liabilities £32,342 (including £31,469 claimed by Mr. Chitty), and assets £21,126. Mr. Chitty said he hoped to be shortly in a position to submit a scheme for the reconstruction of the company under which the creditors would be paid in full. Certain of his friends were prepared to find capital for the concern. After some discussion it was resolved to leave the matter in the hands of the Official Receiver as liquidator.

British Association Screw Threads.—As we go to press the following comes to hand:—"Dear Sir,—We understand that in one of your recent issues you mention that sets of stocks and dies of the B.A. threads are introduced by a certain Whitechapel firm. We would point out to you, however, that we were the first concern to bring out these sets in a commercial form, those previously obtainable having been only of a very crude character. As a matter of fact, we put them on the market no less than six years ago, as you will see from our circular enclosed.—We are, yours faithfully, for Selig, Sonnenthal & Co., G. Cassell."

Catalogues, Lists, &c.—Messrs. Isenthal, Potzler & Co., of 85, Mortimer Street, W., send us their supplementary list of radiographic instruments recently introduced. Amongst other additions we note a "mercury jet interrupter," adjustable for frequencies from 100 to 50,000 per minute; Dr. Wehnelt's "electrolytic break";

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apparatus for Dr. Davidson's "stereoscopic radiography"; and various comprehensive switchboards, and portable X ray sets.

Messrs. Platts & Lowther send us a pamphlet descriptive of their patent "compensating split packing" for engines, pumps, &c. The packing is made of layers of some fibrous material, made up in a U-shape somewhat resembling a cup-leather. It is claimed that this packing has great advantages in respect of durability, saving of steam, and frictionless working.

The Lancashire Dynamo and Motor Company, Limited, Trafford Park, Manchester, sends us a list of continuous current enclosed motors, which is beautifully got up, and gives clear information concerning a well-arranged series of motors ranging from ½ to 30 B H P., and wound for from 100 to 500 volts.

Messrs. Rooper & Harris, Limited, Stafford, send us a price list of emery wheels of all sorts and sizes, with dimensions, speeds, &c., and a few useful hints as to their mounting and use.

Cleaning Metal.—To clean metal electrolytically, says Mr. C. B. Burgess in the *Electrical World*, the article is suspended in a sodium chloride solution and used as an anode. In most cases, the chemical action at the cathode does not affect the metal itself, acting only on the foreign substances present. The current density for cleaning is much greater than for plating, but the time is much shorter. With an electrolyte formed by a nearly saturated solution of sodium chloride, 20 amperes cleaned 1 square foot of metal in 15 minutes; with 40 amperes, the time was 3·5 minutes; whilst with 140 amperes it was about ·75 minute. Using an 80-ampere current the iron was cleaned in a solution of potassium hydroxide almost instantly. By this method it is possible to clean a highly polished surface without destroying the polish.

Fire at the Western Electric Company's Works, North Woolwich.—A serious fire took place last week at the above works, destroying part of the cable-making department. We understand, however, that the damage, although considerable, was not so great as at first reported. The fire did not extend beyond the building in which it originated, and the lead presses and other heavy machinery were untouched. In some departments of the damaged section assistance can be obtained from the company's other factories, and it is anticipated that the normal output will be resumed in about six weeks.

Hope-Jones Electric Organ Company, Limited.—The business of this company, which had passed into the hands of a receiver and manager appointed by the Court on behalf of the debenture holders, has now been purchased by Messrs. Norman and Beard, Limited. A new factory fitted with every modern appliance has been erected by Messrs. Norman & Beard, adjoining their own works at Norwich, where Mr. Hope-Jones and his staff will have every facility for developing the action and special style of organ tone with which his name is associated.

Inkless Printing.—Everything will soon be done without the use of what we are accustomed to regard as the essential factor! An electrical process is being brought forward by the Electric Inkless Printing Syndicate, in which, by means of an electric current and chemically prepared paper, ink is rendered superfluous. The inventor is Mr. W. Friese-Greene.

Outings.—The annual outing of Messrs. Palmer and Watson, of 100, Charing Cross Road, W.C., and Croydon, took place on Saturday, July 22nd, when the employés and principals, numbering 37, journeyed by G.W.R., to Slough; carriages were waiting there to convey them to Burnham Beeches. On arrival there, dinner was served at the "Crown Hotel," and after the usual toasts the continued prosperity of the firm was heartily drunk.

The employés of the Electric Street Car Manufacturing Syndicate, Limited, Wednesfield Road, Wolverhampton, had their annual outing on Saturday. They were driven in brakes to Bridgnorth, where, notwithstanding the very unfavourable weather, a pleasant day was spent.

Rhymney Railway.—The works for the electric lighting and driving of the Rhymney Railway Company's new shops at Caerphilly, for which Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne, and Messrs. J. B. Saunders & Co., of Cardiff, are the contractors, will be carried out in accordance with the specification, and under the superintendence of Messrs. Wardrop & Monckton, consulting engineers, 109, Victoria Street, Westminster.

Trade Announcements.—On and after August 1st, the works of the Jandus Arc Lamp and Electric Company, Limited, will be removed to Hartham Works, Hartham Road, Holloway, London, N., to which all communications should be addressed.

Messrs. Welch & Fry have removed from 113, London Wall, E.C., to 90, London Wall, E.C.

Messrs. Rogers & Co. have opened premises in Paradise Parade, King's Lynn, as electrical engineers.

Mr. A. C. Eborall has removed from 11, Queen's Road, Chelsea, to 104, Upper Tulse Hill, S.W.

ELECTRIC LIGHTING NOTES.

Bangor.—At a special meeting of the City Council held on 24th inst., it was decided to appoint Mr. Pryce F. White, of the Electric Light Department of the G.P.O., London, and formerly of the University College, Bangor, as clerk of works in connection with the electric light works. There were 30 applicants for the post, and the salary is £2 5s. per week. At the same meeting an agreement was sealed between the Corporation and the Free Wiring Company.

Barton.—The Local Government Board has given its consent to the guardians borrowing £3,355 for the electric lighting of the new union hospital at Patricroft.

Bournemouth.—The Corporation Electric Lighting Provisional Order has received the Royal assent.

Brighton.—The standard pressure of the electrical supply is to be increased from 115 to 230 volts under the terms of an order of the Board of Trade. It is stated that with this alteration in the pressure, by an expenditure estimated at £500, the Council will be able to save a sum of £13,000 for electric lighting during the next five years.

Bulawayo.—The present electrical plant, working at its full capacity, is now insufficient to meet the requirements of the town. So rapidly has the demand increased of late that a stop-gap has had to be obtained from Johannesburg in the shape of a small 70-H P. set. As the present machinery only runs up to 250 H P., and the new plant now on order at home will be some 500 H P capacity, when the new installation is set going the company should have enough in hand for a long time to come. During the 18 months since the lighting was first started 195 consumers have been put on, of which the suburbs already account for 24. The street lights are lit on the series system and the house lights on the parallel system, the street lamps being each 50-c P. and numbering 192.

Cambridge.—The Town Council has referred to the Parliamentary Committee the question to consider whether the Corporation had power to provide electricity for traction and for lighting the streets of the town.

Canterbury.—The accounts of the Canterbury electric light undertaking for the quarter ended June 30th show that receipts in respect of current supplied for private use amount to £239 13s., and for public lighting to £75; meter rents came to £15 3s., making a total of £329 16s. Expenditure on the revenue account amounted to £266 4s. 4d., showing a profit of £63 11s. 8d. on current account, but, including repayment of loan and interest (£250) there would be a balance on the wrong side. The quarter under notice was, however, the lightest of the year, and it is confidently believed that the accounts of the entire year will balance. The electric street lighting has now been extended, and only awaits cabling; moreover, there are still many customers in the precincts and elsewhere in the city to be connected. The cable is at the present time being laid in the precincts of the Cathedral.

Continental Notes.—DENMARK.—The great electric light works in the vicinity of the chief railway station of Copenhagen has been destroyed by fire. The damage is estimated at 200,000 kroner.

FRANCE.—The Schückert Company, in conjunction with the French Bank of Africa, is floating an electrical trust with a capital of £400,000.

BELGIUM.—At the present time, according to Consul Roosevelt, there are 66,000 lamps in Brussels. It is proposed to acquire five new vertical machines of 1,000 H.P. each, to be placed in works already supplied with five horizontal machines of 500 H P. each. A company has just been formed in Brussels with a capital of £48,000, to be known as La Compagnie d'Electricité d'Ixelles et Extensions.

GERMANY.—A company has just been formed in Berlin to be known as the Phœbus Electricitäts Gesellschaft, the capital being £65,000. A central electric lighting station is to be established in the town of Langenschwalbach. Messrs. Kramer & Co., of Berlin, have secured a contract to establish and equip a central electric lighting station in the town of Eisleben.

ITALY.—A company has just been formed at Lacchiarella (Milan) to be known as La Società per l'Illuminazione Elettrica di Lacchiarella e Binasco.

SPAIN.—Tenders have just been invited for the concession for the electric lighting of the town of La Quineta (Albacete province) during a period of 15 years.

Coventry.—Sanction has been given to the County Council for the borrowing of £3 000 for the electric light undertaking, which will make the amount expended £33,000.

Derby.—An inquiry was held on July 20th by Mr. W. O. Meade-King, M Inst.C.E., the inspector appointed by the Local Government Board, into the Council's application to borrow £25,000 for the purpose of extending the electricity works. Mr. Wilmshurst (the borough electrical engineer) explained the proposed extensions, and said it was necessary to put down new plant. The present plant was 1,800 H P., and presuming that the whole of it was worked, it

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would supply 18,000 16-c.p. lamps. The number of street lamps was about 77 arc lamps and about 50 incandescent. The private lighting was approximately 14,500 16-c.p. lamps, and the new plant would supply 10,000 16-c.p. lamps. In answer to the Inspector, Mr. Wilmshurst said it was proposed to provide more incandescent street lighting, and this would be taken from the ordinary mains.

East Dean.—With reference to the application of the Council for powers to light the Cinderford and Ruspidge wards at their sole expense, the Local Government Board has replied that if the powers are put in force in part only of the parish, the expenses would nevertheless be declared by the Board's order to be special expenses on the entire parish, and that, for this reason, it is useless for them to grant the powers in respect only of entire contributory places. If the District Council should wish that these powers should be given for the whole parish, they should amend their application accordingly.

Enfield.—At a meeting of the District Council on July 13th, notices of intended application for provisional electric lighting orders to supply Enfield with the electric light were received from Edmundson's Electricity Corporation, Limited, and the North Metropolitan Electrical Company. The matter was referred to a committee.

Erpingham.—The District Council has received notice from the Mundesley Gas and Electricity Company, Limited, of its intention to apply to the Board of Trade for powers to supply electricity for public and private purposes within an area comprising the parishes of Mundesley, Knapton, Gimingham, Trimingham, and Sidestrand. It was decided to give notice of objection.

Eton.—At a meeting of the District Council on July 19th, a recommendation of the Lighting Committee, that the town be lit by electric light, was adopted, and a committee was appointed to draw up a report on the matter.

Exeter.—The City Council on the 19th inst. resolved that the salary of the electrical engineer, Mr. H. D. Munro, be increased to £275 per annum, with an annual increment of £25 up to a limit of £50, and that the increase date from Midsummer last.

Exmouth.—At last week's meeting of the District Council it was reported that, in response to the Council's request, Mr. Robert Hammond, M.Inst.C.E., had expressed his willingness to submit a report on the question of electricity supply for a fee of 50 guineas, plus the usual travelling expenses. The Council decided to engage Mr. Hammond's services on these terms.

Faversham.—The Town Council last week received a letter from the Electric Power Distribution Company, stating that it was its intention to apply to Parliament for a provisional order to supply Faversham with electric light, and that after the light had been established they would be prepared to sell the undertaking to the Council at a fair valuation. It was decided to permit one of the company's representatives to interview the Council on the matter.

Ingleton.—The Electric Lighting and Power Company, Limited, has obtained a license from the Board of Trade, and will commence laying down plant immediately. They hope to have the lights in by the end of summer, and to ensure this have made arrangements to put in temporary steam power should the water power not be ready. Messrs. Gilkes & Co., Kendal, are the consulting engineers.

Leatherhead.—Several letters have been received by the District Council offering to supply electricity in the district. The matter has been referred to a committee.

Liverpool.—At a meeting of the Electric Power and Lighting Committee on July 21st, Mr. A. B. Holmes, M.Inst.C.E., electrical engineer, submitted a report as to the supply of electric energy throughout Liverpool, which will be discussed at the next meeting of the Council. It was resolved to make an application to the Local Government Board for power to borrow the sum of £300,000 for the development of electric lighting, &c., within the city.

London, E.C.—A special meeting of the Court of Common Council was held at the Guildhall on July 20th, the Lord Mayor presiding. The meeting was convened, says the *Times*, for the purpose of considering the letter (which appeared in our last issue) of the City of London Electric Light Company, offering to dispose of its rights to the Corporation, if that body would transfer to the company an amount of Corporation stock sufficient to produce an income of £75,000 per annum.—Mr. Algar, the chairman of the Streets Committee, said that the committee felt that it was desirable to place the matter before the Court of Common Council, in order that the Court might give instructions to the committee. He moved that the action taken by the Streets Committee in opposing the Charing Cross Bill before the House of Lords be approved.—Mr. C. T. Harris moved, as an amendment, that the letter should be referred to the Streets Committee, with power to confer with the company, and that the opposition to the Charing Cross Bill be supported by evidence. The question whether the Corporation should purchase the rights of the company was much too complicated a one to be disposed of at that meeting.—Mr. Morton said the Corporation had no right to enter into any contract with any electric light company; they did not do so with the gas or water companies. Let the Corporation buy of any company which came into the City, giving them a fair price, but there was no need for any contract.—Mr. Brooke-Hitching thought that, considering the price at which the ordinary stock of the City of London Electric Light Company now stood, this would be the proper time for the Corporation to consider the question of the desirability of its purchasing the rights of the company.—Mr. Hollington said the Corporation was asked to pay three millions for what, according to the Stock Exchange price, was only worth at the present time £1,840,000. The amendment was negatived, and the motion agreed to.

Long Eaton.—At a District Council meeting on July 17th, it was resolved to obtain the report of an expert on the desirability or otherwise of an electrical installation for the town, together with capital outlay, probable cost of working, and charges to consumers, &c. Inquiries are to be made to ascertain the probable demand.

Nuneaton.—A public meeting of ratepayers has decided that the town should purchase the undertaking of the Electric Light Company, for which the Council had the option of purchase at £5,000. It was explained that the compulsory area would have to be enlarged, wires laid underground, and additional mains put in. The total expense was estimated at £10,000.

Oldham.—The results of the fifth year of working of the electric lighting works of the Oldham Corporation show that there are some 350 consumers connected to the mains, with 30,000 lamps in regular use. Last year the units distributed to consumers were 456,170, the increase over the output of 1897-98 being at the rate of 41½ per cent. From the total output of last year there was a revenue of £6,549, and the average price yielded per unit was 3·66d. After deducting the working costs, a gross profit of £3,561 was shown, equivalent to 6·71 per cent. of capital employed. This is not so large as that of 1897, but this is accounted for by the fact that substantial reductions were made to consumers in the matter of charges; notwithstanding this reduction, the profit was sufficient not only to cover the interest and sinking fund charges, but to leave a surplus of £885 available for a reserve fund or reduction of rates. The surpluses yielded by the undertaking since the starting of operations total £3,975, in addition to which the redemption of the capital has been provided for to the extent of £2,400. The works' costs amount to 1·68d., and in the matter of price per unit to private purchasers, Oldham takes a premier position with 3·49d. per unit, Edinburgh being next with 3·50d. per unit.

Paddington.—At a meeting of the Vestry on 18th inst. a letter was read from the Vestry solicitor forwarding the order of the Court of Queen's Bench, approving the terms of the arrangement in the case of the Paddington Vestry (plaintiffs) and the Metropolitan Electric Supply Company, Limited (defendants), such terms having been agreed to by the committee on the advice of the expert, Mr. Swinburne. Upon hearing counsel for the plaintiffs and for the defendants it was by consent ordered that this action be stayed on the following terms:—1. The plaintiffs consent to the defendants laying the proposed conduit through the parish of Paddington, but such consent shall not release the defendants in any way whatever from the obligations of the order and Act of 1890. 2. The defendants shall so design and arrange the whole of their distribution works in Paddington, so that if and when the plaintiffs (the local authority) purchase under the Act of 1890, or, by agreement, before the date fixed by that Act, there shall be within the parish a complete, self-contained, efficient distribution system, sufficient for the supply of the parish. 3. In the case of purchase as aforesaid, the plaintiffs (the local authority) shall not have to pay for anything that is not absolutely necessary for Paddington, and in case of stations, substations, mains, transformers, or any other parts of the system in Paddington which are only partially devoted to the service of Paddington, the plaintiffs (the local authority) shall be required to purchase only such portions as are necessary for the supply of Paddington. 4. In the event of the plaintiffs (the local authority) purchasing the system within the parish, no compensation for severance or otherwise shall be paid by the plaintiffs (the local authority) for any works not used for Paddington alone. 5. The plaintiffs (the local authority) to have the option of purchasing the generating and distributing system within its own area without paying compensation for any plant or other part of the system that may be depreciated by severance. 6. That the defendants pay the costs of the plaintiffs, as between solicitor and client, since January 11th last, including those of the application to the Board of Trade, and of this action, and of carrying out the above terms to be taxed in case the parties differ.

Paignton.—At a recent meeting of the District Council notice was given on behalf of the Urban Electric Supply Company, Limited, that it intended to apply to the Board of Trade for a provisional order for electric lighting in the district. If the Council assented to the application the company would be prepared to insert special clauses in the provisional order, giving the Council the option of purchasing the undertaking at a much earlier period than was provided for by the Electric Lighting Act. The subject was referred to the Council in committee.

Radcliffe.—Colonel Marsh, R.E., inspector of the Local Government Board, held an inquiry on July 18th into an application of the Urban District Council of Radcliffe for sanction to borrow £16,000 for the purchase of land and the erection thereon of an electric light station, together with distributing mains, &c., the amount borrowed to be repaid in 30 years. The sum named will cover plant sufficient to run 4,000 8-c.p. lamps, the detailed estimates being as follows:—Buildings, £2,750; boilers, engines, and dynamos, £3,702; station electrical plant, £870; feeders, distribution mains, &c.,

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£7,060; land, £1,100; contingencies, £518; total, £16,000. The inspector expressed his satisfaction at the absence of opposition to the proposal.

Rawdon.—The District Council has received a letter from Messrs. Greenwood & Batley's solicitors intimating the intention of that firm to apply for an electric lighting order for the area of the Rawdon district, if the Council decided not to oppose them. It was decided not to offer opposition to the firm's application.

Rotherhithe.—The Vestry has received notice from the County of London and Brush Provincial Electric Lighting Company, Limited, of their intention to make application on or before December 21st next, for a provisional order authorising the company to supply electrical energy for public or private purposes within the parish of Rotherhithe.

Sheerness.—Mr. Madgen, of the Electrical Power Distribution Company, attended a meeting of the District Council last week, and said that his company intended applying for a provisional order, provided they had the sanction of the Urban District Council. They look mainly to electricity being used for industrial purposes, believing that if they established a power station industries would be attracted to Sheerness. The cost of electric works and plant at Sheerness would be about £18,000, and his company were prepared to undertake the work without any financial assistance from the Council. The Council would have the right to buy the works at the end of 14 years, and also at the end of every subsequent seven years up to 42 years upon giving two years' notice of their intention to acquire them, the price to be fixed according to the market value of the works at the time.

Singapore.—The Municipal Commissioners have under consideration the question of lighting part of the municipality with electricity. According to the *Straits Times* the population is over 200,000, and there are 20,000 houses. The municipal engineer forwarded full particulars to Prof. Kennedy some time ago, to enable him to draw up a report on the subject.

Taunton.—Colonel A. J. Hepper, D.S.O., R.E., one of the Local Government Board inspectors, held an inquiry, on July 18th, into an application by the Town Council for a loan of £10,000 for the purpose of electric lighting. It was stated that the money was absolutely necessary for new plant and extensions of the mains, owing to the increased demand for the light. During 1897, there was connected the equivalent of 1,580 8-C.P. lamps, and during the first half of the present year there was added the equivalent of 2,270 8 C.P. lamps. The balance-sheet for 1898 showed a profit of £750 on the year's working. Allowing for the reduced charges to customers, the past half-year showed an increased income of £250, or £300 over that of the corresponding half-year of 1898. There was no opposition.

West Bromwich.—The Electric Lighting Committee has recommended the Town Council to lay down electric plant to supply the borough with light and power within the area prescribed by the provisional order already obtained.

Weston-super-Mare.—The Board of Trade has sanctioned the transfer of the District Council's electric light provisional order to the Electrical Power Distribution Company, and the work of installation will be pushed on with all possible speed.

Willington Quay.—The District Council has received a letter from the Tyneside Electrical Power Company giving notice that the company intends to apply for a provisional order for the supply of electricity in the district.

Ventnor.—The District Council is considering the question of electrically lighting the whole district and the pier.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Bath.—At a meeting of the Urban Sanitary Authority last week, the objections of the Electric Traction Committee to the electric tramway scheme proposed by Messrs. Brash, Wheeler & Co., were adopted, and the committee was empowered to deal fully with the matter.

Batley.—The report of Messrs. Lacey, Clirehugh and Sillar, on the subject of electric light and traction, has been circulated amongst the members of the Town Council for consideration. The report is a most exhaustive one. The cost of electric light is put down at £16,770, and that of electric traction at £69,000. It is anticipated that other expenses would bring the total cost of the joint scheme up to a sum of £100,000. The Corporation is not as yet pledged to any scheme. The overhead system of traction is strongly recommended as more suitable to the district, as well as less costly, than the conduit system.

Birkenhead.—Colonel Sir Francis Marindin, R.E., K.C.M.G., held an inquiry, on July 18th, on behalf of the Board of Trade, relative to an application by the Town Council for sanction to borrow £208,679 for the construction and equipment by it of electrical tramways in the borough, and for the approval of the Board to the system, and generally in regard to the proposed scheme of Corporation tramways. The town clerk, Mr. Gill, explained the scheme at considerable length. Having sketched the history of the town and shown its phenomenal development since the construction of the docks, he said that the lines of the Birkenhead Tramway Company—the first in Europe—were laid in 1860, and afterwards the Wirral Company's line to New Ferry was established. Owing partially to want of money, neither company was successful, and in 1890, to prevent the stoppage of the service, the Corporation bought up the Birkenhead Company's system for £5,000. They then leased the lines to a new company for 10 years, so that the lease would expire at the end of next year. In 1895 the Corporation purchased the Wirral Company's line for £2,054, and granted a 21 years' lease, which would expire in March, 1916. The lessees' right had since been purchased, and the lines would come into the possession of the Corporation on December 31st this year. Since the incorporation of the borough, in 1877, the population had grown from 77,260 to 115,162, and the rateable value from £373,558 to £504,396. The rates were very moderate, being 4s. 10d. in the £, against 5s. 2d. in 1877. The debt of the borough had increased from £945,575 in 1877 to £1,325,767; and he thought this was a sign of prosperity, considering that the Corporation owned several undertakings, such as Woodside Ferry and the gas and water concerns, the former of which last year yielded £11,935 towards the rates and the latter £10,000. As to the passenger traffic which the new trams would have to deal with, last year Woodside Ferry carried about 8,000,000 passengers, and the Mersey Railway, all of whose stations the trams would pass, probably carried about an equal number. The Wirral Railway Company also conveyed about a million passengers to and from Park Station. Mr. Gill subsequently produced a plan of the lines proposed to be completed within the next two years. At present, the Corporation could not proceed with the whole of their scheme, but would be able to construct the two generating stations and lay down the proposed new routes. He suggested that 30 years was the proper time for the repayment of the money, which would probably be borrowed from the Public Works Loan Commissioners at 2¾ per cent., entailing an annual repayment of £10,277. The borough surveyor and electrical surveyor explained various details to the Commissioner, who at the close of the proceedings was understood to say that he would report favourably on the application.

Brakpan (South Africa).—The large electricity works erected by Messrs. Siemens & Halske for the Rand Central Electric Works Company, which has been at work over 12 months, was handed over to the company at the end of June. There are at present four 1,000-H.P. engines coupled to three-phase alternators; a fifth set is on order. Power is transmitted at 10,000 volts to the various consumers, some of whom are 28 miles distant.

Continental Notes.—GERMANY.—The *Iron Age* states that at the end of 1898 68 cities in Germany were equipped with electric railways, and in 35 other cities electric lines were being constructed, or were provided for, the total length of the operating roads being 888 miles, with 1,205 miles of track, 3,190 motor cars, and 2,128 trailers. The length of new line under construction, or contracted for, was 830 miles. In 1891 only three German cities could boast of railways of this type.

It is proposed to construct an electric tramway between Meder-Herduk and Schweinhochbourts.

AUSTRIA.—A preliminary concession has just been granted in respect of a projected electric tramway between Trieste and Opcina.

SERVIA.—The horse tramways in the city of Belgrade, Servia, are to be converted into electric lines.

Coventry.—Having received formal sanction from the Board of Trade, the Coventry Tramway Company commenced running their electric cars on the extended system to Stoke and other outlying districts on the 22nd inst.

The Dewsbury and Spen Valley Tramway Schemes.—The Board of Trade inquiry, on the application of the British Electric Traction Company, is to be held in Dewsbury on August 1st. The District Council of Ravensthorpe will support the British Electric Traction Company in their application, the company having undertaken to carry a line into the village, and to pay a large sum of money for local improvements. On the other hand, Dewsbury, Cleckheaton and Heckmondwike are opposing the company.

Dundee.—The deputation from the Town Council which recently visited various English towns to inspect the systems of electric traction in use, has drawn up a very interesting report. Gradients of 1 in 9½, and curves of 30 feet radius are being successfully worked. The members preferred the overhead construction adopted at Blackburn, with neat centre poles, not overburdened with ornamental scrolls. The double-deck bogie car met with approval, and was recommended for Dundee. The deputation gratefully acknowledged the uniform kindness and assistance they met with at every place visited.

Eccles.—It is stated that the estimated cost of the light railway and electrical tramway from the Manchester Ship Canal at Eccles to Whitefield, 12½ miles in length, to be put down by the United Kingdom Electrical Tramway and Light Railway Syndicate, Limited, will be about £200,000.

Harrow and Uxbridge.—The Select Committee of the House of Lords, of which Lord Ribblesdale is chairman, sat last week for the purpose of considering the Harrow and Uxbridge Railway Bill, under which the Harrow and Uxbridge Railway Company propose to make extensions at Pinner and Harrow in order to connect their authorised line with that of the Metropolitan Company, and to take power to work both the authorised and new lines by steam or electricity. The proposed railway will be about two miles in length, and will cost about £80,000. The Committee passed the preamble of the Bill.

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Huddersfield.—The Town Council on July 19th had under consideration the recommendations of the Tramways Sub-Committee respecting the tenders for plant and equipment. After a long discussion, turning chiefly on the question of vertical *versus* horizontal engines, and Lancashire *versus* water-tube boilers, it was resolved that vertical engines and Lancashire boilers be installed, with Vicars' stokers and Green's economiser. Messrs. Greenwood and Batley's tender for the generating plant, amounting to £59,602 16s. 3d., was approved, as well as that of Messrs. Milnes and Co. for the car bodies. It was announced that the Board of Trade had sanctioned a loan of £47,782 2s. 4d. for the purpose of electric traction, to be repaid chiefly in 15 and 20 years. The Council decided to proceed with the conversion of the tramways at once, at a cost of about £100,000, and to apply to Parliament for powers to extend the tramway system to several places beyond the borough boundary. Application is also to be made to the Board of Trade for leave to extend the Fortown route as far as Sheepridge. Other extensions have already been carried out or commenced in several parts of the borough—notably a five-mile length to Linthwaite.

The Council will invite the Municipal Electrical Association to hold its next meeting in Huddersfield.

Kingston, Jamaica.—There is a prosperous system of electric traction in the town, worked by the West India Electric Company, Limited; this installation cost £200,000, and consists of six miles of double and 13 miles of single track, well laid on concrete with 90 lb. rails. The generators are driven by water power, and the electric power is transmitted on the three-phase system at a pressure of 14,000 volts, to transformers and rotary converters, from the turbine house, 21 miles from Kingston.

Liverpool.—The Tramways Committee, with the sanction of the City Council, have recently adopted a novel and striking idea in connection with the equipment of their electric tram routes. The speed and frequency of the new service having necessitated the fixing of stopping places, the importance of an effective system of indicators became at once apparent. Hitherto the stations have been shown by the distinctive painting of lamp-posts, but this somewhat crude method is now about to give way to ornamental pavement indicators, which will show the stopping-place, and at the same time serve the purpose of the finger-post. The new indicator consists of conspicuously-coloured pavement, 4 feet square, formed of red granitic concrete, surrounded with a border of white granitic concrete, with an incised foliated design. It is conspicuous from a distance, and, being placed near a lamp, must almost inevitably be seen by every passer-by. Each indicator will contain, first the name of the street or road, which will be legible in almost all conditions of weather, and at all times of day and night; an arrow will indicate the direction of the cars, so that passengers need never make the common mistake of taking a car going in the wrong direction. "Tramcars stop here on request" appears on indicators other than those at which "All tramcars stop," as at terminal and a few other fixed points on the route. This is followed by a statement of the destinations of the various cars. The lettering will be in snow-white letters, on a dark red background. Should the lamp over it be extinguished, it will still be quite legible by the light of the next lamp, 25 yards away. The indicators are being made by the City Mosaic Company, the concrete work involved being done by the Stanley Sand and Brick Company.

Two electric car smashes have occurred in Liverpool, one on the Princes Road route, and the other on the Smithdown Road route. The collision on Smithdown Road was with a cart, in consequence of which a car was crippled and some damage done to the vehicle; a delay of half an hour occurred. The other was a collision with a brewer's dray, the barrels flying up and down the Boulevards. The car was damaged and the passengers alarmed, but no one was hurt.

London.—A special meeting of the County Council was held on July 26th to consider a recommendation of the Highways Committee in favour of very important extensions of and additions to the existing tramways. The new tramways proposed to be constructed north of the Thames will cost £218,630 with horse traction; those on the south side are estimated to cost £543,000, and these it is intended to work by electrical means. But why not *all?*

The Electric Cab Company on July 20th paid off their drivers *en masse*, and kept their cabs in the yard. The reason they give for this step is that there is a great dearth of drivers. The cabs have recently grown in numbers, but the supply of drivers has diminished, so that the majority of the cabs have been kept idle for some time past. The dearth of drivers is accounted for by the fact that many of them have recently accepted situations in private families. It is also stated that the company have other reasons for withdrawing the vehicles. The company, it is added, will be reconstructed, and the cabs will be put upon the streets again shortly. In the meantime, says the *Daily Mail*, 70 cabs of the newest pattern are eating their accumulators off in the company's stable!

Morecambe.—A syndicate known as the Morecambe Electric Launch and Power Syndicate, Limited, has placed two electric launches on the Bay—the *Lady Ida*, 28 feet long, 7½ knots, and the *Lady May*, 40 feet long; the latter has been brought from Windermere. On account of the high price demanded by the District Council for charging—5d. per unit—the syndicate has converted an old hulk into a charging station.

Plymouth.—Preliminary trial runs have been made over the electric tramway from Prince Rock to the Theatre Royal, and it is anticipated that the line will be opened for traffic in a fortnight. The arc lamps for street lighting will be inaugurated at the same time as the tramway.

Ramsey.—The electric tramway from Douglas to the Ramsey Palace station is practically ready for through traffic, but the extension from Ballure to the Palace is awaiting the approval of the Government inspector, the date for whose visit is not yet fixed.

Rand Goldfields.—At the seventh annual meeting of the South African Association of Engineers held at Johannesburg on June 30th, it was stated that there were in the State, at the end of 1897, 2,282 boilers, 1,239 steam engines, 280 dynamos, and 1,408 motors. The total value of the machinery and plant at work of all kinds was £6,355,037.

South Staffordshire.—The engine drivers on this line held a meeting last week for the purpose of protesting against the number of hours they are called upon to work. They state that two or three days every week they are employed as many as 15 and 16 hours. The general manager of the company, Mr. Robbins, met the men and intimated his willingness to forward their complaints to the directors. It was, however, decided to give 14 days' notice for a reduction in the working time, and in the event of a concession not being made, to come out on strike.

TELEGRAPH AND TELEPHONE NOTES.

The Telephone Bill.—The Cardiff Chamber of Commerce has passed a resolution to the effect that the telephone service should be in the hands of the Government; that the proposals embodied in the Bill now before Parliament, which practically postpone the question for 25 years, would prove highly detrimental to the commercial interests of the country; and that the Government be asked to withdraw the Bill pending further discussion.

Cape to Australia Cable.—On Tuesday last in the House of Commons, in answer to Mr. Hogan, Mr. Brodrick said: The Secretary of State has been informed by the Eastern Extension Telegraph Company that they are prepared to provide cable communication between the Cape and Australia without requiring any pecuniary assistance from either the Colonies or Her Majesty's Government, and that they will at once reduce the tariff to 4s. per word between Great Britain and Australia on receiving landing rights for their proposed new cable. No information is to hand as to the conditions, if any, attached to this offer.

The *Daily Mail* states that what the company is prepared to do is to lay a cable from Durban (Natal) to Mauritius, thence to the island of Diego Garcia, a coral reef in the Indian Ocean, south of the Laccadives, thence to Cocos Island, which lies west of Java, from Cocos to Perth, the capital of Western Australia, and thence round to Adelaide by sea. No subsidy whatever is asked by the company, and the only concession they require of the Australian Government is to be allowed to deal direct with the public, and establish their own offices at Adelaide. It is pointed out that with the West Coast cable route to the Cape this would form a complete alternative route to Australia, and by joining up Diego Garcia with Ceylon an additional route to India in case of interruption would be secured. It would be interesting to learn the exact terms of the agreement which the Eastern Company hopes to make with the Colonies and the Cape.

Regarding the above proposal, the Postmaster-General of New South Wales says that the Australian Colonies are pledged to the construction of the Pacific cable.

Edinburgh.—At the half-yearly statutory meeting of the Parish Council on July 17th, a recommendation by the Adjustment Committee, to the effect that the Committee be authorised to submit a memorial to the Treasury, drawing attention to the inadequate amount of subvention in lieu of local rates proposed to be paid by the Postmaster-General in respect of the telephone trunk wires taken over recently by the Government, was agreed to.

The Pacific Cable.—The Dominion House of Commons on July 25th almost unanimously endorsed the Pacific Cable scheme, the only dissentient speaker being Mr. Charlton, who urged that Canadian railway and canal enterprises were more deserving of support. The Hon. W. Mulock, Q.C., Postmaster-General, in introducing the resolution, explained that the capital of £1,700,000 would be contributed in the proportion agreed upon, and that representation on the governing board would be accordingly. Thus Great Britain would have three representatives, Canada two, and Australasia three. Sir Charles Tupper, in approving the scheme, heartily congratulated the Government on its success in carrying the matter through.

The Central News learns that the Imperial Government and the representatives of the Colonial Governments concerned have made very substantial progress with the Pacific cable scheme. A board of representatives of the various Governments is being constituted, and an important meeting on the subject is to be held in Australia within the next few days. The new body thus constituted will be a board of management during the construction of the new cable system, and will then probably merge into a sort of permanent directorate. Its ultimate powers, however, are still in some doubt. The Colonial authorities are welcoming the scheme with open arms, and the London representatives of the Colonial Governments concerned are desirous of getting the necessary legislation through this session, so as to avoid the long wait over the recess, which would mean, as they

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express it, an unnecessary postponement of the benefits of the new scheme over the present cable company system.

Referring to the value of the cable to Canada, Mr. Mulock pointed out in the Dominion Parliament on July 25th that it would afford a ready means of communicating, not only with Australia, but also with China and Japan, whose trade was likely to be of immense importance to Canada.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa ...	April 4th, 1898 ...	...
Jamaica-Colon	July 1st, 1899 ...	...
Bonny-Cameroun	May 29th, 1899 ...	...
Latakia-Cyprus	June 21st, 1899 ...	...
Para-Maranham	April 10th, 1899 ...	...
Maranham-Ceara	July 25th, 1899 ...	...
Landlines.		
Communication between Saloniks and Monastir ...	March 23rd, 1899 ...	...
Communication with Swakopmund	July 11th, 1899	... July 22nd, 1899.
Moulmein-Bangkok...	... July 18th, 1899	... July 19th, 1899.

The Telephone Bill.—In the House of Commons on July 24th the Bill as amended was discussed in Committee. Captain Sinclair moved its rejection, on the ground that it had become practically a different measure since the second reading. Sir C. Cameron, speaking for those who advocated municipal control, thought the Bill had been enormously improved. Mr. Moulton considered that the measure embodied a discreditable surrender to a rich company. Mr. Hanbury defended the Bill, saying the license granted to the National Telephone Company would not be perpetual; only when rival licenses were granted for a period extending beyond 1911 would concurrent licenses be given to the company. Where there was *bonâ fide* competition there would be free intercommunication between the exchanges. He deprecated a policy of confiscation; privileges had been given to the company which he would not himself have sanctioned, but by those privileges the hands of the Government had been tied. The amendment was negatived by 171 to 41, and the House entered upon the report stage. Shortly afterwards the discussion was adjourned. The consideration of the Bill was resumed on the 25th inst., and a number of amendments were discussed.

At a meeting on July 26th the London County Council resolved "that, in the opinion of the Council, it is undesirable that as regards the area of the County of London, the existing license of the National Telephone Company should be extended for a further period beyond the year 1911, when the license will otherwise expire."

Telephone Office Hours.—A correspondent writing to the *Times*, of July 21st, calls attention to the short hours observed in telegraph offices—8 a.m. to 8 p.m. as a rule—as compared with the all day and night service of the National Telephone Company, and calls for an assurance that the hours shall not be curtailed when the Government assumes control of the telephone service.

Reduction of Telegraph Rates to India.—We learn that in Ceylon, the Colombo Chamber of Commerce has taken up a strong position with regard to the excessive rate charged for telegrams to India, and has decided to use all possible efforts to procure a reduction.

Wireless Telegraphy.—According to the *Evening News*, of 19th inst., an electrical engineer, named Schafer, has succeeded in sending messages from Trieste to Venice, a distance of 40 miles.

Wireless Telephony.—Dr. Peter Stiens, a Russian scientist, who is now in England, claims to have invented and developed a system of telephoning without wires over long distances. Another inventor who puts forward similar claims, is Signor Mario d'Asar, who is shortly coming to this country.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barcarrota, Spain.—July 31st. The municipal authorities of Barcarrota (Badajoz province) are inviting tenders until the 31st inst. for the concession for the electric lighting of the town during a period of 10 years. Particulars may be obtained from, and tenders be sent to, El Secretario del Ayuntamiento de Barcarrota (Badajoz).

Barking.—August 12th. The District Council wants offers for the free wiring of premises within the area of supply. See "Official Notices."

Battersea.—August 31st. The Vestry wants tenders for an overhead travelling crane (hand or electric), and batteries for the electricity works. See "Official Notices" July 7th.

Belfast.—July 31st. The Harbour Commissioners are prepared to receive tenders for the conversion of a 2-ton jib crane from steam to electric power. See "Official Notices" July 21st.

Birkdale.—August 19th. The Urban District Council invites tenders for the transfer of its electric lighting powers.

Blackpool.—August 21st. The Corporation wants tenders for 10 double bogie tramcars. See "Official Notices."

Bridgewater House.—August 4th. The Bridgewater trustees want tenders for conduits and wiring for 500 lights in Bridgewater House, St. James's Park, S.W. See "Official Notices."

Carlisle.—August 17th. The Corporation wants tenders for boilers, engines, dynamos, and condensing plant. See "Official Notices."

Denbigh.—August 1st. The North Wales Counties Lunatic Asylum Committee wants tenders for the supply of engines, dynamos, switchboard, injector, piping, and foundations, also wiring of buildings for electric lighting. See "Official Notices" July 7th.

Edinburgh.—July 31st. The Council wants tenders for coal measuring gear and extensions to shafting, &c., for driving mechanical stokers. See "Official Notices" July 14th.

Glasgow.—July 31st. The Corporation wants tenders for the supply of concentric and single lead-covered main cables. See our "Official Notices" July 14th.

Glasgow.—August 2nd. The Corporation wants offers for the electric work required in connection with its fire alarm and A B C telegraph systems. Specifications, &c., from the chief officer of the Fire Brigade, College Street.

Madrid.—July 31st. The Ministerio de Marina is inviting tenders for an electric light installation for the floating naval school.

Malmo.—September 1st. The Gas Works' directors want tenders for the erection of electricity works for the city. Particulars on application to the clerk of the Gas Works (deposit 12s).

Motherwell, N.B.—August 18th. The Commissioners invite tenders for machinery and works in connection with the proposed electric lighting of their town. See "Official Notices."

Perth.—August 28th. The Commissioners want tenders for boilers, condensers, steam dynamos, switchboard, underground mains, and accessories. See "Official Notices."

Portugal.—September 6th. Tenders are being invited by the municipal authorities of Cascaes, Portugal, for the concession for the electric lighting of the town.

St. Mary, Battersea.—August 31st. The Vestry wants tenders for steam pumps, pipes, condenser, economiser, &c., switchboard, and boosters. See "Official Notices."

Salford.—August 8th. The Corporation wants tenders for eight 750-kw. continuous current steam dynamos for electric lighting and traction. See "Official Notices" July 7th.

The War Office.—The Secretary of State for War announces that tenders for various articles, including electrical instruments, will probably be invited from time to time during the next 12 months. Manufacturers who may wish to be applied to when tenders are required, should address Mr. A. Major, Director of Army Contracts, War Office, stating the particular articles they manufacture, and the names of at least two well-known firms or public bodies who have purchased from them, and are in a position to certify as to the quality of their productions.

CLOSED.

Chatham.—Correction.—The contract for the wiring of the Town Hall and offices was let to Messrs. Stevens & Barker, Maidstone; the fittings were supplied by the Edison-Swan Company, Limited.

Crewe.—The Council has accepted the tender of the Hart Accumulator Company, Limited, for the supply of the storage batteries.

Doncaster.—The Board of Guardians on July 22nd accepted the tender of the Keighley Electric Lighting Company (£2,700) for the electrical works at the new workhouse.

Poplar.—The District Board of Works has adopted the report of the Electric Lighting Committee that the following tenders be accepted:—Messrs. Babcock & Wilcox, boiler house equipment, £5,852; Messrs. Mather & Platt, with certain modifications in the wages clauses, engine house equipment, £16,200.

Tynemouth.—The borrowing powers applied for by the Corporation have now been granted, and contracts to Messrs. Lacey, Clirehugh & Sillar's specifications have been placed as follows:—

Two 190-kw. steam dynamos, Holmes & Co., and Bellis & Co. ..	£4,100
One 190-kw. steam dynamo (traction), Westinghouse Company and Belliss & Co.	2,025
Balancer and boosters, Siemens Bros.	549
Boilers, Yates & Thom	8,245
Economisers, Green & Sons	560
Condensing plant, Goddard, Massey & Warner	1,721
Cooling tower, Klein & Co...	985
Feed pumps and pipes, Goddard, Massey & Warner	940
Travelling crane, Carrick & Ritchie	215
Lighting switchboard, Bertram Thomas	603
Traction ,, Westinghouse Company	556
Accumulators, Pritchetts & Gold	1,234
Cables, Siemens Bros. & Co.	5,900

Weston-super-Mare.—At a special meeting of the District Council on July 19th the revised tender of Messrs. Stuart & Moore for providing telephonic communication between the members of the Fire Brigade, at £302 6s. 3d., was accepted, subject to the firm maintaining the system for 12 months from the date of completion.

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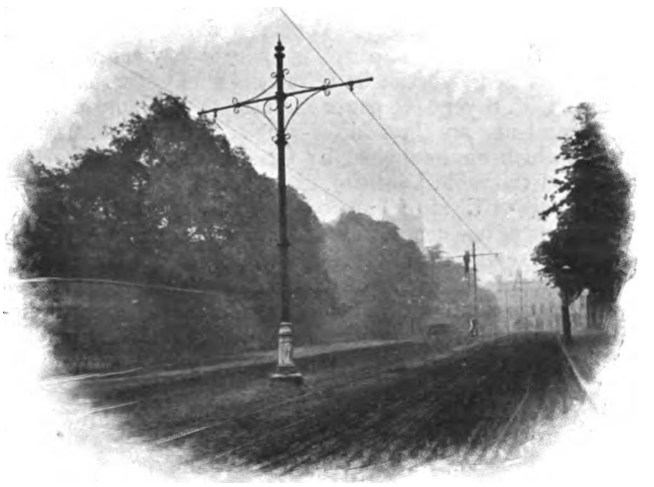
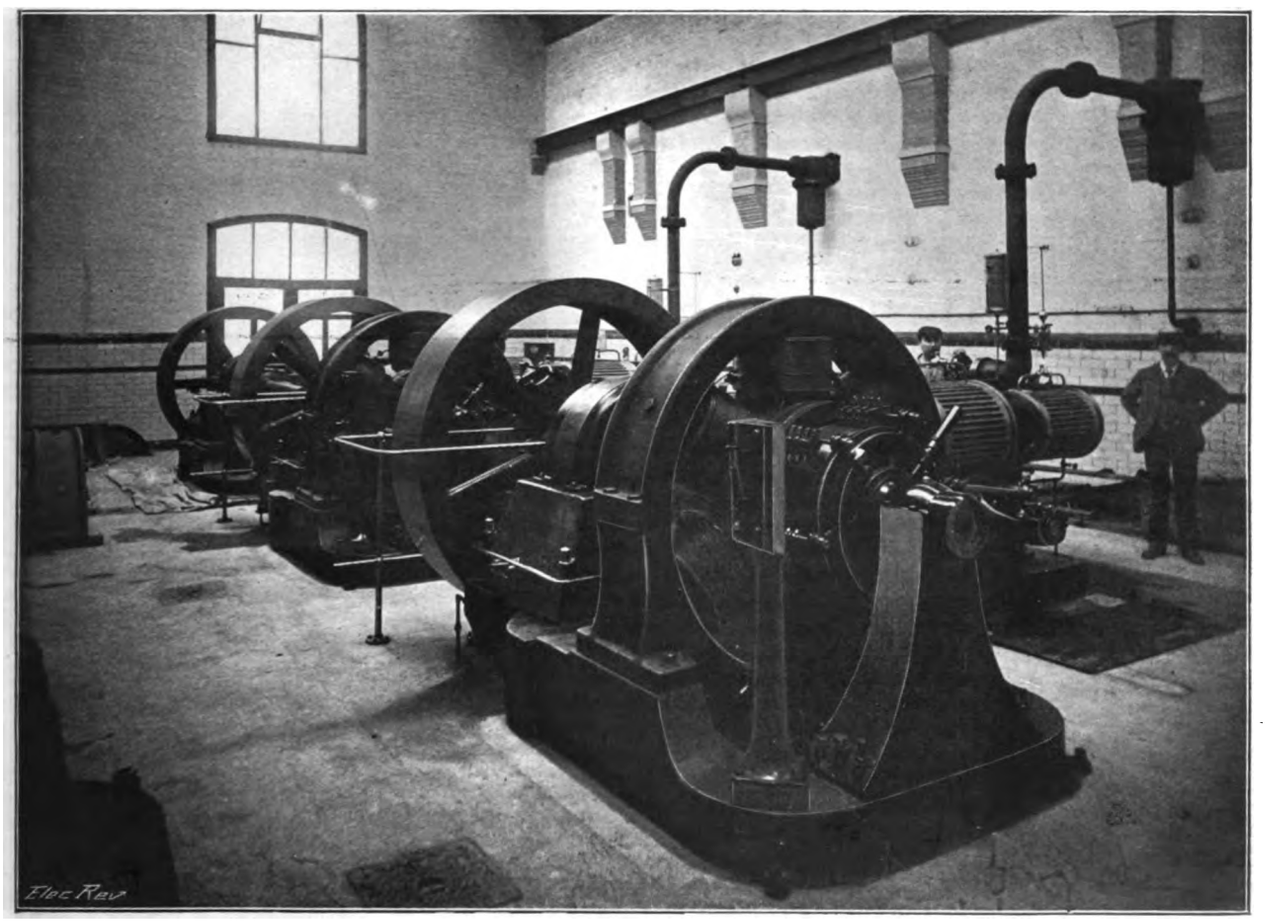
THE DUDLEY AND STOURBRIDGE ELECTRIC TRAMWAYS.

It is now about 15 years since the steam tramway from Dudley to Stourbridge was set to work, but it cannot be said that the line has ever been made to carry the traffic lying to its hand. A miserable half-hour service, and that anything but regularly or punctually afforded, has alone been attempted. Cars have been overcrowded and dirty, and generally the whole system has been a failure, though the line runs through a crowded district not served by any railway, except in a very indirect manner. The distance between the two towns is about six miles, and along the route lie the smaller places of Holly Hall, Harts Hill, Brierley Hill, and Round Oak. The British Electric Traction Company, however, entered into arrangements with the old company for the conversion of the line into one electrically worked, and as about half the line lies within the town limits of Dudley the acquiescence and broad-minded acceptance and help of the Dudley municipal authorities have been very welcome to the converting company. The line has been reconstructed throughout to the old gauge of 3 feet 6 inches, and this was done while maintaining the old service of steam cars. Steel girder rails of 89 lbs. to the yard have been laid on a bed of concrete in the usual modern system. The rails are in lengths of 50 feet with strong fish plates and end plates, Askham's steel points and crossings, and they are double bonded throughout, and cross bonded at frequent intervals. The construction of the line has been carried out in two sections, the power house at Harts Hill on the borders of the Dudley Corporation's authority being about central. The first, or western, portion from the power house to Stourbridge was completed early in the present year, the contractors for the track being Messrs. Dick, Kerr & Co.; for the overhead construction, Messrs. Blackwell & Co.; while the electrical equipment and nine cars have been supplied by the



View on Castle Hill.



Genebal View of Engine Room.

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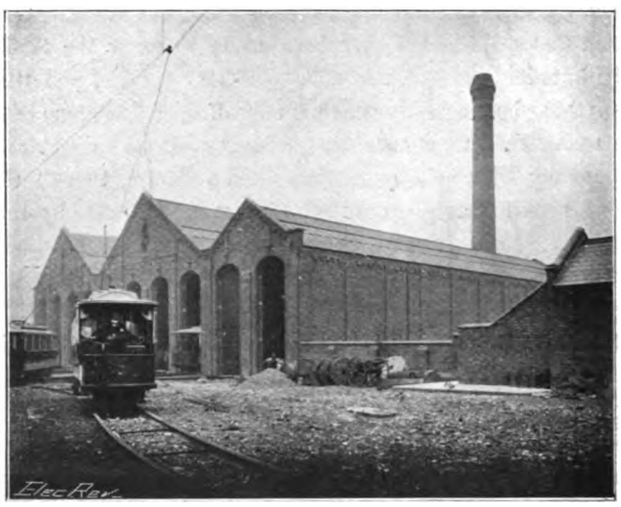
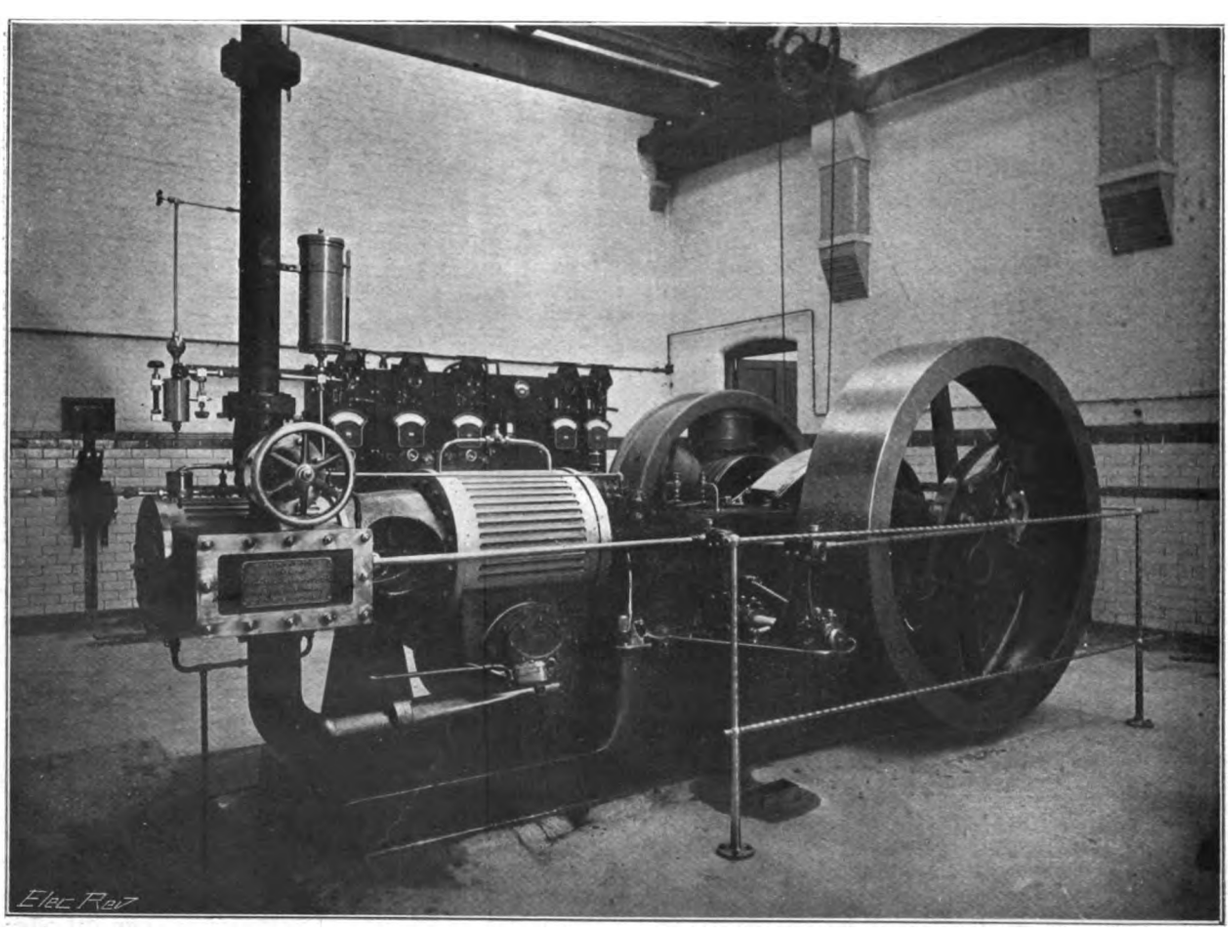
British Thomson-Houston Company. Mr. C. H. Gadsby, late contract engineer, British Electric Traction Company, acted as engineer for the whole work until a few months since. For the remainder, or eastern section, of the line, from the power house to the old steam depôt at the foot of the Castle Hill, at Dudley, the British Electric Traction Company have been their own contractors, the permanent way work being under the control of Mr. Howard Smith, the company's permanent way engineer, and the overhead construction and electrical work under the control of Mr. H. M. Sayers, the power engineer to the company. In the power house are three direct-coupled 100 KW. sets, the first two of which were supplied by the contractors for the first portion of the work, the third, exactly similar, being supplied by the British Electric Traction Company themselves. Each set consists of one compound tandem engine of Ball & Wood's make, with cylinders 11¼ inches and 18 inches diameter respectively, with a stroke of 16 inches. The speed is 235 revolutions per minute, and the governor is of the inertia fly-wheel type and very sensitive in controlling the engines on loads varying suddenly from *nil* to 50 per cent. overload. The fly-wheels are 78 in. × 17 in. face. To each engine is connected a six-pole railway generator of the usual Thomson-Houston type. The engines are fitted with oil pumps and gravity lubricators, and there is also a connection which enables steam to be blown through the oil pipes from the main steam pipes for clearing purposes. Sight feed lubricators are fitted to the H.P. cylinders and also a hand oil pump. The switchboard is built up of six panels of enamelled Vermont marble, viz., one panel to each of the three generators, the Board of Trade panel and two feeder panels. It measures, including the sub-base, 10 feet 8 inches wide by 7 feet 6 inches high, and carries the usual complement of ammeters and switches with automatic cut-outs and Q B. switches on each feeder and generator panel, and a voltmeter on a bracket crane. The steam pipes to each engine are 5 inches diameter and the three engines exhaust into a common exhaust pipe intended for the application of independent condenser plant. The water separators placed near to the engines are of Messrs. Holden & Brookes make and drained by a Geipel steam trap. The engine pipes draw from



Exterior of Car Sheds.

a steam main 8 inches diameter placed along the rear wall of the boiler house, and connected by 6-inch steel pipes with the boiler junction valves. There are three Lancashire boilers by Danks, of Netherton. They measure 30 feet in length by 7 feet diameter, with furnaces of 33 inches arranged with Adamson flanged seams. The shell plates, of Butterley steel, are $\frac{5}{8}$th treble riveted with butt straps inside and out, and the furnaces are of $\frac{1}{2}$-inch plate with end



View looking towards Switchboard.

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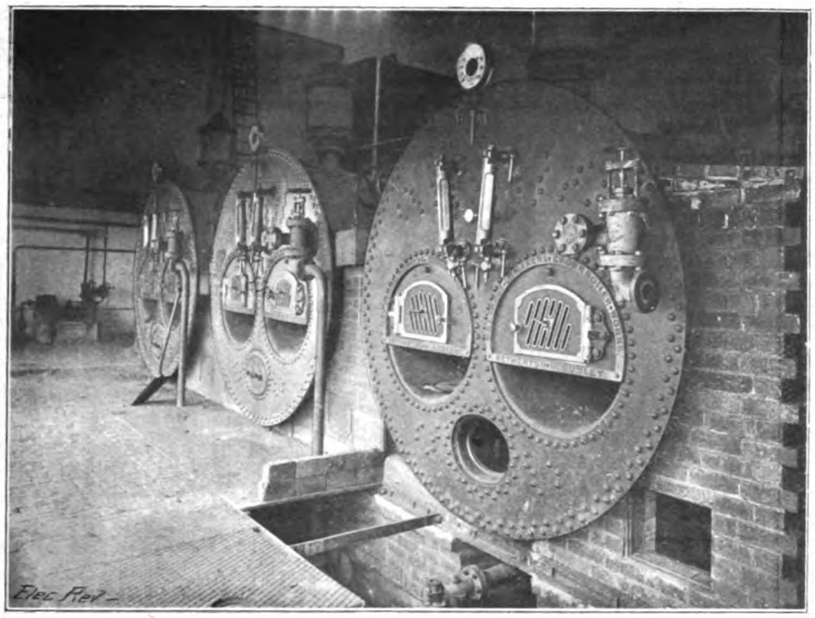
rings $\frac{1}{32}$-inch. The boilers are of the standard Lancashire type as to staying and the construction of the mounting blocks, and are provided with Hopkinson water-gauge fittings, feed valves, slide valve gun-metal blow-out cocks with safety keys, steam junction valves, and low water safety valve, as well as a dead-weight safety valve, and cast-iron perforated anti-priming pipe.

The working pressure is 140 lbs. There are two Blake and Knowles feed pumps, each of a capacity of 1,000 gallons per hour. Two water-tanks, each of 10,000 gallons capacity, are carried on girders at the side of the house with a clear headway beneath, over the passage leading to the engine room. The walls of the engine room are finished below in glazed bricks, and an overhead traveller of 6 tons capacity commands the full length between end walls, being carried on corbels upon the side walls. Car sheds with room for 24 cars adjoin the engine room, one shed being set apart for repairs. The architect for the buildings was Thos. Robinson, Esq., of Stourbridge. Mr. R. F. Browne has acted as resident engineer for the British Electric Traction Company, and upon him has also devolved the construction of the overhead equipment from the power house to Dudley.



Boiler House.

Market Place, Dudley.

All frogs and crossings and the metal portions of the section insulators are of gun-metal, and the whole of the overhead work is double insulated, Verus insulation being employed on the Dudley section with Brooklyn strain and globe insulators. The ears also are of gun-metal and well closed upon the trolley wire, which is of No. 0 S.W.G., and circular in section. Hangers and pull-offs, also of gun-metal, are of the West End pattern. The span wire is a hard galvanised steel stranded seven No. 15 S.W.G. cable with thimbled eyes to the Brooklyn strains and wrought-iron pole straps. The poles are of the "solid swaged and sweated" type, the standard pole of the British Electric Traction Company for ordinary work being one of 7⅝ inches diameter at the butt and weighing 820 lbs. Where stresses are more than usually heavy, poles of the same diameter, but thicker, are employed, weighing 940 lbs., while anchor poles weigh 1,140 lbs. Each pole has two collars and an ornamental cast finial and base, centre poles having also an additional circular raised wheel guard placed below the base. This tramway exhibits the three usual forms of overhead construction; that with centre poles and double bracket arms is used on Castle Hill, a view of which we give, side bracket poles as used through a part of the town of Dudley, and span wires or double poles are used for the remainder of the eastern section and the whole of the western section. The appearance of centre poles with symmetrical double brackets is very neat, but we cannot say we prefer side bracket poles to the span wire construction, and we certainly think municipal authorities might consider the systems at Dudley. They will assuredly choose span wire construction in preference to side brackets.

In accordance with the usual Board of Trade requirements, the trolley wires, which are double throughout, are divided into sections about half a mile in length, the end of each section being fed from a feeder box placed on the line of kerb. The feeder cables are carried into these boxes, which contain a white marble panel and four quick-break switches, one for each of the four trolley wires attached to the section insulator. Between the feeder box and the pole, the feeder cables, of Glover's steel armoured type, are laid in wrought-iron

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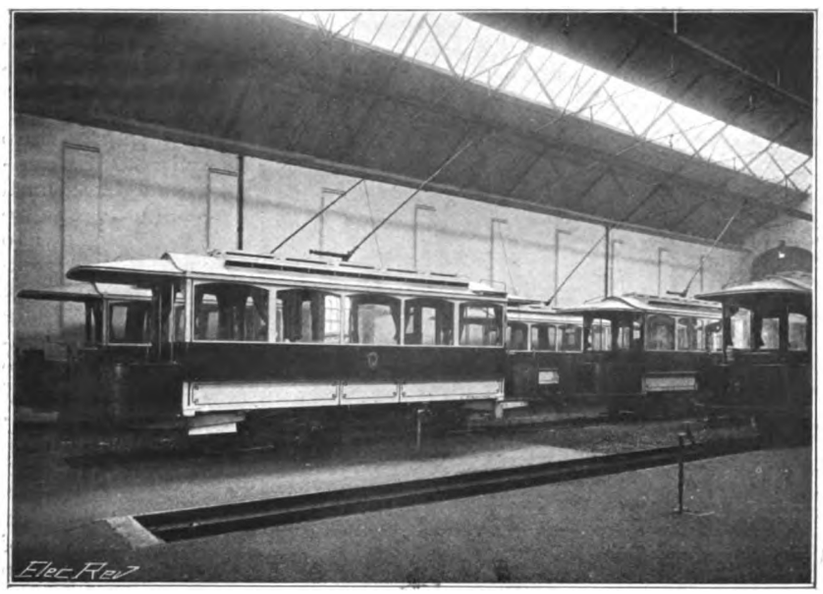
socketed pipes, which are screwed into the poles; the feeder cables emerge near the top of the pole, and are carried across to the section insulator, being much less obtrusive than the feeders of that portion of the line between the power house and Stourbridge. The mains are Callender's, laid in bitumen in wooden troughs. From the power house to Dudley three cables of



Interior of Car Shed.

0·25 area extend as far as the junction of the Cradley line, beyond which point one cable only is carried to the end of the line. One of the three cables is a negative feeder; of the others, one serves the Dudley section, and the other supplies current to both the Kingswinford line, so far as it extends within the municipal area of Dudley, and the Cradley line. There is also a test and telephone cable containing pilot and telephone cores, each core consisting of 7/22 wire.

On the outskirts of Dudley the feeders from the Dudley Corporation power station are brought to a large junction pillar, containing the necessary switches to enable the Corporation station to supply current to the line within their own area. At the same point also the negative return of the Corporation is heavily clamped to six stout bonds fixed to the rails. The western section is supplied from the company's own power house through a cable of 0·5 section, from which also will be supplied the current for the lines to Kinver and Kingswinford, the latter line being almost wholly outside the limits of the Dudley municipality. There are also the necessary test and telephone cable and the negative feeder. The track generally is single, with numerous turn-outs; these are three chains in length. Portions of the track, however, are double, namely, from the old depôt at the foot of the Castle Hill all the way up the hill as far as the Castle gateway.

In the Market Place of Dudley a short length of interlaced track has been employed, and there is a length of double track from the junction of the Cradley line towards the power house to a point about one furlong from the Kingswinford Junction. The trolley wire is suspended at a height of 20 feet on the span system and 21 feet on the bracket arm system above the rails. Telephones are placed at every half mile. The feeder pillars carry a separate small marble panel for the pilot and test wires, the lightning arrester being on the main panel. The line is double bonded throughout, the western or Stourbridge half with Columbia bonds, and the eastern or Dudley half with these and Neptune bonds of 6/0 S.W.G.

The car barns, two in number, each contain four tracks for three cars each, or 24 cars in all, the repair shed holding two cars. A connection is arranged at the large feeder pillar of the Corporation, so that current can if necessary be supplied to the line from either the company's own station or from that of the Corporation.

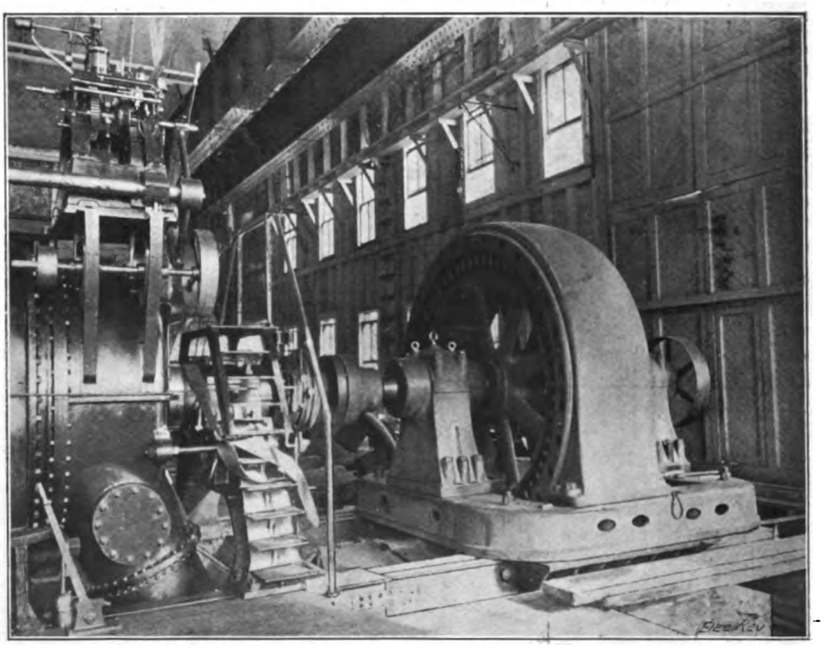
We may add that the overhead material on the eastern section has been supplied, as regards insulators, &c., by the Electric Tramway Equipment Company, of Birmingham, who also supplied the overhead switches for the whole system.

In accordance with the Board of Trade regulations, guard wire of No. 8 S.W.G. has been freely used under all telephone and telegraph wires, and earthed to the rails at numerous points.

It is worthy of note that the first cars were run over the whole line without a single mishap to the trolley which never left the wires on the round journey. The cars are of the single-deck four-wheeled type with Peckham trucks and 30-inch wheels geared 4 to 1 to G.E 800 motors; series parallel controllers are employed and emergency electrical brakes, as well as the ordinary hand brakes. The lighting circuit of the cars is parallel with the power circuit with five lamps in series of anchored filament type.

The cars have a seating capacity of 28 passengers. They measure 18 ft. 8 in. long in the body by 6 feet wide, and are 27 ft. 3 in. in length overall. The wheel base is 6 ft. 6 in. The bottom frames are of oak with pillars and roof sticks of ash and a clerestory with swing ventilators. Windows are of ¼ inch plate glass. The controllers are of the well-known K 2 type. "Common sense" sand boxes with pedal control are fitted. The gears are of cast-steel with cut teeth and soft steel cut pinions, and the gears are entirely encased. Electrical heaters are provided on the cars.

In connection with the Dudley and Stourbridge lines there are several extensions now under construction, or soon to be commenced, viz., the Kinver Light Railway, which branches off from the line about a mile from Stourbridge and extends 4½ miles to the town of Kinver, noted particularly for the scenic beauties of Kinver Edge—a famous holiday resort for Black Country people. Kinver is also noteworthy for the presence of quite a number of troglodytes, a peculiar people who are not yet extinct



700 kw. Generator at Niagara Falls. (See page 153.)

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even in England. Midway to the power house, the Kingswinford line branches out and returns to the main line at Holly Hall, having made a circuit of 5 miles through the country town of Kingswinford. From the outskirts of the town of Dudley another branch line of 2½ miles is in process of construction to Cradley Heath through Netherton, famous as the place whence comes Netherton iron. The Wolverhampton line again branches out from Dudley Town.

The total length of line already constructed or in progress is as follows:—

Dudley and Stourbridge	5⅝ miles.
Kinver	4½ "
Cradley Heath	2½ "
Kingswinford	5 "
Stourbridge Town extension	½ "
	18¼ miles.

in addition to which, there is the Wolverhampton line in prospect.

In Dudley itself, the car service will ultimately be very frequent, no fewer than five distinct services culminating in Dudley, and we venture to say from a pretty extensive experience in the district that the traffic will be heavy. So far as relates to such portions of the above lines as are within the Dudley area, power will be supplied by the Dudley Corporation from a power house at Springsmire. A temporary station has been erected with Babcock boilers and two 100-KW. Westinghouse belt-driven sets. The permanent equipment will be more considerable, and will include three 200-KW. sets, direct connected, and a smaller 100-KW. set, but the station is also to serve for lighting the town, the three-wire system being adopted. The station is in charge of Mr. Marsh, the electrical engineer to the Dudley Corporation.

The line was inspected on July 25th by the Board of Trade, and found to fully comply with the requirements; permission being given to commence running at once, a 15 minutes' service was immediately begun.

For some weeks cars have been running on the line for the purpose of instructing motor men, and as soon as the Board of Trade certificate has been received as full a service as can be afforded by the present nine cars will be run. Another nine cars are nearly ready for delivery by the Brush Company, of Loughboro', making 18 in all, with which the contemplated rapid service will then be run.

BUFFALO AND NIAGARA FALLS.

In the REVIEW of June 23rd was given a short description of the new dynamo recently installed by the Buffalo and Niagara Falls Electric Light and Power Company, of Niagara Falls, together with two illustrations of the lowering of the field over the Niagara cliff. This dynamo has now been set up in the power house of the Niagara Falls Hydraulic Power and Manufacturing Company at the water's edge in the Niagara gorge, where it is direct connected to a 2,500 H.P. turbine (see figure on page 152). The dynamo will furnish current for the incandescent lighting system of the City of Niagara Falls, and will supply 18,000 lights, but this number will not constantly be fed by it, for the reason that a portion of the current supply for this service will come from another station of the Buffalo and Niagara Falls Electric Light and Power Company opposite the power house of the Niagara Falls Power Company. The dynamo was made by the Walker Company, of Cleveland, and was installed under the supervision of Frank G. Lott, manager of the B. & N. F. E. L. & P. Co., who at one time was located in London.

The City of London Electric Light Company.—This company announces reductions in the prices of electricity. Every consumer is given the option of choosing from two methods of charging for lighting, and two for power, heating, and cooking purposes. One of the methods for lighting is an all-round price of 4½d. per Board of Trade unit; one for power, &c., an all-round price of 2½d. for the same amount of electrical energy. Threatened competition seems to be having its effect.

THE REPORT OF THE PACIFIC CABLE COMMITTEE.

(*Continued from page* 68.)

IV.—WHAT REVENUE WILL ARISE FROM THE TRAFFIC WHICH MAY BE EXPECTED TO PASS OVER THE CABLE?

Before going into the amount of revenue which might reasonably be expected to accrue to the Pacific cable, it would be well to examine the evidence given relative to the traffic-carrying capacity of the core of the Vancouver-Fanning Island section, which will, of course, determine the through rate of speed of the whole line; we will, therefore, deal with this section alone. A certain amount of confusion was introduced by the fact that the usual standard "word" (of five letters) was not adhered to throughout. This standard is generally recognised and used in referring to the carrying capacity of cables, but we find that, amongst others, Sir W. H. Preece has not seen fit to adhere to it in this instance, although it is used throughout the latest edition of the "Hand-book of Telegraphy," of which he is one of the authors. In the advertisement for tenders, one of the conditions was that "the calculated speed for each section of the cable shall in no case be less than 12 words per minute." We find in the evidence that the India-Rubber, Gutta-Percha and Telegraph Works Company amended the core which had been included in their tender (without asking for any corresponding increase in the price); this action was taken by them after receiving opinions from Lord Kelvin and Mr. Herbert Taylor, who were consulted by the company in view of the great difference between the core they had suggested in their tender, and the very heavy core estimated for by the advisers of the General Post Office. It appears that there was a slight variation between the weights of the core originally calculated by this company and those given by Mr. Taylor and Lord Kelvin. The core adopted was that calculated by Lord Kelvin, viz.:—552 lbs. of copper and 368 lbs. of gutta-percha for a length of 3,560 nautical miles, which included 10 per cent. of slack after laying. In the case of W. T. Henley's Telegraph Company, the core is given as 650 lbs. of copper and 400 lbs. of gutta-percha; no length is given by Mr. Theophilus Smith, who represented this company, but from his experience in laying other deep-water cables, the amount of slack required is given as from 7 to 8 per cent.; by adding this 8 per cent. to 3,220 miles, which is the distance between Vancouver and Fanning as given by the highest authority, Admiral Wharton, we get 3,478 nautical miles as the length of cable after it is laid. Mr. Alexander Siemens proposed to use a core of 500 lbs. of copper and 320 lbs. of gutta-percha. The length of the span we are dealing with is given as 3,300 miles, but no mention is made of the amount of slack to be added. In the case of the Telegraph Construction and Maintenance Company, the core recommended had 650 lbs. of copper and 400 lbs. of gutta-percha, the length of the section, including 10 per cent. allowance for slack, being given as 3,650 nautical miles. Sir W. H. Preece, on being questioned, did not support the 940 lbs. of copper and 940 lbs. of gutta-percha core originally designed by the General Post Office authorities, but suggested another. We quote from the report:—Lord Selborne's question (No. 1,393): "I wish to get this quite clearly, if you please. Whereas in 1893 you advised for this cable, or, rather, for this section of cable, a cable of the massive type of 940 lbs. copper and 940 lbs. gutta-percha; the probability is, that if you were to reconsider the matter now in the light of more recent experience, you would recommend 600 gutta-percha and 750 copper"? —"That is so." On this Lord Selborne put the succeeding question, as follows:—"I need not point out that the difference of cost between the first and the second specification would be very great?"

The Post Office core thus stands for the moment at 750 lbs. of copper and 600 lbs. of gutta-percha. The distance from Vancouver to Fanning Island is given as 3,298 miles, a figure which Sir W. H. Preece said would probably be confirmed by Admiral Wharton. This, however, was not the case, as the hydrographer made the distance 78 miles less, which is a matter of considerable importance in a long

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cable, as the additional length means in this particular case the decrease of the carrying capacity of the cable by four or five letters per minute, or about 5 per cent. This remark also applies, but in a slightly different degree, to the length given by the Telegraph Construction and Maintenance Company, which exceeds Admiral Wharton's length by 96 miles. As regards slack, 12½ is given here as the percentage amount to be added to the overground distance, thus making the length of the cable after it is laid 3,710 nautical miles. The representatives of the Eastern Telegraph Company took a core of 650 lbs. copper and 400 lbs. gutta-percha, and, after a slight discussion among themselves, agreed that from 13 to 15 per cent. of slack was the right thing. The distance between Vancouver and Fanning was given by Mr. Saunders as 3,300 miles, or 88 miles more than that given by Admiral Wharton, therefore a somewhat similar remark as to percentage decrease of carrying capacity as was made in the case of Sir W. H. Preece also applies in the case of the Eastern Telegraph Company. By adding the 15 per cent. we get 3,795 miles as the length of this section when laid. From Mr. Lamb's evidence we learn that the Post Office core is again changed, and now stands at 800 lbs. of copper and 550 lbs. of gutta-percha, this production being named "Post Office revised," and flatteringly alluded to as "Mr. Preece's model cable;" the amount of slack mentioned by Mr. Lamb in calculating the cost of the working and maintenance of the cable is 15 per cent., which, if added to the overground distance given by the Post Office, makes the cable have a length of 3,793 miles after laying. Mr. Herbert Taylor spoke of the core as 650 lbs. of copper and 400 lbs. of gutta-percha, and of the slack as being 10 per cent., but gives no lengths. Dr. Alexander Muirhead, in his evidence, stated that a core with 650 lbs. of copper and 400 lbs. of gutta-percha would be most suitable, as allowing for extra pressure of traffic, as with automatic curb transmission such a core would give 19 words per minute, but he gave no data as regards either length or slack. Mr. Reeves pointed out in connection with the slack requisite that the French cable laid in the Pacific between Australia and New Caledonia had only an allowance of 5½ per cent. of slack. (This amount is given as 6 per cent. in the proceedings of the Telegraph Conference held in Sydney in 1896.)

We have given above the various opinions as to the weights and proportions of conductor and dielectric recommended by the various witnesses. For the sake of comparison only as to the relative carrying capacity of these cores, we will now assume a set of cables all of the same length, say, 3,600 nautical miles, but provided with the various cores mentioned by the witnesses, using the same standard for all. In this calculation we have the following result. In the last column we give the number of words which each core would carry, judged by a common standard, but taking the actual lengths as estimated after laying:—

	Over a length of 3,600 miles.		Over the lengths as estimated.	
	Core.	"Words" per minute.	Length.	"Words" per minute.
Silvertown Company ...	552/368	14·72	3,560	15 06
Henley's Company ...	650/400	16 7	3,478	17 87
Siemens Company ...	500/320	13·1	3,630	12 87
Construction Company ...	650/400	16 7	3,650	16 22
Post Office ...	940/940	30·07	3,710	28·32
	750/600	21·77	3,710	20·50
	800/550	21 66	3,793	19 51
Eastern Company ...	650/400	16 7	3,795	15 02
Mr. Taylor ... Dr. Muirhead ...	650/400	16 7	...	...

NOTES.

Gas Engines v. Electro-Motors.—With the advent of the Westinghouse engine, English gas engine manufacturers will have to look to their laurels, and some of them might with advantage be somewhat more guarded in their extravagant claims. The Westinghouse engine, which is described and illustrated in our other pages, and which seems equal, if not superior, to the best practice of to-day, is not claimed to give better figures than 1½d. per KW.-hour, that is, about the cost of the best electro-motor results. Yet Messrs. Bilbie, Hobson & Co., in a circular which is going the rounds of the profession, claim that the gas engine is about four times less costly than the electro-motor. We have never come across a more one-sided statement of the relative economies of gas engines *v.* electro-motors, for while the latter are credited with an alarming friction load, "that is to say, the power taken to drive the motors themselves as apart from the power they transmit to the machinery," fearful losses in distribution, and awful wear and tear of an expensive nature, not a word is said regarding gas engine repairs, depreciation, oil, power taken up in running empty, water, &c. Only the gas consumption enters into the calculation of Messrs. Bilbie, Hobson & Co., and, therefore, assuming an average load of 10 H.P., electricity costs, for a working year of 2,500 hours, £234, as against gas at £62. In actual practice, state these enthusiasts, "we are prepared to say that the gas engine would show a greater saving even than this." Twenty cubic feet is their allowance per B.H.P. per hour, which, at a cost of 2s. 6d. per 1,000, would equal ·6 of a penny per B H.P.-hour. Now the Reading Electric Supply Company informs us that a 10-H P. gas engine, when in first rate condition, consumes 22 cubic feet per *indicated* H.P.-hour. The loss in friction in the engine itself—an item carefully overlooked by Messrs. Bilbie, Hobson & Co.—is 2½ I.H.P., which loss, of course, remains practically constant at all loads. The gas consumption will, therefore, be found to be:—

At full load, 27½ cubic feet per B.H P.-hour.
„ half „ 33 „ „ „ „
„ quarter „ 44 „ „ „ „

Which, at 2s. 6d. per 1,000, averages nearly *double* the sum allowed by the "Stockport" representatives, and this, when calculated on the best obtainable results, which, in commercial practice, as the company very fairly remarks, are only realised in a very few cases. So far as oil is concerned, it is practically *nil* in an electro-motor. In a gas engine it is considerable. An electro-motor requires no attendance beyond an occasional cleaning. Wear and tear is considerable in a gas engine, but next to nothing in an electro-motor. A gas engine is generally kept running light if not wanted for a short time, whereas an electro-motor can be shut down and restarted with the greatest ease, thus saving energy. An electro-motor, when required, can greatly exceed its nominal or rated power; a gas engine does not possess this advantage. All these items, together with others such as the extra initial outlay for gas engines of corresponding H.P., interest on extra capital, &c., have been carefully withheld, and we ask Messrs. Bilbie, Hobson & Co., whether they consider their circular fairly represents the matter of gas engines *v.* electro-motors? For our own part, we challenge the accuracy of their figures, and shall shortly proceed to show their assertions to be based on wholly inaccurate and erroneous data, and at the same time give our readers what we hope will be at least an approximation to the truth.

The American Electro-Therapeutic Association.—This Association will hold its ninth annual meeting at Washington, D.C., September 19th, 20th, and 21st, 1899. The president is Dr. F. B. Bishop, and the chairman of the Committee of Arrangements is Dr. D. Percy Hickling, No. 221, Third Street, N.W., Washington, D.C. Willard's Hotel has been chosen for the head-quarters, and special rates have been made for all interested in this meeting. Many able papers have been promised, and a very successful scientific meeting is assured. There will be a large and varied exhibition of electro-therapeutic apparatus in Willard's Hall during the meeting of the Association. The Committee also promises a very pleasant social programme, including a reception by the President of the United States, an excursion to Mount Vernon, Arlington, and Alexandria, &c. The Committee earnestly hope that every Fellow, Active, Honorary and Associate, will be present at this meeting, as they want to make it rank among the notable meetings of the Association.

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Reduction of Metals at very High Temperature.—A discovery made by Dr. Goldschmidt, of Essen, though not directly electrical, may interest our readers, inasmuch as it depends on the utilisation of aluminium in the reduction of metallic oxides to the metallic state. The powerful action of aluminium in abstracting oxygen from other metals has been known since 1845, when the subject was investigated by Wöhler, but with small quantities of metal only, since aluminium at that time was very expensive. The industrial application of this property could only be thought of 20 years later, when the production of aluminium was made much less costly by electric smelting. The question attracted the attention of Dr. Goldschmidt when he was commissioned at Krupp's works to discover a simple and cheap method of producing pure chromium. It was known at the commencement of the experiments that when powdered aluminium was thoroughly mixed with the oxide to be reduced, and a high temperature depending on the stability of the oxide to be reduced, applied, that the process of reduction once started continues of itself. The problem to be solved was to find a means of starting the reduction. After various unsuccessful experiments, Dr. Goldschmidt succeeded in igniting a mixture of chromic oxide and aluminium by the blowpipe flame. When once started, the reduction process swept through the whole mixture, with the final result that the pure metal collected in the bottom of the vessel and a slag of corundum collected on the top. A more convenient means of igniting the mixture was found in barium peroxide. This substance was made up with shellac into balls about the size of a cherry, each ball being furnished with a stalk of magnesium ribbon. One of these "cherries" was laid on the top of the mixture (the top of which had been previously sprinkled with barium peroxide) and the magnesium ribbon was ignited. The ignition of the "cherry" by the magnesium started the process of reduction, which then spread through the whole mixture. After the reduction process is started, sand is usually sprinkled over the contents of the crucible. So rapid is the process, that the outside of the crucible does not even become hot, though the temperature inside is probably over 2,000° C. The process can even be carried out in a wooden vessel coated with sand. The only metal which has hitherto resisted this reduction process is vanadin. The practical application of this process will depend on the price of aluminium, which every year is becoming cheaper. The objects attained by the invention are the production of metals in a high degree of purity, and the production of corundum, an extremely valuable grinding and polishing material, coming next in hardness to the diamond. Minute ruby crystals have been found in the corundum slag. The process is also applicable in difficult soldering processes, even the ends of rails *in situ* may be soldered or welded together. The latter operation is carried out by supporting in a suitable vessel a mixture of aluminium and iron rust round the rail joint, and igniting as above described by the "cherry." For every joint about 8 lbs. of aluminium is required. An advantage of the process is that the quantity of the mixture necessary to give the required heat can be easily calculated beforehand.

Some Electric Properties of Amalgams.—As the thermal capacity of an amalgam is approximately equal to the sum of the thermal capacities of the components, the heat of amalgamation is practically constant, and hence also the temperature coefficient of the E.M.F. must be constant, being given by the expression $E T - Q/n e$; the E.M.F. should, therefore, be a linear function of the temperature. The E.M.Fs. of cells of zinc and cadmium amalgams of various concentrations, and of amalgams against pure metal were determined, and it was found that, except in the case of the highest concentrations, the E.M.F. was in accord with the value calculated by the usual expression, and that E/T was constant and not affected by the nature of the anion. The heat of amalgamation of cadmium was found to be 505 cals., and that of zinc — 2,255 cals. The contact E.M.F. between the pure metal and amalgam was also determined, and was only appreciable in the case of cadmium amalgam, for which it reached about 0 05 volt. The above is an abstract of a paper by Theodore W. Richards and G. N. Lewis in the *Zeitschrift für Physikalische Chemie*, Vol. 28, pages 1—12.

Influence of Pressure on the Electrical Conductivity of Solutions.—The influence of pressure is due to the changes produced in (1) volume, (2) viscosity, (3) degree of dissociation, (4) dissociation of the solvent, and is given by the equation $1/\lambda \times d\lambda/dp = 1/v \times dv/dp + 1/\eta \times d\eta/dp + 1/a \times da/dp + \lambda_1/\lambda a_1 \times da_1/dp$. The last term may be neglected if the number of ions of the solute far exceeds that of the solvent ions. The volume changes of aqueous solutions have been calculated in previous papers, and the first partial value is obtainable. From Cohen's determinations of the effect of pressure on viscosity, the values $1/\eta \times d\eta/dp$ are also obtainable for sodium chloride solutions. The effect of pressure on the dissociation constant is given by the expression $d \log. k/dp = - \Delta v/1{,}000\ RT$, where Δv is the volume change (which must be expressed as a function of the pressure), consequent on the dissociation of a gram-molecule of the solute. The values $1/a \times da/dp$ are hence obtained, and from the sum of the three partial values the total pressure effects are calculated for pressures of 100, 200, 300, 400 and 500 atmospheres. The variation of the pressure effect with varying degrees of dissociation is seen in the case of the chlorinated acetic acids; the values for $1/\lambda \times d\lambda/dp$ decrease with increase of dissociation, and are in all cases in good accord with the values found. In the cases of aqueous solutions of ammonia and water, the volume changes consequent on dissociation are unusually great, hence also the conductivity change due to pressure; in the case of ammoniacal solutions the found and calculated values are compared, with fair agreement. For very dilute solutions, the dissociation of the solvent becomes important, and this is allowed for in the case of dilute solutions ($v = 500$ to $v = 50{,}000$) of hydrogen and sodium chlorides; the pressure effect is found to increase rapidly with dilution, but not as rapidly as calculated. The apparatus employed for the determination of conductivity at high pressure is described, and the results of the determinations are given, the compounds examined being solutions of acetic, monochloracetic, dichloracetic, trichloracetic, phosphoric, citric, tartaric, benzensulphonic and hydroferrocyanic acids, sodium phosphate, tartrate and chloride, potassium citrate and ferrocyanide and ammonia. The above is an abstract of a paper by A. Bogojawlensky and Gustav Tammann in the *Zeitschrift fur Physikalische Chemie*, Vol. 27, pages 457—473.

Molecular Fatigue.—We read in a Belgian contemporary that:—

> **Metals get tired as well as living beings. Telegraph wires are better conductors on Monday than on Saturday, on account of their Sunday rest, and a rest of three weeks adds 10 per cent. to the conductivity of a wire.**

We wonder what the conductivity would be in six months, at this rate!

Rare Brazilian Sand used for Incandescent Mantles.—The Monazite or Prado sand, which is used in the manufacture of the "Auer" incandescent mantles, is found at Bahia, Porto Seguro, and in small quantities in Matto Grosso, Brazil. In the first two places the sand is found close to the shore and is derived from the decomposition of the neighbouring gneiss. It is of a dark yellow colour, like gold, and very heavy. The following is an average analysis:—

Aluminium	3 per cent.
Cerium	62 to 70 per cent.
Iron	2½ per cent.
Lanthanum	2½ per cent.
Thorium	1½ to 3½ per cent.
Yttrium	1 to 2 per cent.

Cerium is an extremely rare metal, hitherto found only in Sweden. Its colour is a whitish-green, and it has considerable metallic lustre. Its specific gravity is almost equal to platinum. Mixed with copper and zinc an artificial gold is produced, having the same lustre and weight as real gold. Thorium is of a grey colour, and when burnt in air or oxygen is converted into an oxide. The metal combines energetically with chlorine, sulphur and phosphorus, and dissolves in hydrochloric acid, liberating hydrogen in the process. As may be supposed, there has been a considerable run on these valuable sands since they were discovered, and it is expected that the value of this current year's exports will be more than double what it was last year.

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Electrical Engineers R.E. Volunteers.—The second detachment of this corps will leave Waterloo Station for Portsmouth on Saturday, 29th inst., at 11 20 a.m., to undergo its annual training for eight days.

Appointment Vacant.—The Leyton District Council requires a shift engineer; salary £100, rising to £150 per annum. See "Official Notices."

NEW COMPANIES REGISTERED.

District Electric Supply Company, Limited (62,822).—This company was registered on July 1st, with a capital of £1,000 in £1 shares, to carry on the business of an electric light and power supply company, electricians, electrical and general engineers, &c. The first subscribers (each with one share) are:—Robert D. Baxter, 22, Lansdowne Crescent, Notting Hill, solicitor; Alexander W. Johnson, St. Kilda, Cranes Park, Surbiton, solicitor; Robert C. Kerr, Glendown, Queen Anne Avenue, Bromley, Kent, solicitor; David M. Carr, 45, Lansdowne Road, Notting Hill, W., solicitor; James Gleazer, 75, Queen's Road, Wimbledon, clerk; Robert B. Somerville, 42, Hamilton Road, Bromley, clerk; and Allan E. Read, 22, Morella Road, Wandsworth Common, S.W., clerk. Registered without articles of association. Registered office, 12, Victoria Street, S.W.

Epstein Electric Accumulator Syndicate, Limited (62,846).—This company was registered on July 4th, with a capital of £10,000 in £1 shares, to adopt an agreement with Roger W. Wallace for the acquisition of certain patents and property, to manufacture and sell secondary batteries, and to carry on the business of an electricity supply company. The first subscribers (each with one share) are:—A. E. Unwin, 25, Tubb's Road, Harlesden, N.W., gentleman; D. Thomson, 81, Kyverdale Road, Stoke Newington, N., bookkeeper; J. W. Hillyer, 3, Seventh Avenue, Little Ilford, E., clerk; F. Wainwright, 50, Hewitt Road, Harringay, N., managing clerk; E. J. Richardson, 42a, Noble Street, E.C., solicitor's clerk; H. S. Church, 5, Belmont Road, Ilford, clerk; and J. H. German, 3, Askew Road, Uxbridge Road, W. The number of directors is not to be less than three nor more than six; the subscribers are to appoint the first; qualification, one share.

Epicyclic Manufacturing Company, Limited (62,849).—This company was registered on July 4th, with a capital of £20,000 in £10 shares, to acquire any patents relating to the regulation of mechanical power, to adopt an agreement with the Epicyclic, Limited, and to carry on the business of mechanical and electrical engineers, machinists, tool makers, &c. The first subscribers (each with one share) are:—J. C. Howell, 24, Queen Victoria Street, E.C., engineer; J. Harrop, Gorseinon, near Swansea, engineer; W. L. Agnew, 11, Portman Square, W., gentleman; P. E. Scrutton, 24, Victoria Street, E.C., gentleman; H. T. Rowntree, 24, Queen Victoria Street, E.C., clerk; A. Austin, 8, Union Court, E.C., solicitor; and R. Austin, 8, Union Court, E.C., solicitor. The number of directors is not to be less than two nor more than five; the first are J. C. Howell and J. Harrop. Registered office, 24, Queen Victoria Street, E.C.

Newcastle Engineering Company, Limited (62,858).—This company was registered on July 5th, with a capital of £15,000 in £1 shares, to acquire the business now carried on at Dunston, Durham, as "The Phœnix Engineering Company," to enter into an agreement with J. Maude and J. Wardle, to acquire the patent rights in respect of "Silverite Metallic Packing," and to carry on the business of electrical and general engineers, cycle manufacturers, motor car builders, tube makers, &c. The first subscribers (each with one share) are:—Stephen Percy, 161, Northumberland Street, Newcastle-on-Tyne, sanitary engineer; E. Mortimer Reid, 52, Dean Street, Newcastle-on-Tyne, chartered accountant; T. G. Bowden, 42, Mosley Street, Newcastle-on-Tyne, chartered accountant; Jas. Routledge, 46, Sidney Grove, Newcastle-on-Tyne, superintendent; Cecil W. Downie, Linden Road, Gosforth, wholesale druggist; Charles H. T. Pelmear, 7, Granville Street, Gateshead-on-Tyne, engineer; and William M. Pybus, junior, Post Office Chambers, Newcastle-on-Tyne, solicitor. The first directors (to number not less than three nor more than eleven) are Joseph Maude, James Wardle and others, to be nominated by the subscribers; qualification, £100; remuneration, £100 per annum divided between them. Registered office, 6, Exchange Buildings, Lombard Street, Newcastle-on-Tyne.

Edison-Bell Automatic Phonographs (Scotland) Company, Limited (4,313).—This company was registered at Edinburgh on July 6th, with a capital of £15,000 in £1 shares, to acquire from the Edison-Bell Consolidated Phonographs Company, Limited, a license to use certain inventions and letters patent, and to carry on the business of manufacturers of phonographs and telephones, electricians, mechanical and chemical engineers, &c. The first subscribers (each with one share) are:—John McFarlane, 151, North Street, Glasgow, grain merchant; Peter Burt, 153, Queen Street, Glasgow, engineer; John Macdonald, 72, Great Clyde Street, Glasgow, manufacturing chemist; John Orme, Hope Cottage, Bishopston, chartered accountant; James Davis, 168, St. Vincent Street, Glasgow, chartered accountant; Thomas Wilson, 129, St. Vincent Street, Glasgow, solicitor; J. Wilson, 39, Gibson Street, Hillhead, Glasgow, writer. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, 200 shares; remuneration as fixed by the company. Registered office, 168, St. Vincent Street, Glasgow.

British Westinghouse Electric Manufacturing Company, Limited.—This company was registered on July 10th, with a capital of £1,500,000 in 200,000 preference shares of £5 each, and 50,000 ordinary shares of £10 each, to adopt an agreement with the Westinghouse Electric and Manufacturing Company, constituted under the laws of the State of Pennsylvania, U.S.A., and to carry on the business of electricians, engineers, and makers and suppliers of electricity for the purposes of heat, power, light, or otherwise. The first subscribers (each with one share) are:—J. Annan Boyce, 8, Austin Friars, E.C., merchant; C. W. Benson, 66, New Broad Street, E.C., merchant; J. Lawrence, Oaklands, Henley, Surrey, newspaper owner; R. C. Parsons, 39, Victoria Street, Westminster, civil engineer; G. Westinghouse, 32, Victoria Street, Westminster, manufacturer; L. Bannister, 32, Victoria Street, Westminster, manufacturer; E. G. Farish, 57½, Old Broad Street, E.C., solicitor. The number of directors is not to be less than five nor more than nine; the first are Geo. Westinghouse, Lemuel Bannister, Hon. R. C. Parsons, M.I.C.E., C. W. Benson, J. Lawrence, and J. A. Bryce; qualification, £1,000; remuneration, £500 each per annum (£1,000 for the chairman), and a share in the profits. Registered office, Cornhill Chambers, 63, Cornhill, E.C.

General Engineering Company, Limited (62,951).—This company was registered on July 12th, with a capital of £15,000 in £1 shares (6,500 preferred ordinary), to acquire the business of the Electrical and General Engineering College and of the Electrical and General Experimental Engineering Works, carried on by G. D. de Tunzelmann at 2—4, Penywern Road, Earl's Court, S.W., and to carry on the business of electricians, engineers, light and power contractors, dynamo and electrical apparatus manufacturers, &c. The first subscribers (each with one share) are:—G. W. de Tunzelmann, 6, Penywern Road, S.W., electrical engineer; C. E. Cree, 12, Nevern Road, Earl's Court, S.W., barrister; A. W. Cree, Brodsworth, Beckenham, solicitor; F. M. Johnson, 61, Chancery Lane, patent broker; J. McHardy, 83, Talgarth Road, West Kensington, engineer; J. H. Reeves, 85, Eltham Road, Lee, S.E., electrical engineer; and H. E. Cree, The Rectory, Brightling, Sussex, solicitor. The number of directors is not to be less than three nor more than five; the first are G. W. de Tunzelmann, J. H. Reeves and J. McHardy; qualification, £500; remuneration, £25 each per annum. Registered office, 2—4, Penywern Road, Earl's Court, S.W.

Rhea Insulite Syndicate, Limited (62,964).—This company was registered on July 14th, with a capital of £15,000 in £1 shares, to acquire from W. J. Cordner certain inventions relating to the manufacture of a composition from Rhea fibre applicable for electric insulation and other purposes, and to carry on the business of spinners and manufacturers of textile fabrics. The first subscribers (each with one share) are:—J. H. Oliver, 2, Beresford Villas, Park Terrace, Southend, cashier; W. Brider, 43, Appach Road, Brixton Hill, S.W., solicitor; W. H. Kemp, 28, Pilkington Road, Peckham Rye, S.E., gentleman; J. H. S. Thomson, 35, Broad Street House, E.C., secretary; J. Feil, 36, Keppel Street, Gower Street, W.C., secretary; S. C. Whittle, 40, Carlingford Road, Green Lanes, N., gentleman; and A. Lowry, 60, Malvern Road, Leytonstone, secretary. The number of directors is not to be less than two nor more than seven; the first are H. P. Burnell and W. J. Cordner; qualification, £200; remuneration, £75 each per annum (£100 for the chairman), and a share in the profits. Registered office, 17, Shaftesbury Avenue, W.

Lisbon Electric Tramways, Limited (62,983).—This company was registered on July 17th, with a capital of £1,000,000 in £1 shares, to acquire the tramlines, tramcars, and other assets and effects of the Companhia Carris de Ferro Lisboa, of Portugal, now held under a concession dated April 10th, 1888, to acquire certain fully-paid shares of 100 milreis each (Portuguese currency), in the said company, to adopt an agreement with Werner, Beit & Co., to construct or acquire and work by horse, electrical, steam or other power, tramways, railways, and other means of communication, in the Kingdom of Portugal or elsewhere on the Continent of Europe, and to carry on the business of generators, accumulators and distributors of electric energy for the purposes of light, heat, motive power or otherwise; manufacturers of cables, wires, lines, motors, generators, dynamos, accumulators, transformers, lamps, plant and machinery; electrical and mechanical engineers, electricians, &c. The first subscribers (each with one share) are:—James H. Cox, 19, Camberwell New Road, S.E., clerk; A. W. Rogers, 8, Denning Road, Hampstead, N.W., gentleman; T. H. Gibbett, 119, Drakefield Road, Balham, S.W., gentleman; W. Buscli, 4, Lewisham Road, Highgate, N.W., gentleman; A. T. Ward, 44, Cambridge Avenue, N.W., clerk; G. Haberland, Olieveden, Southend-on-Sea, gentleman; W. Macgillivray, 368, Green Lanes, Harringay, N, gentleman. The number of directors is not to be less than three nor more than nine; the subscribers are to appoint the first; qualification, £500; remuneration, £500 per annum, divided between them.

French Victoria Accumulator Company, Limited (62,989).—This company was registered on July 18th, with a capital of £60,000 in £1 shares, to acquire from Raymond de Wattsville, of 18, Rue Caumartin, Paris, and Alexander Schanschieff, of Harrison Road, Halifax, Yorks., and to own, develop, and work French Patent No. 264,377, of February 24th, 1897, relating to electric secondary batteries or accumulators. The first subscribers (each with one share) are:—Wm. H. Spencer, Primrose Cottage, Halifax, worsted spinner; Fredk. Walker, Halifax, solicitor; Alex. Schans-

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chieff, Halifax, electrical engineer; Albert E. Hodgson, Montana, Halifax, engineer; Geo. H. Clegg, 42, Park Place, Halifax, clerk; Wm. Peddie, 23, Cheshem Street, Bradford, clerk; and Charles B. Marston, 24, Stanley Road, King's Cross, Halifax, clerk. The number of directors is not to be less than five nor more than nine; the first are Messrs. Walker, Boequet, Hodgson, Duchanoy, Decker-David, Schauschieff, and de Watteville; qualification, £200; remuneration 10 per cent. of the net profits, divisible. Registered office, 10, Harrison Road, Halifax, Yorks.

King's Sanitary Appliances Syndicate, Limited (63,995).—This company was registered on July 19th, with a capital of £10,000 in £1 shares, to enter into an agreement with J. King for the acquisition of certain patents and to carry on the business of iron-founders, tool makers, brass founders, electrical, sanitary and mechanical engineers, &c. The subscribers are:—W. Wright, 231, East India Road, E., tailor (300); G. J. Anderson, 231, East India Road, E., tailor (300); C. H. Nicholson, 155, Fenchurch Street, E.C., iron merchant (300); J. Crighton, Roeburn, Stonebridge Road, N.W., manufacturer (300); H. W. Gracie, 90, Shacklewell Lane, Hackney, clerk (1); R. W. Peatheyjhns, 90, Canton Street, Poplar, E., clerk (1); and A. J. Smith, 30, Moorgate Street, E.C., gentleman (1). The number of directors is not to be less than four nor more than six; J. King is the first managing director.

Midland and Lincolnshire Mutoscope Company, Limited (63,003).—This company was registered on July 19th, with a capital of £18,000 in £1 shares, to acquire a license from the British Mutoscope and Biograph Company, Limited, to manufacture, sell, let on hire and deal in mutoscopes, biographs and mutographs, and to carry on the business of electrical and mechanical engineers, suppliers of electricity, &c. The first subscribers (each with one share) are:—A. E Blake, Prudential Buildings, Nottingham, stock-broker; A Wheeler, Derby Road, Nottingham, accountant; F. W. Draper, 122, Portland Road, Nottingham, cashier; A. J. Ball, Globe Cottages, Wilford, Nottingham, clerk; C. Morris, The Lodge, Radcliffe, auctioneer; A. Wilson, Ashbourne Road, Derby, J.P.; and J. A. H. Green, Elden Chambers, Nottingham, solicitor. The number of directors is not to be less than two nor more than seven; the first are to be appointed by the subscribers, subject to certain rights of the British Mutoscope and Biograph Company, Limited; remuneration, £500 per annum, divisible.

Weybridge Furnishing Company, Limited (63,018).—This company was registered on July 20th, with a capital of £6,000 in £1 shares, to acquire and carry on the business of builders, electrical and sanitary engineers, decorators, ironmongers, hardwaremen, and furniture manufacturers, carried on at Queen's Road, Weybridge, as "The Weybridge Furnishing Company." The first subscribers (each with one share) are:—E. L. Shaw, Heatherdene, Weybridge, gentleman; G. Haddon Eray, Walton-on-Thames, gentleman; H. Willson, Oatland Drive, Weybridge, gentleman; F. H. Weller, 59, Devonshire Road, Greenwich, clerk; G. O. Wallasey, 6, Progress Road, Weybridge, manager; C. Snook, Maybury Road, Woking, cashier; and T. Cave, Princes Road, Weybridge, decorator. The number of directors is not to be less than three nor more than seven; the first are E. L. Shaw, C. H. Eray, H. Willson, F. H. Weller, C. O. Wallasey, C. Snook, and J. Cave; qualification, one share; remuneration £5 each per annum.

Westminster Automatic Telephone Syndicate Limited (63,036).—This company was registered on July 21st, with a capital of £50,500 in £1 shares (500 deferred), to acquire from Victor Veysey certain patents relating to telephonic apparatus, to enter into an agreement with the said vendor to carry on the business of a telephone, telescriptor and telegraph company, and to construct, maintain, and control electric recording systems and electrical communication. The first subscribers (each with one share) are:—F. R. H. Conolly, 48, Sandmere Road, S.W., secretary; H J. Pounds, 4, Holland Grove, Brixton, S.W., accountant; F. G. Brant, 55, Gayville Road, Wandsworth Common, S.W., clerk; W. R. Addiscott, 225, Norwood Road, S.E., stenographer; A. Morgan, 27, Beaumont Road, Hornsey Rise, N., clerk; D. Fisher, 4, Adolphus Road, Finsbury Park, clerk; and G. P. Nixon, 39, Westbury Road, Bowes Park, N., clerk. The number of directors is not to be less than three nor more than eight; the subscribers are to appoint the first; qualification, £500; remuneration, £250 each per annum, and 2½ per cent. of the net profits, divisible.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Woodlands Electric Co., Limited (54,839).—This company's annual return was filed on June 9th, when 442 preference and 200 ordinary shares were taken up out of a capital of £1,000 in 960 preference and 200 ordinary shares of £1 each. All the ordinary shares are considered as fully paid, and £1 has been called up on 336 and 10s. on 106 preference, resulting in the receipt of £376. £13 remains unpaid.

Saxby & Farmer, Limited (38,786).—This company's annual return was filed on June 29th, when 2,021 shares were taken up out of a capital of £25,000 in 2,500 shares of £10 each, 1,800 are considered as fully paid. £10 has been called up on 221, resulting in the receipt of £2,210.

Reuter's Telegram Company, Limited (1,909 C).—This company's annual return was filed on June 13th, when 11,839 shares were taken up out of a capital of £100,000 in £8 shares. £94,712 has been received.

West India and Panama Telegraph Company, Limited (11,116).—This company's annual return was filed on June 20th, when 88,321 ordinary, 34,563 first preference, and 4,669 second preference shares were taken up out of a nominal capital of £2,445,630 in 200,000 ordinary, 34,563 first preference and 10,000 second preference shares, all of £10 each. The full amount has been called and £1,275,530 paid.

Bordeaux Tramways and Omnibus Company, Limited (13,667).—This company's annual return was filed on July 10th, when 33,027 shares were taken up out of a nominal capital of £350,000 in £10 shares. The full amount has been called up and £332,070 paid.

London Platino-Brazilian Telegraph Company, Limited (12,093).—This company's annual return was filed on May 31st, when 37,548 shares were taken up out of a capital of £400,000 in £10 shares. The full amount has been called up, resulting in the receipt or £375,480.

Nernst Electric Light, Limited (60,807).—This company's statutory return was filed on July 5th, when 140,000 preference and 48,720 ordinary shares were taken up out of a nominal capital of £320,000 in 140,000 preference and 180,000 ordinary shares of £1 each; 25,000 shares are considered as fully paid; £1 has been called on 115,000, and £113,138 10s. has been paid, leaving £1,861 10s. unpaid.

Callender's Cable and Construction Company, Limited (48,915).—This company's annual return was filed on July 6th, 1899, when the entire capital of £100,000 in 20,000 preference and 20,000 ordinary shares of £5 each was taken up and paid in full.

CITY NOTES.

The Eastern Telegraph Company.

The fifty-fourth half-yearly meeting of the shareholders of this company was held on Thursday of last week at Winchester House, the Marquis of Tweeddale in the chair.

The Chairman, in moving the adoption of the report, spoke for just over an hour, a large portion of his remarks being devoted to the question of the action of the Government over the Pacific cable. Dealing first with the figures, he said that the gross revenue for the half-year had amounted to £493,504, being an increase of £20,770 over the corresponding period of 1898. The total ordinary expenses for the half-year amounted to £122,561, being an increase of £4,159. The expenses attending repairs and renewals of cables had amounted to £34,520 as against £35,979, a decrease of £1,459. A brief summary of the half-year's working showed the following results:—The gross revenue was about £20,000 more than last half-year. The charges against revenue were £13,000 less, but the balance brought forward from the previous half-year was £6,000 less, so that the net increase in the balance of revenue, after meeting all charges, was approximately £27,000, by which amount they had increased the contribution to their reserves, as compared with the corresponding period of 1898. Having reiterated his opinion that the Marconi system of wireless telegraphy would never successfully compete with submarine cables, his Lordship went at considerable length into the Pacific cable question, which, he said, was a matter of far greater importance to the stockholders of the Eastern as well as to the shareholders of the Eastern Extension Company. On May 4th last the Secretary of State for the Colonies announced in the House of Commons that the British Government was willing to incur a risk of £20,000 per annum in the Pacific cable project. The directors addressed a letter to the Prime Minister protesting against the Governments of this country and the Colonies entering into direct competition with companies, and thus interfering with private enterprise, at the same time calling attention to the advantageous offer of the companies to lay an all-British cable between Great Britain and Australia *vid* the Cape—a cable route which they had good reason to believe was preferred, both for strategic and commercial purposes, by the naval, military, and other technical advisers of the Government. Not having received any reply to that letter, it was arranged that a deputation from the two companies should wait upon the Chancellor of the Exchequer and the Colonial Secretary, in order to express the company's objections to a so serious and, to their minds, unjustifiable attack upon private interests. His Lordship then proceeded to give an account of the deputation, and remarked that he was quite ready to admit that no little consolation might be derived from the assurances contained in Mr. Chamberlain's letter of the 10th inst. to the effect that the Government did not intend to compete with the companies on other than fair commercial lines. The question had, he said, been frequently asked why they did not themselves offer to lay, maintain, and work the all-British Pacific cable between Canada and Australia, touching at Fanning Island. One of the principal objections to undertaking that work was that it would not, in their opinion, be a good commercial route, inasmuch as the great length between Vancouver and

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Fanning Island would not give sufficient speed to enable them to develop traffic to pay the additional expenses of working. Dealing next with the question of the rates charged by the companies, his Lordship said that Sir Edward Sassoon had stated that the British merchant was hopelessly forestalled as regarded business, because the business men of other countries had their messages carried at an enormously cheaper rate. The truth was that every merchant in the world, in every country, was treated on an equality as regarded his telegraph charges, and the tariffs from Germany, France, and all European countries to India and the Far East, were exactly the same. There was some suggestion made by Sir Edward Sassoon which he could cordially support, viz., that a Royal Commission should be appointed to consider the question of foreign telegraph charges. They had nothing to lose by such an inquiry. On the contrary, they had everything to gain, because a true light would be thrown upon the motives which had actuated, and the principles which had guided, the cable companies during the 30 years of their existence in establishing a system of ocean telegraphy—a system which was the envy and admiration of every foreign nation, and whose only detractors were prominent, but ill-informed, members of the Parliament of Great Britain.

Mr. J. DENISON PENDER seconded the motion, and after a few words from Mr. NEWTON supporting the action of the directors, the report was unanimously adopted.

West Africa Telegraph Company.

THE fourteenth ordinary general meeting of the shareholders of this company was held on Thursday of last week at Winchester House, the Marquis of Tweeddale presiding.

The CHAIRMAN, in proposing the adoption of the report, said that the gross revenue for the year ending December 31st, 1898, amounted to £65,523, which was an increase of £800 over the previous year. On examining the receipts, they would find that that increase was due to varying causes. For instance, the loss on exchange amounted only to £8,718 as against £11,602 last year, or a reduction of £2,884. The charge for rents of cables was £2,321 against £3,989, which was a reduction of £1,768, making a total reduction of £4,652. The amount received for messages and subsidies, however, showed a decrease of £3,823, so that the net increase was only £800. The working expenses for the year had amounted to £21,527, or an increase of £314. There were various increases and decreases in the expenditure, the principle increase being in connection with the endowment assurances for the staff. The expenses of repairs and renewals to cables amounted to £17,718, or an increase of £1,062. The net result was that they were enabled to carry forward a balance of £2,179, as against £373 in 1897, or an increase of £1,806. They would observe that the revenue account included a further sum of £12,000 in respect of the subsidy due from the French Government. That item had appeared in previous accounts, and it now amounted to £44,415. Their proposals had been before the French Government, but he regretted to say that the negotiations so far had not resulted in anything. They could only hope that the matter would soon be considered by the Government, and that an agreement would be come to. The present Government appeared to be one of the strongest Governments that France had had for a considerable time, and strong Governments were always able to do more than weak ones in a matter of that kind, which was a question of finance. He hoped, therefore, that very soon they would be able to approach the present Government in France with a view to a settlement of the question, and he hoped, by the time he next met the shareholders, he would be able to announce that some agreement had been arrived at.

Sir HENRY C. MANCE seconded the motion, and the report was adopted.

On the motion of Mr. J. DENISON PENDER, Sir Henry Mance was re-elected a director, and the auditors, Messrs. Deloitte, Dever and Griffiths, were also re-elected.

A vote of thanks to the chairman for presiding terminated the proceedings.

Direct United States Cable Company.

THE forty-fourth ordinary general meeting of the shareholders of this company was held on Tuesday at Winchester House, Old Broad Street, Mr. E. M. Underdown, Q.C., presiding.

The CHAIRMAN, in moving the adoption of the report, stated that the revenue for the six months ending June 30th last amounted in round figures to £51,951, and the working and other expenses, including income-tax but excluding cable repairs, absorbed £20,411, leaving a balance of £31,540 as net profit, making, with £5,921 brought forward from the previous half-year, a total of £37,461. An interim dividend of 3s. per share had been paid on March 31st, which absorbed £9,106, and the directors now proposed a final dividend of 3s. per share and a bonus of 2s. per share, which would absorb £15,177. They proposed to transfer £10,000 to the reserve fund, and to carry forward the balance of £3,177. The revenue showed a very small decrease—£281, compared with the corresponding period in 1898, but the result must be considered satisfactory, because they were contrasting with a period in which a state of war existed, and when consequently a somewhat abnormal use of the cables took place. The very important item of cable repairs amounted only to £2,602, and as usual that had been charged to the reserve fund. On the other hand, however, that fund had already been credited with £6,202 from interest on investments, £233 from profit on the sale of securities realised, and with the £10,000 to be transferred to it from the half-year's revenue, it would amount to £382,365. During the half-year the investments had been increased by £24,443, and the present market value of the whole was about £410,000, or £44,000 more than the figure at which they stood in the books. They must not congratulate themselves too much upon the fact that during the last two years their repairs had cost them so very little, because they were always exposed to accidents in that respect, and sometimes their expenses were very large. The board fully recognised that they must not halt in the policy of building up the reserve fund, but they thought that if they could add £10,000 to that fund, as they had done, and pay a handsome dividend and bonus, they were fully justified in so doing. Referring to the Pacific cable scheme, the Chairman said he hoped that if the cable was laid it would be an all-British cable. He could not help but allude to a statement made by Mr. Henniker Heaton that out of the 12 Atlantic cables only two were used, the others being kept out of employ by the heartless speculators who were managing the business. It was unnecessary for him to say more than that there was absolutely not a shadow of foundation for such a statement. In conclusion, he said the Court at Rouen, to which the French case was transferred, had decided that the French Cable Company which broke away from the pool had got to return an amount of about £280,000, being the amount received by it in excess of what it earned during the period that it was in the pool.

Sir HENRY KEPPEL, G.C.B., seconded the motion, and the report was adopted.

City and South London Railway Company.

THE report of the directors for the half-year ending June 30th, 1899, will be submitted to the ordinary general meeting of the company, to be held at Winchester House, Old Broad Street, E.C., on August 1st, 1899, at 3 p.m. The report states that the receipts from all sources for the past half-year have amounted to £28,125 3s. 6d., and the cost of working has been £15,851, leaving a profit of £12,274 3s. 6d. Inclusive of the balance brought forward from December 31st last, the net revenue account shows an aggregate total of £15,883 7s. 3d. After making provision for the debenture stock interest, a balance remains available for dividend of £11,945 3s. 1d. Out of this sum the directors recommend that the full dividend of 5 per cent. per annum be paid on the preference shares, and that a dividend at the rate of 4½ per cent. per annum be paid upon the consolidated ordinary stock, leaving a balance of £1,107 13s. 1d. to be carried forward. The number of passengers, exclusive of season ticket holders, carried during the half-year was 3,540,098, and the receipts were £26,749 3s. (inclusive), as compared with 3,478,977 passengers and £26,356 16s. 4d. for the corresponding half-year of 1898. The number of passengers carried during the half-year and the amount realised are the largest recorded since the opening of the line, notwithstanding that a severe tramway competition has been carried on at reduced fares along the line of route. The extensions to Clapham and Moorgate Street are well advanced, and the progress made with the new generating station during the half-year has been very satisfactory. The new coaches have all been delivered. In addition to the two locomotives in course of erection in the company's own shops, ten more locomotives are under contract for delivery within the next four months. The 37,500 ordinary shares offered in March last having all been subscribed, the contract for the construction of the extension to Islington has been placed with Messrs. W. Rigby and Co., the contractors for the Clapham extension, and the work will be commenced as soon as possession of the sites for the stations has been obtained. The negotiations with the London, Brighton, and South Coast Railway Company alluded to in the last report, have resulted in a satisfactory agreement with that company for the construction and working, at the joint expense of the two companies, of the subway communication between this company's station at the corner of Denman Street and the London Bridge station of the Brighton Company. At the special meeting to be held at the conclusion of the ordinary business, the necessary resolution will be submitted for converting the existing preference shares into preference stocks. In accordance with the powers conferred on the company by the City and South London Railway Act of 1898, the half-year's dividend on the 5 per cent. perpetual preference shares issued in 1896 will be charged to capital. The warrants for this and the other dividends will be posted on the 5th prox. The warrants for interest on the amounts paid on the 37,500 ordinary shares issued in March will be made up to and posted on September 30th.

Edmundson's Electricity Corporation, Limited.

THE report of the directors and statement of accounts for the year ended March 31st, 1899, will be presented to the shareholders at the second annual meeting of the Corporation at the company's offices, Broad Sanctuary Chambers, Westminster, S.W., on July 28th, at 3 p.m. The report states that the net profit, including the sum of £1,001 7s. 10d. brought forward from last year, amounts to £12,269 5s. 5d. After writing off £1,446 19s. 1d., the expenses of the issue of debenture stock, there remains a balance of £10,822 6s. 4d., out of which the directors recommend a dividend of 6 per cent. upon the ordinary shares for the year ended March 31st, 1899, and a dividend of 1 per cent., being the balance of dividend unpaid on the ordinary shares for the year ended March 31st, 1898, leaving the sum of £2,572 5s. to be carried forward to the next account. During the year central stations for electric lighting at Folkestone, Winchester, Woolwich, Salisbury, Ventnor, Bromley (Kent), Chislehurst, Newmarket and High Wycombe, have been completed, and in all these towns the works are in full operation. Applications for current in all the above towns have been very satisfactory, exceeding, in most cases, the expectations of the directors. Details are given in a schedule. A number of large private installations for country houses,

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&c., have been carried out, and this department of the business has been well maintained. The work of wiring houses in the above towns has been largely secured by this corporation. Central stations are in course of construction at Alderley Edge, Guernsey, Montrose and Brechin. Parliamentary powers have been obtained for electric lighting at Hawick, Newton Abbot, Cowes, Newport, Sandown, Shanklin and Lymington, and works in these towns will shortly be commenced. Since the last report, £75,000 4½ per cent. debenture stock has been issued. Further capital will be required for the works in prospect, and the directors propose at once to issue the balance of the authorised ordinary share capital, amounting to £47,000, which will be offered, in the first instance, to the present shareholders. One of the directors, Mr. J. R. Wigham, retires by rotation, and is eligible for re-election. The auditor, Mr. W. H. May, also retires, and offers himself for re-election.

The Globe Telegraph and Trust Company, Limited.

THE twenty-sixth ordinary general meeting will be held on July 28th, 1899, at 1 p.m., at Winchester House (Room 174), 50, Old Broad Street, E.C. The directors' report for the year ended July 18th, 1899, to be submitted at the meeting, says that the net revenue of the company for the year, after deduction of expenses, amounts to £197,890 17s. 9d., and makes, with the balance of £2,225 4s. 7d. brought forward, a total of £200,116 2s. 4d. From this amount there has been distributed the sum of £132,372 8s. 1d. in interim dividends, leaving an available balance of £67,743 14s. 3d. The directors recommend the payment of a final dividend for the year of 3s. per share on the preference shares, and of 4s. 6d. per share on the ordinary shares, making, with previous distributions, a total dividend for the year of 6 per cent., less income-tax, upon the preference, and 5½ per cent. net (against 5½ per cent. for the preceding year) upon the ordinary shares, leaving a balance of £1,091 2s. 9d. to be carried forward to the next account. Since the last meeting the shares formerly held by this company in the Western & Brasilian Telegraph Company, Limited, have been exchanged for £10 shares in the Brazilian Submarine Telegraph Company, Limited, in terms of an arrangement entered into between those two companies, on the basis of five shares in the Brazilian Submarine Telegraph Company, Limited, for every six ordinary shares in the Western & Brasilian Telegraph Company, Limited. The £10 ordinary shares of the Eastern Telegraph Company, Limited, have, since the last meeting, been converted into ordinary stock. One of the directors, J. Denison Pender, Esq., retires by rotation, and, being eligible, offers himself for re-election. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., and Mr. John Newton also retire, and offer themselves for re-election.

The Chili Telephone Company, Limited.

THE report of the directors, to be laid before a meeting of the shareholders at Winchester House, August 1st, at 12 30 p.m., states that the gross revenue for the year ending March 31st, 1899, was $599,934, the expenditure was $375,230, and the net income $224,764, or at the average rate of exchange for the year (14·27d.) £13,366. The net income for the previous year, at a rate of exchange, 17·52d., was £17,256, the decrease being £3,890. The value of the liquid assets over liabilities has decreased by £2,040 on account of the fall in exchange. This has been charged to reserve. The balance of revenue, including £220 carried forward from the previous year, is £8,169, of which £1,340 has been placed to reserve. The directors recommend the payment of a dividend of 3s. per share (less income-tax), being at the rate of 3 per cent. per annum, and leaving a balance of £448 to be carried forward. During the year the capital outlay in sterling was £1,105, and the total mileage was 8,065 miles 513 yards, an increase of 219 miles 1,127 yards over the previous year. The retiring director, the Hon. Herbert Allsopp, and the auditor, Mr. T. A. Welton, offer themselves for re-election.

The Edison & Swan United Electric Light Company, Limited.

THE sixteenth annual report, which the directors will submit at the meeting to be held at Cannon Street Hotel to-day, shows on the profit and loss account a credit balance of £44,792 11s. 1d. Providing for the interest upon the debenture stock, there remains a balance of £33,607 15s. available for distribution. An interim dividend at the rate of 6 per cent. per annum having already been paid in respect of the half-year ending December, 1898, a further payment, at the rate of 6 per cent. per annum, for the second half is recommended, making the dividend for the book year 6 per cent. per annum, the balance of £10,599 1s. 6d. being carried forward, as against £12,578 14s. in the preceding year. The issue of £150,000 4 per cent. debenture stock was duly made and fully subscribed. Joseph Wilson Swan, Esq., F.R.S., retires by rotation from the board, and offers himself for re-election, as also do the auditors, Messrs. Welton, Jones & Co.

British Aluminium Company, Limited.—An issue at par of 5 per cent. first mortgage debenture stock to the amount of £900,000 is now being made by this company, the object being to pay off existing debentures and other loans and provide further capital for the extension of the business. The company commenced practical operations in the autumn of 1896, and the production of aluminium, the prospectus states, has since then been carried on continuously. The balance-sheet for the year ended December 31st, 1898, shows a sufficient net profit to more than pay the interest on the debenture stock; while it is stated that, as the sales during the first five months of the year show an increase of 48½ per cent. over those for the corresponding period of 1898, the profit for the current year is certain to be considerably greater than that of the past 12 months. The assets, including the extra capital of £80,000 to be provided by the present issue, amount to £877,814, representing, it will be seen, nearly three times the value of the debenture stock.

Reduction of Capital.—Notice is given in the *London Gazette*, of July 18th, that the Order of the High Court of Justice (Chancery Division) confirming the reduction of the capital of the Aluminium Company, Limited, from £80,000 to £65,000, was registered by the Registrar of Joint Stock Companies on July 11th. "The capital of the Aluminium Company, Limited, and reduced is from henceforth £65,000 divided into 60,000 'A' shares of £1 each numbered respectively 1 to 60,000, and 5,000 'B' shares of £1 each numbered respectively 60,001 to 65,000, upon each of which the sum of £1 has been and is deemed to be paid instead of the reduced capital of £80,000 divided into 60,000 'A' shares of £1 each and 20,000 'B' shares of £1 each, and with £1 each credited as paid up."

Eastern Telegraph Company, Limited. — The directors are prepared to receive applications for the exchange on August 1st of the company's £5 per cent. debentures, repayable at par on that date for £3 10s. per cent. preference stock (registered perpetual) on the following terms:—For every 5 per cent. debenture of £100 each (exclusive of the final coupon due on August 1st next), £100 3½ per cent. preference stock (registered perpetual) with dividend accruing from July 1st last, free of stamp and other charges. The dividend on this stock is cumulative.

The National Telephone Company, Limited.—The directors have resolved, subject to final audit, to recommend at the forthcoming general meeting of shareholders the following dividends for the half-year ending June 30th last:—At the rate of 6 per cent. per annum, less income-tax, on the first and second preference shares; at the rate of 5 per cent. per annum, less income-tax, on the third preference shares; at the rate of 6 per cent. per annum, free of income-tax, on the ordinary shares, carrying £60,000 to reserve and about £5,000 forward. The transfer books of the company will be closed from July 28th to August 10th, both days inclusive, and the dividend warrants will be posted on the latter date.

The Charing Cross and Strand Electricity Supply Corporation, Limited.—On the 19th inst. the directors of the Charing Cross and Strand Electricity Supply Corporation, Limited, after providing for debenture interest and dividend on preference shares, declared an interim dividend at the rate of 8 per cent. per annum for the half-year ended June 30th, 1899, and carry forward £8,300. The interim dividend of the corresponding period of 1898 was at the rate of 6 per cent. per annum, with a carry forward of £7,300. The lamps connected up, viz., 24,968 during the past half-year, show an increase of 123 per cent. over those for the corresponding period of 1898.

The Langdon-Davies Electric Motor Car Company, Limited.—The annual meeting was held at the offices of the company, 101, Southwark Street, S.E., on the 25th inst. The report, recommending a dividend of 6 per cent. on the preference shares up to the 31st May last, was unanimously adopted, and the chairman pointed out that this was a very satisfactory position for the company to be in after what was practically the first year of working. The shareholders inspected the works, which are entirely driven by motors of the company's manufacture, and equipped with all the latest machinery. Mr. Walter Langdon-Davies, the retiring director, was unanimously re-elected.

Imperial Tramways Company, Limited.—In a circular to the shareholders calling a general meeting to create additional preference capital, the directors state that the new preference shares will be allotted to the shareholders upon favourable terms. They also announce that the results of the working, up to June 30th, of the various undertakings in which the company is interested show a considerable improvement over those of the corresponding period last year, and the directors have declared an interim dividend on the ordinary shares at the rate of 7½ per cent. per annum against 6 per cent. per annum for the first half of 1898.

Anglo-American Telegraph Company, Limited.—At a meeting of the board of directors of the above company, held on July 21st, it was resolved:—"After paying the sum of £6,000 to the credit of the renewal fund, to declare an interim dividend for the quarter ending June 30th, 1899, of 15s. per cent. on the ordinary stock and £1 10s. per cent. on the preferred stock, less income-tax, payable on August 1st to the stockholders registered on the books of the company on June 30th, 1899." After paying the foregoing dividends there will be a balance of about £24,700 to be carried forward to the next account.

The D.P. Battery Company, Limited.—The D.P. Battery Company, Limited, recently held their annual general meeting and declared a dividend at the rate of 25 per cent. per annum. The progress of the company has been most satisfactory. In order to cope with the increased trade it has been found necessary to acquire further premises, and the freehold and water rights of the Lumford Mill, Bakewell, have been purchased, and work is now being carried on there.

Great Northern and City Railway Company, Limited.—In its report, the board states that the progress of the works is in every way satisfactory. A shaft has been sunk to the

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level of the tunnel, and a full-sized heading driven therefrom into the centre line of the tunnels. Shafts will shortly be sunk at Essex Road and Old Street, and work will be started at Finsbury Pavement and Drayton Park as soon as the necessary possession of land is obtained.

Cape Town and Suburban Electric Lighting Syndicate, Limited.—The annual general meeting of the shareholders herein was held at the offices of the secretaries, Messrs. O'Flaherty, Grant & Co., on June 25th, when there was a large attendance. According to the *Cape Times*, a very satisfactory statement was laid before the meeting, and a dividend of 5 per cent. declared, payable on August 15th next, a sum of £211 9s. being carried forward to next year's account.

Liverpool Overhead Railway Company, Limited.—The report of the directors for the half-year ended 30th ult. states that there is an available balance of £12,945. The directors recommend a dividend at the rate of 5 per cent. per annum on the preference shares, and 2½ per cent. per annum on the ordinary shares, as compared with 3 per cent. on the ordinary shares for the corresponding period last year. The balance to be carried forward is £4,320, against £3,863.

The Kensington and Knightsbridge Electric Lighting Company, Limited.—An interim dividend has been declared on the ordinary shares of this company for the half-year ending June 30th, 1899, at the rate of 10 per cent. per annum. The register of members and transfer books will be closed from July 27th to August 10th, both days inclusive.

The County of London and Brush Provincial Electric Lighting Company, Limited.—The directors have declared an interim dividend on the preference shares for the half-year ended June 30th at the rate of 6 per cent. per annum. The transfer books and register of members will be closed from the 25th to the 31st inst., both days inclusive.

W. T. Henley's Telegraph Works Co., Limited.—The directors have declared the following interim dividends, payable on September 1st, 1899, for the half-year ending June 30th, 1899; on the preference shares at the rate of 7 per cent. per annum, less income-tax; on the ordinary shares at the rate of 8 per cent. per annum, less income-tax.

Westminster Electric Supply Corporation, Limited.—The directors have declared an interim dividend for the half-year ended June 30th at the rate of 10 per cent. per annum, payable on September 1st. During the half-year the company has sold 23 per cent. more units than during the corresponding period of last year.

London United Tramways, Limited.—The directors have declared an interim dividend at the rate of 10 per cent. per annum. This compares with 8 per cent. per annum in the corresponding half-year of 1898.

Waterloo and City Railway Company.—The directors recommend a dividend on the ordinary stock at the rate of 3 per cent. per annum for the half-year ended June 30th.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending July 22nd, 1899, were £1,871 17s. 11d.; receipts for week ending July 22nd, 1898, £745 19s. 10d.; aggregate, July, 1899, to date, £8,334 1s. 8d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending July 21st, 1899, were £3,677 0s. 10d.; corresponding period 1898, £3,047 7s. 2d.; increase, £629 13s. 8d.

The City and South London Railway Company.—The receipts for the week ending July 23rd, 1899, were £864: week ending July 24th, 1898, £935; decrease, £71. Total receipts for half-year, 1899, £3,742; total receipts corresponding period, 1898, £3,763; decrease, £21. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending July 22nd, 1899, were £249 8s. 0d.: week ending July 23rd, 1898, £203 2s. 4d.; increase, £46 0s. 8d. Total receipts to date, 1899, £4,959 7s. 4d.; corresponding period, 1898, £3,969 6s. 9d.; increase, £990 0s. 7d. Miles of track open week ending July 22nd, 1899, 8; week ending July 23rd, 1898, 3. Car miles run week ending July 22nd, 1899, 4,633; week ending July 23rd, 1898, 3,955. Number of cars, week ending July 22nd, 1899, 11; week ending July 23rd, 1898, 10.

The Dublin United Tramways Company.—The receipts for the week ending Friday, July 21st, 1899, were as follows:—D. U. T. Co., horse cars, £2,220 5s. 8d.; ditto, electric cars, £1,368 8s. 4d.; D. S. D. Co., electric cars, £1 195 14s. 5d.; total, £4,779 8s. 5d.; corresponding week last year—D. U. T. Co., horse cars, £2 610 16s. 1d.; ditto, electric cars, £654 1s. 4d. D. S. D. Co., electric cars, £1,299 8s. 8d.: total, £4,554 1s 1d.; increase, £225 2s. 4d. Aggregate to date, £18 418 15s. 9d.; aggregate to date last year, £18,594 3s 1d.; decrease to date, £175 7s. 4d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 12 miles electrically, and 30 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending July 23rd, 1899, amounted to £1,610; corresponding week last year £1,652; decrease, £42.

The South Staffordshire Tramways Company.—The receipts for week ending July 21st, 1899, were £683 16s. 9d.; aggregate receipts for 29 weeks, £18,563 17s. 8d.; week ending July 22nd, 1898, £628 11s. 11d.; aggregate receipts for 29 weeks, £17,746 3s. 10d.

STOCKS AND SHARES.

Wednesday Evening.

A remarkable financial fact that has been in evidence this week is the unusual number of new issues that are being made during the dog-days, and particularly by the engineering firms, electrical and otherwise. It is only necessary to refer, *inter alia*, to the emissions of the British Westinghouse Company, the Electric Resistance and Heating Company, and a Debenture issue by the British Aluminium Company. Others there are, some at this moment appealing to the public for subscription, but the three we have cited are perhaps the most important. Whether the promoters are well advised to introduce their novelties at this season of the year is open to doubt, and the Stock Exchange has taken but very languid interest in the new concerns. Nominal premiums of a fraction are quoted, but scarcely any attempt is stirring to "make a market." Not that there is a very great temptation to do so, as none of the projects present any special fascination, although we consider British Westinghouse Preference, as we said last week, to be a fair speculative investment. As regards the Electric Resistance Company, the market does not like the professional criticism that is directed against it. The British Aluminium 5 per cent. Debentures appear to be well secured, but it is remembered that the company was unable to pay the dividend on its Preference shares at the last half-year.

The electric railway market is unmoved by the announcement of the City and South London, and the Waterloo and City dividends. The latter, as we were able to forecast a fortnight back, is at the rate of 3 per cent. per annum. The price of the Ordinary stock is 105½, and there is no change to record in the quotations of Central London shares. Satisfactory is the feature of the Great Northern and City Company's second annual report, issued on Tuesday, and work is to be started in the City as soon as possession of the land is complete.

Traction shares are in small demand, but British Electrics moved off a fraction to 18¼. The riots among the tramway men in the United States have affected the markets of Capel Court to a very slight extent, and the bonds of the American Electric Tramways Companies have not suffered at all. For instance, the 5 per cent. consolidated mortgage bonds of the Milwaukee Electric Railway are unchanged on the week at 109. Buenos Ayres and Belgrano trams improved, but Imperial shares fell ¼ upon sales from Bristol, where a larger dividend had been expected than was declared last week. New General Electrics exhibit no alteration in price.

Chatting to a member of the Court of Common Council yesterday, we asked him what the Corporation really intended to do about the City of London Electric Lighting Company. He frankly stated that nobody knew, but that of two things there was very little doubt. One of these was that the Corporation would never agree to pay the £75,000 per annum which the company suggests; and that, secondly, the likelihood of the City taking over its own lighting was remote in the extreme. Meanwhile, the course of the market has been erratic. A harder tone at first took the place of the painful nervousness which we have lately had to chronicle, but the passing of the Charing Cross Company's Bill in the House of Lords again caused a fall in Citys. Charing Cross and Strand improved on account of the enhanced dividend; its success in the Upper House has long been discounted. Edmundson's hardened upon the bright outlook for the company as set forth in its report, and Westminsters are a good market. The cheaper shares have been neglected in the attention which the distributions of the larger companies have attracted to their own securities.

National Telephones revived on the hope that the company's license will be extended for a period of 14 years in districts where competition may be allowed. Chili Telephone shares, as a "long shot," should be worth buying about 2⅜ for the £5 shares fully paid. A dividend of 4s. per share was paid last August, and judging from the advices of the last few months, Chili is beginning to go ahead once more in her internal economy. All risk of a war with the Argentine Republic seems now over. United River Plate Telephones are a shade better.

Telegraph securities appear to have turned the corner, and the speech of the Marquis of Tweeddale at the Eastern Company's meeting has served to rally the sinking courage of his fellow-stockholders. Eastern Ordinary quietly moved up, and Eastern Extensions are also better. There seems to be more room for a rise in the shares of the latter than in Eastern stock, which has not fallen quite as much in proportion as Eastern Extensions. The latest Anglo-American report for the quarter is considered a good one, and the Anglo stocks have all risen, taking Direct United States shares in their train.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, July 19th.	Closing Quotation, July 26th.	Business done during week ended July 26th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	61 — 64	62 — 65	62½	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	112 —113	114 —115	115	112⅝
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	13¼— 13¾	13¾— 14¼	14¼	13¾
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	15	...
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	108 —112	108 —112	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105⅛	104⅝
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9½	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3¼ %	3¼ %	11½— 12	11¾— 12¼	...	...
120,000	Direct West India Cable, 4½ % Reg. Deb. ...	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½ %	7 %	7 %	150 —155	151 —156	154½	151
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	99 —103	99 —103	101	99¼
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104	101 —104	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	115 —120	115 —120	118	117
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14½— 15 xd	14½— 15	15	14⅝
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —100	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	100	...
330,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	116 —121	116 —121	...	...
85,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	103 —106	103 —106	103	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —105%	102	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5⅛ %	10¾— 11¼	10¾— 11¼	11⅛	10¹¹⁄₁₆
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15 — 15½	15 — 15½	15⅛	15
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	...	...
80,500	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	5⅛— 5⅜	5¼— 5½	5⁷⁄₁₆	5⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12½— 13½	12½— 13½	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12½— 13½	12½— 13½	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5½	5¼— 5½	5⁵⁄₁₆	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	100½	99¼
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	1	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼xd	4⅜— 5¼	5	...
151,733£	Do. do. 5 % Debs.	Stock	...	...	...	103 —106	104 —107	106	105½
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	100 —103	...	...
80,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	101 —104	101 —104	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	1 %	2½ %	...	1¼— 1½	1¼— 1½	1⅜	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10⅝	10½— 10⅝	10⅜	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	103 —106	103 —106	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	9½— 10½	10 — 11	10½	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅝— 6½	5⅝— 6½	6½	...
84,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8½	8½	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	112 —114	112 —114	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7	10	6 %	12 — 14	12 — 14	14½	13½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 15	13 — 15	14½	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	123 —128	123 —128	124	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	*nil*	*nil*	*nil*	11 — 11½	11 — 11½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13½— 14½	13½— 14½	...	...
220,000	Do. 4½ % Deb. Stock, Prov. Certs (£80% to be paid) Rd.	...	...	...	...	52 — 54	52 — 54	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5½— 6	5½— 6	5⅝	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	8½— 9½	7½— 8½	7⅞	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	8½— 9½	8½— 9½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 7	6⅝	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15½— 16½	15½— 16½	...	...
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	15½— 16½	15 — 16	15½	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	118 —120	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½— 16½	15½— 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	16½— 17½	16½— 17½	16⅝	16⅝
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	4½— 4⅝	4½— 4⅝	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½— 15½	14½— 15½	15¼	15⅛

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
§ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation July 19th.	Closing Quotation July 26th.	Business done during week ended July 26th, 1899. Highest	Lowest
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3½— 3⅝	3½— 4	3⅝	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	18 — 19	18 — 19	18½	18 7/16
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	14¼— 14¾	14 — 14½	...	...
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	13⅜— 14¼	13⅜— 14¼	...	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1¾— 2	1⅝— 2	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2⅛— 2⅜	2⅛— 2⅜	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	14½— 15½	14½— 15½	...	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10½— 11	10½— 11	10⅝	10½
178,308	Do. do. do. £8 paid	10	...	...	...	8½— 9	8½— 9	...	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	2¾— 3½	2¾— 3½	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	5½— 5⅝	5½— 5⅝	...	...
630,000*l*	City and South London Railway	Stock	1 9/16 %	1⅝ %	2⅛ %	67 — 69	67 — 69	67⅜	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 £5 pd.	10	...	...	...	4⅜— 5½	4⅜— 5½	4⅞	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	3⅝	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½ %	6 %	6 %	2 — 2⅛	2 — 2½	2⅛	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½ %	6 %	6 %	4 — 5	4 — 5	4 1/16	4⅜
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	97	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2⅜	2 5/16
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	101 —104 xd	101 —104	102¾	102
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ⅞	⅝— ⅞	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13 xd	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	24½— 25½	24½— 25½	25¼	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	19 — 21	19 — 21	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	111 —114	114	113⅞
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22 xd	21 — 22	21⅜	21¼
800,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	101 —105	102 —106	104	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞ %	3½ %	3½ %	8½— 8⅝	8½— 8⅝	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	14 — 14½	13½— 14½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41 xd	38 — 42	40	39½
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9¾	9¼— 9¾	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅝— 6¼	5⅝— 6¼	6	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	104 —107	104 —107	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10½.
British Aluminium, Ordinary, no market; 7 % Pref., no market.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 106—109. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, ¼—⅜.
Smithfield Market Electric, 2—4 nom.
*T. Parker, £10 (fully paid), 19 xd.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, July 26th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	29/-	29/-	..
a „ Oxalic .. .. .. per cwt.	33/-	33/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	37/-	37/-	..
a Ammonia, Muriate (crystal) .. per ton	£26	£26	..
a „ „ .. .. per ton	£24	£24	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£26 5	£26 5	..
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a „ White Sugar .. .. per ton	£31	£31	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks .. per lb.	3¾d.	3¾d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6 5	5/- dec.
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5 0	£5 0	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots .. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£70 to £145	£70 to £145	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8½d.	..
c „ Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c „ Wire, basis .. .. per lb.	..	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Increase or Decrease.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£86	£2 inc.
g „ Wire (basis price) .. per lb.	10½d.	10½d.	..
g „ Sheet .. .. .. per ton	£88	£86	£2 inc.
g „ Rod .. .. .. per ton	£88	£86	£2 inc.
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/0½ to 4/1½	4/0½ to 4/1½	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	75/3	72/1½	3/1½ inc.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£11 5	£10 12 6	12/6 inc.
g Lead, English Ingot .. .. per ton	£14 10	£14 7 6	2/6 inc.
g „ „ Sheet .. .. per ton	£15 7 6	£15 7 6	..
m Manganin Wire No. 28 .. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 7	£8 6 6	6d. inc.
Mica—according to size and quality ..	..	..	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p r'l'd strip & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£146 10	£135	£11/10 inc.
g „ foil .. .. per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/10	1/9	1d. inc.
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £67	£40 to £67	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	..
j „ Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j „ Hemp, 8 ply 10 lbs. .. per lb.	3½d.	3½d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£12	£12	..
j „ Manila, 24 thread .. per ton	£32 10	£32 10	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£28 6	£30	£1 14 0 dec.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd., Messrs. Thos. Bolton & Sons.

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakespeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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MACHINE TOOLS.*

(*Continued from page* 83.)

Boiler Shell Drilling Machine.

There are three usual methods of drilling boiler shells:—1. (For light work) the drill is made to revolve round the boiler in a vertical position. 2. The boiler is made to rotate upon a vertical axis. 3. The boiler is placed horizontally, and rotates on rollers.

Space does not permit the description of the many other types of drilling machine, but the square hole drilling machine may just be mentioned, and surprise expressed that it has not more largely come into use.

Boring Machines and Mills.

The writer differentiates between boring machines and boring mills, the latter (frequently denominated vertical lathes) being capable of turning as well as boring.

Fig. 11 shows an example of a horizontal boring machine made at the Niles Tool Works. It will bore up to 3 feet 6 inches diameter × 10 feet long. It has been designed specially for dealing with Corliss cylinders, and, in addition to the ordinary boring bar, which is provided with a facing head, it has two independent and adjustable boring spindles for finishing the holes for the valves. Thus the whole of the boring and turning is done at one setting, which whilst economising time increases the accuracy.

An excellent example of vertical boring machine is illustrated by fig. 12 (Hulse & Co., makers). The boring bar is 18 inches diameter, and will bore cylinders up to 10 feet diameter. The machine is provided with a self-contained steam engine, which renders it independent of other tools.

Boring mills are made with either one or two standards, the former, which are chiefly used for small work, are frequently called chucking lathes, owing to the facility with which work can be chucked.

An example of the latter (by Niles Tool Works Company) is shown in fig. 13. The revolving table has a central spindle, having adjustable bearings; it has also a large bearing on the underside, revolving on the base casting. When it is required to run the table at a high speed for setting work, it can be raised off the large bearing by an adjusting screw in the footstep bearing of the spindle. The feed motion is by a friction disc, and is automatic and reversing, and is independent for each of the two boring bars, which enables boring and turning to be carried on at the same time. The cross slide or rail is raised and lowered by power. The amount of work such a machine is capable of doing can only be appreciated by those who have adopted them. As an example of the speed, the author mentioned that turning a heavy fly-wheel, 23 feet 6 inches in diameter, and weighing 57 tons finished, occupied 48 hours, at an average speed of 23¼ square feet per minute, during which time there was removed about 5 tons of metal.

This was done on a machine by the Niles Tool Works Company, who have built machines to take up to 30 feet in diameter. A large machine costs from £1,500 to £2,000.

Milling Machines.

America has had a large share in bringing the milling machine into general use and to its present state of perfection. The idea that it is not suitable for all-round work is gradually disappearing. From the legion of types, only four are selected for illustration. Fig. 14 illustrates a "Lincoln" miller, by H. W. Ward & Co., Birmingham. Noticeable features in this machine are cased-in gears, balanced spindles, solid appearance, and good design. The scope of this tool includes ordinary milling, or it will mill two faces simultaneously with face cutters at different heights or on the same level. The heads have independent

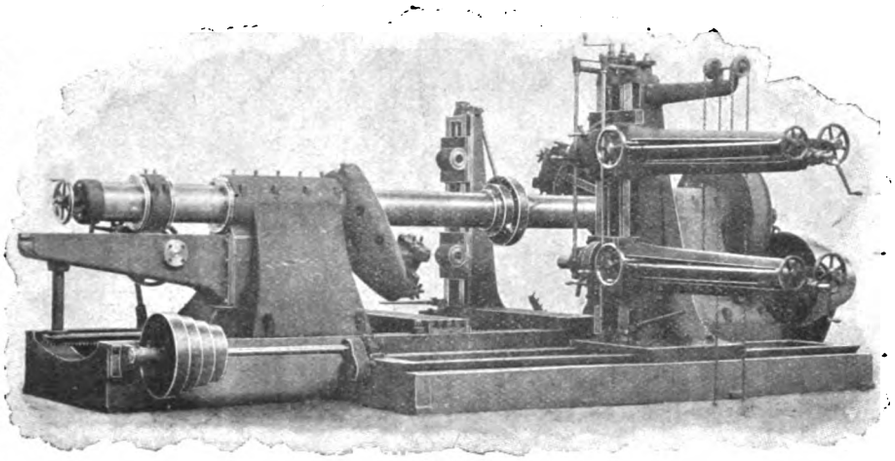

Fig. 11.

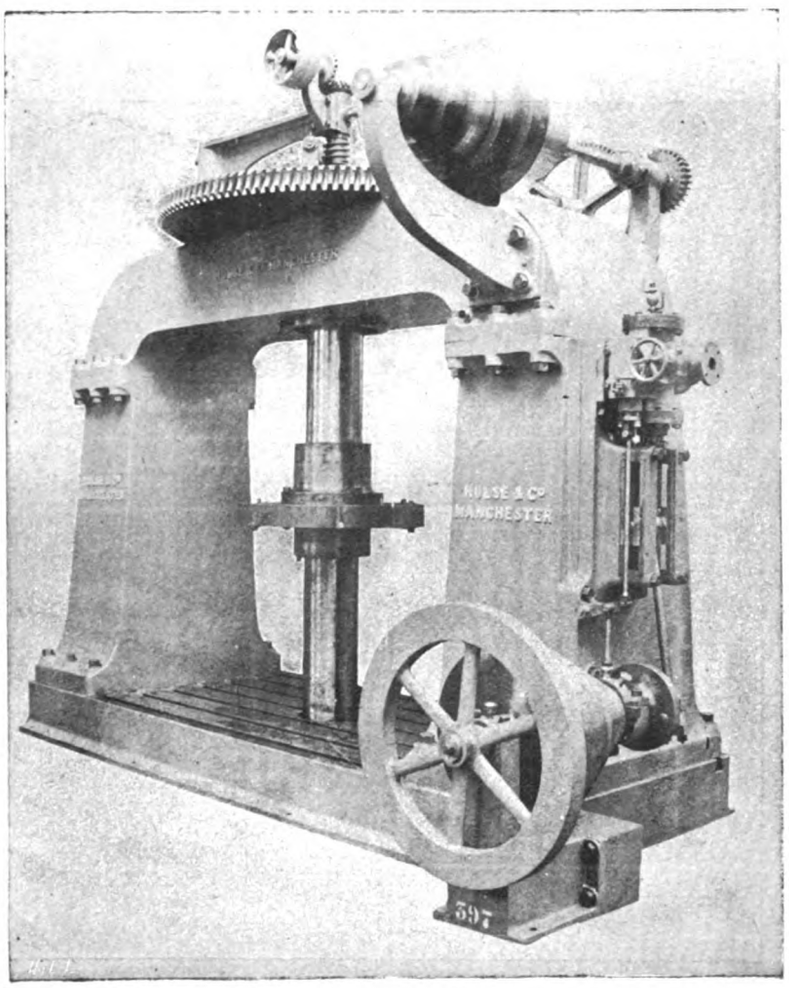

Fig. 12.

* Editorial abstract of a paper on "Machine Tools," by E. C. Amos, recently read before the Society of Engineers.

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horizontal and vertical adjustments, and the table has automatic traverse in either direction with instantaneous reversal. The rate of feed is varied without change of gear or belt.

A form of milling machine much used in America, and now claiming considerable attention in this country, is a tool known as a "slab miller"; an English example of this is depicted in fig. 15. It is used for surfacing large pieces of work hitherto dealt with on the planer or shaper.

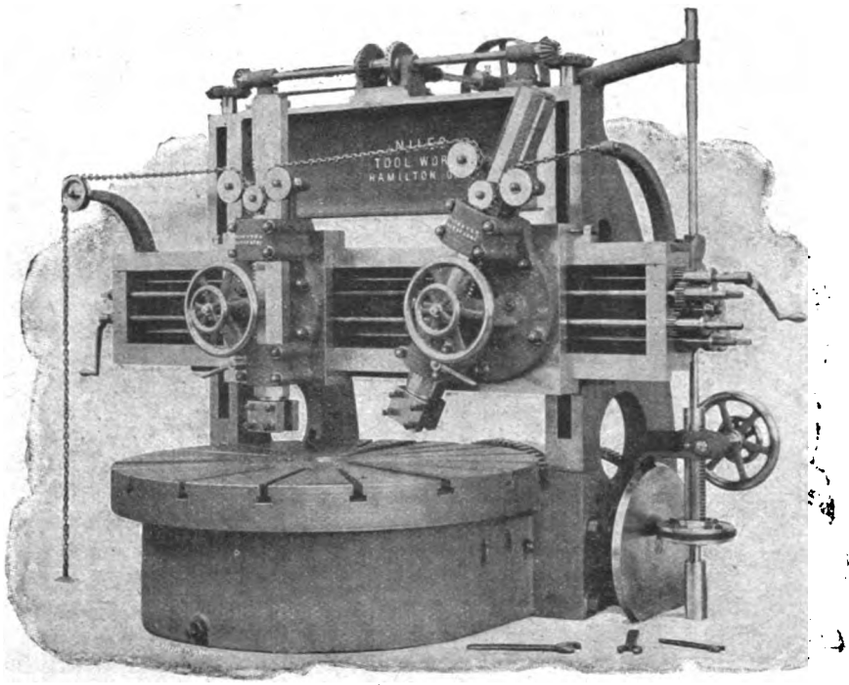

Fig. 13.

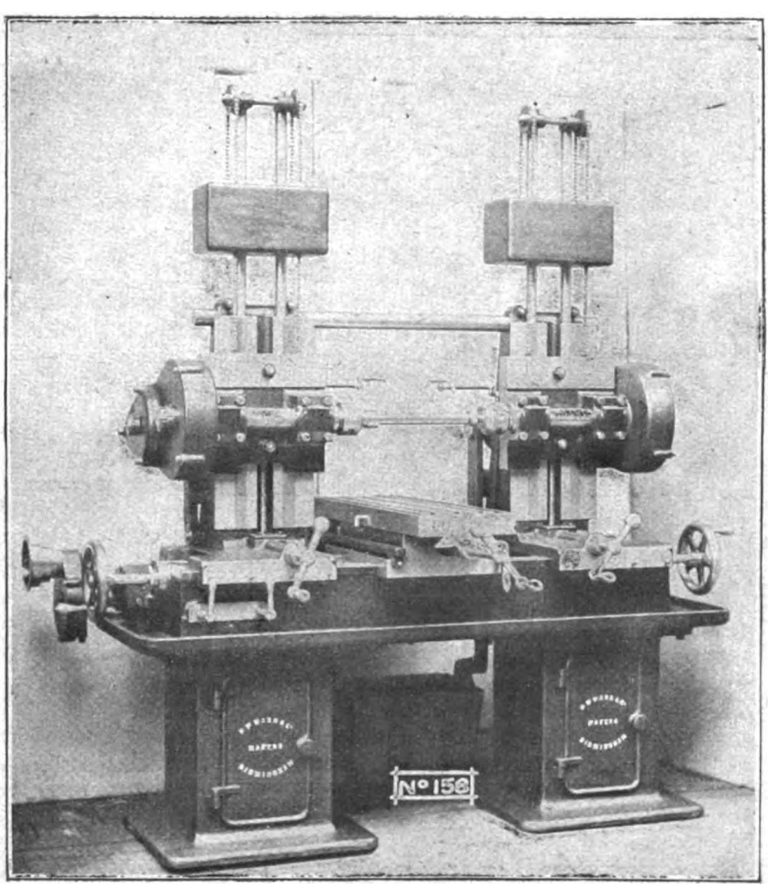

Fig. 14.

The table upon which the work is fixed is provided with a slow traverse whilst cutting, and a quick return when not cutting.

Fig. 16 shows a vertical automatic profiling machine for bicycle cranks by Webster & Bennett.

(To be continued.)

LIGHT RAILWAYS AND THE DEVELOPMENT OF ELECTRIC TRACTION.

It is always the pioneers who are sanguine—if they were not, we should have no progress at all—and one may, therefore, very well spare a large amount of praise and encouragement for those who, three years ago, considered that they saw in the Light Railways Act a suitable means of also developing tramways along roads or streets, and more especially for operation by electric energy.

And, as has been repeatedly pointed out, there was good reason for such a belief. Neither Parliament nor the Board of Trade (or other official department) would pledge itself to a definition of "light railways," and in the absence of restrictions, open or unexpressed, all those with the interests of electric traction at heart might justly consider that street tramways should also come within the range of this improvement in legislation.

In this they were at first amply justified. Applications to the Light Railway Commissioners for orders to build what were essentially "tramways" were successful in such districts as the Potteries, Crewe, North Shields, Coatbridge, Bradford, Leeds, Middleton, &c., and apparently neither the Commissioners themselves nor the Board of Trade found serious obstacles in the way of granting and approving orders, provided the question of public utility or convenience was fully established and the opinion of proprietors or local authorities was tolerably unanimous in favour.

But the dream of more rapid progress in electric tramways worked through the means of a Light Railway Act soon proved to be short lasting; and without attempting to settle whether the rapid increase in the number of applications (reaching for the latter periods to some 70 or 80 proposals in the half-year) so impressed the authorities that it was felt right and proper to put on the brake somewhat, or whether the persistency of opposition from the railway companies on the score of possible competition in goods traffic from these so-called light railways, or whether the spirit of municipalisation has led to opposition from the local authorities to private enterprise developing in this direction, the fact remains that during the past year a distinct set-back has been created in regard to electric tramway progress under the Light Railways Act.

Promoters of new lines or possessors of old ones desirous of extending them are practically driven to the former methods of Parliamentary Bills or provisional orders, with their attendant troubles of obtaining local consents and of scheduling agreements for better purchase terms than the ridiculous conditions of the 1870 Tramways Act.

It is even very doubtful whether a *bonâ fide* light electric railway can advantageously be applied for under the Light Railways Act, unless the adjacent main line steam railways are agreeable to the project, for the Board of Trade—after the Coatbridge-Airdrie and Dundee-Broughty Ferry cases—appears to be most unwilling to admit the remotest possibility of such lines ever developing into railways of a more pronounced kind than a street tramway might become.

Yet the "danger" so feared is absurd. How is a heavy goods traffic likely to be carried over public streets of a more

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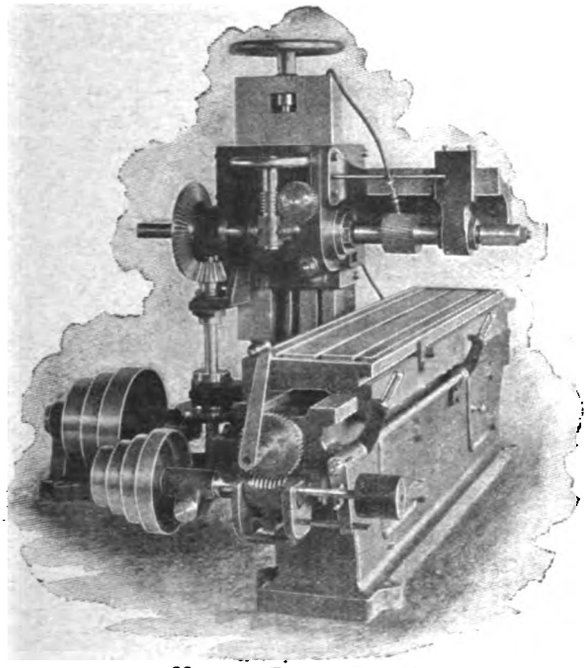
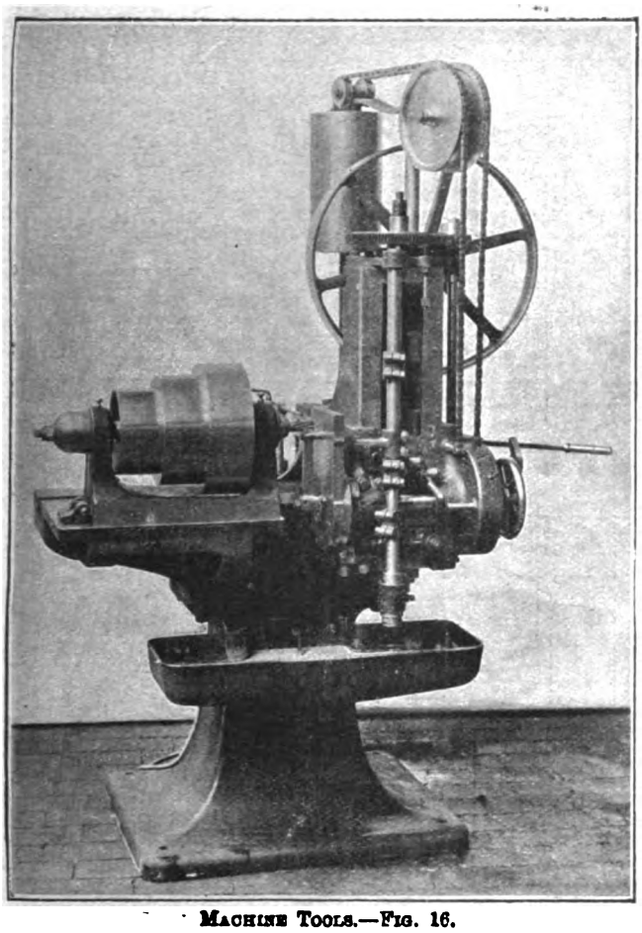
or less crowded nature, consistently with a passenger tramcar traffic which requires all it can get of the roadway for 16 hours out of the 24?

The question of "consent and support by the local



Machine Tools.—Fig. 15.

authority" is of no value here; for in both the above cases the local authorities were supporting the applications for light railway orders. At Paisley, on the other hand, although two local authorities out of three concerned were supporting



Machine Tools.—Fig. 16.

the application, no order was granted, owing to the opposition of the third authority. Apparently, therefore, one has to secure the approval of all the local authorities concerned, and the acquiescence of all the local railways, before there is much likelihood of getting a light railway order for an electric street tramway.

It is less trouble and expense to promote a Bill before Parliament; so much, therefore, for the Light Railways Act as a means of helping on electric traction. Its value is *nil* at present.

In their last report, the Light Railway Commissioners themselves classify the applications for orders into those resembling ordinary railways (*i.e.*, running on their own right of way, within fences, &c.) and those running wholly, or for the most part, on public roads and streets, *i.e.*, tramways.

From the passing of the Act up to the end of last year, out of a total of 51 applications of the second class, the Commissioners had approved of 25, rejecting 14, while 11 were withdrawn and postponed. We doubt very much whether the end of this year will see figures anything like corresponding to the above, and unless some relaxation of conditions is afforded, we shall be surprised next year to see any applications at all made to the Commissioners for lines of this character.

Perhaps for the Commissioners' own sakes that would be a result not altogether to be regretted, for only those engaged in endeavouring to carry through these proposals can have any idea of the work and responsibility devolving upon the Commissioners or of the care and zeal with which they discharge their duties.

So far as electric traction is concerned, however, we may well express a feeling of regret that the Commissioners were not appointed with wider powers for the express purpose of dealing with electric lines alone; not one of the steam light railways can be said to have much interest to anyone outside the service of the particular main lines concerned, certainly not to any large mass of the public, for they are nearly all unimportant branches with scanty traffic.

Of course, no one has any wish unduly to belittle these small evidences of progress, but why didn't Parliament appoint Light Electric Railway Commissioners with powers to remedy the Tramways Act of 1870; and if Parliament didn't know enough to do this in 1896, why doesn't it do it now in 1899 when the thing has been abundantly proved?

INSTALLATION ESTIMATES.

(*Continued from page* 127.)

Data and Cost of Installation Material.

We now come to the installation material, and as this cannot very well be treated by curves the data are given in tabulated form in Table I.

It will be noticed that the lamp voltage is taken at 110 throughout. Below 25 lamps it is usual to use 55 volts, and above 300 lamps the size of the installation justifies an increase of pressure to 220 volts.

The estimates are got out on the basis of the given number of "lamps in use" at one time, and for cable and wire working at about 1,000 amperes per square inch.

The actual amount of cable and wire required for any given installation depends on the characteristics of the building to be lighted, but it will be found that 13 to 14 yards (of all sizes of wire) per lamp or point is a very good average.

When a dynamo is driven by a gas or oil engine it is necessary for it to be fitted with a fly-wheel to ensure a steady light. For dynamos of less output than, say, 9 kilowatts at 1,200 revolutions per minute this fly-wheel generally takes the form of a disc pulley. For the larger sizes a third bearing and separate fly-wheel should be employed. The safest way to make these wheels is to cast them of best "pulley quality" cast-iron and then shrink on a steel rim, arranging the overall diameter so that the maximum peripheral speed shall not exceed 6,000 feet per minute.

When Accumulators are Employed.

Where the voltage is constant and no accumulators are employed the dynamo should be compound wound. A shunt resistance is sometimes employed, but it is apt to become a nuisance, as the contacts become burnt away at the breaking edge, and the coils become brittle and snap off. The exact amount of compounding will depend on the distance between

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TABLE I.—INSTALLATION MATERIAL FOR VARIOUS NUMBERS OF LAMPS.

—	—	25 lamps.	50 lamps.	75 lamps.	100 lamps.	150 lamps.	200 lamps.	300 lamps.
Dynamo ...	One compound wound dynamo 110 volts with bedding rails, belt tightening screws and foundation bolts	1½ kw., 1,600 revs.	3½ kw., 1,500 revs.	4½ kw., 1,400 revs.	6 kw., 1,300 revs.	9 kw., 1,200 revs.	12 kw., 1,100 revs.	18 kw., 1,000 revs.
Belt ...	Single leather driving belt	40 ft. 3 in.	40 ft. 3½ in.	40 ft. 3½ in.	40 ft. 4 in.	45 ft. 4 ins.	45 ft. 4½ in.	45 ft. 6 in.
Main switchboard.	One main switchboard of enamelled slate, surrounded by a polished teak frame, and having mounted on it:—One dynamo single-pole switch and double-pole fuse, one voltmeter, one ammeter, two polished brass bus bars, and all necessary terminals; also single-pole switches and fuses for the following circuits	1 circuit.	2 circuits.	2 circuits.	3 circuits.	4 circuits.	5 circuits.	6 circuits.
Distributing boards.	Four-way double-pole fuse boxes, in polished teak case, with glass front.	One of 5 amperes.	Two of 5 amperes.	Two of 5 amperes.	Three of 5 amperes.	Four of 5 amperes.	Five of 5 amperes.	Six of 7 amperes.
Cables and wires.	The conductors to be of high conductivity copper, insulated with pure and vulcanised rubber, taped, braided, and served with preservative compound. To have an insulation resistance of not less than 600 megohms per statute mile.	15 yds. 7/17 55 „ 7/20 110 „ 7/22 165 „ No. 17.	20 yds. 7/15 165 „ 7/17 220 „ 7/20 220 „ No. 17.	20 yds. 19/17 220 „ 7/17 330 „ 7/20 330 „ 7/22 110 „ No. 17.	25 yds. 12/16 220 „ 7/16 440 „ 7/20 440 „ 7/22 220 „ No. 17.	30 yds. 19/14 330 „ 7/16 660 „ 7/20 660 „ 7/22 330 „ No. 17.	35 yds. 37/16 440 „ 7/16 880 „ 7/20 880 „ 7/22 440 „ No. 17.	40 yds. 37/14 550 „ 7/15 770 „ 7/18 990 „ 7/20 990 „ 7/22 550 „ No. 17.
Casing and capping.	Whitewood casing and capping	550 ft. of 2, 1½, & 1½ in.	1,000 ft. of 3, 2½, 2, & 1½ in	1,500 ft. of 3½, 2½, 2, 1½, & 1½ in.	2,200 ft. of 3½, 2½, 2, 1½, & 1½ in.	3,000 ft. of 3½, 2½, 2, 1½, & 1½ in.	4,000 ft. of 4, 3, 2½, 2, 1½, & 1½ in	6,000 ft. of 4, 3, 2½, 2, 1½, & 1½ in.
Jointing material.	Pure Para rubber tape ... ... India-rubber proof tape ... ... Tin of pure rubber solution ... ... Solder ... ... Resin ... ... Assorted screws	1 lb. 2 „ ½ „ 3 „ 1 „ 7 gross.	2 lbs. 3 „ 1 „ 4 „ 1½ „ 12 gross.	3 lbs. 4 „ 2 „ 5 „ 2 „ 17 gross.	3 lbs. 5 „ 2½ „ 6 „ 2½ „ 25 gross.	4 lbs. 6 „ 3 „ 7 „ 3 „ 40 gross.	5 lbs. 7 „ 4 „ 8 „ 3½ „ 50 gross.	7 lbs. 9 „ 6 „ 9 „ 4½ „ 75 gross.
Switches ...	Tumler switches, each complete with finished wood block ...	13	26	40	52	75	100	150
Fittings ...	Plain cord pendants, each complete with porcelain ceiling rose, two yards flexible cord, bayonet socket lampholder, shade, 16-C.P. 110-volt incandescent lamp and polished hardwood block	25	50	75	100	150	200	300
	Total price ...	£65	£90	£110	£145	£180	£230	£330
	Price of dynamo only with slides and foundation bolts ...	£35	£40	£45	£58	£72	£90	£125
	Extra if dynamo is fitted with fly-wheel for driving by gas or oil engine	£3	£4	£5	£6	£7	£10	£12
	Total weight of above installation material with dynamo ...	13 cwts.	20 cwts.	30 cwts.	40 cwts.	50 cwts.	65 cwts.	90 cwts.
	Weight of dynamo only	5 „	7 „	10 „	15 „	20 „	26 „	38 „

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the dynamo and the lamps. A dead straight line of voltage with constant speed is not obtainable and, as a matter of fact, most engines pull up slightly as the load comes on, it is therefore best to slightly over-compound, say, 3 per cent., or if the distance to the lamps is considerable, then 5 per cent. to 8 per cent. according to the distance.

When a dynamo is required to charge cells as well as run lamps direct it must be shunt wound, or at any rate the compounding coils should be arranged with a switch on the magnets, so that the series coils can be cut out. The proper way to charge cells is undoubtedly to keep the main dynamo at constant voltage and boost up the pressure by means of a separate machine. For the smaller installations under consideration the expense would be too great, so we are obliged to keep to the old, if unscientific, method of getting the extra 30 volts partly by speeding up the engine and partly by field regulation. The size of the battery should be so arranged that the charging current is as little over half the full load current of the dynamo as possible, because advantage can then be taken of the higher voltage which a shunt wound dynamo naturally gives at half load. To get economy the dynamo field should be adjusted as little as possible, as it follows that when running on lamps direct the dynamo is not working at the best point of the magnetisation curve. From 110 volts to 140 volts is a rise of about 27 per cent., and the best compromise is to get about 7 per cent. by charging with a low current, 10 per cent. by increasing the speed, and the rest by adjusting the field resistance.

(*To be continued.*)

THE BURNING OF THE COMO EXHIBITION.

The following is a translation of a letter received from the Mayor of Como in reply to a letter of condolence addressed to him :—

Como, *July 14th*, 1899.

To Signor C. H. Garland, chief of the English Delegation at the International Congress of Telegraphists, London.

In the name of all my fellow citizens, of whom I know I faithfully interpret the unanimous thought, I offer to you and to your colleagues of the English delegation at the International Congress of Telegraphists recently held in honour of Volta, the most heartfelt thanks for your cordial condolence in the terrible affliction of this unfortunate town.

The kind and comforting sympathy, which in this moment of misfortune you and the English telegraphists wish to testify to the fatherland of Volta, increases your title to our recognition and augments the reason for the warm recollection which Como will ever preserve of its dear guests welcomed there to initiate the solemn centenary in honour of our great fellow-citizen in the name of whom we received with such pleasure the telegraphists of all lands gathered there with one common thought as citizens of the same country and children of the same family.

With all my heart I thank you for the comfort which the kindness of yourself and of your colleagues brings to us, reviving still more than our wonted energy to surmount our great trial in the trust that the issue will permit Como to demonstrate to her friends that she is worthy of their sympathy.

Accept, Egregio Signore, the expression of the highest esteem and best consideration with which permit me to subscribe myself,

Il Sindaco,
(Signed) G. B. CADERAZZI.

THE VOLTA CENTENARY.

Congress of Telegraphists at Como.

[from our special commissioner.]

(*Concluded from page* 124.)

On Sunday, June 4th, the Congressists were entertained at a dinner given by the Organising Committee at the Eden Restaurant, Milan. At the conclusion of the dinner the whole of the representatives adjourned to the Covas Restaurant, where the Milan staff had been invited to take champagne with the visitors. The invitation was responded to by nearly the whole of the *personnel*, and a most enjoyable time was spent. Speeches of welcome were made by M. Amiot (France), Mr. C. H. Garland (England), and Mr. W. C. Burton (New York). On Monday, visits were made to the principal sights of the town, and a reception was held in the evening at the headquarters of the General Association of Civil Employés.

At 10.40 p.m. a start was made for Bologna, where the delegates arrived at 2.56 a.m. After a short night's rest, at 9.30 a.m. the delegates assembled in the Piazza Galvani for the purpose of unveiling a bronze tablet which had been placed on the pedestal of the statue of Galvani. Tributes of flowers from the various delegations were also made. The Mayor and his colleagues received the visitors in the municipal palace and afterwards conducted them through the galleries of the Gymnasium of Arts. The town was decorated, and the delegates were accorded a most friendly reception.

In the afternoon a reception was held by the local telegraph officials at the Eden Restaurant, and then visits were paid to all the points of interest in the town. At 7 o'clock p.m. a dinner was given at the Eden Restaurant, at which the Mayor presided, and interest was given to the enthusiastic proceedings by speeches by the Prof. Righi, Marconi's tutor, and also by members of the Galvani family. Speeches were also made by representatives of the foreign delegations.

At the conclusion of the dinner bags were packed, and the company set out for Florence, where they arrived at 7.30 on the following morning, Wednesday, June 7th. In Florence a reception was held at 4 p.m. in the Palazzo Vecchio by the Mayor, the Marquis Pietro Torrigiani, and visits were paid, under his guidance, to the principal sights of the town. At 9 p.m. the Association of Civil Employés held a reception in their fine suite of rooms.

On Thursday, June 8th, at 7.30 a.m., the company set out for Rome, arriving there shortly after 2 p.m. At 8.45 the "Societa di Mutua Assistenza fra gli Impiegati delle Pubbliche Amministrazioni Residenti in Roma" held a concert and reception at their club rooms in the Esedra di Termini. The Minister of Posts and Telegraphs was present, and a most excellent musical programme was gone through.

On Friday, June 9th, a visit was paid to the Forum, under the guidance of professors sent by the Ministry of Public Instruction. Rome was at this period suffering from a heat wave, which, of course, rendered very difficult for the northerners the task of following the well-filled programme. At 5 o'clock, under the same guidance, a visit was made to the Palatine, where the Vessella Band performed a good musical programme for the delectation of the visitors. At 9.30 the Roman Municipality received the Congress at the Capitoline Museum. The whole of the Capitoline Hill was decorated and illuminated, and special light effects had been arranged in the interior of the Museum. This was notably the case in the rooms containing the celebrated Dying Gladiator and the Capitoline Venus.

On Saturday, June 16th, the Congress set out early for an excursion to Tivoli. On the outward journey a visit was paid to Hadrian's Villa, where the Mayor and municipality of Tivoli held an open-air reception. A continuation of the journey led to the famous Cascades. At 2 o'clock the delegates were entertained at lunch by his Excellency the Marquis of San Giuliano, the Minister of Posts and Telegraphs, the function taking place in the *Villa Gregoriana*. The return journey to Rome was made at 6 o'clock, when the delegates were received in the spacious rooms of the Press Association in the Piazza Colonna.

On Sunday a visit was made to the Technical Bureau at Trastevere. Here the extensive workshops were visited, and Engineer Bracchi, Inspector of Telegraphs, carried out some very successful experiments with the Marconi apparatus. The experiments were, unfortunately, adapted to a non-technical audience, and were not in any way novel. Messages and greetings were exchanged very successfully over a distance of 40 or 50 yards. In the evening, at 8.30, a "good bye" dinner, presided over by the Marquis of San Giuliano, was given in the Valiani Restaurant. A very large company assembled, and speeches were made by chiefs of delegations on behalf of their respective countries.

Monday was spent in a visit to the Vatican and St. Peter's,

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permission being granted to visit all the private rooms and gardens. In the evening, the Italian Electro-Technical Society entertained the delegates at the Politeama Adriano, where a special performance of *L'Amico Fritz* was given. The delegates subsequently visited Venice, Padua, Verona, and then returned to Milan, from whence they dispersed to their various countries.

The Congress was, of course, an immense success, from the social point of view, and was not lacking in importance from a practical point of view. The subjects discussed were of great importance internationally, and the exchange of views between those who are actively engaged in the administration and working of the various telegraph departments cannot but be useful. The foundation of personal relations between the workers in the great business of international communication can hardly fail to lead to the more efficient and smoother working of the connected systems. We therefore anticipate with pleasure the renewal of the Congress at Paris next year, and although we can scarcely hope that the event can become an annual one, yet the various States would do well to encourage an occasional —say, biennial or triennial—meeting which would more than repay, by its practical benefits, any outlay involved.

THE ELECTRIC RESISTANCE AND HEATING COMPANY.

THE report of Mr. James Swinburne is naturally the feature in this company's prospectus, to which electrical engineers turned for information as to whether the invention offered to the public for £85,000 is worth it. Since its publication last week we have had a communication from Mr. A. G. Nussbaum.

Mr. Swinburne says :—

I have examined the Vogt resistances being made at the works of Messrs. Ganz & Co., in Buda-Pesth, and at a neighbouring pottery.

Vogt's material gets over the whole of the difficulties of the steps and contacts in ordinary adjustable resistances; and he produces an adjustable resistance which is durable, compact, and inexpensive in addition. The material, which is *clay and black-lead*,* can be worked up and manufactured cheaply at any local pottery, while the mountings and brasswork can be done at any brass finishers. There is thus little special capital expenditure necessary for the manufacture.

The material can be made of *various specific resistances*,* and the adjustable resistances can be therefore made to fit almost any range of resistance required; and the sliding contact works beautifully, sweetly, and sparklessly.

The Vogt material thus lends itself to the making of all sorts of electrical cooking and heating apparatus, at low cost, and free from the drawbacks due to electrolysis when wires are embedded in enamel.

In my opinion the Vogt resistances will have an extended use in all branches of electric industry as they are better than all the kinds in common use.

In the year 1885 Mr. G. A. Nussbaum patented an invention for "Improvements in resistance boxes and similar apparatus, &c.," and we extract the following paragraphs from his specification :—

This invention relates to improvements in resistance boxes and similar apparatus for use with incandescent electric lamps and for other purposes, and has for object to enable such apparatus to be constructed in more simple, cheap, and reliable form than has heretofore been usual.

According to this invention, I employ a substance having a composition corresponding more or less with that of the black lead ordinarily used in black lead pencils, and consisting mainly of a *mixture of plumbago, or graphite and clay*.* These materials are prepared, mixed, and moulded into rods, pencils, blocks, or other desired forms for use as resistances in a similar manner to that adopted for the manufacture of black-lead. Rods, &c., of this material possess considerable electrical resistance in a small mass; they are not liable to damage by strong electric currents, even though they be considerably heated thereby, and do not become perceptibly oxidised even when so heated.

In applying my carbon composition as a resistance to be interposed in an electrical circuit, I make use of any of the ordinary forms of resistances, in which German silver wire or carbon sticks or powder are used, such as the boxes with short-circuiting plugs or switches with a revolving finger pressing on contact plates, as before described. In all cases, however, substituting my improved resistance material for that usually employed. In addition to these ordinary forms, the high specific resistance of my material admits of its employment in forms differing from those in which it is possible to use a substance or metal in which a great length and small section must be used to obtain a high resistance. By employing a high percentage of non-conducting material in my composition, I can make a high resistance, having large sectional area and short length.

* The italics are ours.—EDS. ELEC. REV.

Mr. Nussbaum then describes and illustrates his various apparatus, and his sliding contact arrangement evidently works "beautifully, sweetly, and sparklessly."

He claims the employment, as a resistance to be interposed in any electrical circuit of a substance or material composed of an intimate mixture of *graphite or plumbago and clay, in proportions depending on the specific resistance required.*

Prof. Fleming has also publicly declared that he used the same thing seven years ago.

Possibly if Mr. Swinburne, Mr. Fletcher Moulton, or Mr. Roger Wallace will examine the Specification, No. 2,395 of the year 1885, they will then be so good as to tell us the difference between the old and the new, for we fail to discern any.

Read side by side with the company's prospectus, Nussbaum's specification is wonderfully similar, even to the effects of heating the material.

In the ELECTRICAL REVIEW for January 15th, 1886, appears the following amongst our abstracts of published specifications for 1885 :—

2,395. "Improvements in resistance boxes and similar apparatus for use with incandescent electric lamps and for other purposes." G. A. Nussbaum, dated February 21st. The inventor employs a substance having a composition corresponding more or less with that of the blacklead ordinarily used in blacklead pencils, and consisting mainly of a mixture of plumbago or graphite and clay. These materials are prepared, mixed, and moulded into rods, pencils, blocks or other desired form for use as resistances, in a similar manner to that adopted for the manufacture of black lead.

"The directors before joining the board, carefully considered the report, &c." What a pity they did not look through the files of the ELECTRICAL REVIEW!

It seems to us that as Nussbaum's invention is public property, there is only one thing for the directors to do, and that is, to return the money subscribed.

A SUPERFLUITY OF PROTEST.

AT the half-yearly meeting of the Eastern Telegraph Company, which was held last week under the presidency of the Marquis of Tweeddale, who is the chairman of that company, an interesting account was given of the company's present attitude in its relation to the interests of the public. That this relation has not been satisfactory to those from whom the company derives its revenue, is shown by the fact that the public has been driven to take concerted action against the conservative policy of the Eastern Telegraph Company, and of the companies associated with the Eastern. The irksome and excessive charges made for telegrams to Australasia have assured for the Pacific cable a support which it might otherwise have lacked. The position achieved to a great extent by the help of subsidies from various Government sources, has rendered it not only permissible and equitable, but also necessary that the Pacific cable should be placed on at least a similar footing by the Governments interested; and now, after much vain pleading and argument in favour of fair rates, the germs of a formidable competition for the traffic with India have taken root and are growing apace. There are other less important aspects of the case to which space will not allow us to refer at present. Brought face to face with the position above indicated, the Marquis of Tweeddale found himself compelled to deal with the situation at considerable length in his speech to the shareholders, a speech, which despite its ability, was distinguished by a superfluity of detail and protest. There are many points on which we cannot agree with the speaker. The reference to wireless telegraphy as affecting the value of the company's property we need not enlarge on, but it would almost seem as if the rebuff received from the Chancellor of the Exchequer and the Secretary of State for the Colonies, by the deputation representing the Eastern and allied telegraph companies, had led these to take a distorted view of the situation generally. We are told, for example, that when Her Majesty's Government announced their intention of guaranteeing the Pacific cable against loss, by offering aid, the *maximum* of which was £20,000 per annum, the directors of the Eastern

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Telegraph Company thought it advisable to address to the Prime Minister a letter "protesting against the Governments of this country and of the Colonies entering into direct competition with companies, and thus *interfering with private enterprise.*"* This smacks of audacity, coming as it does from a company already in receipt of large subsidies from the Home and Colonial Governments, and which, within the last year or two, was asking from these same Governments subsidies and money aid amounting to more than £100,000 a year! We learn that this claim has necessarily, and at least in part, been abandoned, and that the allied companies now propose to lay cables from the Cape to Australia without further subsidy, but on condition of being permitted to deal direct with the Australian public. The companies are further reported as being willing to consent to a reduction of rate to Australia. This offer, which has been recently reported in the press, amounts to a confession, and quite justifies us in the opinion which we have always held—that the allied companies could well afford both to maintain an efficient service and to reduce rates without exacting further financial aid from the Governments. With regard to the laying of a cable from England to the Cape, we do not learn that the companies have yet abandoned hope of obtaining the subsidy of £20,000 annually which they recently asked from Her Majesty's Government. It has been shown, however, that for their own security, both to avoid competition and to assure a continuous service, the interests of the Eastern group call for the laying of an additional cable to the Cape. Such a cable, if laid from England direct to St. Vincent, *viâ* the Azores, in co-operation with the Brazilian Submarine and Western and Brazilian Companies, would also serve for South American traffic, and the cost might be shared among the united companies, thus rendering a cable from England to the Cape much less expensive to the Eastern group.

In his speech the chairman asserts that the action now taken by the Government is without precedent, perhaps forgetting that the cables from Halifax to Jamaica, touching at Bermuda and Turk's Island on the way, were laid by the assistance of Government subsidies, which were granted, although the cable route so created came into competition with the British-owned West India and Panama Telegraph Company. In his references to the deputation headed by Sir Edward Sassoon which recently waited on the Chancellor of the Exchequer, Lord Tweeddale attempts to distinguish as between subsidies received by his company for establishing their system of cables, and subsidies received for continuing or duplicating these cables after establishment. This is an unimportant point; the real gist of the matter is, that these companies *are* heavily subsidised, and are thus fortified against unaided competition. It is not for us to defend or explain the statements made, and the arguments advanced, by the rival deputation to which the chairman of the Eastern Company deals out such hard measure; the gentlemen concerned are fully qualified to undertake the task themselves, and we reproduce elsewhere a letter written to the *Times* on this subject by Sir Edward Sassoon. There are, however, some of the criticisms made by Lord Tweeddale which we feel it our duty to notice, as they concern subjects to which we have made frequent reference in these columns. The first of these relates to the charge made for telegrams to India; concerning this Lord Tweeddale is reported as follows in a contemporary:—

Again, it was alleged that myself and Mr. Hesse, in our evidence before the Pacific Cable Committee, stated that 1s. 2d. was the Eastern Company's share of the tariff for Australian messages from Bombay to London, and upon this statement is based an argument against the existing charge between Bombay and London of 4s. for India telegrams. If Sir Edward had taken the trouble to examine the evidence that he refers to, he would have found that the amount of 1s. 2d. represents the out-payments to administrations other than the companies between London and Adelaide, and has nothing to do with the Eastern Company's charge for carrying Australian traffic between Bombay and London.

A perusal of the above would convey to those who are uninformed the impression that some grossly misleading blunder had been made by Sir Edward Sassoon, but that this is not the case will be readily understood by anyone who has read an article which we lately printed on this subject, wherein we showed that, from the evidence given by Lord Tweeddale and Mr. Hesse before the Pacific Cable Committee, "the amount received by those who forward the message on from Bombay to London is only 1s. 2½d."* As a statement similar to this has been called in question, we now reproduce extracts from the evidence given before the Pacific Cable Committee by the Marquis of Tweeddale, Mr. H. A. C. Saunders, and Mr. F. E. Hesse.† In referring to the 4s. 9d. per word rate from London to Australia the following evidence was given in reply to questions by Mr. Murray, representing the Treasury:—

2,003.—Out of each 4s. 9d. you told us that you got 3s. 7d.?—Three shillings and sevenpence, yes. Of the remainder, 7d. goes to South Australia, 1½d. to Java, 3½d. to India, and 2d. to the European administrations.

2,004.—Does the 3½d. to India include the rate for the Persian Gulf?—No, that is simply for the transit across India. The Persian Gulf Department of the Indian Government is one of the four pooled administrations.

2,005.—Then the Indian Government comes in in two ways?—In two ways.

2,006.—In its own business and the Persian Gulf business?—Indo-European or Persian Gulf. Either term would apply, and through the Indian Government Telegraph Department proper.

2,007.—And where does the 2d. in Europe go to?—Partly to Great Britain, the Telegraph Department here, the French Government, the German Government, and other European Governments; the average is about 2d. per word.

2,008.—You do not pay the Telegraph Department in this country anything for messages which you deal with yourselves, I suppose?—Oh, yes, we pay them a small amount, which averages that 2d.

2,009.—For a message coming into your office and delivered from there?—We have landline arrangements with the Post Office.

2,010.—Yes, but you rent the landlines, do you not, out and out?—Some of them, yes.

2,011.—Do you pay the Post Office on those?—Yes, there is a small payment which works out, taking the average, at 2d.

2,012.—I do not want to ask the question if you would rather not answer it, but can you tell us how much of the 3s. 7d. goes to the Eastern and how much to the Extension?—*The Eastern Extension Company take the largest amount, £200,000, of the whole traffic last year.*

2,013.—Out of——?—*Out of £310,000. The Eastern Company have £80,000, the Indo-European £13,000, and the Gulf Department a little over £8,000* ‡ according to the proportion of tariff.

Nothing, surely, can be clearer than the above. Possibly Lord Tweeddale regrets having given this information, but taking it as it stands, after the elimination of the out payments, it clearly means that out of the 3s. 7d. divisible among the companies, those who pass on the telegram from Bombay to London receive only exactly 1s. 3¼d. per word. It was, doubtless, this figure which Sir Edward Sassoon had in his mind, and not the out payment of 1s. 2d. which Lord Tweeddale referred to, possibly with a hope of confusing the issue.

Whether the amount for which a message can be profitably carried from Bombay to London be 1s. 3¼d. or 1s. 2½d. per word is of little importance. The difference of ¾d. per word is inconsiderable to the merchant who finds that he is paying 4s. per word for his message to India, while the same amount of work is being done for others at 1s. 3¼d., simply because their messages are addressed to Australia. As to another portion of his defence, we find that the chairman of the Eastern Company has failed to make out his case; we refer to the strictures made on the opinion expressed by Sir Charles Dilke as to the vulnerability of cables in time of war. It should be well within the recollection of those connected with the Eastern Telegraph Company that during the revolt of Arabi Pasha all this company's lines to the East, passing through Egypt, were at once cut, and that as far as telegraphing from England to India was concerned, the Eastern Company's cables beyond Egypt ceased to be of any value. Not only was the Hong Kong-Manila cable cut during the late war, but the Panay cable also shared the same fate. In Cuba, the cables looped along the south coast were severed in various places, the cable between Hayti and Cuba was also cut, but afterwards re-united by the Americans. Of the cables at Cienfuegos three were cut in shallow water by a steam cutter working under fire from the beach. That communication with Cuba was at no time entirely severed was due entirely to the desire of the United States Government to avoid possible complications with France and England. Since Lord Tweeddale is of opinion that a cable in the deep and distant waters of the Pacific, where vessels of war are few and well looked after, is the

* The italics are ours.

* See ELECTRICAL REVIEW, June 30th, 1899, p. 1057, "Reduction of Telegraph Rates to India."

† See Blue Book C.—9,247 of April, 1899, p. 97.

‡ The italics are ours.

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only one where interruption is "to be apprehended with any certainty," it seems illiberal to rebuke Sir Charles Dilke with such asperity—not so much for an expression of opinion, as for calling attention to cases which have actually happened in shallow water, and under the fire of the enemy. There are many other points which want of space prevents us from dealing with now, but we cannot close this article without a tribute of admiration for the gallant, although hopeless, attempt which the chairman of the Eastern Company has made to retrieve the damaged fortunes of the companies which he represents.

CONTINUOUS POWER METERS.

Numerous continuous power meters have been designed, but perhaps none of them fulfil the conditions of practice so well as the four whose general arrangement we will briefly describe. The four we have in mind are those of Vernon Boys, Little, and Ashton, the latter inventor having brought out two on entirely distinct lines.

Ashton's Number 1 power meter was specially designed as a steam engine indicator, and the work done was indicated by a modified gas-meter index. The indicator consisted of a cylinder in free connection on the one side of its piston with the engine cylinder, and upon the other side it connected with the opposite end of the cylinder. The indicator piston thus communicated to the spring a pressure equal to the difference between the forward and back pressures acting on the main piston. Net forward pressure was thus measured.

The piston rod of the indicator piston carried a small wheel, the spindle of which was parallel with the piston rod. As this rod worked to and fro, it carried with it this little integrating wheel, A, to and fro across the face of a small disc, B. In the neutral position, or position of no work, the point of contact of the disc and the wheel was the exact centre of the disc. Any rotation of the disc at that position is obviously incapable of producing any rotation of the wheel. But movement of the piston will place the wheel above or below the disc centre, and when the disc rotates, it will produce a rotation of the wheel, corresponding with the displacement of the wheel from the disc centre, and therefore exactly proportional to the net working pressure of the engine. Now the disc is given an alternating rotation or oscillation round its centre, being driven by some reducing motion from the crosshead of the engine. As the disc rotates in one direction when the integrating wheel is above the centre point, and in the opposite direction when the wheel is below the centre point, it is obvious that the wheel will rotate continuously in one direction so long as both

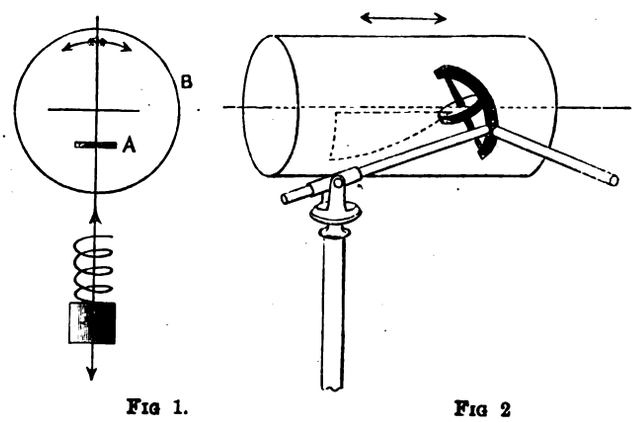

Fig 1. Fig 2

strokes of the engine are performed under a net forward pressure. By a sliding pinion of sufficient length, forming a part of the wheel spindle, the rotation of the wheel is transferred to the dial mechanism, and by suitably proportioning the diameters and the angular rotation of the disc to the scale of the spring and the index, a suitable division of the reading dial can be made to show work. As made, the integrating wheel was about $\frac{3}{8}$ inch diameter, and the disc about 3 inches. It is obvious that when applied to a single acting engine the little cylinder will simply be open at one end to the atmosphere, and, when applied to gas engines, the actual net work will be recorded, the idle and the compression strokes appearing in their proper values against the engine. The fault of this recorder was mechanical only. The maximum wear was upon the more nearly central parts of the disc, for the integrating wheel was pushed across the centre of this transversely to its own periphery, and wore away the disc into a hollow, and in time there was not continuous contact, and the instrument failed to record.

Some years subsequent to Ashton's first effort, Mr. C. V. Boys brought out his continuous recorder (fig. 2). It consisted of a small brass cylinder which was moved to and fro in a longitudinal direction by the reduced movement of the engine crosshead. In contact with it was the small integrating wheel, carried upon an arm in such a way that the integrating wheel spindle was normal to the cylinder axis when the pressures on each face of the indicator piston were equal.

In this position the wheel traced a straight line on the cylinder as the latter slid to and fro beneath and in contact with it. The arm carrying the wheel was pivoted just above the point of contact of the wheel periphery and the cylinder, and its other end was connected with the indicator piston, so that any piston movement moved the disc to an angular position. To and fro motion of the cylinder along its axis does not now trace a line on the cylinder parallel with the axis, but the cylinder being free to rotate on its axis, proceeds to rotate in such a manner, that there is no rubbing or sliding motion of the wheel on the cylinder, for this latter so rotates, as to cause the trace of the wheel edge to be a spiral line everywhere parallel with the disc rim.

As the angular movement of the integrating wheel is reversed with each stroke, just as the sliding motion of the cylinder is reversed, the rotation of the cylinder is continuous in one direction. The circumference of the cylinder

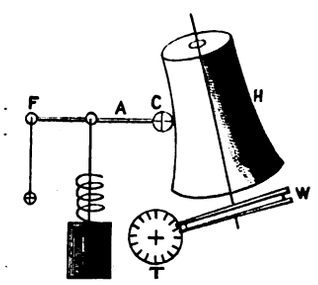

Fig. 3.

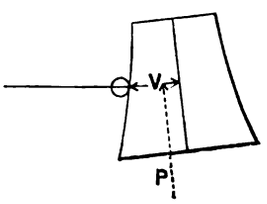

Fig. 4.

revolves through an arc, which is measured by the tangent of the angle of twist given to the integrating wheel, and proportional otherwise to the length of traverse of the cylinder. For correct results, equal movements of the indicator piston should give an equal tangent difference, and this is to be obtained by suitably arranging the arm connection to the indicator. The reading of this meter was taken off from the rotation of the cylinder. There is a theoretical fault obvious in this instrument in the fact that when an infinite pressure is recorded by the integrating wheel being set with its axis parallel with the cylinder axis, no rotation will be given to the cylinder. No power, in fact, will be recorded just when the power is a maximum. This fault can be avoided in practice by suitable proportions. As in the first-named instrument, the difficulty in this was that of contact and chattering, and this difficulty lead Ashton to produce his second pressure contact of hyperboloidal design.

In this instrument (fig. 3) a brass hyperboloid drum was placed upon an inclined axis in a frame, and drawn back and forth by the reduced crosshead movement of the engine. It was made to rotate, as it was so moved, by being kept in spring contact with a small roller, the axis of which was in the line of sliding of the conoid drum. This roller was carried by an arm which, at the position of no work, was radial to the (approximately circular) curved face of the drum. The other end of the arm was carried by a swinging pivot, which

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compensated for the to and fro motion of the roller caused by the face of the conoid not being a true circle. This pivot bearing was on a frame with a spring, by which means the roller was kept firmly against the conoid.

Obviously, if the conoid drum be drawn to and fro against the roller an equal distance every stroke, it will rotate through an equal angle so long as the roller is not moved. But if the roller is raised, the drum will rotate through a larger angle, and if it be lowered, a smaller rotation of the drum will be caused by reason of its different diameters.

Now, the roller arm is worked by the indicator piston, and is at the top of the drum when the drum slides, say, to the left, and at the bottom of the drum when this slides to the right. The drum will thus rotate through a larger angle on a left movement than on a right movement, and will thus continually add up movement in one direction, for it will roll forward in one direction more than it will roll backwards in the other direction.

But the index is so contrived as always to be moved forward. Though not necessary, this is proper to be done, for, without an equalising movement, the strokes of the engine would be positive and negative, though the positives prevail, and no real final error is introduced beyond one stroke of work difference.

This equalising movement is exceedingly simple, and ingenious also. On the inclined spindle of the conoid drum is placed a large flat worm, the threads of which gear with a long spirally toothed roller. This is really a pair of screw gears of very different diameters. If the drum slides to and fro without turning, the worm will simply rotate the fluted roller through a small angle to and fro. When the indicator roller is at its middle position on the conoid, and this rolls to and fro, the pitch of the screw gears is so proportioned that the angular rotation of the worm is exactly equal to its thread movement, and the worm thread advancing along the spiral of the roller or pinion produces no rotation in this. But any movement of the indicator roller disturbs this condition, and as the drum slides to the one end of its travel its angular rotation gives an equal angular rotation to the large worm, and the sliding on the fluted pinion roller is less than the screwing produced by the worm rotation, while when the cone slides back and revolves in the contrary direction with its larger end in rolling contact, the spiral pinion is rotated forward by the screw-sliding contact more than it is now drawn backward by the worm action. Thus the fluted roller moves forward every stroke by the correct difference. The movement is a differential of very marked ingenuity.

The reason for the conoid being hyperboloidal is as follows:—The equation to the hyperbola is $p\,v$ = constant. In fig. 4 the roller actuated by the pressure in the cylinder takes a position along an abscissa which represents a value of p. Then the ordinate will represent v, or in this case the distance travelled or rolled by the drum upon the roller. As the position of the roller varies with the pressure and $p\,v$ must be constant, it follows that the distance, v, which is proportional to the angular movement of the conoid must be such as to fulfil the condition $p\,v$ = constant. In other words, the angular motion of the conoid is in an exact inverse ratio to the pressure. Hence equal increments or decrements of pressure which vary the distance, p, along the abscissa from the origin of the curve, cause equal differences of angular rotation of the drum. A simple rectilinear, or plane cone, would be too large in diameter at the middle position, and would roll through too small an angle compared with its rotation at extreme positions, and would register too low a power at small pressures. In this power meter there is a freedom from chattering, because there is no improper sliding movement between the integrating surfaces. The roller and the drum each roll upon the other without improper sliding. Hence, wear should be small and there should be no slip.

This meter is shown in diagram in fig. 3. H is the drum which is carried in a frame that slides to and fro. In the instrument as made, this sliding movement is effected by means of a revolving screw actuated by the engine. The rolling bar, or roller, C, is carried on an arm, A, pivoted at F to a swinging fulcrum, and is worked up and down by the indicator piston rod, P, controlled as usual by a suitable spring; W is the worm on the conoid spindle which gears with the long screw pinion, T, from the spindle of which the index is graduated.

In Little's instrument a drum rotates to and fro on its axis, this drum occupying the place of the paper drum of the ordinary indicator. Against this drum is firmly but lightly pressed a small integrating wheel pivoted upon a horizontal bar that receives an oscillating movement from the indicator piston. According as this spindle is rotated, so will the plane of the integrating wheel be inclined to the cross-sectional plane of the oscillating drum. The instrument, as in Ashton's disc instruments, records the amount of rotation of the integrating wheel. In Ashton's conoid instrument and Boy's instrument, the reading is a record of the amount of rotation of the drums that is caused by the position upon them or relative to them of the integrating wheel.

Little's instrument is shown diagrammatically in fig. 5.

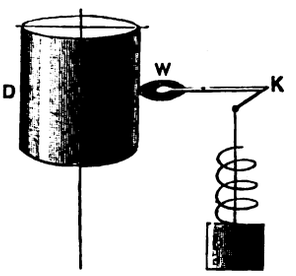

Fig. 5.

D is the drum driven by the engine crosshead, and W is the small integrating wheel, which is set to different angular positions by the small crank, K, and the piston, P, of an ordinary indicator, to which Little's mechanism can be applied. Excepting one of Ashton's earlier instruments, which made a voyage to India and back, we do not know of any lengthened trial of any of these integrating indicators. All smooth surface integrators at high speeds tend possibly to chatter, and this would be fatal to accuracy. In Little's instrument the point of contact of the integrating disc is always upon one circumferential line upon the drum, and so far as we have seen there is no chatter. The instrument is really a modified Amsler planimeter and gives very accurate results and will run at high speeds, for there is no movement of the disc over the surface. Contact is only upon a line by a point. Our brief descriptions will be sufficient to show the direction which has been so far taken by inventors.

The problem is a difficult one for high speed engines.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

14,167. "Electrical appliance for lighting miners' safety lamp." W. Leavesley and J. Allen. Dated July 10th.

14,194. "Improvements in relays." L. Cerebot and A. Silbermann. Dated July 10th. (Complete.)

14,267. "Improved telephone apparatus." L. G. G. Benard. Dated July 10th. (Complete.)

14,216. "Improvements relating to electric railways and tramways on a road contact system." J. Wetter. (The Elektrizitäts Aktiengesellschaft vormals Schuckert and Co., Germany.) Dated July 10th. (Complete.)

14,224. "Improvements in or relating to apparatus for electrically transmitting orders signals or indications from one place to another." A. U. Alcock. Dated July 10th.

14,235. "Improvements in apparatus for measuring indicating and registering time by electricity." M. Hoepf. Dated July 10th. (Complete.)

14,250. "Improvements in or appertaining to casings for electric light and similar cables." A. Hudson. Dated July 11th.

14,265. "An automatic signalling apparatus for electric tramways and the like." C. Wehner and H. Laube. Dated July 11th. (Complete.)

14,300. "Improvements in primary batteries." W. C. Callmann. Dated July 11th. (Complete.)

14,504. "Improvements in and in the application of electric motors for automobile vehicles." W. P. Thompson. (E. Cantonio, Italy.) Dated July 11th.

14,307. "Improved tool for use with insulated wires." P. G. Wayse. Dated July 11th.

14,317. "Improvements in electricity meters." H. T. Harrison. Dated July 11th.

14,328. "Improvements in insulators for the overhead conductors of electric tramways." W. L. Wise. (The Actien-Gesellschaft Elektricitätswerks vormals O. L. Kummer & Co., Germany). Dated July 11th.

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14,388. "An improvement in dynamo and other magnet coils." H. A. EARLE. Dated July 11th. (Complete.)

14,396. "Improvements in switches for electric lamps." J. HUNTER. Dated July 12th.

14,397. "Improvements in electric bell or alarm apparatus." D. DENNETT. Dated July 12th.

14,399. "An improved electric motor starter regulator and cut-out." VERITYS, LIMITED, and E. J. SELBY. Dated July 12th.

14,401. "Invisible adjusting apparatus for electroliers and gaseliers and the like." M. WEIDLICH. Dated July 12th. (Complete.)

14,402. "Improved triple or multiple pole filings tube or coherer for wireless telegraphy and the like." W. H. BERNER. Dated July 12th.

14,403. "Apparatus actuated by electricity for the delivery of comestibles and drinks after the introduction of a coin." N. DEZSO. Dated July 12th.

14,408. "Improvements in submarine cables." G. G. M. HARDINGHAM. (The firm of Felten & Guilleaume, Germany.) Dated July 12th.

14,449. "Improvements in wireless telegraphy." S. G. BROWN. Dated July 13th.

14,460. "Improvements in electric telegraphs." W. JUDD. Dated July 13th.

14,467. "Improvements in and relating to electric traction." T. PEASE and C. B. BURDON. Dated July 13th.

14,489. "Improvements in coin-controlled call-recording device for telephone systems." J. B. GILL. Dated July 13th.

14,501. "An electrical accumulator or secondary battery." R. HILLS and J. MATTHEWS. Dated July 14th.

14,559. "Improvements in regulating devices for electric currents." A. W. GATTIE and A. G. SEAMAN. Dated July 14th.

14,568. "Improvements in electrical alarm apparatus." C. EGGERDING. Dated July 14th.

14,569. "Improvements in dynamos." W. B. SAYERS. Dated July 14th.

14,572. "Improved system of electro-dynamic propulsion." L. ROSENFELD, C. ZELENAY, and J. DULAIT. Dated July 14th.

14,593. "Improvements in hand, vice, and other strainers or stretchers for telegraph, telephone, and other wires." W. S. MACKIE. Dated July 15th. (Complete.)

14,632. "Improvements in roller conductors for electric cars." F. CHONE. Dated July 15th.

14,636. "Improvements in electric current interrupters." J. G. LORRAIN. (M. Levy, Germany.) Dated July 15th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

10,755. "Improvements in or applicable to electrically-driven cranes." W. Craven. Dated April 30th, 1897. Relates to improvements in electric cranes.—The brake described in Specification No. 21,883, A.D. 1891, is fitted to a disc. A cam bar which acts upon a weight is connected to an arm which slides backwards and forwards on the shaft. When, therefore, the hand lever is operated to control the motor, it simultaneously partially rotates the shaft through levers and links and in such a way that the brake is put on when the motor is not running. 2 claims.

10,822. "Certain improvements in apparatus for the electro-deposition of metals." W. Evans and J. W. Smith. Dated April 30th, 1897. Plating small articles.—A preferably octagonal water-tight wooden receptacle is supported in bearings by end bosses and journals and rotated by a pulley. The bosses are connected by brushes with the current generator. One side is removable. 5 claims.

10,908. "Improvements relating to the transmission of signals through submarine telegraph cables." F. L. Muirhead. Dated May 1st, 1897. Automatic transmitters, such as are described in specification No. 19,183, A.D. 1893, for submarine telegraphy, are provided with means for independently adjusting the positions of the pins which enter the perforations in the strip, and of the contact makers. Three arrangements are described. A pin is connected with a lever and is held against a stop by a spring. The upper edge of the lever is curved to bear against a pin, attached to a lever, which is reciprocated by a crank, the pin being guided by a slide adjustable by a screw and nut. The lever carries a contact spring and is drawn by a spring towards an insulated contact adjustible by a nut. In the modification, the pin lever is reciprocated by a pin, and the contact spring operates between two stops, these, and the contact lever being carried by an adjustable slide. In another form, the perforations are entered by the end of a lever which is connected by a wedge and pin with the contact lever; the wedge is movable by a lever, spring, and cam. Intermediate or local transmitters or relays are constructed as follows:—Two coils are pivoted or suspended by pairs of thread between the poles of two magnets, each coil enclosing a stationary iron core. The lower threads are passed under pulleys to springs attached to an adjusting rod. Each core carries a contact arm between two stops. The coils are connected in series, and receive positive or negative current from a hand key or an automatic transmitter, causing opposite movements of the arms; the stops are connected with a battery so that the arms transmit corresponding positive or negative currents to the circuit in which they are connected. The coils are shunted by an adjustable inductance, which causes a curb current to follow each main impulse. 5 claims.

13,838. "Improvements in or relating to electrical switches." G. Page. Dated June 5th, 1897. In order to secure efficient contact the movable contact bar is made in two or more independent sections forced together, or apart, by springs. The movable contact bar adapted to enter the contacts is formed of two pieces forced apart by springs. Springs are provided to give a quick break, and the handle is fitted with an enlarged part to serve as a guide. In a modification the contact bar is carried in an enlargement of the lever. The contact is preferably carried in a block having a rotary movement. The contact strips may be slit to give them greater resilience. 4 claims.

13,972. "Improvements in and relating to controllers for electric motor circuits and in blow-out magnets for use with same." The British Thomson-Houston Company, Limited. (W. B. Potter and F. E. Case, United States.) Dated June 8th, 1897. Consists of a combination of resistance switch, reversing switch, commutator (to vary the relations of the motors), and switches to cut out either of the motors in case of disablement. The switches interlock and a magnetic blow-out is fitted to minimise arcing. The shaft of the resistance switch is supported by bearings in the cover, and in a footstep above the shaft of the reversing switch. It carries spiders to which are secured insulating strips on which the contacts are fitted. These contacts bridge the fixed contacts arranged in vertical rows when the switch is reciprocated. The ends of the contacts or brushes are fitted with tips which are arranged within chutes to insulate them from the pole pieces of the blow-out magnets. These consist of a number of coils mounted on a core, each coil being in a separate circuit and separated by the pole pieces. The magnet structure is so mounted that it may be locked in position or be drawn aside by the handle in order to inspect the contacts. The contacts are so arranged on the switch that the circuit is broken on either side alternately. The reversing switch is mounted on the shaft and turns within the resistance switch to save space. It consists of rotary contacts which engage with fixed contacts. The shaft of the resistance switch carries a cam which operates a rod and locks the handle of the reversing switch, so that it cannot be operated except when the resistance switch is in the "off" position. The commutating switch for varying the relation of the motors is contained within a casing, and is operated by the handle through the shafts and rod. The shaft can only be rotated when the resistance switch is off. The cut-out switches for the motors are so connected to the commutating switch that they can only be operated when the motors are in series, and when operated they lock the commutating switch. The discs of the reversing and commutating switches are so mounted on the spare spindles as to give a universal joint of limited play. 22 claims.

13,975. "An improved electrical bond or connection for railway and like rails." The British Thomson-Houston Company, Limited. (W. B. Potter, United States.) Dated June 8th, 1897. Rail bonds.—Two end plates are attached, preferably by casting, to a bundle of laminated copper, and are roughened over the central part of their surfaces to hold a plastic conducting compound or amalgam where they bear on the rails to which they are bolted. 4 claims.

13,976. "Improvements in or relating to induction motors." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated June 8th, 1897. The field coils of a two-phase induction motor, having a short circuited rotatable armature, are supplied with currents differing in phase, from a single alternating current circuit. The main circuit is divided through two field coils and two different coils on one core. This arrangement is applicable to meters for registering current or differences of potential, with slight modification. One coil carries the main current. Another coil is connected across the mains through an inductive coil and an adjusted part of a small coil which is connected in parallel with the coil. The inductances are made such that the currents in the coils, C, D, are in quadrature. The armature may be a conducting non-magnetic cylinder, with the coils C, D, arranged crossways inside it. An additional coil parallel to the main current coil C, and connected in series with a non-inductive resistance across the mains, compensates for friction. Ordinary brake and counting devices are provided. Meters may be arranged similarly for polyphase circuits; thus, in a three-phase three-wire system, two meters are placed in two of the mains, one end of each potential coil being connected to the third main. 5 claims.

14,022. "Improvements in and relating to electric furnaces for the manufacture of carbides." R. Memmo. Dated June 8th, 1897. Relates to arc or incandescence furnaces for making carbides. The graphite bed of the furnace is carried in an iron tray, and may be lowered within a tube as carbide accumulates, by a screw or rack and gearing. The upper part of the mass of carbide may be subsequently held up, by clamping it in the tube between three jars movable by screws, while the lower part is removed from the bed; this is afterwards raised to the upper part, the operation of the furnace being thus made continuous. Carbons may be fed through gas-tight tubes by gearing; polyphase currents may be used, and the carbons may be arranged for either star or ring arcs or incandescent conductors. The materials formed into blocks and broken up, are fed by a screw from a hopper with a refractory lining. The materials contain water, to produce water-gas, which may be delivered through a space and used for any purpose. In one arrangement it is burnt to heat the materials in the hopper with air which has been heated by passage through channels around the tube containing the carbide. Otherwise this heated air may be delivered into the body of the furnace, to burn the gas there. 7 claims.

14,035. "Improved means for producing continuous current effects from alternating electric current generators." O. Berend. Dated June 9th, 1897. Relates to means for producing continuous-current effects for charging accumulators, or for electrolysis or the like, from alternating-current generators. The circuit is arranged as shown with contact-breakers, operated alternately by means of polarised electro-magnets arranged in shunt circuits. The result is that intermittent currents flow in a constant direction through the accumulators, as shown by the arrows. 1 claim.

14,136. "Improvements in or relating to coin-freed mechanism and machines for giving electric shocks." F. Ashburner. Dated June 10th, 1897. The primary circuit of an induction coil with pull-handles is completed when the coin striking one end of a beam tilts it into the position shown in dotted lines, so that the other end wipes a curved plate. The beam sinks to its original position slowly, being provided with a pawl which catches in a ratchet-wheel governed by an escapement. 2 claims.

14,187. "Improvements relating to telephone systems." H. H. Lake. (E. Von Szvetics, Hungary.) Dated June 10th, 1897. When a large number of receivers are arranged in circuit with one or more transmitters at a central station, condensers are inserted in the line, or the receivers may be grouped in parallel between two leads; in this case the condensers may be in the line, in the branches or in both. In a third arrangement, all the receivers are grouped on one outward lead, but each group has a separate return. The telephone returns may be bifilar, and may be enclosed in insulating instead of conductive casings. 7 claims.

14,199. "Improvements in or connected with electric arc lamps." F. S. Worsley. Dated June 10th, 1897. Arc Lamps.—A regulating solenoid is formed at its upper end as a dash-pot containing a detached piston with which the core comes in contact in striking the arc, but which does not touch the core in the normal working of the lamp. For this purpose the motion of the piston is limited by a shoulder in the solenoid tube, or by a flexible cord, or otherwise. The return of the piston may be assisted by a spring pressing on it or by providing it with an armature of magnetic metal. 3 claims.

14,247. "Improvements in and relating to electric furnaces." W. P. Thompson. (La Societa Italiana dei Forni Elettrici, Italy.) Dated June 11th, 1897. The hot gas produced in an electric furnace, making carbides or other products, is passed through a chamber surrounding it, and after purification and storage is burnt to heat the materials supplied to the furnace. The current passes between carbon blocks. The block is supported by a metal tray on a lever, the fulcrum of which is movable on horizontal guides. The upper block is carried by a metal tube movable through a plate packed with asbestos or other material. The furnace is preferably lined with carbon. The gas produced passes through openings into the chamber surrounding the furnace on three sides. The purified gas is burnt below a tube preferably elliptical, through which the materials are fed by a screw. Specification No. 13,297, A.D. 1896, is referred to. 8 claims.

14,252. "Improvements in mechanism for electric traction systems in which the electric current is supplied to the car or locomotives from studs, sections of rails, or the like laid in the road." S. P. Thompson and M. Walker. Dated June 11th, 1897. Electric railways and tramways on a road contact or sectional conductor system with electro-magnetic switches similar to those described in specifications Nos. 19,455, 19,455A, and 19,456, A.D. 1896. Conductors, switches, collectors.—In specification No. 19,455A, A.D. 1896, the action of the switch depends on the closing, or partial closing of a magnetic circuit by a mass of iron on the car. The initial or partial closing of the switch is now made independent of this iron mass, which only serves to complete the closing and to hold up the switch. The magnetic parts of one form of switch for this purpose are shown in the drawings where the plunger is moved up to the loose part by the solenoid, and then these parts are lifted when the iron skate comes over them. This partial movement starts the switch and may also break an earth connection of the stud. Several methods of connecting the operating coils with the mains and switch contacts are described. In modifications there are main studs and auxiliary studs, and the skate collector is divided into five parts connected to the motor. Current from one main stud at switch 1 passes to the forward auxiliary stud at switch 2, thence through the switch operating coil to the forward main stud, and so to the motor. For running in the opposite direction to the arrow, the connections of the parts of the skates are reversed. Modifications of the skates, &c., are described. By the use of two auxiliary studs with the switch coil between them, the main stud, S, is connected directly through the switch contacts to the feeder. 6 claims.

25,235. "A roller bearing locking or under-carriage applicable especially to electrical and other motor vehicles." Hon. R. T. D. Brougham. Dated October 30th, 1897. Consists of a roller bearing locking or under-carriage especially for electrical and other motor vehicles. The two swivelling rings or wheels of the under-carriage are separated by a series of horizontal and vertical rollers, carried by a loose intermediate ring. 2 claims.

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THE

ELECTRICAL REVIEW.

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DIRECT COUPLED PLANTS.

ONE hears so much at the present time of American standards, that it comes almost as a shock to read an address by an American engineer before an American engineering society, the text of which is practically based on the want of standards in American electrical work. Yet Mr. J. B. Stanwood, before a recent meeting of the American Society of Mechanical Engineers, urges the members very strongly to adopt standards for direct coupled generating sets. On the question of standards, we, in this country, thought we had everything to learn from the States, and it comes almost as a positive relief to find that in one direction at least the Americans are probably not in as good a position as we ourselves. It is readily admitted, as the author of the paper points out, that the application of standards has proved an important feature in the industrial progress of America, for the Americans have standard dimensions for materials, standard sizes for the parts and capacities of machines, standard gauges for measurements, and standard systems of inspection. There is very little doubt that the care with which such systems have been elaborated, has permitted an interchangeability which is comparatively rare on this side of the Atlantic. Having regard to these things, therefore it is a little curious that on one particular branch of electrical work it should be necessary to call the attention of Americans to their short-comings. Direct driving, Mr. Stanwood points out, has been responsible for great alterations in the design of machines, and this has involved manufacturers in great expense. Curiously enough the author refers to a system in America which we have always supposed was monopolised by this country, that is, the specifying, by a third party, usually a consulting engineer, of a type of engine which was not in stock, or differed in detail from standard types. Apparently, however, such conditions are not confined entirely to Great Britian, for not only is trouble referred to under this head, but the difficulties of obtaining complete co-operation between a dynamo-builder and an engine-builder are dwelt upon. But it is new to us to find trouble arising under such circumstances, and one can hardly realise Mr. Stanwood's complaint that the dynamo-builder may have to wait for the engine-builder, after which there comes the adjustment of the engine's speed to suit the generator's speed. In direct coupled plants the electrical engineers of this country have had special experience, and, indeed, it is not going too far to say that, England being practically the home of direct driving plants, much of the trouble that is being experienced in America in fitting engines and dynamos hardly ever arises here. Apparently in the States the question is felt so acutely that a plea was put forward for a standard series of capacities and speeds. Moreover, it is said that those parts of the engine and generator which have to be connected or fastened together should be standardised for each different size, to facilitate the assembling of a combined machine or set. Apparently the author of this paper assumes that such a

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system introduced by Americans both at home and abroad might give them a large share of the electrical and engineering business of the world. In order to achieve this, Mr. Stanwood makes some recommendations as to standardising the dimensions of those parts of the engine and dynamo which are connected together, they are:—(*a*) the shaft diameter and armature bearing, which should be expressed in thousandths of an inch; (*b*) the length of shaft outside the engine and the location thereon of the bearing should be given in inches and feet; (*c*) the distance from the centre of armature to sub-base in inches, and (*d*) the length and width of generator base, and the size and location of the bolts which attach it to the sub-base. Apparently these are the chief requirements which are to enable the Americans to take possession of the world's markets as far as direct coupled plants are concerned. We have the greatest admiration for American practice in certain directions, and we should hardly have thought that such trouble had been experienced in arranging dynamos and engines for direct driving. English designers of dynamos, first and foremost, have designed their machines for direct driving, and we can hardly conceive that any of our large engine-builders experienced trouble in the directions indicated by Mr. Stanwood. Even in the driving of alternators it has been for some time past the standard practice in this country to make the alternator as an integral part of the engine, and we do not think that any modern station is ever designed for rope or belt driving. In some respects the Americans have themselves demonstrated the efficacy of direct coupled plant, but their practice has differed from ours in that they have employed slow speed Corliss engines provided with considerable fly-wheel energy. On the contrary, standard practice in this country has been to directly connect high speed engines, and it can hardly be said that the method has not proved a distinct success. There is, of course, a considerable tendency in some quarters to adopt a slow speed engine of the American type, particularly for tramway work, and it will be interesting to watch the effect of this type of plant in the development of electricity supply. There are many engineers who hold the opinion that in spite of the success of the high speed engine, we shall be compelled eventually to adopt an engine having a low piston speed. Whatever may be the true aspect of the case, it can hardly be said that the adoption of American engines is part of that reversal of policy; indeed, it would appear to be due rather to the manner in which the Americans have been able to place their tramway apparatus upon the English market. This much may be said, beyond all question there does not appear to be any decided limitation to the size of high speed engines. Years ago, when the Willans engine first came to the rescue of electricity supply, one scarcely expected that there would have been such an extraordinary development in this class of prime mover. And so completely is the practice of engine-builders altered in regard to size, that they practically refuse to build a high speed motor of less than 60 H.P. It is not long ago that we recorded in these columns the fact that Willans & Robinson were making an engine of 5,000 H.P.; that alone ought to be a partial answer to the out-and-out advocates of slow speed engines. It is said occasionally that a high speed engine is all very well as long as nothing goes wrong, but it is difficult to see wherein it differs from other engines. Not long ago it became a well-known axiom in American electricity works employing slow speed engines to retreat behind a pillar and await developments whenever the engine reached a certain speed. That the precaution was not wholly unnecessary was shown by the occasional bursting of heavy fly-wheels.

The Pulverization of Metal Cathodes.—Last year it was found by Fritz Haber that the electrolysis of hydrochloric acid with platinum or platiniridium electrodes resulted in an attack of the platinum at ordinary temperature when the acid is concentrated, but the platinum remained unaffected when the concentration is below 30 per cent. HCl. Platiniridium containing 10 per cent. of iridium was hardly attacked at all by the concentrated acid, and if the alloy contained 20 per cent. of iridium it remained unaffected. At the boiling point an 11 per cent. acid solution attacks the platinum as vigorously as a 36 per cent. solution at the ordinary temperature, but an 8 per cent. solution leaves the platinum intact. During the course of the electrolysis a deposition of platinum on the cathode is observed, but this is not due to transference of platinum from the anode to the cathode, as the cathode loses in weight. It is probably due to mechanical action, and in some way connected with the absorption of gases by the platinum. Lead is found to behave in a similar manner, so that formation of a layer of spongy lead on the cathode can be obtained by the electrolysis of sulphuric acid with lead electrodes. Since this Haber has associated himself with Georg Bredig, and has continued his researches, an account of which is given in the *Berichte der Deutschen Gesellschaft*, Vol. 31, pp. 2741—2752. When a cathode consisting of a bright lead plate or wire conveying a current at 24—72 volts is brought into dilute sulphuric acid, a platinum anode being employed, a momentary pulverization of the lead occurs, and a fine metallic powder falls through the liquid. This takes place at isolated spots on the surface of the metal, bright indentations being left, with rounded edges. A similar phenomenon takes place in alkaline solutions, but in this case it is continuous and much more energetic. The metallic lead thrown down is peculiarly susceptible to chemical change, and can readily be converted into white lead by the simultaneous action of air and carbonic anhydride. The addition of small quantities of a chromate of chromium salt prevents the occurrence of the phenomenon. Mercury, tin, bismuth, thallium, arsenic, antimony, and Rose's metal all show the same phenomenon in alkaline solutions, whereas cadmium, zinc, copper, silver, aluminium, platinum, and palladium do not act in this way. In acid solution, on the other hand, only bismuth and Rose's metal behave in a similar manner to lead. The phenomenon is to be distinguished from the loosening of the surface which occurs with cathodes of platinum, palladium, and lead. In an alkaline solution, it is probably preceded by the formation of an alloy of the metal of the cathode with the alkali metal present, which is then decomposed by the water. This is especially marked in the case of mercury, but no similar action can occur in acid solution.

Single Differences of Potential.—Hector R. Carveth has determined a number of single differences of potential by the dropping mercury method, attention being directed more especially to the measurement of metals in solutions of their salts; in opp ition to the results of Paschen, it would appear that both anion and cation have an effect. With different concentrations of the same electrolyte the values obtained apparently follow in regular order. Cases in which the dropping electrode gives values corresponding with the polarization method have been observed, as well as cases in which a difference in the value occurs. The solution pressure formula of Nernst was tested and found to hold approximately in a few cases, whilst in the great majority of cases it failed. The author concludes that the values given by the drop electrodes are not true single differences of potential. The above is an abstract of a paper in the *J. Physical Chem.*, Vol. 2, pp. 289—321.

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MACHINE TOOLS.*

(*Concluded from page* 164.)

Fig. 17 illustrates a good example of a powerful profile and general milling machine with a rising and falling cross-slide by W. Muir & Co., Limited. The general design approaches that of an ordinary planer. The table is driven by a screw, and is provided with self-acting, longitudinal reversing and hand-feed motions, also quick traverse in either

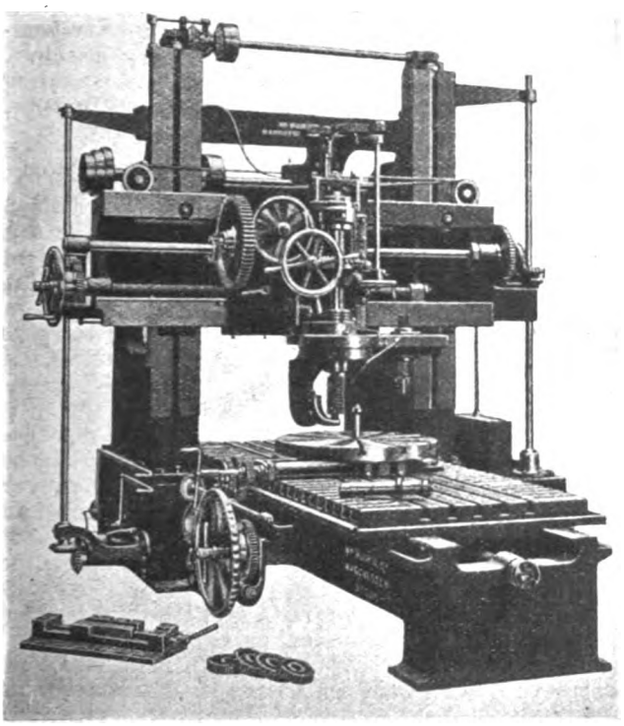

Fig. 17.

direction by power. A useful attachment is a removable self-acting circular table. The saddle on the cross-slide is fitted with variable and reversing self-acting and hand feeds; there is also a quick traverse and balance weight when doing "former" work. This machine, which is treble-geared, has a spindle 4 inches diameter, and will admit 4 feet 7 inches between uprights. It weighs 14 tons, and is a very fine English-built tool.

Planing Machines.

The importance of the planing machine is only equalled by that of the lathe. Experiments with an electrically-driven planer have revealed the fact that the return stroke absorbs twice the power taken by the cutting stroke. Joseph Buckton & Co., Limited, have designed a planer with a double cutting tool box, and have also fitted the machine with a quick return for use where cutting in both directions is not applicable. Mr. Bird's tool holder shown in fig. 18 effects the same purpose and can be applied to existing machines. The inventor has also designed a special feed mechanism, to ensure an independent but alternative feed to either tool.

A powerful Armstrong-Whitworth screw-driven planing machine, capable of planing up to 12 feet wide by 12 feet high, is shown by fig. 19.

Fig. 20 shows a high class make of American planer; the general design approaches the English style, the chief difference being in points of detail, methods of feed, and driving motions. The spiral system is more in vogue in America than here, although this particular machine is rack-driven.

Side planers are now so much in use, that reference is hardly necessary; it will be recollected that the machine is a combination of a planer and shaper, the advantage over the former being the saving in space, and over the latter the length of stroke.

Space does not permit of reference to other types of planers, such as wall planers, plate edge planers, &c.

Shaping Machines.

These machines, which are largely being replaced by milling machines, we have not thought it necessary to illustrate in this article.

Slotting Machines.

There is nothing sufficiently novel to justify any special reference.

Keyway Cutting Machines.

Fig. 21 illustrates an American keyway cutting machine, the special features of interest being the upper support for the cutter bar. The keyways are always cut central; the depth of the cut is regulated by a micrometer screw, which facilitates repetition work; the cutting tool has perfect clearance on the upward stroke.

Punching and Shearing Machines.

There are no striking developments in this direction.

Bending and Straightening Machines.

The size of these machines is assuming large proportions, as may be inferred from a machine by Craig & Donald for bending mild steel plates 1½ inches thick to 12 feet wide. The machine weighs 75 tons.

Metal-Sawing Machines.

Considerable attention is being devoted to this class of machine, and makers recognising how greatly success depends upon the proper condition of the saw blade, are fitting a self-contained grinding attachment to the machines.

Forging and Welding Machines.

The "Standard" hand-power forging and welding machine made by the Jos. C. Nicholson Tool Company is an excellent tool, that ought to find a place in every smithy. It is of

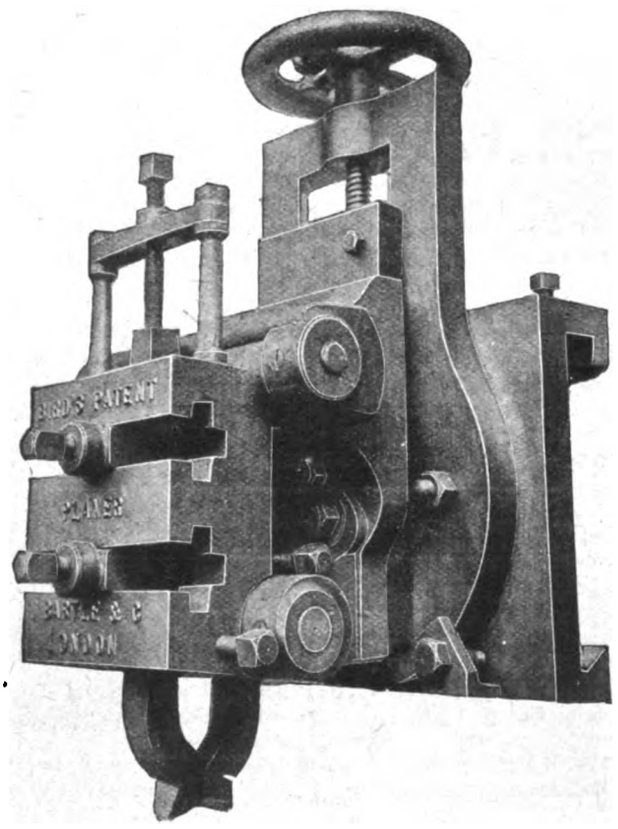

Fig. 18.

very simple character, and consists of a pair of clamps for holding the two pieces of iron to be welded, and a powerful lever arrangement for forcing them into contact when at welding heat. With this tool no scarf is required, and the weld is actually stronger than the original bar. By

* Editorial abstract of a paper on "Machine Tools," by E. C. Amos, recently read before the Society of Engineers.

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reversing the lever arrangement the machine can be used for drawing out and elongating bars.

Hydraulic Machine Tools.

Space does not permit of an extended description of water-driven tools, the advantages of which are now well known.

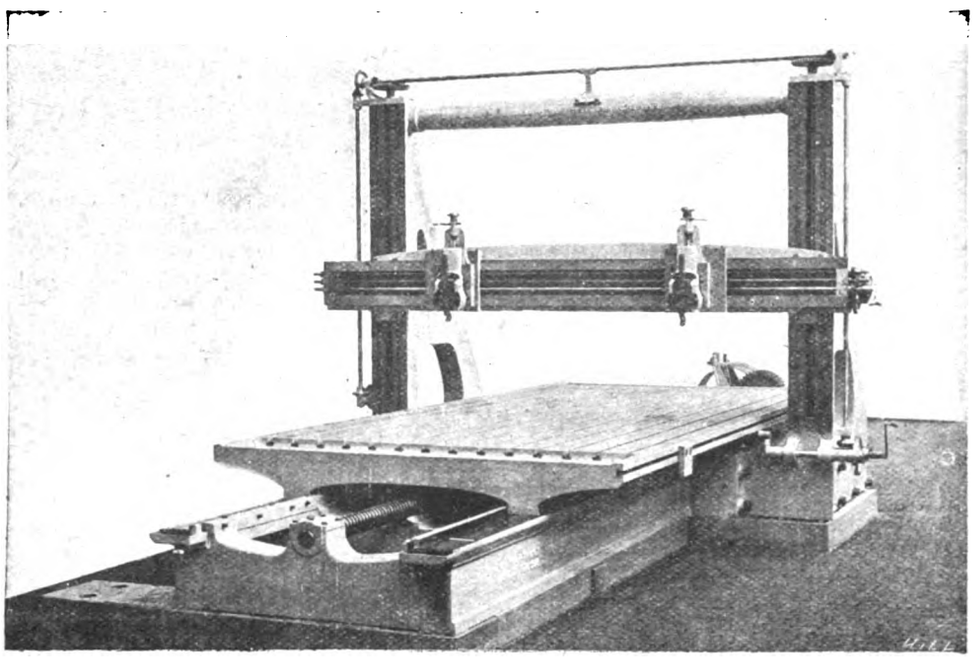

Fig. 19.

One of the more important developments in the direction of boiler makers' tools (to which class of tool hydraulics are particularly suitable) is a boiler shell plate bender, by Fielding and Platt, Limited. It is quicker in its action than rolls, and costs less, does not occupy so much space, and bends narrow strips as accurately as shell plates.

The plate to be bent passes through a vertical slot in the press, the two edges of which are respectively convex and concave. These edges are made to approach each other by means of a vertical ram operating upon an inclined plane. The method of working is very simple; the plate being placed edge up on small rollers on a cast-iron floor, is pulled through the machine in steps of 3 inches by means of an automatic feed gear, after every stroke of the bending girder.

Another useful type of machine is a hydraulic flue flanger, which will flange an Adamson flue ring at one heat, and will also do many other kinds of work in stamping, welding, and bending.

The chief advantages obtaining from the use of hydraulically-driven tools are the simplicity of mechanism and saving in power from gearing and belting losses, another advantage being the independence of line shafting, it being possible and easy to put tools down in any position.

Space does not permit of description of other classes of hydraulic tools, such as punching, closing and riveting machines, and for forging, welding, shell drawing, tube drawing, wheel bossing, &c.

Pneumatic Tools.

The rapidly increasing use of pneumatic tools demands some reference to them.

One of the most commonly used pneumatic tools is the hand hammer, which is used for chipping, caulking, driving hot rivets, heading, driving nails and spikes, scaling boilers, &c. The hammer contains a rapidly reciprocating piston, which carries the operating tool. The shock or vibration is very much less than might be expected.

The pneumatic breast drill is another example of the air-driven tools.

Another type of tool is the riveter, to which compressed air lends itself even better than steam or hydraulic pressure, and the speed at which good work can be effected pays for the cost of these machines very quickly.

Other Tools.

Space does not allow of more than a reference to the following tools :—Wheel-cutting and dividing machines, emery grinders, measuring machines, gauges, gas furnaces, chucks and hand tools.

British v. American Tools.

The author has devoted considerable attention to this subject, and has been forced to the conclusion that the majority of tool makers in this country are not keeping pace with those in America, and that the large sale of American tools in this country is good evidence of their quality.

The author, who, it may be mentioned, is not interested or connected with any American firm of tool makers, is of opinion that it lies within the power of the majority of British makers to turn out tools comparable with those of their trans-Atlantic cousins, but this can only be done by wholesale scrapping of obsolete designs, and by adopting more modern methods of manufacture. The advent of the foreign tool is certainly a blessing in its

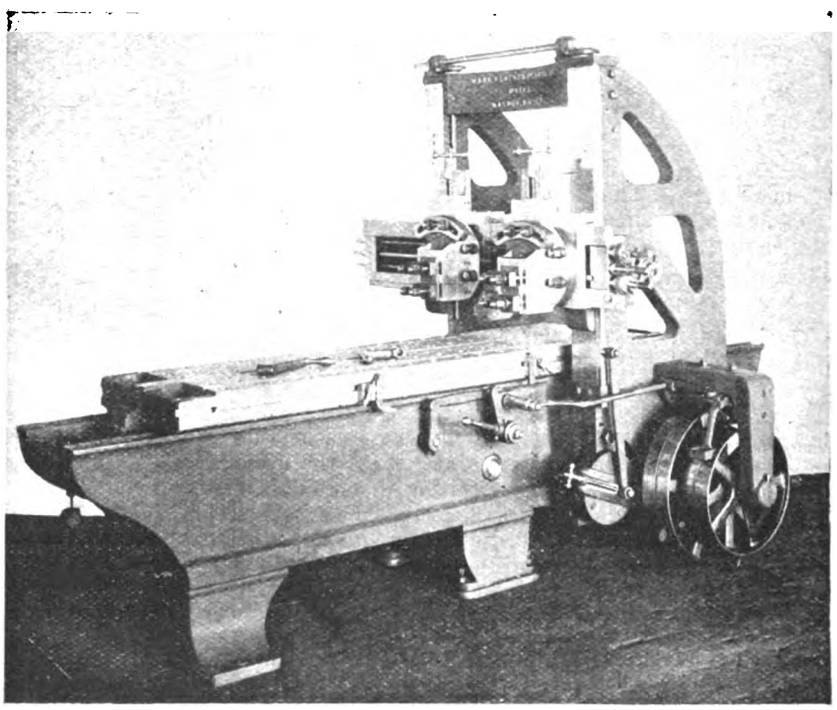

Fig. 20.

dual capacity of improving the efficiency and output of the users' works, and of furnishing data for the improvement of their own tools.

It is only fair to remember that many of the ideas embodied in American machines originated in this country; but the Americans, by their marvellous attention to detail, have so improved the original designs, as to make them hardly recognisable.

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The difference between the two makes is more one of design than quality of workmanship. Tool makers are more or less guided by the requirements of their customers, but the Americans, with their high wage rate, have been stimulated to make a special study of reducing labour to a minimum, and have, as a consequence, produced a highly productive class of tool. The English are now following suit, and have, in some cases, "gone one better," but, generally speaking, the progress is slow. Owing to the abnormal boom in trade, they have not experienced the necessity of greatly improving their tools, but the slump is bound to come, and they should be preparing for it.

That Americans can compete in the English market is greatly due to the fact of their specialisation of one or two classes of tool, in which, as a consequence, they excel.

The English have also a lesson to learn in the matter of selling their productions, most of them being chary of imitating the American practice of opening showrooms in large towns.

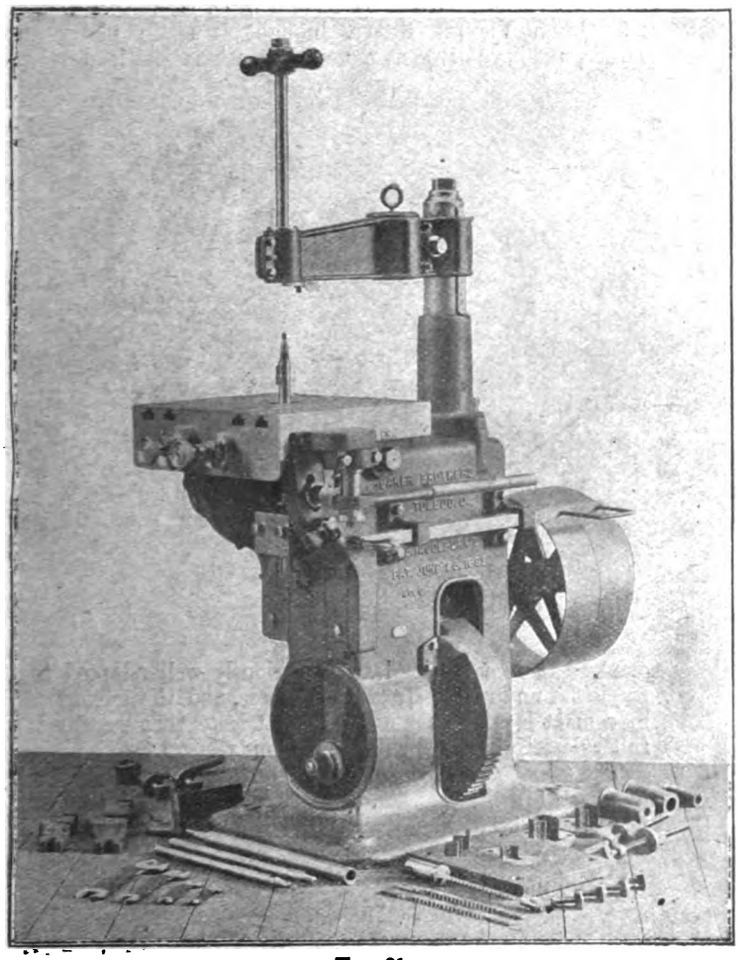

Fig. 21.

Of the lighter class of tools, including hand-tools, the American make is undoubtedly superior to our own.

Then, again, where Americans gain so much is in their methods of manufacture, for they put in hand at least a dozen tools, which permits the employment of elaborate jigs and templates, whilst we, as a rule, only manufacture to order.

Cheap v. Good Tools.

As a rule, cheap tools are not good, neither are good tools cheap. Two quotations, given by different makers but to the same specification, vary as much as from 50 to 100 per cent., and yet as much is expected from the lower priced tool as from the higher one. There are many works at the present time which would do the same turnover at less expense if they replaced their present plant of old-fashioned tools by half the number of modern machines.

In America, it is the general practice not to repair tools, but when they show signs of wear to replace them by new machines.

Too much stress cannot be laid upon the advantage of good tools.

Conclusion.

The author, in closing his paper, desires to thank those who have assisted him, and regrets that want of space has compelled him to omit reference to many important tools.

He trusts that the information given may be of some assistance in helping to a fuller acquaintance with a department of the engineering profession which demands constant attention.

THE INSTALLATION OF STEAM BOILERS.

V.

Strictly speaking, on grounds of safety, a high pressure steam boiler should have no holes cut in it; but some are absolutely necessary. These should not be unduly large, and, if necessary, the plate cut away ought to be so far made good that the boiler may not be weakened below the strength of the longitudinal seams. Such small holes as are cut for the mounting blocks of safety valves are stiffened by the steel mounting block itself, reinforced when necessary by rings of plate. For the larger holes cut for the steam outlet or junction valve, a stout reinforcing ring must necessarily be placed inside the boiler. The internal diameter of the manhole mouthpiece is 16 inches. This implies a hole of 19 inches diameter cut in the shell plate, a very serious gap which needs careful reinforcement. Up to 100 lbs. pressure this may, perhaps, be sufficiently provided by the steel mouthpiece itself, about $\frac{3}{4}$ inch thick on its riveted flange, and by an internal treble riveted ring of equal strength. For higher pressures, however, it is necessary to better distribute the stress, and for this purpose the whole of the boiler crown is doubled at this particular manhole plate by the addition of a rectangular plate extending considerably on each side of the manhole mouthpiece.

It must be considered that the stress that would be carried by the 19 inches of the plate cut away will be concentrated on the edges of the hole just at the crown of the boiler. The use of the long and wide reinforcing plate is to prevent this concentration upon the plate edges, and distribute it upon the whole of the added plate section, the net undrilled area of which, taken along the longitudinal of the boiler crown, must exceed the area of the cut-away portion. In fig. 11 is shown the manhole mouthpiece in section with the boiler crown and reinforcing plate, and in fig. 12 the mudhole mouthpiece, whose duty it is to remain flat under the heavy pressure, and to strengthen the lower part of the front end plate where no central gusset stay is possible. The mudhole has an inside cover held by two bolts, and this and the mouthpiece are made particularly stout. The opening usually measures 15 inches × 11 inches, to admit a man.

A light external cover is usually added as a finish to conceal the bolts of the inside cover. The propriety of such covers is a matter of opinion. It is questionable whether good mechanical work can be improved by covering it up by false covers, serving no purpose of protection or strength.

It is usual to employ steam junction valves of 6 inches diameter. This is still the practice with pressures of 150 lbs, and yet it was only considered necessary when pressures were 100 lbs. Some years ago a committee sat on safety valves—not literally, be it said, but figuratively, and in the way of inquiry. They investigated safety valves on the basis of certain facts relative to steam outflow. We need not at this moment discuss the question of steam outflow, but for the present purpose we may agree that the weight of steam flowing through a given opening will vary with the absolute pressure. This is equivalent to saying that three times as much steam at 90 lbs. pressure will flow through a given opening as will flow at 30 lbs. pressure. Now, it is well recognised that at all pressures the evaporative capacity of a steam boiler remains practically unchanged. Such being the case, it follows that high pressure boilers require correspondingly less outlets for steam than do low pressure

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boilers. At 160 lbs. absolute pressure a 2-inch safety valve will pass as much steam as will flow through a 4-inch valve at 40 lbs. pressure. Consequently, if a 6-inch junction valve

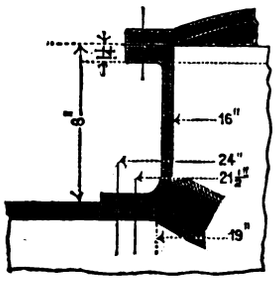

Fig. 11.

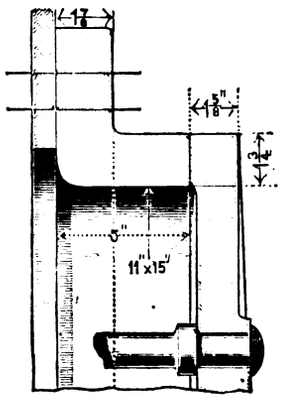

Fig. 12.

be large enough for 100 lbs. (115 lbs. absolute) a 5-inch valve is big enough for an absolute pressure of 165 lbs., and a 6-inch valve should amply provide steam outlet from an 8 feet boiler at 150 lbs. gauge pressure.

The tendency is to use valves too large, forgetting the findings of committee on safety valves which were very carefully worked out, and to which we hope to draw more particular attention in the near future. One other external mounting block demands particular attention, for it is often made too small and slight. This is the blow-out. Though only 2½ inches diameter at the blow-out tap, the elbow pipe tapers gradually larger towards the boiler, where it should be 5 inches inside diameter, so as to be stiff and strong to resist possible stresses which are brought upon it by the careless use of the blow-off key, &c. Such an elbow pipe of cast-steel is shown in fig. 13, with its stiffening flange. The

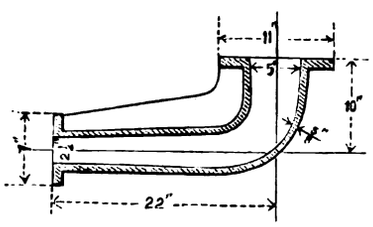

Fig. 13.

depth of 10 inches must be such as, with the mounting block of 7 inches projection, will bring the blow-out tap itself below the hearth pit cover plates, these being at least 1 inch below the edge of the front end plate. The blow-off block itself is about 15 inches from the face of the front end plate. This brings the centre of the blow-out tap about 12 inches in front of the boiler.

The cutting completely away of a 19-inch circle for the manhole of a high pressure boiler cannot be looked upon as satisfactory practice. It is usual, and precedent appears sufficient to justify many bad practices. We have seen better practice in similar situations, which might well receive the attention of high-class boiler-makers, with a view to a modification of the present system. The practice we have in mind was, if we remember rightly, first carried out by an

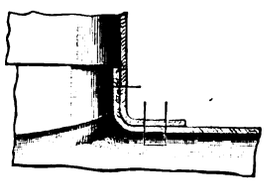

Fig. 14.

American boiler works, and consisted in cutting the hole for a dome manhole something like 6 or 8 inches smaller than the intended opening, and flanging up the edges. The final connection was somewhat as in fig. 14. In this method of construction there was no plate edge at the point of possible concentration of stress, but merely the rounded bend of the upward flange. An extra row of rivets was got in round this flange, and nothing in the arrangement precludes the use of a further reinforcing ring on the inside of the shell, just as in ordinary practice. For an opening of 16 inches the piece cut away would be about 10 inches only, and the flanging would reduce the upper edge of the flange to about five-eighths that of the plate, but at the angle of the bend the reduction would be very slight.

Having now considered the shell and its external attachments, the furnace tubes next demand attention.

(To be continued.)

HUMPAGE'S GEARING.

Some time ago we printed a short note on the subject of this mechanism. Recently Messrs. J. C. Howell & Co., of 24, Queen Victoria Street, brought it again under our notice, and have given us more information about its develop-

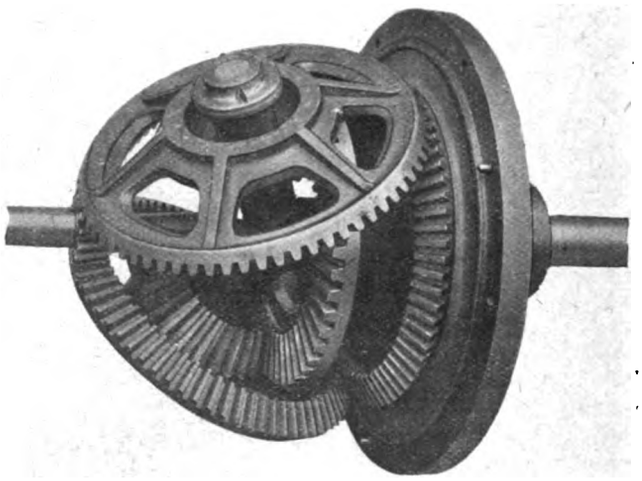

Fig. 1.

ment. It is a mechanism so curiously well adapted to a particular and extremely useful purpose, and the geometrical movement is at the same time so intricate, that we think a fuller description of it will interest our readers.

The gearing was originally designed to replace the back gearing of a lathe head, and was contained in the cone pulley. It has, we understand, been extensively used for

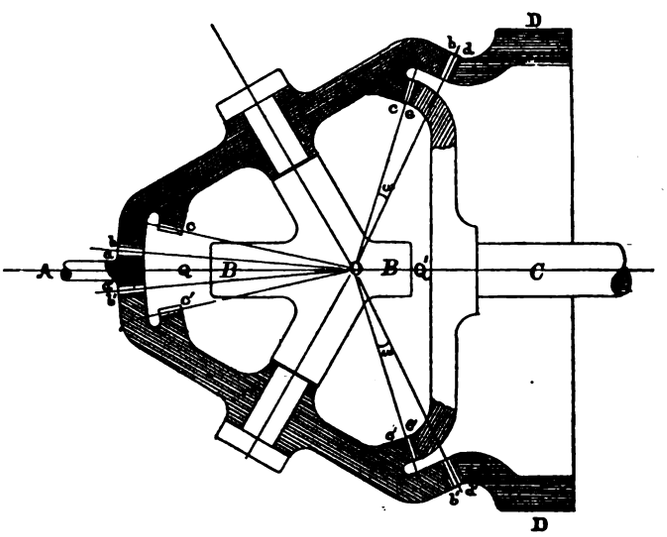

Fig. 2.

this purpose, but there seems to be an indefinite field for its employment wherever motion is to be transmitted from one shaft to another in the same line with a change of speed.

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The change of speed may be quite small, say, 2 or 3 times, or it may be very large, 200 or 300 times, with surprisingly little difference in the numbers of the teeth employed, and these numbers are in almost any case very moderate. The wheels may be arranged in such a way that there is no strain or pressure upon any bearing in the gear except the small end thrust due to the interaction of pairs of bevel wheels. The construction lends itself readily to, and almost necessitates, complete enclosure in a case which forms a convenient oil bath. The dimensions of the whole gearing are very moderate and the arrangement is compact. The very construction of the gear provides a convenient means of gradually throwing the load of the driven shaft on to the driver, running at full speed, by what is equivalent to a slipping friction clutch. It is evident that a mechanism which appears to meet so completely the particular difficulties of driving heavy slow running machinery from a light fast running electrical motor is worth some attention.

Fig. 1 is a view of a Humpage's gearing for transmitting 30 H.P. with a reduction of speed as between the driver and driven shafts of 1,400 to 70. Its actual dimensions can be judged from the size of the largest fixed wheel on the right, which is 24 inches in diameter. The dowels seen in the large disc belong to a cast-iron cover placed over the whole gear forming an oil bath. The driving axle, that on the left, passes through a bearing in the end of the cover, and is thereby kept in a central position. The driven axle, that on the right, runs in a bearing in the large disc.

The action of the gear will be clearly seen by reference to fig. 2. In this diagram the driving shaft, A, carries a bevel wheel, $a\ a'$. On a piece, B B, which is free to move about the axis, Q Q', are carried two pairs of bevel wheels, $b\ b$, $c\ c$, $b'\ b'$, $c'\ c'$, each pair being made in one piece free to turn on an axle fixed in B B and carried round with it as it turns about Q Q'. $b\ b$, $b'\ b'$, gear with $a\ a'$, and also with a fixed wheel, $d\ d'$, while $c\ c$, $c'\ c'$ gear with a wheel, $e\ e'$, on the driven axle C.

If the numbers of teeth in the wheels are $a\ b\ c\ d\ e$ respectively, the ratio of the speed of A to the speed of C is $\left(\frac{b}{d} + \frac{b}{a}\right) \div \left(\frac{b}{d} - \frac{c}{e}\right)$. For large speed reductions b should be large compared with a and d, and $\frac{b}{d}$ should nearly equal $\frac{c}{e}$. It would be inconvenient in practice to make d small, but a may be small compared to b, and $\frac{b}{d}$ may be nearly equal to $\frac{c}{e}$. Indeed, it is the possibility of making these last two nearly equal that gives to this and other differential gearings their great range of possible reduction.

In fig. 2, $\frac{b}{d} = \cdot 9$, $\frac{b}{a} = 10$, $\frac{c}{e} = \cdot 75$, and the speed reduction ratio is about 73.

In the arrangement of fig. 2, moreover, the contact points between wheels a and b, between wheels b and d, and between wheels c and e, are in a straight line, so that there is no pressure on the journal of $b\ b$, $c\ c$, beyond that due to the outward thrust of the bevels. From the symmetry of the arrangement it is clear that no side pressure is thrown on the bearings of the axles, A, C, by the action of the gear.

If the wheel $d\ d'$, instead of being fixed, turns freely in a collar, the part B B will run round without driving C. If D D be carried in a clamp, and the motor driving the shaft, A, be started to full speed with the clamp loose, the load can be thrown gradually on to A by slowly tightening the clamp. The peculiar facility for this operation afforded by the gear will greatly increase its field of application.

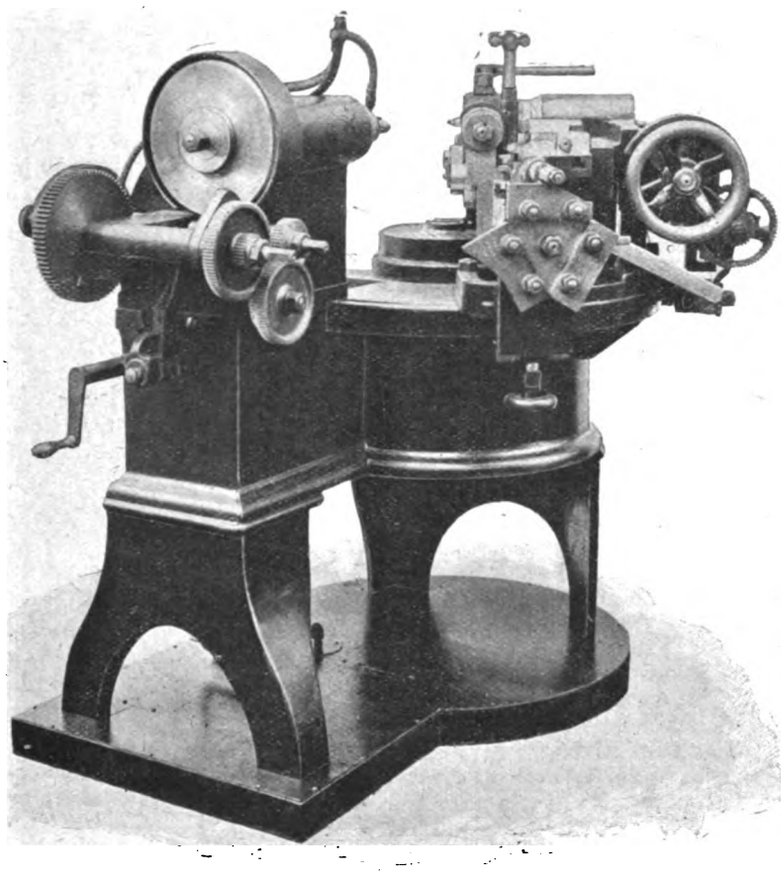

Fig. 3.

The mechanical construction affords many pretty problems. It is clearly a machine which will repay the cost of very accurate construction, and Messrs. Howell and Co. are fully alive to this. Machines have only recently been available for cutting accurate bevel gears, and the very best makers of gears, even in America, have been content with the rough approximation to the geometrical form obtained by cutting the teeth with parallel cutters, and doing something or other afterwards to make them look a little better. In a pair of correct bevel wheels every generating line of every tooth in both wheels converges to a single point—the wheel centre—and the section of every tooth is of the same shape at every point, only differing in scale. Such teeth can only be machined by a tool moving always in a direction which passes through the wheel centre. Machines for producing bevel wheels in this way are now manufactured by the Gleason Tool Company, of Rochester, New York, and Messrs. Howell & Co. employ the machine shown in fig. 3 for cutting their wheels. In this machine the wheel centre is over the middle of the circular bed seen on the right. The wheel to be cut is carried on the large horizontal mandrel of the left, which points directly to the wheel centre. The planing tool is carried on a slide which is directed to the centre and can be placed in any altitude or azimuth. The form of the tooth planed out is determined by the steel template fixed in the front of the machine as it is seen in this view. It may be observed that the Gleason machine will form the hyperboloid of revolution as easily as the cone, and the teeth formed on this surface will gear in the same way as the spiral teeth used so much for large power gears.

When the wheels are assembled as in fig. 2, all their centres should coincide at the point O. To secure this, very accurate machining will be required, but if the gears are to run

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quietly and easily it is quite indispensable. With really accurate machining and suitable materials extremely good results ought to be obtained.

GLASGOW TRACTION CONTRACTS.

The Glasgow Corporation have recently asked electrical firms for tenders for the following plant for the tramways :—

Four 2,500-kw. 6,500-volt three-phase generators, suitable for mounting on engine crankshaft. Speed, 75 revolutions per minute.
Two 600-kw. 600-volt dynamos, suitable for mounting on engine crankshaft. Speed, 90 revolutions per minute.
160 100-kw. oil transformers, to work at 25 cycles per second.
Six 50-kw. 100-volt exciter dynamos, to run at 300 revolutions per minute.
24 rotary converters and boosters combined, with spare armatures, field spools, &c.

It will be seen that this is one of the most important electrical contracts which has thus far been put out to public tender in this country, and it will be a very great pity indeed if the work goes abroad.

We fear, however, that some of the sections will have to be placed in America, as it is questionable whether any firm in this country is in a position to undertake the design and construction of *four* three-phase generators of 2,500 kw. within the 12 months allowed for delivery. In the case of the rotary converters again, the work will probably be given to a foreign firm who have the necessary experience in this particular class of machine. The rest of the apparatus—auxiliary dynamos, transformers, and exciter dynamos—is, however, well within the capacity of British firms, and we trust that the Glasgow Corporation will do their best to keep the work on this side. Where there is only a small difference in the amount of tenders it would only be fair to give home manufacturers the benefit.

This matter of placing contracts abroad is a most important one, because the effect is cumulative; the more work given out, the more experience do our competitors gain, and the worse it is for British firms.

We are glad to see that the specifications are drawn up clearly and concisely (rather an unusual thing nowadays), but are afraid that unless an easy view is taken of the penalty clause, there is likely to be trouble. £25 per day on each section of the specification seems to us just a little too severe. Suppose, for example, that a firm undertook the exciter generators at £2,500, on which, under ordinary conditions, they could make £300 profit. Then, if they were so unfortunate as to be 12 days late in the delivery of the first generator, the penalty on that alone would swamp all their profit on the six machines, while if they were late with the rest they would actually have to pay the Glasgow Corporation a large sum to take the machines off their hands. It seems to us that the regulation penalty of 1 per cent. per week is quite strict enough.

RETURN FEEDERS FOR ELECTRIC RAILWAYS.

(*Continued from Vol. 44, page 326.*)

If the central station is situated at the middle of the track, the line may be looked upon as two lines with the central station at one terminus, such as we have considered above. The volume of copper in this case may be obtained by substituting in the proper formula, for C and L, half their values.

$$\Sigma\,(\text{vol.}) = \frac{\frac{C}{2}\left(\frac{L}{2}\right)^2}{3\,K\,\Delta} + \frac{\frac{C}{2}\left(\frac{L}{2}\right)^2}{6\,(m+1)^2\,K\,\Delta} = \frac{C\,L}{24\,K\,\Delta} + \frac{C\,L}{48\,(m+1)^2\,K\,\Delta}.$$

The quantity of copper in the cables is, therefore, only $\frac{1}{8}$th of that required in the former case.

We have still the case to consider, where the track forms a semi-circle with the central station at its centre. Let the two cables connecting the central station to the termini of the line be called end cables; and let m intermediate cables be connected at equal intervals. By these m return cables the line is divided into $m + 1$ equal parts, and the current in each is :

$$c_m = \frac{C}{m+1}.$$

The end cables carry each a current half this amount.

Since the lengths of all the return cables are equal, their total cross-sections will be given by the formula

$$\Sigma\,(s) = \frac{C}{m+1}\cdot\frac{l}{K\,\Delta}\;m + 2\,\frac{C}{2\,(m+1)}\cdot\frac{l}{K\,\Delta} = \frac{C\,l}{(m+1)\,K\,\Delta}\,\{m+1\} = \frac{C\,l}{K\,\Delta}.$$

Therefore the sum of the cross-sections of the cables is also in this case a constant, and is independent of the number of the cables. Since $l = \frac{L}{\pi}$,

$$\Sigma\,(s) = \frac{C\,L}{\pi\,K\,\Delta},$$

and the total cross-section is less than in the first case in the ratio $2 : \pi$, that is, about 50 per cent.

The volume of the copper, in this case, may be calculated by considering that for an intermediate cable it is $\frac{C}{m+1}\cdot\frac{l^2}{K\,\Delta}$, and for an end cable $\frac{C}{2\,(m+1)}\cdot\frac{l^2}{\Sigma\,\Delta}$; therefore

$$\Sigma\,(\text{vol.}) = \frac{C\,l^2}{(m+1)\,K\,\Delta}\,m + 2\,\frac{C\,l^2}{2\,(m+1)\,K\,\Delta} = \frac{C\,l^2}{K\,\Delta}$$

In this, evidently, the volume of copper is constant whatever the number of the end cables. If we substitute for l its value $\frac{L}{\pi}$

$$\Sigma\,(\text{vol.}) = \frac{C\,L^2}{\pi^2\,K\,\Delta}.$$

For comparison, note that the volume of copper for a straight line with the central at one end is

$$\Sigma\,(\text{vol.}) = \frac{C\,L^2}{3\,K\,\Delta},$$

i.e., the copper in cables for the semi-circular line is about 0·3 of that in the straight line.

The case in which the line forms a complete circle with the power station in the centre is important in connection with closed circular lines in cities. Let L be the circumference of such a line and l its radius. Let there be m return feeders at equal intervals running from the line to the central power station. Each of these feeders will carry a current $\frac{C}{m}$; and the cross-section of one cable will be

$$s = \frac{C}{m}\cdot\frac{l}{K\,\Delta}$$

and for m cables

$$\Sigma\,(s) = \frac{C\,L}{2\,\pi\,K\,\Delta}.$$

The total volume of copper is

$$\Sigma\,(\text{vol.}) = \frac{C\,l^2}{K\,\Delta} = \frac{C\,L^2}{4\,\pi^2\,K\,\Delta}$$

In this case also, both the total section and the total volume of the copper are constant quantities, independent of the number of cables.

For the straight line with an infinite number of return feeders, as we have seen above, the total copper volume is

$$\Sigma\,(\text{vol.}) = \frac{C\,L^2}{3\,K\,\Delta}$$

Comparing this with the volume for the circular line, namely, $\frac{C\,L^2}{4\,\pi^2\,K\,\Delta}$, we can see that the latter is only about $\frac{3}{40}$ths of the former.

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III.—Example for Calculation.

As an example, take a case where the central station is at one end of the line. Let $C = 540$ amperes; $L = 18$ km.; let there be a loss of potential in the cables of 30 volts; assume for simplicity that the conductivity of the copper $K = 60$; then

$$\Sigma(s) = \frac{C\,L}{2\,K\,\Delta} = \frac{540 \times 18{,}000}{2 \times 60 \times 30} = 2{,}700 \text{ mm}^2.$$

This must be the section of a single return feeder from the terminus, or it must be equal to the sum of the cross-sections of any number of return feeders. This we shall prove arithmetically. One cable at the terminus has to take off half the current, *i.e.*, 270 amperes, and therefore its section must be

$$s = \frac{270 \times 18{,}000}{60 \times 30} = 2{,}700 \text{ mm}^2.$$

If an intermediate cable 9 km. in length is applied, this must take off 270 amperes, while 135 amperes are taken by the end cable, the remaining 135 amperes flowing through the rails to the central station. Therefore,

$$s = s_1 + s_2 = \frac{270 \times 9{,}000}{60 \times 30} + \frac{135 \times 18{,}000}{60 \times 30}$$
$$= 1{,}350 + 1{,}350 = 2{,}700 \text{ mm}^2.$$

The quantity of copper for one return cable from the terminus, since in this case $m = 0$, is

$$\Sigma(\text{vol.}) = \frac{540 \times 18{,}000 \times 18}{3 \times 60 \times 30} + \frac{540 \times 18{,}000 \times 18}{6 \times 60 \times 30}$$
$$= 32{,}400 + 16{,}200 = 48{,}600 \text{ dcm}^3.$$

We obtain the same value if we multiply the cross-section calculated above, by the length; for 2,700 mm² × 18 km. = 48,600 dcm³.

For one intermediate and one end cable $m = 1$, therefore

$$\Sigma(\text{vol.}) = \frac{540 \times 18{,}000 \times 18}{3 \times 60 \times 30} + \frac{540 \times 18{,}000 \times 18}{6 \times 2^2 \times 60 \times 30}$$
$$= 32{,}400 + 4{,}050 = 36{,}450 \text{ dcm}^3.$$

If, now, the sections found above are multiplied by the corresponding lengths, we obtain

$$\Sigma(\text{vol}) = 1{,}350 \times 9 + 1{,}350 \times 18 = 12{,}150 + 24{,}300 = 36{,}400 \text{ dcm}^3.$$

With nine intermediate cables the second member of the expression has only the value 162 dcm³, and amounts therefore to only 0·5 per cent. of the first member.

For the semi-circular line we get—

$$\Sigma(s) = \frac{540 \times 18{,}000}{\pi \times 60 \times 30} = 1{,}720 \text{ mm}^2$$

and

$$\Sigma(\text{vol.}) = \frac{540 \times 18 \times 18{,}000}{\pi^2 \times 60 \times 30} = 9{,}848 \text{ dcm}^3.$$

For the circular line we get—

$$\Sigma(s) = \frac{540 \times 18{,}000}{2\pi \times 60 \times 30} = 860 \text{ mm}^2$$

and

$$\Sigma(\text{vol.}) = \frac{540 \times 18 \times 18{,}000}{4\pi^2 \times 60 \times 30} = 2{,}462 \text{ dcm}^3.$$

These examples may serve to establish the correctness of the formulæ arrived at by the investigation.

(To be continued.)

RENEWABLE INCANDESCENT LAMPS.

Our pages have from time to time borne witness to the desire on the part of inventors to devise a method of replacing used or broken filaments in the bulbs of incandescent lamps. Apparently a serious attempt is now about to be made to carry out this idea in practice under the patent No. 23,623 of 1897, granted to Messrs. Charles Howard and Richard Mayer, for which purpose a company is being floated under the title of "The Renewable Electric Lamp Company, Limited," having as directors Messrs. Jacob Atherton, M. F. Armstrong, J. E. Tonch, M.I.M.E., and H. E. Kershaw, with Sir W. H. Preece and Major Cardew as consulting engineers. We certainly wish well to any enterprise which by its operations will tend to assist the consumer or reduce the cost of electric lighting, and this company claims to be able to turn out lamps at 6d. each, or "at not more than the price of other first-class lamps of English manufacture with a guarantee for their renewal at about half the original cost." Assuming that this forecast be verified when the time comes to do business, everyone connected with the industry, save, perhaps, competing lamp manufacturers, will have reason to be grateful to those gentlemen whose names are given above, even if they have fixed the purchase consideration at such a high figure as £100,000.

In connection with the company's proposals, however, there are certain statements that require somewhat careful consideration. Everything depends upon the relative value of the materials used in manufacture, and the cost of labour in effecting renewals. An ordinary lamp is regarded as having reached the "smashing point" when either the filament is broken, or the bulb is internally coated with deposited carbon to such an extent that the light emitted is seriously reduced.

We are told that by the company's process, when the filament becomes burnt out, the glass neck of the bulb is cut, the wires supporting the filament detached, a new filament is inserted, and the two parts of the glass bulb are fused together again, the bulb being finally exhausted in the usual way. It is claimed that "the whole of the material originally used is saved as well as the cost of manufacture." It has always been stated by lamp makers that the cost of material is trifling compared with the plant and establishment charges, the cost of exhaustion and general labour charges. Inasmuch as the filament is replaced, it is difficult to see exactly where the promised economy comes in, but the interesting point of how a blackened bulb is cleaned is not referred to at all. Of course, if the company can do what they profess to be able to do, well and good, but exactly the same claims have been made over and over again by inventors whose "renewed" lamps have been heard of but never seen.

One of the peculiarities of the special lamp made by the company (which alone—judging from the prospectus—will be "renewed" by the process) is an elongated neck to the bulb. Mr. Manville, in his report, states that this "should enable the lamp to work at a greater efficiency" than others, because it keeps the lampholder cool. Exactly what this has to do with the efficiency of the lamp (*i.e.*, with the emissivity of the filament), he does not explain, and it is, indeed, difficult to see what he is referring to in making the statement.

Mr. Newton Russell, of Shoreditch, follows by another remark that "a great saving will be effected, both in efficiency of candle-power and current consumed." Why? Unless the filaments are of an improved or better material or form the efficiency must be something like that of lamps our readers are well acquainted with, and nothing is said about a new material or method of treating the filament.

We can only hope that the main claim will be realised; that lamps can be effectively renewed at half their original cost. True, the cost of lamp replacements at present does not exceed 10 per cent. of the energy consumed; a lamp costing 1s. will, during its life-time, consume about 10s. worth of electrical energy; say a total of 11s. for 600 hours lighting, but few consumers will have any objection to reduce this figure to 10s. 6d. The public must, however, by this time be aware that an efficient lamp is far more important than a cheap lamp, and it is to be hoped that "renewed" lamps will not sacrifice efficiency for renewal "at a nominal cost." Frequent replacement will, however, be possible if the company finds its process a success, and this is the most pleasing expectation, for at present a majority of the lamps to be seen in use have reached their "smashing point," and it would pay to replace them more frequently (and gain, therefore, indirectly in efficiency) by the better light that would be obtained.

We will conclude what little space permits us to say by asking a question, Why has the company so timed its subscription list, by closing on a Thursday, that the comments of the technical press cannot possibly be read by intending investors?

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REVIEWS.

Mechanics Applied to Engineering. By John Goodman. London: Longmans, Green & Co. 1899. 7s. 6d.

This book has been written for those already possessing a fair knowledge of theoretical mechanics and elementary mathematics, and the author states that the book should be useful to those intending to enter the Inst.C.E., or to obtain B.Sc. and B.A. degrees in engineering and others.

On the whole, the book is a good practical work. We should like to hear more on the subject of ball bearings. The author condemns the theoretically perfect angular grooves, and advocates a curved groove of larger radius than the balls as better in practice. Generally, he deals with principles, however, rather than practice, but the section on friction is good and full, and we are glad to note a frank recognition of the experiments of Wohler on stress repetition, especially as these have been far too little appreciated.

In the appendix will be found a short treatment of the operations of differentiating and integrating with a view to encouraging engineers to take up the study of this subject. It is a little difficult to see why there should be such a multiplicity of books on mechanics. They are all more or less the same in subject, if slightly different in treatment. The great multiplicity of books is in the mechanical line. We like Mr. Goodman's methods and his arrangements, and could wish that some as practical a professor would undertake to deal with the physics and chemistry of engineering.

Text-Book of Mechanical Engineering. By W. I. Lineham. Third Edition. London: Chapman & Hall. 1898. 12s. 6d.

The author of this book has certainly been singularly successful in hitting the mark at which he aims, namely, to condense into one volume a rational *précis* of the whole theory and practice of mechanical engineering. He has accomplished this end in a manner that we should have hardly believed possible. True, he fills over 900 pages, but this is not an enormous space into which to compress so much, and, on the whole, so correct a compression. The padding is reduced to a minimum, and there is an entire absence of mere pictorial representations of machinery which make some books little better than trader's advertisements.

Mr. Lineham's illustrations are genuine explanatory sketches. Where perspective has been employed, its use has been justified as giving a better view than a working drawing would do, but generally the illustrations are not far removed from being working drawings. From them a fair designer would quickly make a working drawing, or a pattern maker would make a pattern.

Workshop methods are briefly but clearly described. There is even a brief account of iron smelting and steel making, and other processes of metallurgy. There are good descriptions and illustrations of smith work, but we do not think the author happy in his description of the forging of a bent crank. It may be done with very small cranks on the system he describes, by means of a pair of dies, but the usual method is quite different. The straight bar is first jumped thicker at the places where the bends will come, and the bar is then bent by a system which puts in two bends at one time, and involves an altogether different process from that described by the author.

We think, also, that Regnault's law, that the specific heat of a gas is constant at all temperatures, should be qualified. This is not now held to be a fact. Berthelot has shown the variation of specific heat, especially at temperatures beyond 1,600° C., and we think, also, it is a mistake to quote a fixed ratio between specific heat at constant volume and constant pressure. It is usual, and Rankine did it, to state the ratio for air as $\gamma = \frac{c_p}{c_v} = 1{\cdot}40\ v$, or, approximately, 1·41, or $\frac{\cdot 2375}{\cdot 1686}$. The molecular heat of a gas is, for the two conditions, about 6·8 and 4·8, the difference being 2 (metric system), or, more accurately, 1·94. Thus c_p is not really $c_v \times x$, but rather $c_v + x$. The quantity, x, is the external work done by a gas in occupying a larger space when its temperature is raised 1°, and it is an equal quantity for each degree of increment. It appears probable that all true gases have the same difference, x, and that variations observed in the ratio, $c_p : c_v$, are only such as are due to the fact that some of the gases are really very close to their points of liquefaction. The so-called perfect gases all behave nearly alike.

The treatment of the steam engine is good and sound, but we do not care for the author's description of the history of superheating as anomalous. He says the curious anomaly occurs that a 5 per cent. extra heat supply will often eliminate a 20 per cent. loss. There is nothing either curious or anomalous in this. Engineers have long recognised that the loss in a cylinder is very largely the evaporation which occurs during the exhaust stroke, and it is an obvious truism that a cylinder cannot be robbed of heat by evaporation of water, if no water is present to evaporate, and therefore any little additional heat which will serve to reduce condensation will be cumulative in its action. Indeed, it appears very probable that if the superheat be a little in excess of the condensation due to work, the greater part of the advantage of superheat will be secured. Entropy is briefly treated upon in the additions, which take the form of appendices, and there is added material on high speed engines, turbines, evaporative condensers, and upon defects in boilers, scale, feed heaters and filters, fuel and draught mechanical stokers, and gas engines, as well as gas producers.

We need scarcely say that full treatment of any subject is not attempted, but the author has been very successful in his selection of matter. There is one thing he might have done more. He might have given, however invidious may have been the task, a selection of books dealing more fully with the various items, so that any student wishing specially full treatment of a particular subject, would have a guide to the means of finding it. We feel sure Mr. Lineham would be generally correct in his choice.

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15 *Lezioni sperimentali su la Luce considerata come fenomeno elettromagnetico.* By A. Garbasso, lecturer on mathematical physics at the University of Pisa. Milan: The office of *Revista l'Elettricita.*

This is a reprint of a course of lectures delivered at Pisa to an unadvanced class, the object of which was to give by a course of experiment and explanation, without mathematical discussion, a connected and consecutive account of the theory of the electro-magnetic ether. Many scientific conceptions, which are now accessible only by mathematicians, will undoubtedly and before long become part of the common stock of knowledge and ideas, just as have the ideas of the conservation of energy, or the resolution of periodic functions within recent years. Among such ideas are Maxwell's of the vector potential and the electro-magnetic theory of light, which are now almost exclusively the property of the mathematicians. Though we appreciate its aim, it does not seem that the book before us is sufficiently well done for the purpose. It is poorly expressed in a colloquial style, and its cheap get up indicates the publishers' opinion of its importance. The material, however, is there, is well arranged, and fairly deals with the more obvious properties of light on the electro-magnetic basis, and it might be of assistance to a lecturer preparing a course on this subject.

Il Montatore Elettricista. By E. Barni. Fourth edition, revised and enlarged. Milan: The office of *Rivista l'Elettricita.*

This is a very complete hand-book for a working electrical engineer, and is freely illustrated. The information is of an elementary character, but on glancing through it all the general information that would be required by a workman erecting, or in charge of, an electrical installation seems to be clearly and easily given. At 1 lira in a paper cover it is certainly very inexpensive.

Journal of the Institution of Electrical Engineers, No. 140.

The principal contents of this number are as follows:—"A Rotary Converter," by Prof. E. Wilson; "The Effect

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of Governors on the Parallel Running of Alternators," by Leonard Wilson; "The Hissing of the Electric Arc," by Mrs. Ayrton; discussion on Messrs. W. Duddell and E. W. Marchant's paper on "Experiments on Alternate Current Arcs by Aid of Oscillographs."

THE REPORT OF THE PACIFIC CABLE COMMITTEE.

(*Continued from page* 154.)

In the preceding table a noticeable feature is the difference in the estimated length of the cable when laid. Taking the two extremes we find that in the case of the Eastern Company and the Post Office, there is an excess of length over the Henley Company's assumed estimate, as great as 315 miles, which would mean in the case of similar cores, a reduction of 14 letters per minute, or, say, 19 per cent. in the carrying capacity of the cable. It is also noticeable that the greater lengths are those supplied by the Eastern Telegraph Company and the Post Office. The manufacturing companies, who in the course of their business have much more experience than either of these two, although they differ each from each, are all considerably under the Eastern Company and the Post Office in the lengths given. This difference to a great extent is due to the varying amount of slack, 10 per cent. at most is the figure given by those with the greatest experience of the subject. Several cables in the Atlantic have been laid with 10 per cent. or less of slack, and we do not know of any sufficient reason why the same should not be the case in the Pacific. It is true that in the Atlantic this percentage used to be exceeded, but, with increasing knowledge, and with an improved type of cable and adequate machinery, this has been modified, very much to the advantage of those who own the cables, as the diminution in length means a corresponding increase in the carrying power of these cables. We have chosen the length of 3,600 miles in the table given, as this is the length taken by Dr. Muirhead, who is an acknowledged authority on the subject of the carrying capabilities of cables. Dr. Muirhead points out that the ability and experience of the clerk receiving the message is of much importance, as this governs the amount of the definition in the signals which is requisite for legibility. Thus, taking the core of 500/320, 3,600 miles in length, we are told that by using the automatic curb method of transmission as many as 90 letters (18 "words") per minute *can* be deciphered, but that the limit of speed under the same conditions, with an average clerk, would be 76 letters per minute working simplex (Mr. Siemens gives this in his evidence as 75 letters), or 70 letters each way if using the duplex method of transmission. With the core 552/368 for the same length and by the same methods, 87 letters (17·4 "words") would be transmitted simplex, and a total of 160 letters (32 "words" per minute) if working duplex. It is obvious that the duplex method with automatic curb transmission should be adopted over this long section. In speaking of the core 650/400, Dr. Muirhead says that "working with the same signals as you would get with the proposed cable of 500 copper and 320 gutta-percha at the rate of 70 letters per minute, a speed of 95 letters by automatic curb transmission, of 64½ by the ordinary method of transmission," could be obtained. Dr. Muirhead states elsewhere in his evidence, that by the introduction of the automatic curb system an increase of more than 40 per cent. in speed has been obtained, as compared with the ordinary method of transmission. For the core 650/400 over a length of 3,650 miles, Mr. Lucas takes the speed as 70 letters per minute; this is presumably without automatic curb transmission. Sir W. H. Preece, in speaking of the 650/400 core over a length of 3,628 miles, calculates a speed equal to nearly 63 letters per minute. We are afraid that this and the other calculations which the same authority gives *re* speeds are founded on an erroneous basis, as for the purposes of this calculation Sir W. H. Preece says that he has taken the two 1884 Atlantic cables of the Commercial Company, each of which had a core of 350/300 and a united length of 4,699 miles, whereas the two cables which when united for the purpose of experiment gave the speed result he deals with, had a length of 4,512 miles, which looks as if the Southern one of the 1884 cables, which is 2,353 miles long, had been united with the 1894 Commercial cable, which is 2,161 miles long, the total length of these being 4,514, but the core of the newer cable being 500/320 instead of 350/300. If we are correct in our supposition, and apart from the evidence given by Mr. F. Ward, the figure mentioned as the total united length, seems to indicate this, Sir W. H. Preece's figures, which he says were based on a core of 350/300 throughout, must be fallacious. The representatives of the Eastern Company give the speed over a 650/400 core, presumably 3,795 miles long, as being 70 letters per minute. For a core 800/550 and a length of 3,628 Mr. Lamb gives (on the authority of Sir W. H. Preece) a carrying capacity of 85·6 letters per minute. Over a core of 550/350 Mr. Carson is of opinion that 80 letters could be carried. Mr. R. K. Gray gives 62 letters as the speed over 3,560 miles with a core of 552/368.

Besides the actual number of words or letters which a cable will carry, there arises in relation to possible revenue, or earning power, the question of how many letters go to the average word actually transmitted, and what proportion of unpaid-for words are necessarily transmitted in connection with the organisation of the cable, either as indications, &c., on the messages, or as service messages connected with the management of the line? It is obvious that the proportion of this dead traffic depends to a great extent, among other things, on the ability with which the cable in question is managed. Mr. Carson points out that on the trans-Atlantic cables under his control, the average length of the words transmitted is eight letters, and that of all the words which pass over these cables, 90 per cent. are paid for, and he estimates that on the Pacific cable, with a core of 550/350, and by using duplex, 10 paying words could be carried each way, or, say, 20 paying words per minute of eight letters each. Mr. Carson explained that his cables were worked on a specially arranged system of checking, and that his lines do not work under the rules of the International Convention.

As regards ordinary messages, the Commercial Cable Company find, according to a footnote attached to Mr. Ward's evidence, that 16 per cent. is the amount of dead work, or non-paying traffic carried over their cables. Mr. R. K. Gray found that out of 100 messages to and from South America, picked out at random, the average number of letters to the word was 6·03 in the body of the message, and that the non-paying words carried came to about 13 per cent. of the traffic.

Mr. Finch, the director-general of the Indo-European Telegraph Department of the Indian Government, which works in joint-purse agreement with the Eastern Telegraph Company, and carries a considerable proportion of their traffic, gave the average number of letters to the word as eight ("seven or eight"), and an average of 12 or 13 paying words to the message. From this gentleman's evidence we find that the non-paying words due to administrative work and indications or messages, &c., come to 15 per cent. of the total traffic.

From this it will be seen that there is a fairly general agreement among the witnesses above referred to, as to the proportion of dead traffic carried over various cables, but the evidence which follows is of a different complexion. The representatives of the Eastern Company give 9·43 as the average number of words which is made up as explained by the following extract from the evidence:—

Q. 1,831. Could you explain exactly how you get at that 9·43?—Taking the ordinary Australasian traffic we find 473 words of Government messages, containing 2,652 letters, giving an average number of letters per word of 5·61. Then there are 2,608 Press words containing 16,185 letters, or an average number of letters per word of 6·21. Ordinary messages contained 44,664 words, or 341,332 letters, giving an average number of letters per word of 7·64 and the average taking all the words and letters together, comes out at 7·54. As the Government messages are carried at half rates, and Press messages at quarter rates, it is necessary to multiply the Government average by two, and the Press average by four, to arrive at the earning power of the cables at full rates. Consequently, the average length of fully paid words is 9·43 made up as follows:—Taking the percentages of the different classes of traffic (Government, Press and ordinary) for the whole year 1895, and multiplying the Government average by two, and the Press average by four, we find the Government messages work out at 11·22 number of letters; the Press 24·84; and taking the ordinary at 7·64, as above the net result is 9·43.

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Rejecting, for the moment, the composite figure obtained, as above explained, we find that actually the average length of the word is 7·54. Basing his information on a month's actual traffic on the Aden-Bombay cable, the theoretical speed of which is given by Mr. Hesse as "about 150 letters per minute, the actual speed attained of payable letters during that month, there being 73 per cent. of loss through preambles, repetitions, service messages and delays through pausing in transmission." This is a very great difference from the figure given by the previous witnesses. It would almost seem as though the whole 24 hours had been taken into the calculation, although it is evident that this time cannot have been fully occupied. The Eastern Company say that the mean theoretical speed through from London to Australia, working simplex, is about 145 letters per minute, and that the paying letters actually carried would only be a quarter of that number, say, 36 letters. Such a result along the proposed Pacific cable would leave a margin of over 36 letters more, available for paying traffic, independent of the 15 per cent. of dead messages which would be required if the cable were worked by the method indicated by Mr. Carson.

CORRESPONDENCE.

200-volt Supply from the Consumers' Point of View.

Now that the pressure of supply to consumers' terminals has been, and is being, almost universally raised to 200—250 volts, have any central station engineers given a thought to the effect this has on both the convenience to their customers and the influence on the amount of their accounts?

I am not going into the question of less copper in the mains or a closer regulation of voltage in the distributing network. I simply look at the disadvantages it entails on the user as compared with a supply at 100—110 volts.

In the first instance we hear of lamps using 2½ watts per C.P. for 100-volt circuits. I think that 200-volt lamps use 4 watts or more.

At one time when the number of lamps on a system used to be counted in 16-C P. lamps, these were taken as 60-watt. Now in one publication at least, 8-C.P. lamps are taken as 35-watt, or much over 4 watts per C P.

Taking an average of 3 watts per C.P. for 100—110-volt lamps, and 4 watts per C.P. for 200—250-volt (and I believe this is below the actual average), it means an expenditure of one-third more for the same light on the increased voltage. Further, no practical commercial 2 or 3-C.P lamps are made for 200-volt circuits, but good 2-C.P. lamps for 100 volts can be bought from several makers, and in passages, stairways, &c., where a 2-C P. lamp would be sufficient, a customer has to use an 8 C P., entailing four times the cost, and, moreover, these are usually long-hour lamps. I mean lamps that are lighted at dusk and remain burning till the house is closed for the night.

I might also refer to the matter of arc lights on continuous current circuits. I take it, therefore, that for the sake of the central station all the consumers are penalised to the extent of at least 30 per cent. on their accounts, and at the same time have not the same advantages they would have with the lower pressure.

I surmise that they do not know this. When the undertakers are a company, they look to themselves, but in the case of a municipality, which is practically a co-operative supply, would not the 100—110-volt supply, and more copper in the mains, be best for the using ratepayer who is, in fact, a part proprietor of the central station and mains?

X.

Direct Reading Ohmmeter.

As agents for the American Electric Speciality Company of New York, we have been interested in Mr. Woodfin's letter in your issue of the 14th ult.

We are very glad to hear that Mr. Woodfin has found the ohmmeter "to be of great utility and convenience and really a great advance" on the ordinary Wheatstone's bridge. Of course it is not claimed that the ohmmeter is as accurate as a high-class bridge, but then no one would think of using such an instrument while up a ladder or hanging on to a column or girder. The ohmmeter is designed specially for testing rapidly and with reasonable accuracy in positions and circumstances where the ordinary bridge would be of no use, and judging from Mr. Woodfin's experience, the instrument is well adapted for the purpose.

We are bringing the suggested improvements before the attention of the makers.

In conclusion, may we congratulate Mr. Woodfin on his good fortune in being able to conduct his dynamo tests under such ideal conditions as are indicated in his letter.

Cooped up in a city office, and working in a temperature of about 90°, we can only look forward to the time when we shall be *disturbed* by the singing of a bird. Unfortunately, the telephone bell is a very inferior substitute.

Jas. Hartley & Co., Limited, of Manchester,
(Late Smith, Simpson & Co., Limited, Manchester.)

Renewable Electric Lamp Company, Limited.

I am not up in the patents on this subject, but I know of the many failures. The prospectus is evidently the work of a master, and makes the very best of that class of scheme, easily grasped from its apparent common sense by the public, and ranks with the recovery of tin from scrap metal, the making of "zinc white" to replace "white lead" from battery refuse, &c., and, in my opinion, is even more impracticable.

There is no mention as to the necessity of cleaning the old glass bulbs before they can be used again—a most difficult operation through the small and elongated neck, and not effective, as the cleansed bulb cannot be and is not as clear as the original untouched glass, and therefore there must be a loss in efficiency, rather than a gain. The breakages of the old bulbs during this process would be considerable.

The real crux is the breakage of the glass bulbs. The glass, after being used, appears to fatigue, or deteriorate, probably from the great heat necessarily used in forming the original lamp (in that process the glass bulb is kept tempered at every stage). During the life of the lamp the heating becomes unequal and the glass strained. Anyhow, it is the experience of manufacturers that about 75 per cent. of the old glass bulbs are broken in the attempt to use them again. It would be very unwise to attach new bulbs to the old glass ends.

The old caps require chemically treating, by dipping or otherwise, to clean them, particularly at the contacts. Detachable caps are not good, they will not stand the strain of the lamps when tight or set in the holders, and electrical engineers will not use them.

Connecting wires become brittle and weak at the last moment. The point of sealing on the filament becomes foul and useless.

Altogether I fail to see any real advantage. The cost, taking the failures into account, must be greater than the cost of entirely new lamps. Of course, actual experience is the only real guide as to this.

The existing lamp makers find it very difficult and a very heavy burden to deal with so many classes of lamps, some hundreds of varieties, and even the largest of the lamp companies hardly pay. This new company proposes in addition to collect odds and ends of broken lamps, and possibly customers' experimental purchases, and match them and make them into new lamps. In my opinion this will handicap them most seriously, and it is highly probable they will soon drop the renewing business.

It takes a year or two to find out (even in the best equipped factory) how to make good lamps, and it takes an immense amount of pushing and advertising to start a new lamp business, whilst the factory expenses are out of all proportion to the first two or three years' turnover.

Experientia Docet.

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LONDON COUNTY COUNCIL.

The Council, on Tuesday, resolved to convene a special meeting to consider the question of making application to the Light Railway Commissioners for powers to construct certain light railways which it is proposed shall be worked by electric traction.

The Conduit Systems.

On the adjourned report of the Highways Committee being brought forward (*vide* the Electrical Review of the 28th ult.), Mr. Parker asked and obtained the permission of the Council to substitute another recommendation to that proposing an expenditure of £180,000 for the purpose of installing the conduit and surface contact systems on the six miles of double line between Westminster Bridge and Tooting. The amended proposal recommended the Council to sanction an outlay of £10,000 for the preparation of plans, specifications and estimates, the Highways Committee intending to submit, at a later date, a scheme for the actual expenditure to be incurred in the carrying out of the work. Mr. Parker, in the absence of the chairman of the committee, formally moved the adoption of the recommendation.

Mr. Gilbert, as an amendment, proposed that the recommendation should be referred back to the Committee. He opposed the expenditure of £10,000, because he thought the Council ought not to expend such a large amount of the ratepayers' money in making experiments. The report of Prof. Kennedy was very meagre, and he considered that it ought to have been brought before the Council in a more detailed form. He did not think that the adoption of the conduit system was the best for London. No tramway company in England would undertake to spend £15,000 per mile of single track, not including the cost of the power station and the cars, and he did not think any provincial Corporation would do so, or that the Council should expend the money. Referring to Prof. Kennedy's report, the speaker drew attention to the statement that it was not necessary to experiment with the overhead system, because the Council had arranged with the London United Tramways Company for that to be introduced in conjunction with the conduit system, and he expressed the opinion that the Council should wait and see the results of those trials. The Highways Committee should have brought up a report on the subject by the manager of the tramways in conjunction with the report of the consulting engineer. Having referred to the conduit systems in Washington, New York, and Buda-Pesth, the speaker challenged the Highways Committee to say whether there was a practical surface contact system in the world. Personally he was not opposed to the overhead system, which was not only much cheaper, but it had been adopted in every town except Birmingham. There was another point to be considered in the sense that the Council was not the road authority along the route of the proposed electric tramways, and he thought they ought to obtain Parliamentary powers for that purpose. In conclusion, the speaker moved that the report should be referred back, in order that the Committee might bring up a detailed report on the subject.

Mr. Piggott, in seconding the amendment, stated that there was not sufficient evidence before the Council to authorise the expenditure of the money proposed by the Committee. With the figures before them that the conduit system would cost four times more than the overhead method, he thought the Council ought to hesitate before agreeing to the expenditure.

Mr. T. B. Westacott suggested that the Committee would be well advised to omit from the recommendation the words "underground systems." He believed the conduit system would be expensive to lay down, but if Mr. Parker would leave the question of traction open, the Committee would have power to instruct Prof. Kennedy to prepare plans and specifications, and then the Council would be able to come to a decision with the full facts before the members.

Colonel Ford considered that the proposal of the Committee was unreasonable, and he expressed the opinion that the Council was indebted to Mr. Gilbert for the information that as long as two years would be occupied in reconstructing the tramways in question.

Lord Welby (chairman of the Council) at this stage called upon the acting chairman to reply.

Mr. Parker, in reply to the discussion, said that he did not consider that Mr. Gilbert had adduced anything to induce the Committee to alter the recommendation. He thought the Council would be better advised to accept the advice of Prof. Kennedy than that of the proposer of the amendment. The Highways Committee were not prejudiced against the overhead trolley system, but they had to consider the local authorities in regard to the matter. The two authorities concerned—the Lambeth Vestry and the Wandsworth Board of Works—would only give their consent to the experiments being made on condition that the Council adopted the conduit system, and the consulting engineer recommended the Council to introduce that method in conjunction with the surface contact system.

On a division the amendment was rejected by 65 to 20 votes.

Colonel Ford, as a further amendment, proposed that Clapham should be substituted for Westminster Bridge, but this was rejected, and a further amendment suggesting the adjournment of the report met with a similar fate. The recommendation of the Committee was then put, with the result that it was carried by a large majority.

Change of Pressure.

The Highways Committee reported that the Westminster Electric Supply Corporation had applied for consent to an alteration of the standard pressure of supply. The company had hitherto used a standard pressure of 100 volts between the middle wire and either of the outer wires, and of 200 volts between the outer wires of the distributing mains, and now desired to increase the standard pressure in the one case to 200, and in other to 400, volts. The company had given notice, by advertisements, of its application to the Council, and the Committee had taken into consideration the letters received from the company's customers in regard to the matter. On the recommendation of the Committee, the Council resolved to consent to the alteration on certain conditions.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending Aug 2nd, 1898		Week ending Aug. 1st, 1899.	
Adelaide	Value £4,880	Alexandria	Value £83
Albany	32	Amsterdam	25
Alexandria	47	Antwerp	70
Barcelona	535	Auckland	25
Bombay	89	Bangkok	628
Bolougne	65	Batavia	12
Buenos Ayres	70	Boca	240
Calcutta	141	Bombay	57
Cape Town	33	Boulogne	17
Colombo	83	Buenos Ayres	181
Durban	55	" Teleg. cable	657
East London	53	" Teleph. fittings	100
Hamburg	70	Calcutta	466
Hankow	10	" Teleg. wire	20
Hobart	400	Cape Town	138
Hong Kong	43	Christiania. Teleg. wire	71
Melbourne. Teleg. mat.	35	Copenhagen. Teleg. wire	116
Naples	60	Durban	22
Oporto	20	Genoa. Teleg. mat.	95
Port Elizabeth	19	Gottenburg. Teleg. mat.	21
Rotterdam. Teleg. wire	29	Hamburg. Teleg. mat.	21
Singapore	250	Hong Kong	134
Sydney	735	Jersey and Guernsey	1,526
Wellington	387	Key West. Teleg. cable	46,000
" Teleg. mat.	311	Lisbon Teleg. mat	40
" Teleg. mat.	2,564	Melbourne	146
Yokohama	103	" Teleg. mat.	1,143
		Port Elizabeth	633
		" Teleg. mat.	162
		Sarawak Teleph. mat	68
		Shanghai	198
		Singapore	21
		" Teleg. mat.	668
		St. Petersburg	887
		" Teleg. wire	380
		Stockholm. Teleg. wire	28
		Sydney. Teleg. cable	650
		Teneriffe	80
		Vigo. Teleg. appa.	85
Total	£11,119	Total	£55,764

Foreign Goods Transhipped.

Telegraph material	Value £350	Sydney. Teleph. appa.	Value £45
		Tientsin. Teleg. mat.	188
Total	£350	Total	£233

Advance in Price.—The Newton Electrical Works Limited, announce that owing to the continuous rise in cost of raw material, they are compelled to increase the prices for all their manufactures 10 per cent. on the net.

Bankruptcy Proceedings.—At the Court of Bankruptcy, at Glasgow, on 7th ult., Messrs. Wilks, Sloan & Co., electrical and consulting engineers, 112, Bath Street, Glasgow, and John Lumsden Sloan, electrical and consulting engineer there, the sole partner of said firm, as such partner, and as an individual came up for examination to be examined in Sheriff Balfour's Chambers, County Buildings, Glasgow.

The *London Gazette* contains notice of the release of trustee in *re* W. R. Riding, electrical engineer, Bournbrook, Birmingham. The date of release was June 5th, the trustee being Mr. L. J. Sharp.

Liquidations, Dissolutions, &c.—Creditors of the Apostoloff Automatic Telephone Parent Syndicate, Limited, are to send particulars of their debts, &c., to the liquidator, Mr. E. Cooper, 14, George Street, Mansion House, E.C., by October 2nd.

A petition for winding up the Madras Electric Tramways Company, presented by the Electric Construction Company, is to be heard before Mr. Justice Wright in the High Court on August 9th.

Berry's Electrical Company, Limited, Birmingham, is winding up voluntarily, Mr. A E. Chatterley, St. Bernard's Road, Olton, Warwickshire, being appointed liquidator.

The Phæton Electrical Company meeting at Nijmegen, Holland, on July 11th, decided to wind-up voluntarily, and appointed Mr. W. J. Ogden, 6A, Austin Friars, E.C., liquidator.

In the *London Gazette* we observe notice of the release of liquidator in Elmore's French Patent Copper Depositing Company, Limited. The liquidator was Mr. J. H. H. Duncan, and the date of release June 17th.

An account of the winding-up of the Bedford Electric Light Company is to be laid before the shareholders at 3, St. Paul Square, Bedford, on September 1st, by the liquidator (Mr. E. A. C. Rawlings).

Messrs. Wheatley Kirk, Price & Goulty have dissolved partnership so far as concerns Mr. W. R. Goulty. The business will be carried on under the style of Wheatley Kirk, Price & Co., by H. Sherley-Price, and S. and E. A. Sherley-Price, in partnership with John Place, of Altrincham, and they will attend to debts, &c.

Messrs. G. H. Driver, E. W. Fladgate, and J. P. K. Clark (Geo. Driver & Son, electrical and mechanical engineers, Hythe Road, Willesden) have dissolved partnership so far as concerns E. W. Fladgate. Debts, &c, will be attended to by the two other partners, who continue the business under the old style.

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Breaking Insulators.—Three boys have been remanded to the workhouse for a week for wilfully breaking telegraph insulators, the property of the Metropolitan District Railway Company, at Acton. It seems a pity that the magistrate could not, as requested, order the boys a good flogging, if only as a preventative for the future.

Colliery Lighting.—Messrs. John Worthington & Co., of Hanley, have obtained the contract for a complete plant for the electric lighting of the Woolley collieries, near Barnsley.

Electric Lighting (Clauses) Bill.—In the House of Commons on 28th ult., the Earl of Dudley, in moving the second reading of this Bill, said that at the present time 60 or 70 provisional orders were granted every year under the Electric Lighting Acts, and in each of these orders there were 80 or 90 clauses, many of which were identical in terms. That entailed a considerable amount of expense to the promoters, and labour to the printers. They therefore proposed to consolidate all those clauses in one Bill, exactly in the same way as in the case of railways, tramways, gas, and other matters. The Earl of Morley agreed that the Bill would have the advantage of saving a great deal of labour, but in dealing with electric lighting orders which had not been put into operation, he suggested that it would be an improvement, instead of saying that the Board of Trade should revoke such orders, that they should lapse within a given time if nothing was done, unless the Board of Trade saw fit to give an extension of the time. The Earl of Dudley said the Board of Trade had already done something in the direction suggested by the noble earl. Last November they communicated with all electric lighting companies who had had orders, and who had not fulfilled their statutory requirements, and warned them that if those requirements were not carried out immediately, the Board would revoke the orders. The effect of that warning had been to bring those companies up to a much higher point of activity, and they proposed to adopt the same course every year. The Bill was then read a second time.

Electric Pumping.—An installation for the electrical pumping of the Arniston Coal Company's mines at Gorebridge, which has lately been introduced, was viewed, on 26th ult., by a large company. The installation is said to be the largest in Britain. The dynamos are driven by two steam engines of horizontal compound long-stroke type, by Messrs. Robey & Co., Limited. Each engine is capable of giving 350 I.H.P. with 120 lbs. pressure, and is fitted with Richardson & Rowland's automatic trip-expansion gear. Each dynamo weighs about 20 tons. The two pits of the Arniston Coal Company are 1,000 yards apart. The shaft of the Emily Mine is 937 feet in depth, and the Gore Pit 678 feet. The parrot seams of the former pit are 308 feet down. The water accumulates at the foot of the main dook road, and to pump this improved mining pumps of the three-throw type, by Messrs. Scott & Mountain, Limited, Newcastle, are fitted up.

King v. Turner.—At the Liverpool Assizes last week in the Nisi Prius Court, before Mr. Justice Bigham and a special jury, Messrs. King, Limited, ventilating engineers, Liverpool, sought to recover damages from Messrs. John Turner & Sons, manufacturing engineers, of Denton, for breach of contract. Mr. Horridge appeared for the plaintiffs, and Mr. Neill was for the defendants. The case for the plaintiffs was that Messrs. King had ordered from the defendants for erection at Messrs. Lever's Sunlight Soap Works, seven electrical motors and automatic resistance frames, to be used in connection with ventilating machinery. The arrangement between the parties had been that the motors should be workable at a voltage of 300, but after they had been supplied to the plaintiffs, and fixed by a practical electrician at Messrs. Lever's, the latter complained that they did not work satisfactorily at all. Plaintiffs communicated several times with the defendants, but although the latter, after considerable delay, sent down some of their own workmen to adjust matters, the motors remained defective. The plaintiffs' manager, Mr. Lees, stated in evidence that, including the profit which they had lost by not being able to fulfil the contract with Messrs. Lever, they were entitled to £237. From this there would have to be deducted the value of the motors, which were at present no more valuable than scrap-iron, worth about £10. The plaintiffs had paid the defendants £140 for the motors. Other evidence for the plaintiffs ascribed the failure of the motors to the fact that the wires of the armature were too slight, and were, consequently, unable to carry off the heat, which became in time excessive. Mr. Neill, for the defence, contended, according to the *Liverpool Post*, that the machines had been made of the best workmanship, according to the plaintiffs' drawings. The machines were accepted by the plaintiffs, and there the defendants' responsibility ended. The cause of their falling off was that they had been neglected by Messrs. Lever's workmen.—Evidence to this effect was given, the witness agreeing that the wires of the armature were sufficiently thick for the work they had to do. The defendants' workmen ascribed the burning of the wires to the use of an excessive current.—His Lordship said the question for the jury was whether the motors were made in accordance with the contract. —The jury found for the plaintiffs, £50 damages.—Mr. Horridge asked for costs on the higher scale.—His Lordship assented, and said it was a proper case to be brought into that Court.

Leather Belting.—At the invitation of the directors of the Woven Leather Machine Belting Company, Limited, Birkenhead, a considerable number of friends and others interested inspected the works, and were shown the various processes, from the treatment of the raw hide to the finished belt. The company have a secret process by which the hide retains its flexibility, and by which the tanning process is considerably shortened. The raw hides, after being stripped and scraped, are placed in revolving vats, in which they remain for two days. They are then transferred to similar vats, in which they remain for a further 48 hours. The hides are then partly dried and split, after which they are cut into strips by hand, the average length of continuous strip from each hide being about 2,500 feet. The strip, which is still damp and very flexible, is wound on spools and shuttles and passes through the looms, after which the belting undergoes the final tanning process, occupying 12 hours. The belt is then stretched by power until all the elongation is taken out, and it is then ready for use. At the luncheon which followed the inspection of the works the chairman, in proposing the toast of the guests, made some remarks on the belting, for which he claimed special suitability for dynamo driving and for machinery when small pulleys were used, owing to its extreme flexibility and elasticity. We had an opportunity of seeing the belt running in the ordinary work of the factory, and also driving the lighting dynamo, and, so far as we could see, the chairman's claims were justified, as the running under full load was extremely smooth, and the belt being spliced showed no jerking or irregularity in the drive. The company will make a speciality of belting for dynamo driving.

Municipal Trading.—From the Liberty and Property Defence League we have received a booklet containing reprints of speeches by the Earl of Wemyss, the Attorney-General, and others, on the dangers of municipal trading.

New Book.—At the end of the month Messrs. Whittaker and Co. will publish a new work, by Mr. W. Perren Maycock, entitled "Electric Wiring, Fitting, Switches, and Lamps." The book will comprise some 446 pages and 360 illustrations.

Oil Filters.—Messrs. Shelby & Co., of Finsbury Circus Buildings, E.C., have supplied the "Warden" oil filter recently to the following houses:—Messrs. Harmsworth Brothers, London (third order); Railway Lighting, Limited, Manchester, for the Great Central Railway's electric power stations (second order); the Corporation of King's Lynn; The Patent Nut and Bolt Company, Birmingham, &c.

Picnic.—The employés of Messrs. Ward & Goldstone, of Manchester, held their picnic on Saturday, July 29th, the day being spent at Morecambe.

Pressing the Button.—The electrical arrangements by means of which H.M. the Queen was last Friday enabled to open the children's wing of the Isle of Wight Infirmary at Ryde by pressing a button were supplied by Mr. F. J. Coleby, of Manchester Square, W.

Stealing Electricity.—On 27th ult. the Recorder's jury found Luigi Armanni guilty of stealing a quantity of electricity belonging to the Metropolitan Electric Supply Company, Limited. The facts of the case have been already recorded in the Electrical Review. Sentence was postponed.

Threatening Prof. Dewar.—Chas. Bomberger who, as already mentioned in these columns, was charged with sending threatening letters to Prof. Dewar, has been discharged and sent to the workhouse as a lunatic.

Weatherley v. The Cornish Hotels.—In the Chancery Division, on 28th ult., this case came again before Mr Justice Kekewich.—Mr. Warrington, Q.C., for the plaintiff, reminded his Lordship that the action was to restrain a nuisance by noise and smell, arising from the working of the engine which supplied the hotel with electric light. Since the investigation and report made by Mr. Ashdown, and referred to on the last occasion, that gentleman had made a further report, he having, as the result of an invitation by the solicitors of both parties, again visited Newquay. The plans suggested for the remedying of the defect had been carried out, and he was given to understand that under the modified conditions plaintiff would have no further ground for complaint. After discussion as to costs, it was decided that the motion be treated as the trial of the action.

Westminster Arc Lamps.—We hear that the Electric Traction Company have placed an order with the Westminster Engineering Company, Limited, for 200 of their "Westminster" long burning arc lamps for lighting the stations, tunnels, yards, &c., of the Central London Railway. They are to burn five in series, and to be fitted with automatic cut-outs and substitutional resistances. We understand that before the order was placed, these lamps, and several other makes in competition, were subjected to a long and careful test extending over some months.

Workmen's Compensation.—Last Saturday Mrs. Merroe claimed compensation for the death of her stepson who was accidentally killed on the first day he entered the employment of the Dublin United Tramways Company as a traverser at the Ballsbridge Power Station. The Recorder at the Dublin City Sessions said that at present he had before him six cases in which the persons were employed for less than a week. The Act of Parliament forced him to give a higher compensation to a man employed for a fortnight than to a man employed for a year, unless the latter worked every day of the year. His award was that the case came within the section of the statute, and he awarded the plaintiff as a partial defendant, as defined by the new statute and Lord Campbell's Act, one-third of the minimum compensation, namely, £50 with seven guineas costs.

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ELECTRIC LIGHTING NOTES.

Aberdeen.—At a meeting of the Gas and Electric Lighting Committee of the Town Council on July 28th, the City Chamberlain submitted a statement as to the revenue and expenditure on the electric lighting account for the six months ending June 30th, showing an income of £4,447 and an expenditure of £4,524, giving a deficit of £77. It was agreed that the charge for electric lighting during the next six months should remain the same as at present.

Acton.—The Council has instructed Messrs. Lacey, Clirehugh & Sillar to prepare at once the necessary plans and specifications for the electric light and power plants in connection with the scheme drawn out by them last year.

Belfast.—On July 28th Mr. P. C. Cowan, M.I.C.E., held an inquiry on behalf of the Local Government Board into the application of the County Council for sanction to a loan of £75,000 for electric lighting purposes.

Blackburn.—The Local Government Board inquiry for the borrowing of £25,000 to carry out the scheme of lighting and traction extensions prepared by Messrs. Lacey, Clirehugh & Sillar was held at Blackburn, on Tuesday, August 1st.

Blaenau Festiniog.—The District Council has decided to appoint an electrical engineer to report on the question of electricity supply in the town.

Barnsley.—The Park and Lighting Committee recommends that application be made to the Local Government Board for sanction to borrow £3,000, the estimated cost of proposed extensions at the electric light station. The tender of Messrs. Johnson and Phillips for supplying additional electric plant for £2,236 has been accepted.

The Light Railways Commissioners held a public inquiry on the 2nd inst., into the application of the British Electric Traction Company, Limited, for an order authorising the construction of a light railway in Barnsley and district.

Bath.—Mr. R. Hammond has reported to the Electric Light Committee that the now familiar "noisy" arc lamps are quite satisfactory.

Battersea.—The Vestry, on July 26th, decided to oppose the application of the County of London and Brush Provincial Electric Lighting Company for a provisional order for the parish. In a report by the Law Committee, it was stated that the latter company had again opened Boundaries Road without the permission of the Vestry. The Committee observed that the injunction obtained in the Chancery Divison, which was confirmed by the Court of Appeal, restrained the company from laying any further mains in the parish. The committee recommended, and it was decided, that they be authorised to take such proceedings against the company in regard to the matter as might be considered necessary.

Bridgend.—The English Industrials Company has come to an agreement with the District Council to supply electricity for public lighting at the rate of 2d. per unit, and for general use at 6d. for the first hour, with 3d. for every additional hour.

Byfleet.—The Parish Council has approved of the application of the Cobham Gas Company, for powers to supply Byfleet with electric light and power.

Camberwell.—The General Purposes Committee having received notice from the County of London and Brush Provincial Electric Lighting Company that within 48 hours from date of notice it intended to commence supply in certain specified streets at a pressure of 205 volts, recommended that the company be informed that unless it agrees to carry out the conditions contained in the purchase clause of its order in a reasonable manner, the Vestry intends to make an application for its own order. A letter was received from the company stating that before it can consider the request for certain information, and for an undertaking as to new works it would be glad to know (1) whether the Vestry has passed a resolution in accordance with Section 60 of the Camberwell order, and (2), if so, whether the Vestry intends to require the company to sell the Camberwell undertaking as provided by that order.

Cobham.—The Parish Council has received from the Epsom District Council a letter addressed to the latter on behalf of the Cobham Gas Company, which states the intention of the company to apply for a provisional order to supply electricity in the district. The Cobham Council requested the Epsom Council to oppose the application to the utmost.

Cowes (I.O.W.).—The *London Gazette* contains formal notice of the intention of the District Council to transfer the electric lighting order to the Ventnor Electric Light and Power Company, Limited.

Dudley.—The Electric Lighting Committee of the Corporation have issued a report recommending the Council to accept the following tenders, amounting to £21,472, for permanent work and plant for electric lighting and power station:—Messrs. Babcock and Wilcox, £2,017, for boilers, &c.; the Westinghouse Company, £6,169, for machinery, &c.; Callender's Cable and Construction Company, £7,146, for cables and street work; Messrs. Johnson & Phillips, £423, for street lighting; Messrs. Whittaker & Co., £5,466 18s. 3d., for building stack and engine beds, and £250 for travelling crane (estimate). The committee also recommend that application be forthwith made to the Local Government Board for their sanction to the borrowing, by the Council, of a loan of a further sum of £33,000, on account of the expenses to be incurred in the construction of the generatin station, electric lighting and work connected therewith, to be repaid, together with interest thereon, within a period of 30 years, such amount being made up as follows:—Amount brought down, £21,472 13s. 2d.; meters and house connections, £2,000; steam piping, pumps, heaters, £3,000; railway siding, £500; contingencies, engineering expenses, &c., £6,027 6s. 10d. The Council have already had applications by prospective consumers for the electric light.

East Grinstead.—The Sanitary Committee has received notice that application is to be made to the Board of Trade in December next for a provisional order authorising Mr. L. Dennis and Mr. F. Verrall to supply electricity for lighting and other purposes throughout the parishes of Rotherfield, Buxted, and Withyham.

Godstone.—The District Council has received a communication from Edmundson's Electricity Corporation, Limited, giving formal statutory notice on behalf of the Urban Electric Supply Company, Limited, of intention to apply to the Board of Trade for a provisional order for electric lighting in the parish of Warlingham.

Harwich.—In the *London Gazette* the usual formal notice appears of the transfer of the provisional order to English Industrials, Limited, by the Corporation.

Kettering.—The District Council has resolved to engage Prof. Kennedy to report on the question of proceeding with its electric lighting order, at a fee of 100 guineas.

King's Lynn.—The Corporation having made application to the Local Government Board for sanction to borrow an additional £2,500 for the purpose of extending the electric light in the borough, Colonel W. R. Slacke, R.E., conducted an inquiry into the matter on July 26th. It was explained that the Corporation wished to light by electricity all the streets now lighted by gas, and to extend the mains to South Lynn railway station, which is now lighted by oil lamps. Although the current had not yet been turned on, applications to the extent of 3,500 8 c.p. lamps had been applied for, in addition to the Corporate buildings and the theatre, which result was considered highly satisfactory.

Liverpool.—The city electrical engineer, Mr. A. B. Holmes, has drawn up a lengthy report regarding the system of supply of electrical energy in the city. The report states that electrical energy is supplied in Liverpool by direct current at a pressure not exceeding 500 volts. An area of supply not more than 4 miles in diameter, and requiring not less than 10,000 H.P. is dealt with under the most favourable conditions as regards economy, if supplied from a single station placed in the centre of the area, the electrical energy being generated and distributed at 500 volts pressure. In dealing with larger areas, it is necessary to adopt either a high tension system of supply for the more distant districts, or to increase the number of generating stations. The latter course has advantages as regards simplicity and consequent economy of working, and also as regards safety, as it would be imprudent to depend on a single station for the whole supply of electrical energy for a large city. The greater portion of Liverpool lies within a radius of 2 miles from Pumpfields and Lister Drive respectively, which sites have been selected for the two main electric power stations, as affording cheap delivery of fuel by rail at Lister Drive, and by canal at Pumpfields, the canal at Pumpfields also affording a supply of water for condensing. The demand for electrical energy for lighting is at a maximum only for three or four weeks in mid-winter, and the horse-power of plant required at that period very largely exceeds that which would suffice for the other portions of the year. The Highfield Street, Paradise Street, and Oldham Place stations are very favourably situated and equipped for dealing with the excess winter demand, which is chiefly required for the area included within a radius of 1 mile from the common centre of these three stations. The adoption in Liverpool of a direct current system at 500 volts pressure enables the same plant to be used both for lighting and for tramways. The maximum constant working load of the plant in the stations, when completed, will be as follows: Pumpfields, 15,000 H.P.; Lister Drive, 15,000 H.P.; Highfield Street, Oldham Place, and Paradise Street combined, 9,000 H.P.; Lark Lane and Smithdown Road, 1,200 H.P.; Cobb's Quarry, 600 H.P.—40,800 H.P. To meet the present demand for lighting requires plant of about 10,000 H.P., and with the rapid rate of increase of the last few years, it seems probable that the demand for lighting, together with the demand for mechanical power, which is only commencing, may before long reach 20,000 to 25,000 H.P. The tramways, when completed, will probably require not less than 10,000 H.P. Although the requirements of the present time, and of the immediate future, can be dealt with most advantageously at a pressure of 500 volts, it may, at a future date, be desirable to use a high tension system of transmission in dealing with the development of outlying districts, and there will be no difficulty in providing such a supply, when requisite, from the sites already in the possession of the Corporation.

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Manchester.—At a meeting of the City Council on Wednesday, Alderman Lloyd Higginbottom in moving the adoption of the minutes of the Electricity Committee, including the acccounts for the year which have already appeared in the Electrical Review, moved a reduction in the price of electricity to large consumers for lighting purposes, and also to consumers for motive power. He explained that it had not been found advisable to recommend a reduction to small consumers. The total reduction would mean a difference of £3,500 as compared with £7,000 allowed for in the estimates. The proceeding of the Committee were adopted. It was decided to apply to the Local Government Board for sanction to borrow £22,000, for the outlay in connection with the new cable, &c., stores at Ardwick. This is part of £500,000 which the Council has authorised the Electrical Committee to borrow for the purpose of their undertaking.

Mauritius.—The tender of Messrs. Dawson & Co., of Pancras Lane, E.C., has been accepted by the Municipal Council of Port Louis, Mauritius, they having been granted the concession for the sole right to light the town and suburbs by electricity. Messrs. Dawson & Co. are the owners of the present gasworks, and they have decided to instal the electric light throughout the entire area. They have already received applications from householders for electric lighting equal to 6,000 lamps.

Newark.—The District Council has received from the Electrical Power Distributing Company formal notice of intention to apply for an order to supply electricity within the borough. It was agreed to have the opinion of a competent engineer to report as to the probable cost of obtaining electrical powers.

North Riding.—The County Council has resolved to devote the sum of £4,500 to a scheme of electric lighting for the Asylum.

Oswestry.—An extraordinary general meeting of the Oswestry Electric Lighting and Power Company, Limited, was held on July 24th, for the purpose of considering the following resolution: "That the shareholders of this company hereby confirm the sale of the undertaking to the Corporation of the borough of Oswestry, on terms already agreed to by the directors of the said company, subject to the necessary consent being obtained, and that the directors be and are hereby empowered to take all necessary steps to carry out the same." The chairman having explained the terms of sale, at the price of £11,200, the motion was put to the meeting and carried.

Ross.—Messrs. Harvey, of Purland Chase, Ross, have abandoned their intention of applying for a provisional order for the installation of electric light at Ross. The question of electric lighting now lies solely with the District Council, which is awaiting the report of the electrical engineer.

Wakefield.—The Corporation has decided to apply for leave to borrow £25,000 for the purpose of carrying out extensions.

Wingate.—At a parish meeting held at Wingate on July 25th it was decided to adopt the Lighting Act, and expend a sum not exceeding £400 for the first year's cost. The contract for the erection of 42 lamps and all accessories has been let to Mr. G. H. Armstrong, Chester-le-Street, for £301. The necessary power for lighting will be supplied by the Wingate Coal Company at a cost of £2 per lamp per year.

West Bromwich.—The Electric Lighting Committee of the Town Council have decided to proceed at once to lay down the requisite plant for lighting the town by electricity. The committee have resolved to make application to the Local Government Board for sanction to borrow the sum of £20,000 for the purpose of carrying out the scheme agreed upon. It is proposed at first to supply only the compulsory area for which a provisional order has already been granted, and to extend from time to time when necessary.

Wrexham.—The Town Council has resolved to apply to the Local Government Board for consent to borrow £20,000 for the establishment of an electrical supply works, and for incidental expenses.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Ben Cleuch.—This, the highest mountain in the Ochil range, is about to be made more accessible by an electric railway to its summit. Mr. Hewitt, of Manchester, the engineer to the promoters, has made the final arrangements for the necessary concession, with Mr. Atherton Gray, factor to Miss Johnston, of Alva, the proprietrix of Ben Cleuch, who has given every facility to the promoters, her desire being to benefit the district. It is intended to erect a sanatorium or hotel on the summit should the option obtained to make the railway be taken advantage of. We understand that in all likelihood the construction of the line will be proceeded with without delay should no engineering difficulties of a serious nature present themselves.

Bexhill.—The Light Railway Commissioners have granted the application of Mr. W. M. Murphy for an electric tramway to connect Bexhill with St. Leonards.

Dublin.—It seems that on Sunday evening, a London tourist (named Manners) was travelling on the top of an electric car coming from Clontarf to Dublin, and being desirous of alighting he asked the conductor, who was collecting fares from the outside passengers, to stop the car. The conductor told him to pull the cord of the bell, but Manners, in error, pulled the rope attached to the trolley, which, being thus displaced, struck the span and guard wires, breaking them, and causing the broken ends to fall amongst the passengers on the car. Owing to the contact of those wires with the overhead conductor three passengers received shocks. They remained unconscious in the hospital for three or four hours, and were afterwards suffering from the effects of the shock. At the Dublin Metropolitan Police Court Manners was charged with unlawfully interfering with the wires; the city magistrate, in dismissing the charge, said that the Tramway Company was to blame for not having a man to remain constantly in charge of the trolley ropes!

On Monday night an accident occurred at Gardiner Street. The trolley pole of a double-decker slipped from the wire and became entangled in the span wire, which snapped and fell upon the car and into the street in an electrified state. No one was injured.

Electric Railways.—The Earl of Morley's House of Lords Committee last week ordered to be reported the Charing Cross, Euston, and Hampstead Railway Bill, and the Brompton and Piccadilly Circus Railway Bill.

Gateshead.—At a special meeting of the Town Council on July 26th, the committee recommended that the Council rescind their resolution of June 7th, refusing permission to the Tramways Company to construct a railway from Askew Road *vid* Pine Street and Team Street to the borough boundary at Dunston, and in view of the company having met the Council upon the points at issue, do now grant permission to construct the line under the Light Railways Act, and subject to the provision as to purchase under the Tramways Bill of the present session of Parliament, and to all other conditions contained in that Bill being made applicable to the said railway. After some discussion the recommendation was agreed to.

Gillingham.—On July 27th Mr. Madgen, a director of the Electrical Power Distribution Company, Limited, interviewed the Council relative to the company's proposed application for a provisional order to supply electrical energy for public or private purposes in the district. It was decided that the matter should be dealt with in committee.—The Chatham and District Light Railways order came into force on July 25th.

Halifax.—The Corporation is about to apply to the Local Government Board for sanction to borrow the sum of £18,842 for electric lighting purposes, and also £49,217 for electric tramways.

Italy.—A contract has just been placed with Messrs. Felix Singer & Co., of Berlin, for the construction of about 30 kilometres of electric tramways in and about the town of Catania.

Liverpool.—At the next meeting of the Liverpool City Council a proposal will be submitted by the Tramway Committee to extend the electric tram system to the whole of the city. The proposal involves the expenditure of close on a quarter of a million sterling. About £120,000 is represented by the cost of the permanent way and the necessary overhead electrical equipment, while £110,000 is put down for the extra cars required. It is proposed to purchase 200 top-seated electric cars at a cost not exceeding £550 each, 50 cars to be delivered in each quarter of the year 1900.

The city electrical engineer has, in compliance with a request of the City Council, reported that the standard top-seated cars weigh, when fully loaded, about 10 tons, the American long cars about 15 tons, and the German car and trailer about 14 tons. The experimental runs that have been made show that the amount of electrical energy used per ton per mile over the same route is, approximately, one-tenth of a unit for the standard four-wheel cars, and about 10 per cent. less for the long American cars, which run with less friction round the curves, being mounted on swivelling trucks. The amount of energy consumed per passenger per mile, when the cars are fully loaded, is about two-hundredths of a unit for the top-seated cars, and nearly three-hundredths of a unit for the long American cars, and also for the German cars and trailers. In the event of the long American cars being fitted with top seats, the consumption of energy per passenger per mile would not exceed that of the four-wheel cars. The insulation resistance of the tramway conductors and feeders is tested every night at the generating station, at a pressure of 500 volts, and up to the present a very much higher insulation resistance has been maintained than the limit prescribed by the Board of Trade. If the insulation could be maintained at the above standard, the cost of the electrical energy lost by leakage would be, for the existing tramways, at the present rate of charge, less than 8d. per annum.

The Metropolitan Railway and Electric Traction.—Addressing the shareholders of the Metropolitan Railway Company last week, Mr. Bell said, as to the important question of electrical traction, the engineer had expressed the hope that the experimental train would be ready in about two months' time. This was certainly good news, and they all looked forward with great hopes to a successful result. But it was only an experiment, and he did not want it to be supposed that in two months' time electrical working would commence to take the place of steam working. That this

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result would come about in the future he had not the least doubt, but with the enormous traffic which the Metropolitan had to accommodate and the punctuality which had to be observed the change from steam to electrical traction required the most anxious care and precautions. To change the conditions of working of a railway over which 95 millions of passengers travelled in the year, without interfering with the punctuality and usefulness of the service, was necessarily a serious enterprise.

Mirfield.—The Huddersfield Corporation have agreed to the extension of their proposed electric tram service to Mirfield, provided the District Council supports them in their application to Parliament for powers, and provided the roads are the necessary width.

St. Helens.—The new electricity works, which was recently described in our columns, was formally opened on July 31st. The Town Council has voted a bonus of £100 to Mr. Highfield, the borough electrical engineer, as an expression of its satisfaction with the way in which the work has been carried out by him.

Sheffield.—A Mr. Turton, writing to the *Sheffield Independent*, points out the danger of cars with seats on the top but no roof, in cases where the trolley wire is suspended over the centre of the track. That such danger exists cannot be disputed; a breakage of the trolley wire might have very serious results to those upon whom it fell. (See also under Dublin.)

South Staffordshire. — Mr. Robbins, the general manager of the South Staffordshire Tramways Company, has laid the grievances of the engine drivers with respect to their long hours before the directors of the company, and they have decided that the number of working hours of the drivers and also the guards shall be reduced.

Stoke-on-Trent.—At a meeting of the Corporation on July 27th, a letter was read from the Potteries Electric Traction Company in reply to a communication from the Corporation to the effect that unless the extension to Trent Vale was completed within the time stipulated the Corporation intended to enforce the penalty of £500. The company wrote that they were making every effort to get all the authorised lines constructed as soon as possible, but they had been much handicapped by circumstances over which they had no control. Delay had also been caused in consequence of the improvement proposed by the Corporation at Etruria. They presumed the Corporation desired to have the lines to Trent Vale carried out, and that object was not likely to be furthered by the Corporation adopting the attitude expressed in the town clerk's letter.

TELEGRAPH AND TELEPHONE NOTES.

British North Borneo Telegraphs.—The British North Borneo Company is said to have decided to take over and occupy the Tambunan Country, in the interior of British North Borneo. The company has sent instructions to Sandakan for its officials to construct a road and telegraph line into the heart of Tambunan.

Foreign Telegraph Rates.—It is stated that Sir Edward Sassoon has given notice in the House of Commons that on Tuesday next he will ask the Under Secretary of State for Foreign Affairs whether, in view of the efforts now being made for a reduction of foreign, colonial, and Indian telegraphic charges, Her Majesty's Government will request Her Majesty's Ambassadors at Constantinople and Teheran and Lord Cromer to procure from the Turkish, Persian, and Egyptian Governments respectively copies of all concessions granted to, and all agreements made with, either the Eastern Telegraph Company, the Indo-European, or the Telegraph Construction and Maintenance Company, or the agents of all or any of them, and with the Indian Government.

Glasgow Telephones.—In the House of Commons on Wednesday the order for the second reading of the Glasgow Corporation Telephones Bill was discharged and the Bill withdrawn.

Iron Telegraph Poles for Victoria.—Iron poles are in future to be used for the support of telegraph lines in Victoria. They have been in use for many years in the neighbouring colony of New South Wales, and have been tried in a small way in Victoria with the result that the Postmaster General has decided that they are to be employed generally instead of wooden poles as soon as supplies can be obtained. One of their advantages for colonial use is that they are less liable than wooden poles to be affected by bush fires, besides which they last longer than wood. As iron poles will be used not only in the equipment of new lines, but for the replacing of the present wooden posts as they wear out, they will be in constant demand, and it is intended, if possible, to establish a colonial manufactory for them.

Liverpool-to-Paris Telephone.—The Postmaster-General has informed the Liverpool Chamber of Commerce that negotiations were proceeding with the French Administration of Post and Telegraphs with regard to tariffs and other matters, and adding that no difficulty was apprehended in eventually establishing a telephone communication between Liverpool and Paris.

The Reduction of Rates to India.—We have shown that while telegrams in transit from London to Australia or *vice versâ*, are profitably passed between Bombay and London at the rate of 1s. 3½d. per word, a telegram from London, passing over exactly the same line, and requiring exactly the same amount of attention, has to be paid for at the rate of 4s. per word, if it is destined for Bombay instead of for some point in Australia. There is evidently something wrong about this, which, doubtless, will be put right in the near future. There is, however, a point of apparently minor importance to which we wish to call the attention of our readers, and which we will try to lay before them as clearly as may be. In giving evidence before the Pacific Cable Committee, the representatives of the Eastern Extension Telegraph Company (among them the Marquess of Tweeddale, who is also chairman of the Eastern Telegraph Company), showed that the Eastern Extension Company, whose lines come no further westward than Madras, were liable to substantial out-payments to the Governments of Australia, Java, and India, but what concerns us most at present is the fact that, as far as the associated companies are concerned, the *only* out-payment that is made on a telegram from Bombay to London is the sum of 2d. per word, while the cost of the same telegram to the public is 4s. per word. This 2d. per word is paid to "Europe" (see reply to question No. 1,787 Blue Book, C—9,247, of 1899), but further on in the evidence we find the following:—Q. 2,007, "And where does the 2d. in Europe go to?—Partly to Great Britain, the Telegraph Department here, the French Government, the German Government and other European Governments; the average is about 2d. per word." The remainder of the evidence, which we printed *in extenso* last week, shows that the company pays the English Post Office an amount "which works out taking the average at 2d." From this last statement it would seem that as the English Post Office gets all of this out-payment of 2d. per word, the payments to "the French Government, the German Government, and other European Governments," resolve themselves into vanishing quantities! Surely such a self-contradictory statement calls for explanation, especially when made by those who so indignantly challenge the accuracy of the grounds for the arguments recently advanced by Sir Edward Sassoon and others on this and kindred subjects.

Telegraph Rates to India.—In a letter to the *Times* Mr. J. Henniker-Heaton says:—"It is gratifying to learn that the Eastern Telegraph Company announce their intention to reduce the telegraph rates to Australia to 4s. a word and to expend an enormous sum in constructing what will be a duplicate line to Australia. May I prophesy that the Eastern and the Indo European Company will reduce their telegraph rates to India to 2s. per word within the next six months? In a few days I purpose asking for a little space to inquire regarding certain alleged monopolies enjoyed by the Eastern Telegraph Company and its satellites over landlines, which I am certain the Marquis of Tweeddale (whose courtesy I am bound to acknowledge) will reply to when the Royal Commission is appointed."

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Europa ...	April 4th, 1898 ...	...
Jamaica-Colon	June 30th, 1899 ...	...
Bonny-Cameroun	May 29th, 1899 ...	...
Latakia-Cyprus	June 20th, 1899 ...	...
Para-Maranham	April 10th, 1899 ...	...
Maranham-Ceara	July 25th, 1899 ...	...
Medan-Olehleh	July 31st, 1899 ...	...
Accra-Grand Bassam... ...	August 1st, 1899 ...	...
Landlines.		
Communication between Salonika and Monastir ...	March 23rd, 1899 ...	...
Communication between Bolama-Bissao	July 28th, 1899 ...	...
Landline between Puerto Plata-St. Domingo	... August 1st, 1899	... August 2nd, 1899

Telegraphists' Grievances.—Under the auspices of the Joint Committee of the Postal and Telegraph Associations, a conference of postal and telegraph servants was held on Tuesday at the Westminster Palace Hotel, for the purpose of urging the expediency of the appointment of a Parliamentary Select Committee to inquire into the grievances of those engaged in the postal and telegraph services of the country. Mr. William Davis presided. He said there was now every reason to believe that the postal and telegraph servants would ere long secure from the Secretary to the Treasury what had so long been denied them—the appointment of an independent Parliamentary committee to consider their grievances—and that in the result they would obtain some measure of reform and justice.

The Telephone Bill. Third Reading.—The Telegraphs (Telephonic Communication) Bill passed its third reading in the House of Commons on Monday night. In the course of the debate Sir J. Joicey said the Bill had been entirely changed since it was before them on the second reading. He had strong objection to the Bill on various grounds, and not the least of them was that the Government proposed to treat London differently from other parts of the country. London required very little special assistance. The Government seemed to have given up all idea of competition in the Bill, but all the opposition offered was of no avail in the face of the great majority at the back of the Government. He believed, says the *Times* report, if the supporters of the Government had been left free on this question the Bill would have been of a different type from what it was. The Government had the power to establish telephones in any part of the country, but instead of doing that they discouraged competition. The object probably was that they looked forward to the future when they would obtain the telephones, and that then it would be better to have to deal with only one instead of several

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companies. Another of his objections was that he did not want to see municipalities become the suppliers of telephone services. The chief objection, however, to the Bill was that it deferred the nationalisation of the telephones for very many years, if it did not put it out of the question altogether.

He concluded by moving that the Bill be read that day three months.

Mr. Hedderwick who supported the amendment, said the right hon. gentleman the Secretary to the Treasury had produced a Bill which he would not have been responsible for had he been allowed to carry out his own ideas. If the right hon. gentleman had had the courage to purchase the National Telephone Company in the interest of the country he might by means of a sinking fund have obtained for the country by 1911 a national telephone system at practically no cost.

Sir H. Bullard supported the third reading of the Bill. Any further delay would be detrimental to the utility of that useful invention, the telephone.

Mr. Pirie opposed the Bill, which he said was an example of the manner in which the Government placed private, sectional, and company interests before the benefit of the general community. The duty of the nation was to strain every nerve to maintain, if not to increase, our commercial lead, and to this end the development of such a valuable commercial instrument as the telephone was very necessary. It seemed to him, however, that this Bill was more likely to perpetuate our inferiority. It was an unworkable Bill, and he did not believe that an assembly of poor men would have passed a Bill so crooked.

Sir C. Cameron supported the Bill, and congratulated the Secretary to the Treasury on having secured a number of advantages in the course of the negotiations with the company. In its present shape the Bill was a vast improvement on the measure originally introduced, and he hoped that steps would soon be taken to establish a system of rural telephones throughout the country.

Mr. Lawrence said his constituents were of opinion that the introduction of this Bill had been a mistake, and he protested against its passing. It was evident from the terms of the Bill that it was only one step in the direction of the nationalisation of the telephone. London was to enjoy this nationalisation without delay, and what London would receive to-day the provinces would receive to-morrow. The country districts would not rest content till the facilities which were given to London were extended to them. In the interests of the State and the taxpayers it would be well if the Treasury were to buy up the existing telephone system while it was still in its infancy instead of postponing the time for 20 years, when they would have to pay 100 per cent. more than the present value. As, however, the Bill gave to London what it denied to Liverpool he could not give it his support.

Mr. Cawley, as a Liberal member, supported the Bill, because he believed it carried out the recommendations of the Select Committee that general, immediate, and effective competition was desirable and should be set up. The Bill was an honest endeavour to give a cheap and effective telephonic system, and he believed it would give to constituencies such as his own, containing many small shopkeepers and traders, the inestimable benefits of the telephone at a moderate price.

The House then divided, and the numbers were—

For the third reading	132
Against	29
Majority for	—103

The Bill was then read a third time.

Wireless Telegraphy.—We read in an American newspaper that Marconi's system is to be put in operation in Hawaii as a means of communication between the different islands of the group. An organisation has been formed, capital is subscribed for the project and some material for the system is already on the way. There is only one channel between islands in the group that is wider than the English Channel. That is the one between Oahu and Kauai, and to the minds of the promoters of the enterprise, communication across this is the only part of their plan which is problematical. It is stated that in connection with the forthcoming Health Congress at Blackpool it is proposed to utilise the summit of the Blackpool Tower for transmitting messages by Marconi's system to Manchester, Liverpool, Glasgow, Oldham, the Isle of Man and London. The Wembley Tower is to be used as the London station.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking.—August 12th. The District Council wants offers for the free wiring of premises within the area of supply. See "Official Notices" July 28th.

Battersea.—August 31st. The Vestry wants tenders for an overhead travelling crane (hand or electric), and batteries for the electricity works. See "Official Notices" July 7th.

Battersea.—August 31st. The Vestry wants tenders for steam pipes, pumps, condensers, economiser, tools, &c., also switchboard and booster. Specifications at the office of Prof. Kennedy, 17, Victoria Street, S.W.

Birkdale.—August 19th. The Urban District Council invites tenders for the transfer of its electric lighting powers.

Blackpool.—August 21st. The Corporation wants tenders for 10 double bogie tramcars. See "Official Notices" July 28th.

Bridgewater.—August 4th. The Bridgewater trustees want tenders for conduits and wiring for 500 lights in Bridgewater House, St. James's Park, S.W. See "Official Notices" July 28th.

Carlisle.—August 17th. The Corporation wants tenders for boilers, engines, dynamos, and condensing plant. See "Official Notices" July 28th.

Darwen.—August 22nd. The Corporation wants tenders for rail bonds. See "Official Notices" this week.

Dundee.—August 23rd. The Council wants tenders for the overhead line equipment and rail bonding of the Perth Road and Lochee tram routes. See "Official Notices" this week.

East Ham.—September 9th. The Urban District Council wants tenders for combined electric light and traction plant, engines, generators, overhead line equipment, cars, switchboard, arc lamps, &c., water-tube boilers, condensers, and other steam plant, electric light cable. Mr. W. C. Ullmann, The Limes, White Post Lane, East Ham, is the Council's electrical engineer. See "Official Notices" this week.

Germany.—Tenders are at present being invited by the Frankfort-am-Main Municipal Tramways Committee for the supply of 200 steel tyres and 40 sets of wheels and axles for electric tramcars. Tenders to be sent to the Betriebs Direction der Städtischen Strassenbahn, Frankfort-am-Main (Bockenheim), whence particulars may be obtained.

Glasgow.—August 21st. The Corporation wants tenders for the supply of switchboards, copper bus bars, and electricity meters. See "Official Notices" this week.

Ingleton.—The Ingleton Electric Light and Power Company wants tenders for the supply of dynamos, switchboards, batteries, and wiring. See "Official Notices" this week.

Malmo.—September 1st. The Gas Works' directors want tenders for the erection of electricity works for the city. Particulars on application to the clerk of the Gas Works (deposit 12s).

Motherwell, N.B.—August 18th. The Commissioners invite tenders for machinery and works in connection with the proposed electric lighting of their town. See "Official Notices," July 28th.

Perth.—August 28th. The Commissioners want tenders for boilers, condensers, steam dynamos, switchboard, underground mains, and accessories. See "Official Notices" July 28th.

Portugal.—September 6th. Tenders are being invited by the municipal authorities of Cascaes, Portugal, for the concession for the electric lighting of the town.

St. Mary, Battersea.—August 31st. The Vestry wants tenders for steam pumps, pipes, condenser, economiser, &c., switchboard, and boosters. See "Official Notices" July 28th.

Salford.—August 8th. The Corporation wants tenders for eight 750-kw. continuous current steam dynamos for electric lighting and traction. See "Official Notices" July 7th.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

The War Office.—The Secretary of State for War announces that tenders for various articles, including electrical instruments, will probably be invited from time to time during the next 12 months. Manufacturers who may wish to be applied to when tenders are required, should address Mr. A. Major, Director of Army Contracts, War Office, stating the particular articles they manufacture, and the names of at least two well-known firms or public bodies who have purchased from them, and are in a position to certify as to the quality of their productions.

Withington.—August 8th. The Urban District Council wants tenders from electrical engineers who would be prepared to enter into contracts for wiring and fitting the Town Hall for electric lighting. Particulars from the surveyor, Mr. A. H. Mountain, Town Hall.

CLOSED.

Barton (Manchester).—The Board of Guardians, on Wednesday, accepted the tender of Messrs. S. H. Heywood, Manchester, for the supply of the electrical plant, dynamo, and engine for the new Union hospital at Patricroft. The estimated cost of the work is £1,278 10s. There were 32 tenders, independent of seven for the requisite fittings, the consideration of which was referred to the Building Committee.

Blackheath.—The British Electric Installation Company, of Soho Square, has secured the contract for lighting the Arts Club and Conservatoire of Music, at Blackheath.

Doncaster.—The Guardians have accepted the tender of the Keighley Electric Lighting Company for lighting the new workhouse electrically, at £2,700.

London.—The London County Council on Tuesday considered the undernoted tenders for wiring the Holborn fire station:—

F. A. Glover & Co.	£264
Drake & Gorham	349
Russell & Russell	397

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As the lowest tender exceeded the estimate of £200 suggested by the Chief Engineer, the Council decided not to accept any of the tenders but to cause the work to be carried out by the direct employment of labour under the supervision of the Chief Engineer.

The Council received the following tenders for the erection of the proposed generating station to be built on the Victoria Embankment:—

Holloway Bros. (accepted)	£10,950
F. & H. J. Higgs	11,614
J. Shillitoe	11,790
B. Nightingale	13,573

Spain.—La Société La Metallurgique, of Brussels, has secured a contract for 80 electric tramcars for Madrid.

Sunderland.—It is stated that the Corporation, on Wednesday, gave a contract to Messrs. Dick, Kerr & Co., at £126,000, in connection with the electric trolley equipment of the tramways.

Wolverhampton.—The Town Council, on Tuesday, accepted the amended tender of the District Electric Company (£69), for the electric fittings at the new swimming bath.

FORTHCOMING EVENT.

Saturday, August 5th.—2 p.m. Annual general meeting of the North of England Institute of Mining and Mechanical Engineers, at the Wood Memorial Hall, Newcastle-on-Tyne.

NOTES.

Wireless Warfare.—The daily papers are full of sensational descriptions of experiments with wireless telegraphy by Mr. Maskelyne at Newbury. Magazines have been exploded at 400 yards from the sending station, and could, according to Mr. Maskelyne, be exploded with equal ease 10 miles away. The imagination of the reporter sees in this a revolution in warfare. French powder magazines, in dangerous proximity to our shores, could, of course, be exploded from the North Foreland lighthouse. The *Pall Mall Gazette*, which is usually accurate in its science, recognises that somebody will have to plant the receiver and the detonator in the magazine, but our contemporary does not appear to realise that this is merely a variation of the traditional method of catching a bird by putting salt on its tail. The *Daily News*, in discussing a rival system by Mr. John Munro, says:—"With these, and other inventions, such as the Tesla torpedo, in prospect, it would seem that electricity is destined to revolutionise the art of war. Mr. Maskelyne has proved, if proof were needed, that ether waves can blow up a powder magazine at a distance of miles. Is there anything to hinder guns from being fired from a distance? Surely not. It is possible, therefore, that batteries or maxims may in future be worked and fired from a safe cover, and this improvement is the more likely in that smokeless powder enables the sharpshooters of the enemy to pick off artillerymen working guns at a distance of a mile or more." If one belligerent can work its artillery and maxims from a safe distance by wireless telegraphy, so can the other. We may expect, therefore, that battles in the future will be carried on by the unmanned artillery, while the armies retire a few miles to the rear to lunch. We understand that the apparatus used at Newbury was supplied by Messrs. A. Rosenberg & Co., of Southampton Row, W.C.

The Westinghouse Gas Engine.—Referring to our description of this engine in last week's issue, a correspondent has reminded us that the Dawson gas engine was specially made for direct coupling to dynamos, and we illustrated this on page 225 of the ELECTRICAL REVIEW for February 18th, 1898. There are also, he says, two or three gas engines on the English market that do not govern on the "hit-and-miss" principle, the Wells motor amongst others.

Röntgen Society.—We have received a copy of the report of the Council of the Röntgen Society, for the year ended July 1st, 1899, together with the rules and list of members. Dr. F. H. Low is nominated for election as honorary secretary, Dr. Walsh having resigned. Mr. Wilson Noble has been nominated as president for the ensuing year.

The Institution Visit to Switzerland.—We have received a detailed programme of the visits arranged for in connection with the reunion of the Institution of Electrical Engineers in Switzerland from September 1st to 9th. We understand that this has been sent round to the members of all classes of the Institution resident in Europe. We extract a note of some of the arrangements:—

On Saturday, September 2nd, there will be a visit to the Rheinfelden power station (low speed turbines, three-phase and continuous current generators) and lunch at Rheinfelden. In the afternoon the party will proceed to Baden and visit the works of Messrs. Brown, Boveri & Co., for the construction of electric generators, motors, transformers, &c.

On Monday, September 4th, the works of the Maschinen Fabrik Oerlikon, for the construction of electric generators, motors, transformers, electro-mechanical appliances, machine tools, &c., will be visited, and the Dowson Gas Generating Station of the Zürich-Oerlikon Street Railway, to be followed by a visit to Messrs. Escher, Wyss & Co.'s works for the construction of turbines, pumps, steam engines, refrigerating machinery, steamboats, boilers, &c.; also to the steam and water-driven municipal central station of Zürich, generating single-phase, three-phase, and continuous current; and, the municipal sub-station, for transforming three-phase into continuous current for street railway service. For those who prefer instead of some of these visits, to see the engine and boiler, &c., works of Messrs. Sulzer Bros., and the works of the Locomotiv Fabrik at Winterthur, arrangements have been made.

On Tuesday, September 5th, in the morning and afternoon, there will be visits to the old station for the transmission of power by wire rope, and to the new electrical power station (supplying single and three-phase current) at Schaffhausen, and to the Falls of the Rhine; or to the iron and steel (including electric welding) works of Messrs. Georg Fischer; or a visit to the National Museum at Zürich, under the personal guidance of the director of the museum, Mr. H. Angst (who is also the British Consul-General); and visits to the telephone exchange, postal telegraph department, post office, and new gas works. In the evening there will be a banquet offered by the Swiss firms and the Schweizerischer Elektrotechnischer Verein to members and ladies accompanying them.

On Wednesday, September 6th, there will be a meeting in the Polytechnikum, lunch to the Swiss hosts, visit to the Polytechnikum, and departure for Lucerne.

On Thursday, September 7th, there will be visits to either the Stanstad-Engelberg Railway (three-phase metre-gauge railway, 14 miles long), or to Interlaken *via* the Brünig Pass. The Rathhausen central station (a two-phase, low speed, turbine-driven plant for lighting and power) and the Lucerne tramways may be inspected by members before starting for Interlaken. Rathhausen is about four miles from Lucerne, and can be reached by carriage.

On Friday, September 8th, there will be a visit to the Jungfrau (three-phase rack) Railway, and three-phase turbine-driven generators in power station, *viâ* Lauterbrunnen and the Wengern Alp Railway; lunch at the Scheidegg; return to Interlaken. The power station at Lauterbrunnen may be inspected.

On Saturday, September 9th, arrangements have been made for a visit to the Kander Werk at Spiez (central station for power distribution, lighting, and for the Burgdorf-Thun Railway; power transmitted at 16,000 volts); and to the Burgdorf-Thun Railway (three-phase railway, 25 miles long, with through passenger traffic from ordinary railway lines).

The Labour Clause Question.—We congratulate the Sheffield Electric Lighting Committee upon taking an independent line in placing one of its electrical contracts. We wish that other municipal committees would cease to impose their unfair and interfering labour clauses. We sincerely hope that the Sheffield Committee will have force of character to treat the following bit of bluff as it deserves:—

The Sheffield Branch of the Steam Engine Makers' Society last week passed the following at a special meeting:—"That this meeting of engineers hereby regrets that there appears to be a disposition on the part of the Electric Light Committee to let contracts to a firm which is well known not to pay trade union wages, nor to observe proper conditions of work, and urges them to reconsider their decision."

The *Pall Mall Gazette* prints the following letter, headed "Unfair Conditions," from "P.":—

In connection with certain contracts lately advertised, some of the London District Councils, notably Poplar and Hackney, have decided that the orders shall be placed—in one case at an advanced price—only with firms employing members of certain societies—thus giving an undue preference to their own friends. Should not the Local Government Board take steps to prevent this by refusing powers to obtain loans to such councils as act in this protectionist spirit?

In connection with their electric lighting scheme the Council of Battersea, apparently, has decided to take the same course, with the result that if such action is allowed, every skilled labourer will ultimately be forced to join some union—either the local society or the workhouse.

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The Renewable Lamp Company.—A correspondent writes too late for our "Correspondence" columns:—"I have not seen the actual lamp, but having read all the patents relating to lamp manufacture, I am fairly acquainted with its details. There have been a large number of patents for renewable lamps, and I have manufactured and tested a good many such lamps; up to the present I do not know of any one which is successful. The reasons for this are that the raw materials of such a lamp are now so cheap, whereas the labour is dear. The ordinary lamp is so arranged that a minimum of skilled labour is required, whereas with such a renewable lamp, greater skill and care are required to prevent an undue amount of breakage and faults. For instance, the bulb for such a lamp will be dearer to start with, and its initial working up into a lamp will be dearer; when this lamp requires a new filament, the extra cost of a skilled glassblower, and the cleaning of the bulb, will exceed that of a new ordinary lamp bulb; then, again, the labour on the latter bulb, to make it into a new lamp, will be less than that required to even close up the neck of the renewable lamp, and the breakage in each case will be far greater with the renewable lamp. Thus the renewable lamp starts by being more costly in its first stages, and it has no chance of gaining ground in the succeeding operations. I may say that the filament in an ordinary good class lamp is dearer than the bulb, and is worth a good deal more than the 'brass socket and nickel wires' all lumped together. As I have given you the comparison (above) as to platinum and bulb saving, it is impossible to see where these renewable lamps 'will be of great value in reducing the cost of electric lighting.'

"The difference between old and new platinum amounts to almost nothing, the cost of making the nickel or platinum supports is also a small fraction of a penny. The subsequent operations of pumping and testing may be the same for both kinds of lamp and the special cap which is used over again has the same fatal drawback as the bulb—*i.e.*, increased expert labour and liability to increased breakage. Altogether, I think a renewable lamp cannot now be made on a successful commercial basis owing to the low selling price of an ordinary new lamp, which will, from every standpoint, be a better and more durable article. I note that it is only possible to renew their own pattern of long-neck bulb.

"Please excuse the length of this letter, and its practical particulars; it is difficult to otherwise give you some of the chief difficulties which such lamps present to an actual manufacturer. To the public a 'renewable lamp' is a very catching title."

A Hole in the Corner!—Surely the end of the copper combine cannot be far off! We read in the *Standard* that a vessel has taken to New York 250 tons of Indian copper coins, imported as scrap, they being at present more valuable thus than as money! It is added that China and India are both in danger of losing their circulating medium in this way! The Copper Trust has much to answer for, but, there, we are not told to whom these copper coins were consigned. Perhaps they are to be held in Trust until the crash comes! May we suggest a wholesale collection of copper kettles and domestic etceteras? Let us take heart from the fable of the lion and the mouse.

Appointments Vacant.—The following advertisement appeared in the *Times* the other day:—

> Wanted, manager for company interested in tramway development in England. Must have knowledge of electricity and gas traction, and be used to negotiations with local authorities. Liberal salary and participation to active and competent man. Apply to X.Y.Z., care of Messrs. Street & Co., 30, Cornhill, London, E.C.

An electrical engineering draughtsman and designer, and a physical lecture demonstrator, are wanted for the Northampton Institute, Clerkenwell. See "Official Notices" this week.

Electrocution.—On July 31st, two murderers were electrocuted at Sing Sing Prison. It is stated in a London daily that five successive applications of the current were necessary before one of the men could be pronounced dead.

Electrical Resistance Company.—The following letter, dated August 2nd, from Mr. James Swinburne arrived too late for our "Correspondence" columns:—"In your last issue you published an unsigned article dealing with the prospectus of the Electric Resistance Company and of the patents acquired by it, and you say, 'What a pity the directors did not look through the files of the ELECTRICAL REVIEW.' If that article be a specimen of these files, it would be most unprofitable to do so. The author of the article is either very careless or very unscrupulous. If he has read the patents to which he refers, his aim must have been to mislead the public. If he has not read them, his writing in such terms is an act which needs no comment. It only remains for me to add that Nussbaum's specification was before counsel, and that anyone acquainted with patent law will see on examining it that it does not anticipate the claims of the company's patents. The names of the counsel who pronounced upon this question are a sufficient guarantee for this."

[It is hardly necessary to tell Mr. Swinburne that the Editors of this journal take the responsibility of unsigned articles, and it seems to us that our reference to the files of the REVIEW was perfectly clear to everybody except our esteemed correspondent, as we quoted the very patent which we thought it might have been desirable for the directors to have seen. Our aim is ever to guide, not mislead, the public, and the sole patent to which we referred was that of Nussbaum, the greater part of which we published. We fully admit Mr. Swinburne's exceptional knowledge of patent law, but we simply made a comparison between his report to the company and Nussbaum's specification, and again we would ask wherein the difference exists between the old and the new. No one could accuse Mr. Swinburne of being unscrupulous, but that he has been careless in reading our article there seems to be no doubt, for his letter merely begs the question at issue without in the least degree affecting our contention that anybody is free to use the material of which Mr. Swinburne says the resistances are made.—EDS. ELEC. REV.].

Gas Engines v. Electric Motors.—As we go to press Messrs. Bilbie, Hobson & Co. write as follows:—"We note your remarks in reference to the circular we issued *re* gas engines *v.* electric motors. You ask the question whether our circular fairly represents the matters of gas engines *v.* electric motors? We have the reputation of being straightforward people, although we are, as you say, enthusiasts on our own side. This we consider is natural and reasonable. As you promise further particulars in a later issue, we will not trespass greatly on your space until then. We may say, however, that the figures we have given are, to the best of our knowledge, correct. Our calculation of gas consumption of 20 cubic feet per B.H.P. on 10 H.P. load was on an engine of, say, 19 to 20 B.H.P. working at half load. In modern gas engines about this size the gas consumption per B.H.P. on full load does not exceed 16 cubic feet. When you have given the further particulars which you promise, we shall be pleased to reply in detail, but we, in the meantime, still adhere to the advantages claimed in our circular."

Appointments.—Mr. J. K. Bock, who has been chief assistant at West Ham from the commencement of the scheme, was unanimously appointed borough electrical engineer, *pro. tem.*, by the West Ham Town Council on Tuesday last week.

Mr. C. W. G. Little, chief construction engineer of the British Thomson-Houston Company, Limited, has been appointed on the managerial staff of the British Electric Traction Company, Limited.

Obituary.—We hear with regret of the death of Mr. William Stiff, senior partner in Jas. Stiff & Sons, of London Pottery, Lambeth, which took place on the 19th ult. The business will continue to be carried on under the same style by the surviving partner of the original firm, Mr. Ebenezer Stiff, with the assistance of the three junior members of the firm, Messrs. Sydney J., James A., and W. Frederick, Stiff.

(*Continued on page* 197.)

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BARROW-IN-FURNESS ELECTRICITY WORKS.

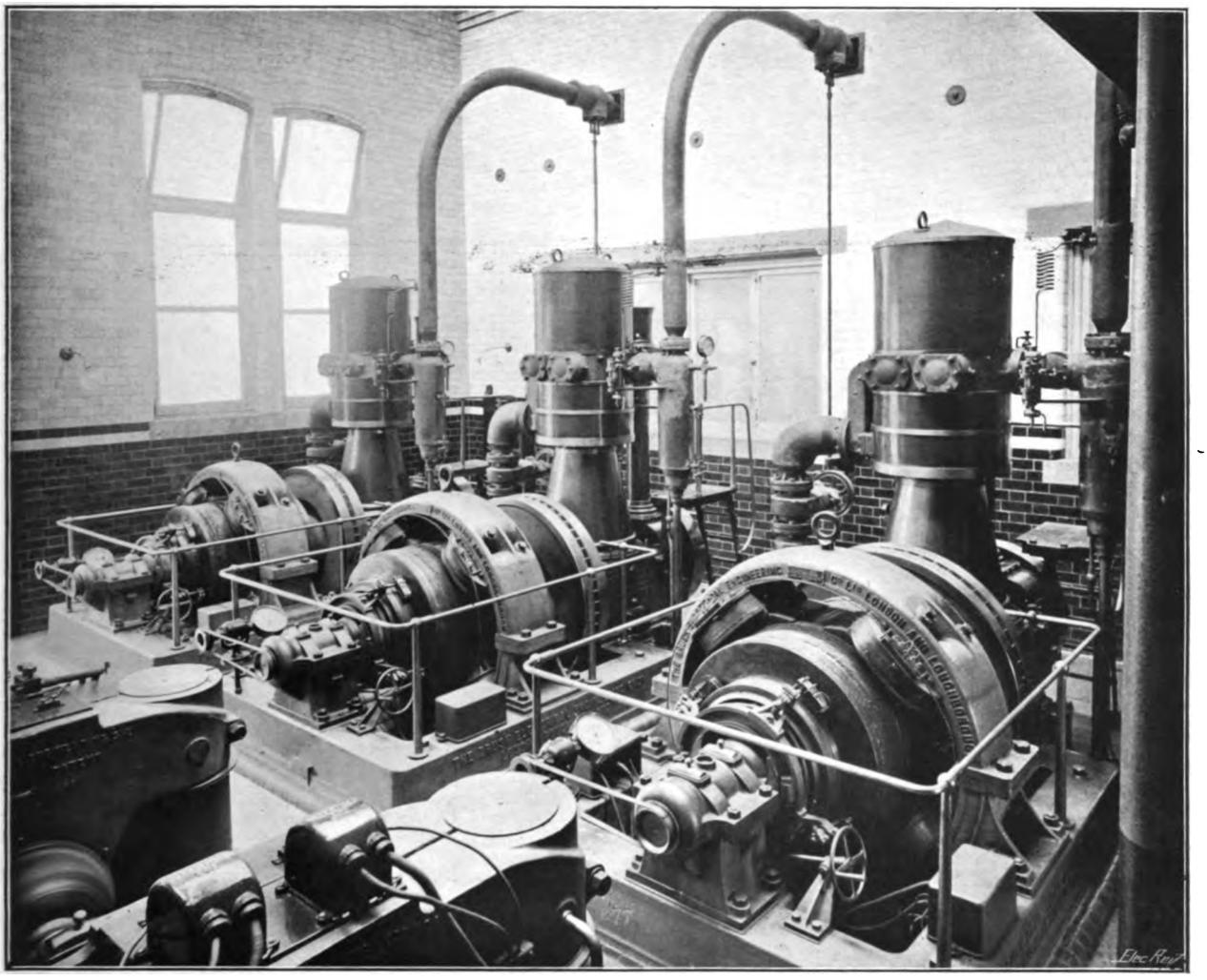
The introduction of electric lighting into Barrow has been under consideration since December, 1897, when the Local Government Board held an inquiry into the question of a loan of £30,000 for this purpose. Thanks chiefly to the exertions of Councillor J. P. Smith, the scheme was rapidly pushed forward; Messrs. Kincaid, Waller & Manville, the consulting engineers to the Council, decided in favour of a high pressure direct current system with rotary transformers in sub-stations, and distribution on the two-wire system at 220 volts. The high pressure system was rendered necessary by the nature of the district, in which there are densely populated centres some distance from one another; in two cases—one to Walney Island and one to the docks—the mains will have to cross salt-water channels.

The station is situated in a central part of the town, with a view to supplying the greater portion of the demand direct; in point of fact, the demand has so rapidly increased since the station was informally set to work in February last, that already extensions are in progress almost equal to the original capacity of the works, for supplying the business quarters at low pressure.

The buildings were designed by Mr. W. H. Fox, the borough engineer. The boilers were supplied by Messrs. Babcock & Wilcox, Limited, and are three in number, of their usual pattern; each boiler has a heating surface of 1,218 square feet, and is to work at a pressure of 160 lbs. per square inch. On account of the nature of the site, it was found necessary to arrange the stoking space between the boilers and the engine room—a not very desirable plan.

There are two three-throw feed pumps, made by Messrs. Hayward, Tyler & Co., each capable of delivering 1,000 gallons of water per hour against the full boiler pressure; these are driven by steam, with the usual duplicate steam and feed piping, and are situated in a pump room next the boiler house. There is a cast-iron feedwater storage tank over the pump room, with a capacity of about 9,000 gallons.

The chimney is 200 feet high, 6 feet in diameter, and is lined half way up.



Barrow-in-Furness.—Fig. 1.—General View of Engine Room.

The steam pipes form a ring main in the boiler house with single pipes to the engines, and are of mild steel; the stop valves are of Fletcher's make, and are all of cast-steel, except a few small ones of gun-metal. The exhaust pipes are carried in a trench, and terminate in a vertical pipe carried up the side of the chimney. A Green's economiser is installed, having 168 tubes in two sections of 84 each; the scrapers are driven by a small motor.

A 5-ton travelling crane was also supplied under Messrs. Babcock & Wilcox's contract.

There are at present three generating sets, each consisting of a single-crank vertical compound engine of Raworth's "Universal" type, direct coupled to a four-pole "Universal"

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dynamo (see fig. 1). The output of each set is 75 KW., at 340 revolutions per minute. The engines are familiar to our readers, and need not be described; the dynamos have toothed armatures, and are wound on Mordey's patent system for 1,100 volts, 68 amperes. The commutators are of large diameter and short length; carbon brushes are used. It has not been possible to make accurate tests of the steam dynamos as yet, but they are guaranteed to give a commercial efficiency of 84·5 per cent., with a steam consumption of 24·9 lbs. per E.H.P.-hour at full load, 25 5 at ¾ load, and 30·5 at ½ load, all non-condensing. These figures include the energy required for exciting the field magnets, which is taken from the low pressure mains.

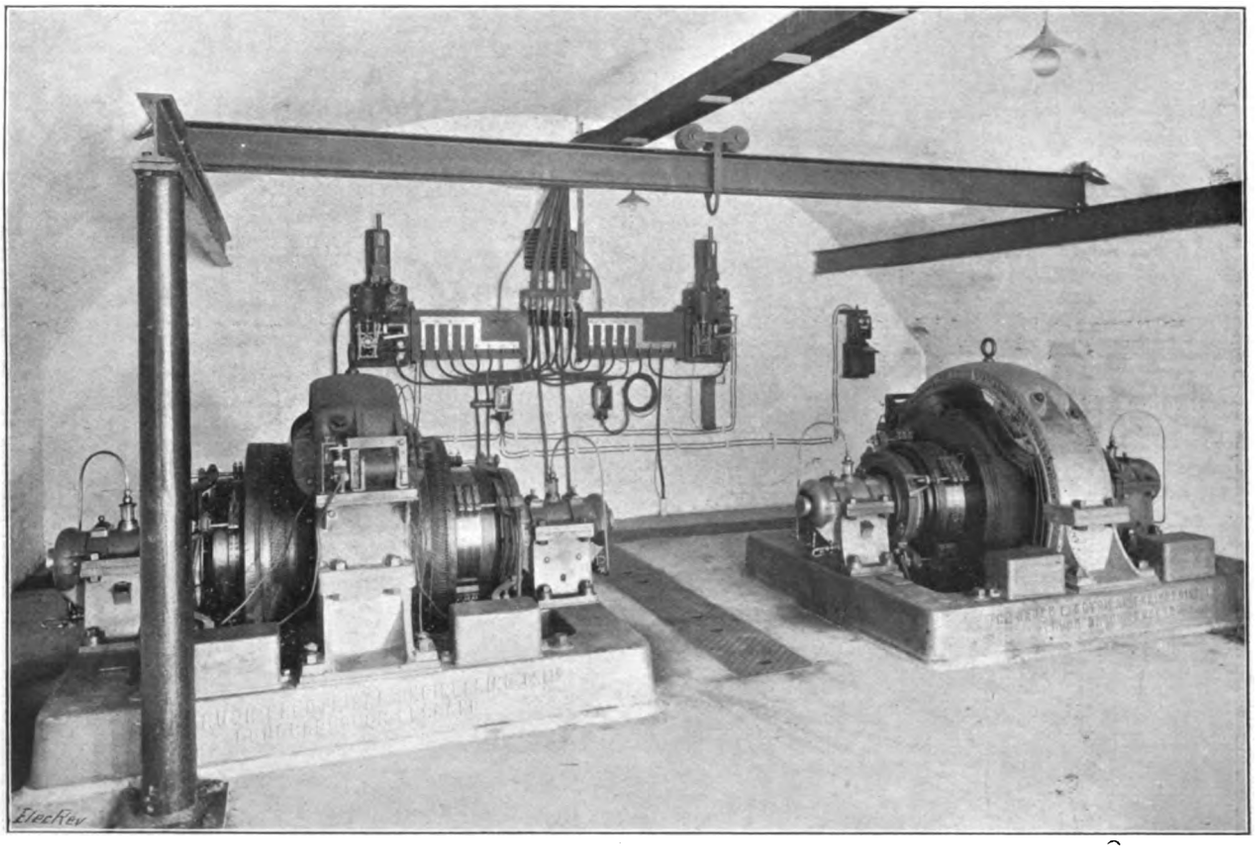
An additional set is on order for extensions, consisting of a 150 KW. low pressure generator made by Messrs. Bruce Peebles & Co., and coupled to a Willans engine.

There is in the engine-room a variable-ratio motor-transformer, taking power from the high pressure mains and supplying current at pressures from 250 to 350 volts, for charging the battery. This transformer consists of two 2-pole "Universal" machines coupled together.

centre. The latter is fitted with ammeter, single-pole switch, auto. max. cut-out, single-pole fuse, two-way single-pole switch for cutting out starting resistance, field switch, and field regulator—all on the high pressure mains; the low pressure switches are on the low pressure board at the right. On the transformer panel there is also a high pressure starting switch and resistance; this is used for starting any of the transformers, including that in the station, and is provided with an automatic release, so that when the two-way feeder switch is thrown over from the starting bus bar to the main bus bar, the resistance switch is disconnected and returned to the off position.

Each feeder panel is provided with a large dial voltmeter connected with the low pressure mains at the feeding points, and with ammeter, single-pole switch, cut-out, fuse, two-way switch, and regulator, all on high pressure, and a low pressure "firing" switch for controlling the long range switches in the sub-station.

All high pressure parts are protected by plate glass shields, as will be seen in the detail view of a feeder panel (fig. 5), to ensure the safety of the operator.



Barrow-in-Furness.—Fig 2.—Sub-station under Archway; Two 52-kw. Rotary Transformers.

The battery includes 135 cells made by the Tudor Battery Company, type L B 11, with a discharge capacity of 100 amperes for six hours, and a maximum discharge rate of 175 amperes for a short time. The battery is arranged in an ingenious manner; as it is highly desirable that the cells should all be in one tier, while the space at command was insufficient for this, a light upper floor of wooden bars was put in the battery room, to support a number of the cells.

The battery works on the network, and is able to take the whole of the light load. It can be used if necessary to work backwards through the transformer, and so to supply the high pressure sub-stations.

The switchboard was constructed by the Electric Construction Company for the Brush Company, and is of the type used at Shoreditch and elsewhere; there is a separate feeder panel for each transformer sub-station, and the transformers are controlled on what has become familiar as the "Oxford" system from the generating station, with automatic switches made by the Electric Construction Company.

There are three generator panels (on the left hand in our illustration, fig. 4) and a station transformer panel in the

The low pressure board consists of four panels, and is fitted with the usual battery charge and discharge switch (with two bars moving over the same contacts, actuated by separate handles), voltmeter, ammeter, switches, and fuses.

There are at present only three sub-stations, but more are contemplated. In each there are two similar rotary transformers of the Brush Company's make, with double-wound armatures and single fields (see fig. 2). Four of the rotaries are 52 KW. four-pole machines, and two are 25 KW.; they give no trouble in any particular, not even by sparking, and are running extremely well. One of the sub-stations is close to Furness Abbey, about two miles from the works.

The larger rotaries have field frames of the same size as the 75 KW. generators, and the armature is of similar construction. As usual, the transformer is started up, and the low pressure side is switched on the service mains, entirely from the generating station. At times of light load the transformers are shut down.

This is, we believe, the first installation of this kind carried out by the Brush Company, and the complete success

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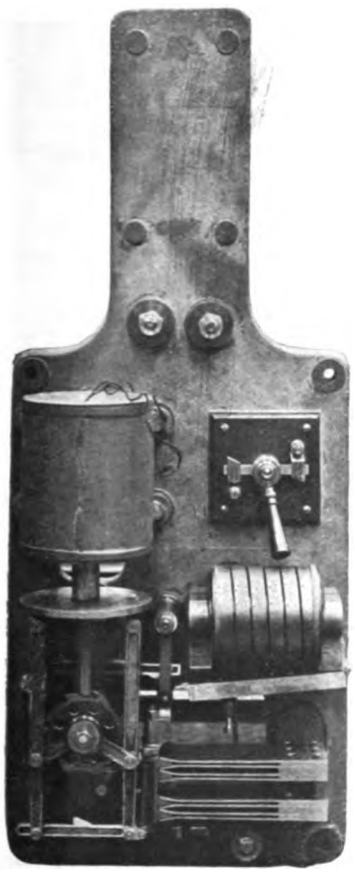
which has attended their maiden effort must have been very gratifying to the company.

Each sub-station board carries a long range switch,



Barrow-in-Furness.—Fig. 3.—Automatic Switch in Sub-Station.

actuated by a solenoid in series with the pilot wires. On short circuiting the voltmeter wires with the "firing" switch in the works the switch is closed, connecting the secondary of the transformer with the network. An automatic cut-out releases the switch when the current falls to zero or reverses. Each switch has also been provided with a maximum demand meter, which is not seen in our photograph, fig. 3. There are no batteries in the sub-stations.

The whole of the cables were made and laid by the British Insulated Wire Company, Limited, and are paper insulated and lead covered; the feeders are concentric, and are drawn into earthenware pipes, chiefly of Doulton's make. The longest feeder, which runs to Furness Abbey, is of 0·062 square inch cross section; the remainder are 0 048 square inch. A low pressure feeder from the works to the nearest point of the network is 0 15 square inch. The distributors are of three sizes, but chiefly 0·5 and 0·25 square inch, and are laid usually on both sides of the roadway, on the solid system.

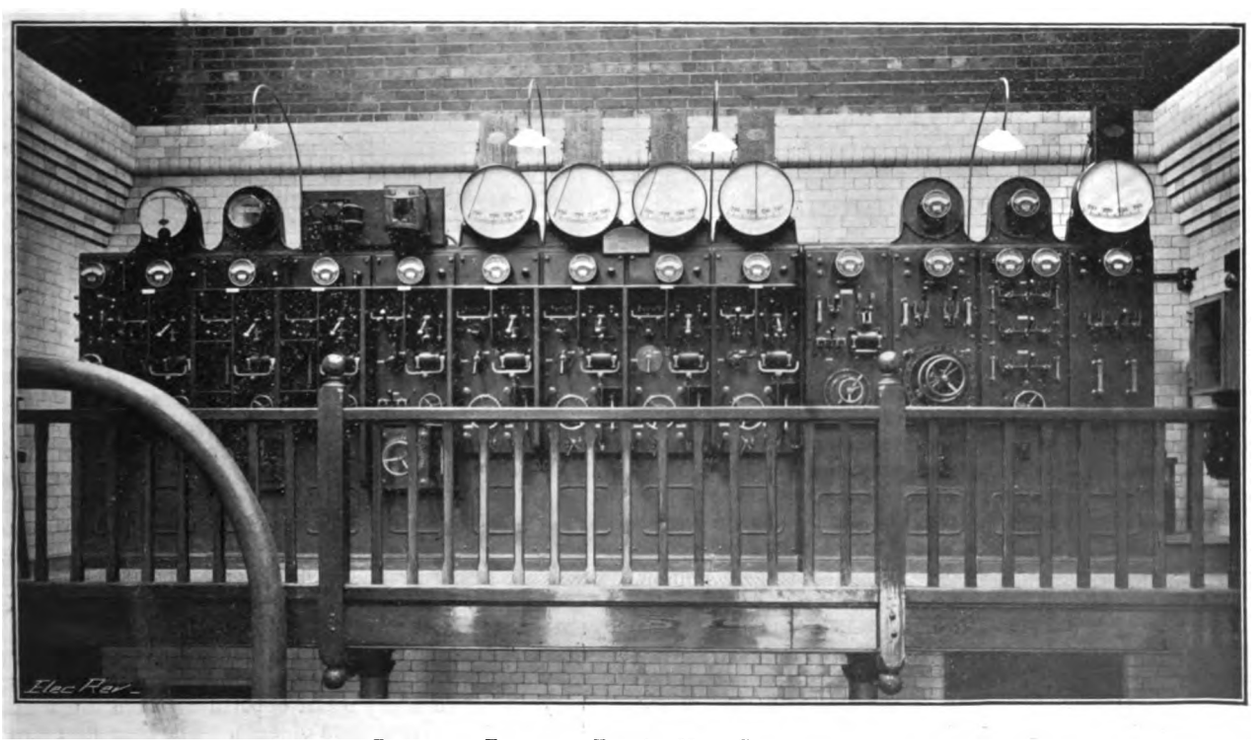
There are at present 21 arcs for public lighting, arranged in series on the 1,100-volt mains, along the chief business streets; the posts, of which we give an illustration (fig. 6), are similar to those in use at Edinburgh, and carry two glow lamps in addition. The glow lamps are substituted for the arcs at midnight by means of an Edmunds' switch. The lamps were made and erected by Messrs. Crompton & Co., Limited, with British Insulated Wire Company's cables. Amongst other large buildings the Town Hall is supplied, but no dock lighting has been taken up at present; nevertheless the plant would have been fully loaded up in the early spring if the street lighting had been in use, and the extensions will certainly be required before next winter.

Mr. H. R. Burnett was appointed electrical engineer to the Council at an early date, and is now the resident engineer. The work was carried out by Mr. O'Brien for the Brush Company, under the superintending engineer, Mr. R. A. Dawbarn, while Mr. Forrest represented the British Insulated Wire Company.

In conclusion, we beg to tender our thanks to Messrs. Kincaid, Waller & Manville, the consulting engineers, and to the various contractors who have kindly afforded us particulars of the undertaking.

EVAPORATIVE CONDENSERS.

We are sorry we cannot reproduce the whole of Mr. Oldham's recent paper on "Evaporative Condensers" read before the Institution of Mechanical Engineers. The evaporative condenser is necessarily also a surface condenser, but differs from this in having a limited supply of water. For condensation



Barrow-in-Furness.—Fig. 4.—Main Switchboard.

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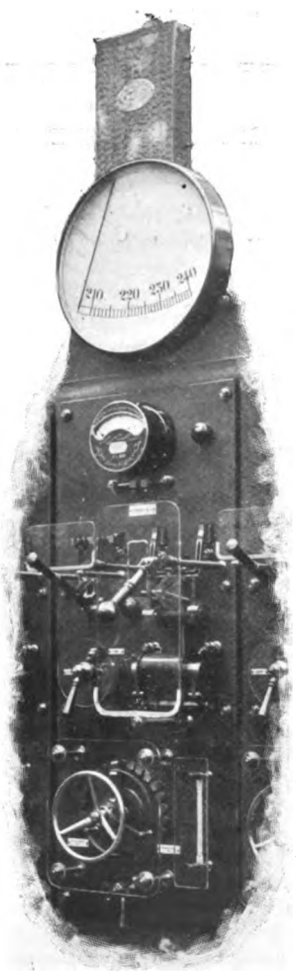
with vacuum, the cooling water must be 20 to 30 times the weight of the steam condensed. In the evaporative condenser the latent heat of the steam to be condensed is transferred as latent heat to the cooling water which disappears. The exposure of the cooling water to, preferably, a moving atmosphere, enables the air to carry off some of it as vapour, and water cannot exist as vapour without latent heat. But it is not simply requisite to absorb the latent heat and leave water at 212°.

This would not produce the vacuum which is aimed at, and it is therefore requisite that, besides transferring latent heat, there must be a transfer of sensible heat. To effect this the steam must be cooled to about 100°. Obviously much of the success of an evaporative condenser depends upon the efficient covering of the pipes with thin films of water and the complete movement of the steam inside such pipes. Also the movement of the external air should be provided for. The movement of the air is very sluggish, especially in hot weather, and it is often remarkably sluggish when most laden with natural moisture. Such conditions are inimical to successful working.

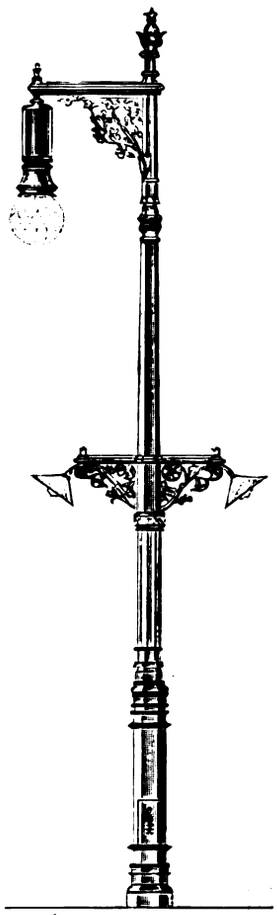
In water-cooling towers considerable success has attended the employment of fans to compel atmospheric movement and promote evaporation, and it seems to us that if the evaporative condenser were enclosed in a light casing and exposed to a mechanically-produced movement of air its operation would be made more certain. The sides of the casing might be made to open in windy weather, so as to save the fan power, which would not, however, be great. The Fraser condenser is one which does make use of fan draught. An apparatus for 600 H.P. employs four fans of 66 inches diameter run at 300 r.p.m. The ground space occupied is 1 square foot per 5 H.P. The Thiesen condenser is also fan cooled. About



Barrow-in-Furness.—Fig. 5.—High Pressure Feeder Panel.

one-seventh of the steam condensed is required in the shape of cooling water, and the fan power required is about 2 per cent. of the total power.

A minimum of 1 square foot of tube surface per 8 lbs. of steam per hour is provided. About 20s. per H P. is the cost of evaporative condensers.



Barrow-in-Furness.—Fig. 6.—Lamp-post.

The cooling tower for cooling large quantities of water has the disadvantage that the water requires to be raised to a considerable height, and in its fall through the apparatus it gives back no useful energy.

Evaporative condensers call for much less pumping. Evaporative condensers must be placed, as a rule, some distance from their engines. They introduce the risk of air leakage at the numerous pipe joints which are necessary, and it is essential that special care be taken in this respect, so as to minimise air leakage. The exhaust pipes should be well painted. On the discussion which ensued on the reading, various speakers expressed themselves somewhat unfavourably. It is easy to understand this, for in applying the principle of condensing it is not merely sufficient to provide so much tube area and so much cooling water. The water and the surfaces must be brought properly together, and the steam on the other side of these surfaces must be made to touch such interior surfaces and circulate properly. We have seen a surface condenser absolutely useless for lack of a bit of sheet-iron spreading plate to prevent the exhaust steam going too directly through the condenser; hence the importance of carefully considering all details of the arrangement. Happy indeed is the engineer who can run a perennially flowing stream through his surface condensers! We are much inclined to agree with Mr. Fraser that it is not necessary to secure very thin films of water flowing over the tubes. Thin films may entirely dry off; they are always apt to be partial in their covering effect, and they do not offer any better opportunity than thick films for the absorption from them of heat. The thin film idea is, in fact, probably one of those mistaken ideas which arise from want of sufficient thought. The maximum thickness of film is, of course, reached when gravity would pull the water off a tube at its horizontal diameter against the adhesion which prompts the water to flow round the pipe and only drop off at the lowest point.

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NOTES.

(*Continued from page* 192.)

City and Guilds of London Institute.—At a meeting of the Council of the City and Guilds of London Institute held on Monday afternoon, it was resolved to confer the Fellowship of the Institute (F.C.G.I.) upon William J. Pope for the valuable and original chemical research work which he has done since he gained his diploma of Associate of the Institute; and upon Arthur E. Childs for the services he has rendered in developing several new branches of engineering industry. The Fellowship of the Institute is conferred by the Council upon those who, having obtained the Associateship of the Institute and spent at least five years in actual practice, produce evidence of having done some original and valuable research work, or of having otherwise contributed to the advancement of the industry in which they are engaged. According to a note in the *Times*, the diploma of Associate of the City and Guilds Institute (A.C.G.I.) was awarded to the following matriculated third-year students of the Central Technical College who have completed a full course of instruction as prescribed by the Council:—Civil and Mechanical Engineering.—F. E. Whittle (Siemens medal), A. P. Ackery, H. C. Armstrong, R. Arthur, C. L. Bryden, E. W. Cook, W. H. P. Craig, H. Danell, S. Gowan, P. Hackforth, J. Hammersley-Heenan, G. A. Hicks, A. G. Hounsfield, J. I. Hunter, J. A. Parker, A. Reynolds, S. Robertson, F. Shœberlein, T. B. Smith, A. D. Tisdall, F. N. Trier, E. Way, W. White. Electrical Engineering.—F. C. Hounsfield (Siemens medal and premium), W. H. Arundel, C. Calliphronas, F. Fernie, R. MacKay, F. Miller, J. St. V. Pletts, L. Redmayne, F. G. Sharp. Chemistry.—F. G. H. Billows, A. Bunce, E. J. Fairhall, S. S. Napper, F. J. Plymen, Miss A. R. Rollinson, L. P. Wilson.

Personal.—Mr. A. G. Marshall, late assistant engineer at the House-to-House Electric Supply Company, Limited, has joined the staff of Messrs. Preece & Cardew, consulting engineers.

It is stated that Mr. P. O. L. Moll has resigned his position of traffic manager of the Direct United States Cable Company, and that the resignation has been accepted.

The Crown Agents for the Colonies have appointed Mr. W. Phillips (late assistant engineer and electrician of the Bangkok electric lighting station, Siam, and late consulting electrician to Howarth Erskine, Limited, engineers, Singapore) assistant engineer at Lagos. He leaves on the 12th inst.

The Wolverhampton Town Council has confirmed the appointment of Mr. C. E. C. Shawfield as electrical engineer, at a salary of £300 per annum.

Mr. B. H. Jenkinson has resigned his position as manager to the National Electric Wiring Company, Limited, for the purpose of going into business with Mr. A. C. Hands, manufacturer of electric light fittings, art metal work, switchboards, switches, and accessories, Garlick Hill, Cannon Street, E.C.

Effects of Lightning on Beech Trees.—The consulting botanist of the Royal Agricultural Society of England, in investigating a disease affecting beech trees, had found that the damage was primarily due to the effects of lightning. The committee has suggested the desirability of publishing a note in the journal on the susceptibility of different species of trees to injury from this cause.

The New Knights.—Sir W. H. Preece, and Sir G. H. Murray, secretary to the General Post Office, journeyed down from London to Osborne on Wednesday to be personally invested by Her Majesty with the insignia of the Orders to which they were recently admitted. A very fine portrait of the former gentleman appears in *Fielden's Magazine* for this month.

Good Business.—We read in an evening paper that the London County Council may, in the autumn, have before it a proposal to spend £1,000,000 upon the conversion of its tramways to electric lines.

NEW COMPANY REGISTERED.

Deansgate Foundry, Limited (63,058).—This company was registered on July 24th, with a capital of £25,000 in £1 shares, to acquire and take over as a going concern the business now carried on by Edward Bennis, under the style or firm of the "Deansgate Foundary Company," at Deansgate, Bolton, Lancashire, to enter into an agreement with the said vendor, and to carry on the business of electrical and mechanical engineers, machinists, fitters, founders, millwrights, smiths, wire drawers, annealers, ironmongers, tool makers, &c. The first directors (each with one share) are:—Edward Bennis, Beech Hill, Astley Bridge, Bolton, engineer; Ernest H. Lowden, 28, Victoria Street, Westminster, engineer; Alfred W. Bennis, 28, Victoria Street, Westminster, engineer; Edwin Haslam, 21, Mawdsley Street, Bolton, auctioneer; John Balshaw, 22, Acresfield, Bolton, solicitor; William Geipel, M.I.E.E., Parliament Mansions, Westminster; Edwin J. Taylor, 75, Seventh Avenue, Manor Park, Essex, clerk. The number of directors is not to be less than three nor more than seven; the first are Ernest H. Lowden, William Geipel, Alfred W. Taylor, and Edward Bennis (managing director); qualification, £500; remuneration as fixed by the company.

CITY NOTES.

City and South London Railway Company.

The half-yearly meeting of this company was held at Winchester House on Tuesday, Mr. C. G. Mott, presiding.

The Chairman, in moving the adoption of the report, which was printed in the Electrical Review last week, regretted that he could not again announce an increased dividend. This was partly due to the loss of traffic consequent upon the tramway competition. Ordinary business competition they did not object to, but the competition to which they had been subjected by the London County Council—who had taken over the tramways, and were reducing the fares below a legitimate paying point in order to draw from the electric railway—was not a fair or business competition. This had, to some extent, reduced the earnings of this line during the half-year, but the punctuality, comfort, speed and other facilities which they gave on the City and South London Railway, were so appreciated by the public that even with that competition they were able to hold their own, to show an increase in the number of passengers of 61,121, and in the receipts of £392. They had fair reason to be satisfied with such a position. The most important part of this railway was the question of its future extensions. Hitherto, it had been a purely isolated line connected with nothing, three miles in length and dependent purely upon the local residential traffic. The extensions which would be opened in a few months would connect them with almost every railway system which had its terminus in the metropolis. They hoped this would justify the recommendations which they had made from time to time, and the authority given to the board to spend the money upon these extensions. They expected the extension to Moorgate Street to be opened in October. That to Clapham was following close after it. The work was getting on exceedingly well, and they had full hopes that they would be able to get it opened in January. Then they would have a system of a very different character in every respect to the present one. He hoped that the traffic, as it developed, would prove of a thoroughly remunerative and satisfactory character. The extension to Islington had been started. It would take some time to carry out, probably another year and a half, or perhaps more. That extension would be one of the most valuable pieces of their line, and the most valuable extension made or to be made. To work all these lines they had to put down a very large additional generating plant. They had endeavoured to make it as up to date as possible. It had been very well thought out by their engineer and others, and he hoped that it would not only do its duty well, but economically—more economically than the present plant which was now 10 or 12 years old, and since the time it was put down a great many improvements had been made in electrical machinery. They were providing also new rolling stock, which was necessary. They had the full complement of the carriages in their possession, and the engines were making considerable progress. They issued the capital for the Islington extension in March, and it was all subscribed at the price at which it was issued, and it had placed them in a position to go on with that line without any possible delay. They had for some time been in treaty with the Brighton Company for the connection of their station at London Bridge with the Brighton Company's station. Considerable difficulty had arisen as to the mode in which that was to be constructed, and they had now settled it satisfactorily, and had agreed that it shall be the joint property of the two companies, owned and worked jointly. They proposed to do very much the same thing with the Great Northern and City Railway Company at the Old Street station. Though not yet settled, the general terms were agreed upon, and there would be a joint station there, so that passengers may walk from one platform to the other. The board was doing its best to make complete the connections of this line with the other railway systems, and to do it, both in construction and future working, as economically as possible. Turning to the accounts, the capital account showed that the amount received on shares during the half-year was £248,722, that being the gross nominal amount taking the shares of the last issue as issued at par. Then they received for debentures £48.000, and in premiums £22,114, making a total receipt of £318,836. They had expended during the

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half-year £182,518, and there had been written off as discounts £130,923, particulars of which appeared in the statement No. 4 in the report, making a total of £312,541. The receipts from passengers showed an increase of £392, and there were various other small increases making the total increase for the half-year £573. The expenditure showed increases in maintenance, traffic expenses, general charges, law charges, and rates and taxes, and decreases in locomotive and carriage expenses, making a net increase in expenditure of £237. The receipts had increased by £573, and the expenditure by £237, leaving a net increase of £336. This half-year the interest on increased number of debentures had to be paid and an increase of the dividend upon the first preference shares. They had to pay £2,276 increased interest and dividends upon these, and against that they had increased interest of £2,333, chiefly arising from arrangements of certain contractors and others to pay interest during the half-year. That had added to their ordinary interest receipts so that they amounted to £2,333 leaving a balance of £193 to the good altogether. In regard to the percentages of working, there was one very satisfactory feature this last half-year, and that was the slow but steady increase in the number of passengers carried per train. It was most important on all railways to fill up the trains and have as little dead weight as possible. He doubted if there was a railway anywhere which could show such a large percentage used as the City and South London. Their seating capacity was 96 per carriage, and they had carried an average this half-year of 47½, which was very good, compared with only 46½ in the previous corresponding half-year. The receipts per train-mile had increased from 7s. 4½d. to nearly 7s. 6½d. The receipts per passenger were 1·90d. in 1898 and 1·91d. this year. There was not much room for increase under this heading. The total working expenses had decreased from 56·57 to 56·36, they went down steadily, and that spoke volumes for the management. The expenses per train-mile had increased from 1s. 3·92d. to 1s. 4.17d. The locomotive charges and the traffic expenses remained almost exactly the same percentages as before. There was a general increase in passengers carried in every division. They carried passengers at varying fares from 1d. to 3d., and there is a steady increase in all those fares all over the line, and at all hours. After the meeting closed a special meeting would be held for turning both classes of preference shares into preference stock, which were all fully paid up. At a later meeting they would ask them to convert the £225,000 ordinary shares because they would be all paid up very shortly, the last instalment becoming due that day. The dividend also on the 5 per cent. preference shares of 1896, was for this half-year and the next, carried to capital account. He hoped that long before they had to meet the dividend on those shares they would have a large traffic on their extension to do so.

The adoption of the report was seconded by Mr. G. S. Grenfell, and carried unanimously, after Mr. Drake, a shareholder, had said complimentary things about the directors and officials, and one or two questions had been asked and answered by the chairman. One speaker asked whether there was no way of improving ventilation so as to remove the present "stuffiness" of which passengers complained, and another shareholder asked whether, when the extensions were carried out, the present fitful and unsatisfactory lighting of the carriages would be improved. The Chairman said that the stuffiness would only be found to exist when the trains were crowded, and that was noticeable on all railways at overcrowding times. As to the lighting, that matter had exercised the attention of the company perpetually since the opening of the line. The lamps were lighted with current direct from the line, and there was extreme difficulty in effecting satisfactory lighting. As soon as the extensions were ready, the arrangements made would ensure a perfectly steady light. The resolutions declaring dividends having been passed, the meeting became "special" for passing the necessary resolutions converting the preference shares into stock.

The usual vote of thanks closed the meeting.

Globe Telegraph and Trust Company.

The twenty-sixth ordinary general meeting of the shareholders of this company was held on Friday last at Winchester House, Old Broad Street, the Marquis of Tweeddale presiding.

The Chairman, in proposing the adoption of the report, said that the receipts showed a further increase as compared with the previous year. The total receipts, after deducting expenses, amounted to £197,890, as against £196,974, or an increase of £916. That was the more satisfactory when it was borne in mind that those figures compared with the receipts of a year which showed an increase of £10,000 over the preceding year. The expenses of working the Trust, which were never high, were £174 below those of last year. The net result of the year was that they were able to recommend the payment of a final dividend of 4s. 6d. per share on the ordinary shares, as against 4s. 3d. per share last year, in other words, in addition to the usual 6 per cent. on the preference shares, they had funds available for the payment of a dividend on the ordinary shares at the rate of 5¼ per cent., as against 5½ per cent. for the preceding year, leaving a balance of over £1,000 to be carried forward to the next account. That was the second time in the history of the company that they had paid such a good dividend. Turning to the more important investments held by the Trust, he said that their holding in the Anglo-American Telegraph Company had been further reduced since the last meeting by the sale of 10,000 nominal, of the "A" or deferred stock, the price being the highest such stock had reached during the last two years. Their holding in the Brazilian Telegraph Company had been largely increased, due almost entirely to the fact that the shares formerly held in the Western Brazilian Company had been exchanged for shares in the Brazilian Company on the basis of five shares in the latter company for every six ordinary shares of the former. They had also bought some additional shares in the Brazilian Telegraph Company on profitable terms. The debentures formerly held in the Commercial Cable Company, had been sold during the year, and the proceeds invested in some of the Brazilian shares, the sale of that stock realising a profit of £9,500. Their holding in the Direct United States Cable Company required a little explanation, for while their actual receipts from that company during the financial year had been a little less than those of the preceding year, the position of the company had decidedly improved, and they were paying a better dividend than for some years past. The fact was that for 1896-97, the company paid a very small interim dividend, and their final dividend, which they received at the beginning of last year, carried with it a bonus, which went to swell the receipts of the Trust for that year unduly as against the present. With reference to the Eastern and Eastern Extension Companies, a good deal of alarm had been created in the minds of shareholders by the proposed Pacific cable, but he was glad to say that they had received a positive assurance from the Colonial Minister that the Government did not intend to compete with those companies other than on fair commercial lines. They had sold 150 debentures of the Telegraph Construction and Maintenance Company at a profit of £450, and had invested the proceeds in the Brazilian shares, to which he had before referred. Their investments in other companies remained about the same, and it would be satisfactory to the shareholders to know that, notwithstanding the recent fall in the shares of some of the companies in which they had investments, their investments, as a whole, still showed a profit of nearly £700,000 over the capital.

Sir J. Pender, Bart., M.P., seconded the resolution, which, after a short discussion, was carried.

Edmundson's Electricity Corporation, Limited.

The second annual general meeting of this company was held on Friday last, at the offices of the company, Broad Sanctuary, Westminster, Mr. J. R. Wigham, J.P., presiding.

The Chairman, in proposing the adoption of the report, said that at the last annual meeting he submitted to them a short statement as to the formation of the corporation and its operations up to date. At that date several of their central lighting stations were nearing completion, and there had now been finished—in fact, during the last year they had completed no less than nine important stations, viz., at Folkestone, Winchester, Woolwich, Bromley (Kent), High Wycombe, Salisbury, Newmarket, Ventnor, and Chislehurst. Most of these had been working long enough to enable them to form an estimate of the results they might expect. At Folkestone the number of lights taken up had been so satisfactory that a fair dividend is assured upon the first year's working, a result seldom obtained on the first year's working of electric lighting stations. In most of the other towns the demand for electric light had been very satisfactory, and they all promised to give fair interest upon the capital invested within a very reasonable time. As the report showed, the directors had been encouraged by these results to take up the lighting of a number of other towns, for which they have been able to obtain the necessary powers, and during the present year several other stations will be completed and ready for working, including one for Guernsey, where a valuable concession under a special Act has been obtained, and where the prospects are particularly encouraging. The accounts spoke for themselves. The directors had been careful to take into account only such profits as had been realised as cash, but the balance-sheet showed a large sum, viz., £87,319, to the credit of the corporation for investments at cost. This item represents shares and debentures which the company holds in the various local companies, the face value of which is of considerably greater amount than that set down in the balance-sheet. There is also another large amount, viz., £67,129, expended upon unfinished work in various towns, which has also been taken at cost, the profit on which items will appear in future accounts. These two items constitute a substantial reserve profit, which, when realised, will be available for future dividends. He congratulated the shareholders upon the report, which clearly indicated that a very substantial measure of success had attended the operations of the corporation during the past year. On the last occasion he intimated that they would have to raise further capital. This they had done by the issue of debenture stock for £75,000, which was offered in the first place to the shareholders, and was largely subscribed for by them. It appeared to him that their debenture stock at 4½ per cent., secured as it was by the valuable property of this corporation, was an excellent investment. The directors now propose to issue the remainder of the authorised ordinary share capital. The amount already issued is £153,000, and it is proposed at once to issue the balance of £47,000. The shares of the company are now quoted at a premium of 15s., which is equal to about 10 per cent. premium, ex dividend, and it is proposed to offer this fresh capital to the present shareholders at par.

Mr. W. R. Davies seconded the motion.

Mr. T. Powell asked whether the directors had taken into consideration the question of entering upon electric traction. He had heard that the British Electric Traction Company had gone into electric lighting, and he thought he was correct in saying that the Isle of Thanet Company was also going in for electric lighting. Considering the unique opportunity this company had before it on the Isle of Wight more particularly, it certainly might be well to enter upon electric traction. He had often seen in the Electrical Review that their corporation met with opposition in its proposals for electric lighting in one quarter and another, and in view of this, it might be advisable for them to have two strings to their bow in this sense. If they were beaten by a municipality which proposed to take

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upon itself the lighting of its particular town or district, the company might under those circumstances suggest the placing of themselves at the disposal of that town or district to carry out the work.

The Chairman said the question about traction was a very important one, and it had by no means escaped the attention of the directors. They had not taken it up with a view of carrying it out necessarily, but with the idea of giving it careful consideration. There were many things that had to be thought of before a matter like that was taken fairly in hand, one being the question of capital. To enter upon electrical traction successfully would require a very large capital. Of course there was nothing more natural, when a company was established and had large power houses for lighting, than that they should also desire to use that current for traction or *vice versâ*. But there were difficulties, however, to be overcome in connection with existing supply corporations and other matters.

Mr. Gripper said there were, of course, a great many ways of dealing with a local authority, and this company did not confine itself to one method by any means. In several cases where they had found the local authority had entirely made up its mind to stick to its own order, they had entered upon negotiations with it for letting the company carry out the works, the local authority finding the money, and granting a lease of the works for a certain number of years. If, for instance, a town was not very certain of being able to work the thing properly, it might be glad to get a company like this to put the works up and run them for three, four, or more years, the company undertaking that the municipality should incur no loss on them, that the interest and sinking fund they had to pay in respect of their loans would be paid by the company who would run the works and take what profit could be made out of them. It was, however, exceedingly difficult to get local authorities to allow companies to step in; they had a great idea that electric lighting was a profitable undertaking, and were inclined to keep the powers themselves. There was no doubt they were wrong in doing it, because very few local authorities were able to make a small station pay. The results that that corporation had got in connection with small stations were much better than those shown by any local authority. No local authority, with hardly an exception, had made both ends meet in the first year after it had carried out the works itself. When they started a moderate sized station in the town where people had always been afraid to go in for electric light, the first year must be regarded as satisfactory if there was no loss incurred. As a matter of fact, the schedule sent out with the report showed that in all the stations they had been running during the last six months—in nearly every case it being the first six months of their running—they had not only paid working expenses, but they had a small balance over as profit. Of course, if they could do that in the first six months, when the number of lights were small, they would get a further increase in the future. The motion was then carried unanimously.

A dividend was declared at the rate of 6 per cent. on the ordinary shares for the year ending March 31st, 1899, and a dividend of 1 per cent. being the balance of dividend unpaid on the ordinary shares for the year ending March 31st, 1898.

Mr. J. R. Wigham having been re-elected a director, Mr. W. H. May was re-appointed auditor, and the proceedings terminated.

House-to-House Electric Light Supply Company.

Mr. W. Page presided on Thursday, last week, over an extraordinary meeting of the above company held at Winchester House, for the purpose of altering the articles of association, by passing the following resolutions:—

"1. That the name of the company be changed to the Brompton and Kensington Electricity Supply Company, Limited. 2. That the 101st article of association be cancelled, and that the following clause be substituted therefor:—(Article 101).—The directors may, from time to time, at their discretion, borrow or raise money at interest for the purposes of the company, and may raise and secure such moneys and interest, and the repayment of such moneys, in such manner and upon such terms and conditions in all respects as they may see fit, and particularly may create, issue, make and give respectively any perpetual or redeemable debentures or debenture stock, or any mortgage or charge on the undertaking, or the whole or any part of the property, present or future, or uncalled capital of the company, provided that the directors shall not borrow or raise any sum of money which would make the amount borrowed or raised by the company and then outstanding, exceed the paid up capital of the company for the time being."

The Chairman, in moving the first resolution, said it was scarcely necessary to make any remarks as to the object of the change. The present name was that given to the company at its inception, about 10 years since, at which time the then board had very great ideas as to what they were going to do. They were not to confine their operations to Kensington and Brompton, but were to go all over the kingdom. They applied for provisional orders in Scotland and Ireland and other parts of England, but when the present board came into office they found it very desirable to abandon that policy and to confine their operations pretty much to Kensington, and finally to quite confine themselves to Kensington, and now they had no interest to speak of beyond Kensington and Brompton. Therefore, it seemed most desirable, for Stock Exchange purposes, that the locality of the company should be indicated by its title. He did not know that they had any other reason for changing it than that. When the district they supplied was thus indicated it would help to give a better value to the shares, because only those interested in the company now knew that they supplied Kensington and Brompton.

Mr. R. Davies seconded the resolution, and it was carried.

The Chairman then moved the second resolution, and said that under the old articles of association their present borrowing powers were £100,000. They had not reached that yet, but they thought when they were having a meeting, it would be desirable to bring themselves into line with other similar companies with regard to borrowing powers. It was a matter of finance in which he did not take a very deep interest, although they had several gentlemen on the board who were fully alive to all that went on, and they considered it desirable that this should be done.

Mr. W. F. Lemesle seconded the motion.

Mr. Matthews asked if there were any debentures at present knocking about.

The Chairman said there were £50,000 debentures of 4½ per cent. redeemable, at six months' notice, at 107½. Probably one of their next operations would be to redeem them.

Mr. Matthews said he was very glad to hear that, and he would like to know when they issued new debentures, if the board would give the shareholders a pull over the outside public?

Mr. Davis said it had always been the custom of the board to give the shareholders a preference, and he did not suppose that they would depart from that principle.

The motion was then carried.

Consolidated Telephone Construction and Manufacturing Company, Limited.

The eighteenth ordinary general meeting of the shareholders of the above company was held on Thursday, last week, at Winchester House, E.C., when the chair was taken by Mr. A. H. Baker.

The Chairman said his duty was a very short one, because since he had come into the room he had heard for the first time of the resignation of his old colleague the chairman, Mr. C. L. W. FitzGerald. Hearing that only half an hour ago, and having been connected for so many years with Mr. FitzGerald, it was his intention, after moving the first resolution—without going into any details—to hand in his resignation to the shareholders so that they might fill up the vacancy with whom they liked. He would first ask the secretary to read the letter of resignation from Mr. FitzGerald.

Mr. C. Curtoys (the secretary) read Mr. FitzGerald's letter, which stated that the shareholders had, by their votes, informed him that they did not consider his services necessary, and under the circumstances he thought it best not to attend the meeting. In placing his resignation in the hands of the shareholders, he wished to state that the paragraph in the committee's report, which alleged that he resented any interference with the general manager, was absolutely untrue. When he joined the company 15 years ago he found it hard to raise even £500 on the assets, but they had since paid a great deal to the shareholders, and the assets were still worth £50,000. If the new directors did as well, he, for one, would not grumble.

The Chairman then put the motion that the report be adopted, and that a dividend of 1 per cent. per annum be paid.

Mr. H. Grewing seconded the motion, and it was carried.

The Chairman said he had now to leave the chair, and he did not know who was going to take the place. He could only say that he wished the company every success, and he trusted that the gentlemen who replaced them would make it more prosperous than they had done in the past. It had not been for want of trying that the company had not been more prosperous. They had tried to deserve success notwithstanding the comments of one or two shareholders, who were not satisfied with what they had done.

The solicitor invited Mr. Grewing, the remaining director, to take the chair, but on his declining, Mr. Stoop was elected by the shareholders as chairman.

Mr. Stoop said he was sorry it had been necessary for them to place him in that position, but it would be wise not to rake up any incidents which had occurred in the course of the performance of the duties of the committee. He was sure that they would all regret the death of Sir A. Armstrong, who was largely responsible for preventing the company being wound up. The committee had acquired the conviction that there was life in the old dog yet, and that the company could be made to flourish. Personally he felt grieved that he had been obliged to place himself in opposition to Mr. FitzGerald, for whom he had the most friendly feelings, and he trusted that that gentleman, when the troubles of the company were forgotten, would reciprocate these feelings. Mr. Baker had been a good and useful director for many years, but the committee felt itself obliged to assume a position of opposition to him. There were two gentlemen nominated as directors, viz., Mr. Hubert Jackson and Mr. C. Woolley, and he moved that they be elected directors of the company.

Mr. W. R. Lawson seconded the motion, and it was carried.

A Shareholder asked if Mr. Stoop would go upon the board, but that gentleman declared that it was quite impossible.

The auditors having been re-elected, the meeting closed.

Central London Railway Company.

The report for the half-year ended June 30th states that the expenditure has amounted to £396,908, the total to June 30th, 1899, being £2,841,985. The amount of £432,354 shown in the accounts as due to the Electric Traction Company, is for work done and plant supplied. Notice will shortly be given of the final call of £2 per share, which will be payable on September 1st on the partly paid ordinary and preferred capital. The whole of the main line and station tunnels are completed. The permanent way is in position throughout the up and down tunnels, and the lifts and gear for working them are being erected. The large buildings at the generating station at Shepherd's Bush are practically finished. The boilers, engines, and dynamos are now in position, more than half of the electric locomotives are ready, and rapid progress is being made with the electrical

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installation generally. The carriages are being constructed, and several are ready for delivery. The station buildings are well in hand, and, with the exception of Shepherd's Bush, Davies Street, Chancery Lane, and Post Office, are approaching completion. In February last the engineers were enabled to make arrangements for the construction of the steel roof of the Bank station and public subways, to be proceeded with by day as well as by night, and this work has now been completed. The underground booking hall is also in a forward state. The Bill promoted by the company for an extension of time for the completion of the works, and for an increase in the sum authorised to be paid as interest during construction, which was submitted to the proprietors for approval at the last half-yearly meeting, has passed both Houses of Parliament unopposed, and now awaits the Royal assent. The Bill promoted by the North-West London Railway Company for an underground electric line from Cricklewood to the Marble Arch, with a subway connection to the Central London station there, has also been approved by Parliament.

The eighth half-yearly general meeting of the shareholders of this company was held on Wednesday at Westminster Palace Hotel, Sir Henry Oakley presiding.

In proposing the adoption of the report, the Chairman said that during the half-year they had spent £396,000 on the certificates of the engineers, which made their total expenditure, down to date, £2,841,985. They were nearing so rapidly the end of their work, that it was necessary to make the final call upon the shareholders on September 1st. The position of the railway was that it was fast approaching towards completion, and they would see by the engineer's report the amount and the nature of the work that had been carried on during the last half-year. Happily they had met with no trouble or disturbance to impede the steady progress of the works. As he had explained on previous occasions the nature of the work rendered it unavoidably slow. The whole of the underground work must be carried out and completed before they could commence that on the surface. Everything had gone on very satisfactorily, and several members of the board had the pleasure a week ago of travelling from one end to the other over the permanent way, and of seeing that they were in a substantial condition towards reaching the final end of the work. At the Mansion House, where they had met with some trouble, everything underground had now been happily accomplished, while the whole of the railway was supported by their steel roofs, and the shafts to reach the lower station were completed. The larger tunnels for the stations were also finished, so that what they might term the substantial fabric of the undertaking at that point had passed all chance of danger or further difficulty. The City authorities helped them most materially by allowing them to work on a small portion of the surface by day as well as by night, thus shortening the time of construction by at least three or four months. It would be interesting to know that when the directors made the journey the other day from end to end they found the atmosphere of the tunnels thoroughly enjoyable, in fact, it was far more pleasanter than on the surface. At Shepherd's Bush, their Western terminus, their works had gone on exceedingly well, the whole of the large buildings were finished, the boilers were fixed, the dynamos, the engines, and the motors for hauling the trains were fast approaching towards completion, and the place now looked a busy hive of machinery that promised well for their future ability to carry on the railway successfully. Eighteen out of the 20 motors were ready, the electric fittings were advancing, and all the cables necessary for the conduct of the electric force from one end to the other were upon the ground and in hand. There was, however, still a vast amount of detailed work to be done, and such work could only be carried on slowly and with the greatest possible care and circumspection. The carriages were being completed, and there was no doubt they would be ready by the time they required them. The stations were probably the least forward, for the reason they could not undertake them until the underground work was completed, but they were all making good progress. In conclusion, he said that another company had obtained a Bill to form a railway from the Marble Arch to Cricklewood, which would be connected with their line at the former place.

Lord Ratemore seconded the motion.

In reply to questions, the Chairman said that he must forbear from making any promise as to when the line would be open, for the reason that he could get no promise from the engineer. He told them the work was so difficult and so important, and needed so much careful attention, that while he undertook that every possible diligence should be exercised he thought it unwise to make any promise. They were, however, justified in saying that the railway was rapidly advancing towards completion.

The report was then adopted.

Imperial Tramways Company, Limited.

Extraordinary general meetings of the shareholders of this company were held on Saturday at the offices of the company, Clare Street House, Bristol, Mr. George White, chairman of the company, presiding.

The Chairman explained that the first meeting was called for the purpose of making a few formal alterations in the articles required by the committee of the London Stock Exchange in connection with the directors' application for a quotation of the company's ordinary and preference shares and debenture stock. The resolutions confirming the articles were carried unanimously. At the second meeting a resolution was passed as to new capital (£100,000) which it may be necessary to raise during the present year. The date of issue depends upon the works.

The National Telephone Company, Limited.

The directors' report for the half-year ending June 30th, 1899, to be presented to the shareholders at Cannon Street Hotel, on Thursday August 10th, at 12 o'clock noon, reads:—

"The income accrued in respect of the business of the half-year amounts to £602,146 3s. 6d., as compared with £538,959 1s. 6d. for the corresponding period of 1898, being an increase of £63,187 2s. The working expenses for the half-year amount to £332,257 1s. 1d. as compared with £303,101 6s. 10d. for the corresponding period of 1898, being an increase of £29,155 14s. 3d. The net result for the half-year (after deducting the Post Office royalties amounting to £58,859 17s. 3d.) is a profit balance of £211,029 5s. 2d. as compared with £186,184 8s. 11d. for the corresponding period of 1898, being an increase of £24,844 16s. 3d. The rentals carried forward for unexpired terms of running contracts amount to £651,741 5s., as compared with £565,620 5s. 4d., at the corresponding period of 1898, or an increase of £36,120 19s. 8d. Out of the available balance of £178,963 7s. 9d. shown by the net revenue account (No. 3) the board will recommend the payment of a dividend at the rate of 6 per cent. per annum, less income-tax, on the first and second preference shares, 5 per cent. per annum, less income-tax, on the third preference shares, and 6 per cent. per annum, free of income-tax, on the ordinary shares. The board also propose to transfer £60,000 to the reserve fund, and to carry forward the balance of £5,213 7s. 9d. The sum of £372,329 5s. 5d. has been expended on capital account during the half-year in the erection of 10,479 additional exchange and private lines, and in the construction of underground lines. The rapid and continuous growth of the company's business already established in the great commercial centres of the kingdom, and the possible expansion of telephony predicted to follow the initiation of the new policy of the Government, raises the question of additional capital somewhat earlier than appeared to be necessary until recent developments have made it possible to act upon a reasonable forecast of the future. The board have therefore determined to submit the matter to the proprietors at the forthcoming general meeting, and will then, in accordance with the accompanying notice, propose a resolution to the effect therein indicated. Retiring directors.—At the general meeting four directors retire, and, being eligible, offer themselves for re-election, viz., the Right Hon. Lord Harris, G.C.S.I., G.C.I.E., Mr. Charles Swain Agnew, Mr. George Hunter Robertson, and Sir Albert Kaye Rollit, M.P. Retiring auditors.—The auditors, Messrs. Welton, Jones & Co., also retire, and are eligible for re-election. Proxies.—A form of proxy is enclosed for the signature of the shareholders who may be unable to attend the meeting, and it is particularly requested that the proxy may be signed and returned to the secretary, Oxford Court, Cannon Street, London, E.C., so that he may receive it not later than Monday, August 7th. The special direction of any shareholder will be obeyed."

Edison & Swan United Electric Light Company, Limited.

The sixteenth annual meeting of the shareholders of the above company was held at the Cannon Street Hotel on Friday, when the chair was occupied by Mr. J. S. Forbes.

In moving the adoption of the report, the Chairman said that those who attended those meetings from time to time would have learned the importance in their company of a certain reticence. They were surrounded by extremely keen competitors, and there was no particular reason why they should reveal more than would satisfy the proprietors, without prejudicing them with outside competitors. The profit and loss account showed a credit balance of £44,792, and after providing for the interest on the debenture stock, there remained a balance of £33,607 available for distribution. They had already paid an interim dividend of 6 per cent., and would declare a final dividend at the same rate. With regard to the profit and loss account, they would see that the stock brought into the account was £148,110, while the stock in hand on June 30th, 1899, was £160,000, this item thus having been swelled to the extent of £12,000. That seemed a large sum to be locked up in stock, but it meant lamp fittings and a variety of things spread over a large number of towns in which they had depôts. Although in the aggregate it represented a large amount of money, yet parcelled out in a great many places it was a moderate amount, and not more than the business requires. Wherever they had a depôt they had to have a large stock of fittings, as any shareholder would find on going to their depôt in London. They had no misgivings as to the stock, as the book value of the stock was each year depreciated reasonably, and if it was judiciously realised there would certainly be no loss, but probably some profit on the book amount.

The Earl of Lichfield seconded the motion, which was carried.

The Chairman next moved, "That a dividend be, and is hereby declared on the 'A' shares of the company, at the rate of 6 per cent. per annum in respect of the six months ending June 30th, 1899; making, with the interim dividend paid on February 24th, 1899, 6 per cent. on the 'A' share capital of the company as now paid up, in respect of the year ending June 30th, 1899."

This was also seconded by the Earl of Lichfield, and agreed to.

In announcing that the retiring director was Mr. J. W. Swan, the Chairman said that he had a message from that gentleman. Mr. Swan had devoted a great deal of his time in his own laboratory to studying and improving the lamp. Of course a man of his great experience and scientific attainments was a very desirable aid to the company, and he wished him to say that in his opinion at that moment, the lamp made at the works at Ponder's End was the very

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best electrical lamp in the world. Mr. Swan had tested the lamp with every kind of lamp made, and his conviction was that their lamp was the best.

Mr. Dee moved the re-election of Mr. Swan as a director, and it was agreed to.

Replying to a vote of thanks, the Chairman said he must not forget to show his appreciation of the work done by the staff, to whom they owed a debt of obligation.

W. T. Henley's Telegraph Works Company, Limited.

An extraordinary general meeting of this company was held at Cannon Street Hotel, on Monday, July 31st, Mr. Sydney Gedge, M.P., presiding. The subjoined resolutions were brought forward as special resolutions:—

1. That each of the existing fully paid shares of £10 each in the capital of the company be divided into two fully paid shares of £5 each.

2. That the following article be inserted in the articles of association of the company immediately after Article 8:—"8a.—All shares in the capital of the company shall be held upon the terms that all, or any of the rights, privileges, advantages or restrictions attached to any class of shares may be affected, altered, modified, or dealt with in any manner with the sanction (whether previously or subsequently given) of an extraordinary resolution as defined by Section 129 of the Companies Act, 1862, passed at a separate general meeting of the holders of the shares of that class. To any such general meeting all the provisions of the articles of association of the company relating to general meetings shall *mutatis mutandis* apply, but so that the necessary quorum shall be one-tenth the number of the members of the class holding, or representing by proxy, one-tenth of the nominal amount of the capital paid on the issued shares of the class, and that the holders of the shares of the class shall have the like right of voting as the holders of ordinary shares would have at an ordinary general meeting of the company."

3. That the capital of the company be, and it is hereby increased, from £180,000 to £300,000 by the creation of 24,000 new shares of £5 each, to carry dividend as from September 1st, 1899, or from such later date or dates as the directors shall determine.

4. That the agreement dated July 19th, 1899, and made between George Sutton on behalf of the holders of the preference shares of the company of the first part, Arthur Edward Salmon on behalf of the holders of the ordinary shares of the company of the second part, and the company of the third part be and the same is hereby sanctioned and ratified.

5. That the said 24,000 new shares and the 6,000 preference shares of £5 each (arising from the sub-division of the 3,000 preference shares of £10 each created by special resolution in September, 1891) shall, as from September 1st, 1899, rank together as one class of shares, and shall be called preference shares, and shall confer on their holders the rights following in lieu (as regards the holders of the said 6,000 shares) of the rights now belonging to them under the articles of association, namely:—

(a) The holders of the preference shares shall have the right to receive a fixed cumulative preferential dividend at the rate of 4½ per cent. per annum on the amount paid up, or credited as paid up thereon, such dividend to be payable on March 1st and September 1st in every year, and the right on a winding up to receive in priority to any payment in respect of the ordinary shares payment of (1) all arrears of such preferential dividend, such arrears to be calculated down to the commencement of the winding up; (2) interest at 4½ per cent. per annum on the capital paid up, or credited as paid up thereon, as from the commencement of the winding up to the time of the actual payment of such capital, and (3) a sum equal to the amount of such capital, but the preference shares shall not confer on the holders thereof any further or other rights to or in the profits or assets of the company.

(b) Notwithstanding anything in the articles of association contained the holders of the preference shares shall not be entitled to be present or vote at or to receive notices of any general meeting of the company unless (1) The published balance sheet and accounts of the company for the financial year next preceding such meeting show that the dividend on the preference shares has not been earned or (2) Default shall have been made in paying the dividend on the preference shares or any part thereof for the financial year next preceding such meeting or (3) A resolution for winding up the company or any resolution which directly affects the rights or privileges conferred by the preference shares on the holders thereof is to be proposed at such meeting.

6. That notwithstanding anything in the articles of association contained the directors of the company be and they are hereby authorised and directed (in case an extraordinary resolution within the meaning of Section 129 of the Companies Act, 1862, shall be passed at a separate general meeting of the holders of the preference shares sanctioning and ratifying the said agreement of July 19th, 1899) to apply a sum of £30,000 out of the moneys standing to reserve account in the company's books in paying a special bonus or dividend of £100 per cent. on the capital paid up on each share arising from the sub-division of the 3,000 preference shares created in September, 1891, to the person who shall on the date of the confirmation of this resolution as a special resolution be the registered holder of such share or entitled by transmission thereto, but so that the acceptance by any person of such bonus or dividend in respect of any share shall be deemed to be an express acknowledgment that the said agreement and the special resolutions set out in the schedule thereto are binding upon him and upon every person claiming through or under him any interest in such share.

7. That the directors be and they are hereby authorised to offer 6,000 of the new shares to the holders of the existing preference shares in proportion to the number of such shares held by them upon condition that upon the issue of such new shares to the holders of existing preference shares the same shall be paid up in full by applying the aforesaid special bonus or dividend in payment up of the amount payable on such shares as by the said agreement of July 19th, 1899, is provided.

8. That subject to the provisions contained in the last preceding resolution the directors be and they are hereby authorised to issue the new shares on such terms at such times and to such persons as they shall in the interest of the company consider proper.

9. That notwithstanding anything contained in the articles of association the directors be and they are thereby authorised to make such regulations as they shall think fit providing for the surrender by any member of the company whose shares shall have been sub-divided or have undergone any alteration or modification of rights of his certificate for such shares and for the issue to him in lieu thereof of a new certificate and any regulations so made shall be binding upon each of the members of the company.

The Chairman, in moving the adoption of these resolutions, congratulated the shareholders that, as a company, they wanted more money, which they could employ profitably. The business had been increasing—not by leaps and bounds, which were apt to be uncertain—but year by year, for eight or nine years, until it had arrived at a very satisfactory position, as shown in the balance-sheet adopted in February last for 1898. For the year 1896 the available profits were over £20,000, in 1897 £24,000, and nearly £28,000 in 1898. He was not going to reveal secrets, nor to indulge in prophecy, but the business had gone on increasing to such an extent during the first seven months of 1899, compared with the business in the corresponding period of last year, that if it continued, as they hoped it would, in the same proportion during the remaining five months, it would not be an increase of £4,000 or £8,000 in the available profits, but a larger increase than that upon which he would have to congratulate them next February. There was therefore ample security for the preference dividend which it was proposed to create upon the preference shares in the company. The scheme might seem perhaps a little complicated, and he therefore proceeded to explain it in detail. They proposed to turn their £10 shares into £5 shares, upon the recommendation of Stock Exchange gentlemen, for the convenience of investors, believing that they would increase the market for their shares by giving them a smaller nominal value. The £10 shares now stand at £25 and upwards. The alteration would not affect shareholders in the least pecuniarily. When increasing the capital on several former occasions they had offered new shares to the shareholders *pro rata* at something like 20 per cent. below the market price, and all the necessary capital had been promptly subscribed. But there were objections to continuing that course. The company was doing so well now that on the old terms they would be raising the additional capital at a high rate, and as the directors had paid 14 per cent., and had a prospect of increasing that dividend, they felt their security for preference dividend was so good that it would be a better plan to issue the new capital by the creation of 4½ per cent. preference shares. Then came the difficulty connected with the existing £30,000 preference shares. When that capital was issued it was necessary to pay 7 per cent. They did not then dream that the capital would require to be raised to £300,000, and no provision was made for increasing that preference stock by further issues. With a view to getting rid of that stock they had arranged liberal terms with the holders. That £30,000 was valued in the Stock Exchange list at £58,000, and the board determined to ask the shareholders to give them power to give £60,000 in the new shares to carry interest at 4½ per cent. He thought it was not a bad bargain for either the ordinary or preference shareholders. The speaker referred to the great demand for cables and wires for telegraph, electric lighting and power purposes, and also to the Pacific cable project. The new capital would not be issued unless it was going to earn large profits and pay big dividends. By the scheme they not only provided for their present needs in an economical fashion, but kept the powers in their own hands of providing further capital without using anything like compulsion on stockholders. They proposed to offer the new shares to the shareholders in the first instance, and they hoped that shareholders would find the capital within the next few months. They had had to make large purchases of copper and gutta-percha, and the large increase of business necessitated a large expenditure for wages, &c., without immediate return in cash. Therefore, they wanted this additional capital. They had nearly completed the new buildings which were to be opened in October. They had an eye to future increase of business. If the resolutions were adopted they would come before an extraordinary meeting on August 15th, and after confirmation, applications for the new shares would be immediately invited.

General Hutchinson, C.B., seconded the adoption of the resolutions, and after a shareholder had recommended the exercise of caution in adding a large amount of new capital, and advised them not to be deceived by booms, the resolutions were carried *nem. con.* The usual vote of thanks closed the meeting.

Great Northern and City Railway Company.

The half-yearly general meeting was held on Tuesday at the Westminster Palace Hotel, Sir Charles Scotter, presiding.

In moving the adoption of the report, the Chairman stated that the progress of the works was in every way satisfactory. He had been favoured by Sir Douglas Fox, engineer to the company, with a detailed report dated July 28th, from which it appears, *inter alia*, that at the Regent's Canal the access heading and shield chamber had been completed, and everything was ready for the first shield, which was in course of being sent off from the maker's yard. The second shield, says the *Times* report, would follow within a week, and the remaining two were expected to be ready as soon as the contractors should be in a position to utilise them, it being their intention to run one tunnel somewhat in advance of the other. There had been some delay in the delivery of the shields. At Essex Road houses had been pulled down and the station site fenced off, and sinking operations would be commenced at once. At Drayton Park, possession of the land for the station site had been obtained, for temporary purposes only, from the Great Northern Railway Company, and an easement had been arranged for with them for the construction of permanent works on their property south of the station. Among other materials and plant, 200 tons of 16 feet tunnel segments were on the ground, and 80 tons of bolts had been delivered, while dynamos for the electric light were being fitted together. Referring to the delay in the delivery of the shields, the chairman remarked that everybody connected with trade and commerce was aware how exceedingly difficult it was to get any ironwork or mechanism completed within contract time. There never was a period, he supposed, in the history of this country when the iron and steel industries had been in such a prosperous state, and this enterprise was only suffering in common with all other railway companies and other large undertakings in this respect. Still, the engineer assured him that he was not, considering all the circumstances, dissatisfied with the progress which had been made. The accounts, professionally audited, contained a full statement of the financial position. In a short time, he added, the board would have to make another call, but it was a tacit understanding that the second call should not be made within a certain interval of the first, and, of course, due notice would be given.

The Earl of Lauderdale seconded the motion, which was carried unanimously.

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Anglo-American Telegraph Company, Limited.

The directors' report to be presented to a meeting of proprietors at Winchester House on August 4th, at 2 o'clock p.m., reads as follows:—

"The total receipts from January 1st to June 30th, 1899, including the balance of £588 3s. 7d., brought forward from the last account, amounted to £202,728 7s. 5d. The traffic receipts show an increase of £255 as compared with the half-year ended June 30th, 1898. The total expenses of the half-year, including the repair of cables, &c., as shown by the revenue account, amounted to £61,027 4s. 3d., being a decrease of £589 2s. 3d, as compared with the corresponding period of 1898. The directors, under the powers conferred upon them by the articles of association, have, before declaring the net profits, set apart the sum of £12,000 to the renewal fund, leaving a balance of £129,701 3s. 2d. One quarterly interim dividend of 15s. per cent. on the ordinary stock, and of £1 10s. per cent. on the preferred stock, was paid on May 1st, 1899, absorbing £52,500, and a second quarterly dividend of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, amounting to £52,500 will be paid on August 1st, 1899. The balance of £24,701 3s. 2d. will be carried forward to the next account. The cables and landlines of the company are in good working order."

The Liverpool Overhead Railway Company.

The directors' report for the half-year ending June 30th, 1899, to be submitted to the twenty-second half-yearly general meeting of the shareholders to be held at the Law Association Rooms, 14, Cook Street, Liverpool, on Tuesday, August 15th, 1899, at 3 o'clock, reads as follows:—

"In presenting the half-yearly statement of capital and revenue accounts to June 30th, 1899, the directors have to report that the gross revenue receipts amount to £36,683 12s. 6d., and the working expenses to £24,924 5s. 8d. The number of passengers carried during the last two years is as follows:—

	Half-year ending Dec. 31st, 1897.	Half-year ending June 30th, 1898.	Half-year ending Dec. 31st, 1898.	Half-year ending June 30th, 1899.
First class	621,392	637,547	663,177	594,669
Second class	2,790,768	2,686,651	2,962,827	2,445,572
Workmen (special return tickets)...	1,055,330	1,148,743	1,268,917	1,435,038
Total	4,467,490	4,472,941	4,894,921	4,475,279

"There has been an increase in the number of passengers carried of 2,338, but a decrease in the receipts of £946, mainly due to the extension of the time during which workmen's return tickets are available, and to a decrease in the number of first class passengers, caused by the competition of the electric tramways. By consent of the Dock Board, trains are now run on the northern section up to 11.30 p.m. The Bill sanctioned by the shareholders at the last meeting for the equipment and working of the Waterloo and Great Crosby Tramways has passed both Houses of Parliament, and now awaits the Royal assent, and the work is being proceeded with.

Revenue Account.

Receipts from passenger traffic amount to ...	£35,960	5	3
Miscellaneous receipts	723	7	3
	£36,683	12	6
Less working expenses	24,924	5	8
	£11,759	6	10
Deduct interest on mortgage debentures ...	3,400	0	0
	£8,359	6	10
Add balance brought forward, December 31, 1898	4,586	1	5
Leaving available for dividend	£12,945	8	3

"Out of this balance your directors recommend the declaration of dividends at the following rates (less income-tax), payable on and after August 17th next:—

5 per cent. per annum on preference shares ...	£3,000	0	0
2½ " " ordinary shares ...	5,625	0	0

leaving a balance of £4,320 8s. 3d. to be carried forward to next half-year."

Certificates are appended to the directors' report, in which the engineer, Mr. S. B. Cottrell, certifies that the permanent way and rolling stock have been maintained in good order.

The City of London Electric Lighting Company, Limited.

In their half-yearly report the directors say:—"Your directors now beg to submit their half-yearly report to the shareholders, the issue of which has been deferred until the Select Committee of the House of Lords had given their decision on the provisional order for empowering the Charing Cross and Strand Electricity Supply Corporation, Limited, to supply electric energy in the City of London in competition with your company. Your directors regret that, notwithstanding the strenuous opposition of this company, the order has been confirmed. A copy of the speech of the company's counsel, Mr. J. H. Balfour Browne, Q.C., is enclosed. Under these circumstances your directors have been compelled to reduce the company's charges for electric energy to no higher prices than are scheduled in the Charing Cross Company's provisional order. This must have a very serious effect on this company's revenue, and your directors can only hope that the increase of customers will be such as to gradually mitigate the seriousness of the reductions. In view of the entire alteration of the position which has been brought about by the passing of the Charing Cross and Strand Corporation's provisional order, your directors will seriously consider the policy of extending your company's area of supply in various directions. The demand for electricity in other districts would employ your company's machinery during the times when it is now idle owing to the restricted demand in the City, and consequently your company would be enabled to charge lower rates than are now being charged in the Strand and other districts, and which would still be remunerative to your company. Your directors propose also to apply to Parliament, as soon as possible, for an Act to relieve the company of the obligations imposed by the Act of 1893 as to depreciation and reserve funds, imposing in lieu thereof no larger obligations than are imposed on other companies which have to keep their accounts in the form prescribed by the Board of Trade. Your directors, in view of the unknown effect which the above-mentioned reductions in the price for electricity will have upon the company's revenue, have decided that it is inadvisable to declare an interim dividend on account for the six months ended June 30th last on the company's ordinary shares. Warrants for the half-yearly dividend on the company's preference shares will be posted on August 3rd, 1899. The interest on the company's debenture stock for the six months ended June 30th last has been paid. Your directors have appointed Mr. Philip Debell Tackett, a very large shareholder, as a member of the board. The following statement shows the progress made by the company:—

Number of Customers and Lamps Connected

(after allowing for disconnections on account of removals, &c.).

	Dec. 31, 1893.	Dec. 31, 1894.	Dec. 31, 1895.	Dec. 31, 1896.	Dec. 31, 1897.	Dec. 31, 1898.	July 19, 1899.*
No. of customers being supplied ..	1,080	2,740	4,290	5,303	6,822	7,414	7 863
No. (equivalent) of 8-c.p. lamps connected	65,841	135,460	195,817	247,785	296,012	855,825	390,809

* The corresponding figures on July 20th, 1898, were 6,715 customers and 323,868 lamps.

On July 19th, 1899, there were in addition 12,432 lamps awaiting connection, on completion of the consumers' wiring, &c."

Chili Telephone Company, Limited.

The annual meeting, held at Winchester House, E.C., on Tuesday, was presided over by Mr. G. Keith.

In moving the adoption of the report, which appeared in the Electrical Review in abstract last week, the Chairman said that the period under review had been anything but favourable for successful business in Chili. In July last year the financial difficulties of the country brought about a suspension of the gold standard and the sudden return to paper money. Since then, the currency in which the company's rates had been collected had been at a large discount. The value had been as low as 11½d., and the average 14½d. as compared with 17½d. for the previous year. The business had not suffered so much in volume as in value. The subscribers had increased from 4,463 to 4,486, and the profit in Chili was about 5 per cent. less than in the previous year. Every year the revenue suffered more or less from the irrecoverable amount written off against subscribers in arrears. That amount had been unusually heavy during the year, and the sales business had not been so large. All these things, brought about by the fall in the value of the currency, had told against revenue. They had to pay for their instruments and material imported in sterling. Increase in currency value of salaries and materials had, with the lower rates of exchange, added largely to the year's expenditure. If allowance were made for all those things, the profit in Chili had been well maintained, but when converted into sterling, its value came out at a decrease of £3,890 compared with the previous year. This was practically a loss imposed on the company's business by the sudden return of Chili to paper money. During the year £5,000 debentures had been issued to defray the cost of certain switchboard work. The result of the year's working was that after placing £1,340 to reserve, they recommended a 3 per cent. dividend for the year. The result was disappointing, but at the same time it was satisfactory to know that it was entirely due to the fall in exchange, and not to any falling off in business. With the value of the dollar the same as for the previous year, they would have paid the same dividend as for that year. The debenture issue matured on March 31st, and it had been extended for five years upon the same terms. The condition of the plant allowing subscribers to be connected up at small cost, had helped in some degree to counteract the effect of the currency upon their accounts. The rates to users were fixed according to the 1895 Conversion Act fixing the par value of the dollar, but with the alteration in the value of that, they were giving attention to the adjustment of their charges. Since the beginning of the year the revenue had been improving, and the prospects of the business were very bright. The rise in copper and other products had stimulated business

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and that was favourable to increased rates. Altogether the outlook was more favourable.

The adoption of the report was seconded and carried, as were also resolutions declaring a 3 per cent. dividend, and re-electing the retiring directors and auditors. The usual vote of thanks closed the meeting.

Hobart Electric Tramway Company.

The report of the directors for the year 1898, submitted at the annual meeting held in London on 19th ult., stated that the revenue for 1898 amounted to £12,725, as against £12,380 for 1897, being an increase of £345, while the working expenses amounted in 1898 to £8,940, as against £8,853 for the previous year, being an increase of only £87. After payment of debenture interest, administration and other expenses in Hobart and London, there is a small loss shown of £90, repairs to the rolling stock having been very heavy during the past year. The revenue for the current year is steadily increasing even over that of last year.

Submarine Cables Trust.

An extraordinary meeting of the second certificate holders of the Submarine Cables Trust was held at Winchester House, Old Broad Street, on Friday afternoon, for the purpose of electing a new trustee to fill a vacancy in that body.

The Marquis of Tweeddale, who presided, said he had to propose that the vacancy be filled by the appointment of Mr. Clement Sleyd Colwin, C.S.T.

This was seconded by Mr. Pember, and agreed to.

Nernst Lamp, Limited.

An extraordinary general meeting of this company was held at Winchester House, Old Broad Street, E.C., on the 28th ult., when the directors submitted their report and balance sheet. The object for which the company was formed, viz., the flotation of the Nernst Electric Light, Limited, having been accomplished, the chairman, Mr. Cyril Wanklyn, stated that it had been decided that the company should be wound up voluntarily and the assets divided amongst the shareholders. It was proposed that 21,500 shares in the new company should be held in trust by the chairman, until certain negotiations with Prof. Nernst for the acquisition of his royalties on all the English business were completed.

The Chairman having moved the adoption of the report and accounts, the motion was seconded by Mr. Drake, and after some discussion, was passed. Resolutions to the effect that the directors should receive 3,500 shares, and the solicitors 1,000 shares, and that 21,500 shares be allotted in trust to Cyril Wanklyn, the chairman, were passed; and it was resolved that the company be wound up voluntarily, W. Chaplin, Dashwood House, being appointed liquidator.

Official Announcements re Companies.

The following have been struck off the Register of Limited Liability Companies:—

Akester Electro-Motor and Accumulator Company, Limited.
Anders' Telephone Company, Limited.
Danison Auto-Telegraph Machine Syndicate, Limited.
Economic Electric Speciality Company, Limited.
Electrical Plant, Limited.
Globe Electric Company, Limited.
Hermite British Electro-Bleaching Company, Limited.
Lineff Electric Traction and Lighting Syndicate, Limited.
Mexican Gas and Electric Light Company, Limited.
New Electricity Supply Company of Croydon, Limited.
Omnibus and Tramcar Electric Lighting Company, Limited.
Phœbus Electric Battery Syndicate, Limited.
Rogers Arc Lamp Company, Limited.
Self-Generating Electric Vehicle Light Syndicate, Limited.
Tayler-Smith Electric Company, Limited.

Notice is also given in the *London Gazette* that unless cause is shown to the contrary within three months, the following companies will likewise be struck off the register:—

"Blot" Electric Accumulator, Limited.
British Electrical and Industries Company, Limited.
British Electrical Cycle and Motor Engineering Company, Limited.
Electrical Investments Trust, Limited.
Electric and General Exploring Syndicate, Limited.
Electric Transformer System, Limited.
Feed Water Purifier Syndicate, Limited.
Franco-English Motor Car Factory Company, Limited.
Leatherhead Electric Lighting and Power Company, Limited.
Maxim Foreign and Colonial Motor Syndicate, Limited.
Phœnix Accumulator Syndicate, Limited.
Pioneer Motor Car Syndicate, Limited.
Practical Primary Electric Battery Syndicate, Limited.
Randall Telephone Syndicate, Limited.
Rottingdean Electric Lighting and Power Company, Limited.
Safety Incandescent Lamp Syndicate, Limited.
South Manchester Electric Supply Company, Limited.
Walton-on-Thames Electric Lighting and Power Company, Limited.
X Ray Syndicate, Limited.

Aluminium Company, Limited.

The report for the 12 months ended June 30th shows a net profit of £19,801, after paying the debenture interest and writing off £2,076, the amount at debit of the suspense account. The directors recommend a dividend of 20 per cent. on the share capital of £65,000, the balance of £6,801 being carried forward. The resolutions for the reduction of the capital by the extinction of three-fourths of the "B" shares, the remaining one-fourth ranking *pari passu* with the "A" shares, having been sanctioned by the court, the arrangement has been carried out, and the existing "B" shares will participate in the dividend now declared. The amount, £15,000, by which the capital is reduced, owing to the re-arrangement of the "B" shares, is applied in reduction of the cost of the works at Oldbury. A sum of £11,388 is applied in reduction of the amount at which patent rights stand in the books of the company. This is the sum realised by sale of patents in Germany and Canada during the past year.

Waterloo and City Railway Company.

The report for the half-year ended June 30th states that the gross receipts, less Government duty, amounted to £13,114. From this amount the London and South-Western Company have retained £4,690 in respect of the working expenses, leaving the sum of £8,424 payable by them in order to provide, under the agreement of March, 1894, for a dividend at the rate of 3 per cent. per annum on the company's ordinary and borrowed capital. The number of passengers carried during the past six months was 1,715,825, exclusive of season-ticket holders, who numbered 747 at June 30th last. Good progress has been made by the Central London Railway Company with the subways and approaches at the Mansion House and Royal Exchange, and these are expected to be completed by the end of the year.

Prospectuses.

During the past few days there have been several prospectuses before the public. That of Messrs. Browett, Lindley & Co. (1899), the well-known engineers of Patricroft, near Manchester, invited applications until yesterday afternoon for part of £50,000 6 per cent. preference and £50,000 ordinary capital, all in £1 shares. The nominal capital is £120,000, and of the present issue the vendors take 8,000 preference and 26,522 ordinary fully paid shares in part payment of the purchase price. It is intended to extend the works and at once purchase a considerable quantity of the most modern labour-saving tools and machinery. When these extensions are completed and equipped, the company will be in a position to make engines of the largest power, and to do a very large business under very favourable conditions. (The largest engine that could be built in the present works is about 2,000 H.P.) The record of the business from the first has been one of almost uninterrupted progress and expansion, and the firm has earned a very high reputation, placing it among the foremost firms in the country for its leading production, viz., modern engines of all the leading types for use with electrical generators for lighting purposes, and for the distribution of power for electric tramways and general purposes. Most of the leading firms of electrical engineers in the United Kingdom are customers of the firm, and large and important contracts have been carried out, or are in hand, for local authorities and private companies. A list of the most important is given with the prospectus. The orders in hand at the present time exceed in value those at the beginning of the year (which were then larger than usual), and are sufficient of themselves to keep the works fully employed for many months to come. The auditor's certificate shows that the result of the working of the business for the four years, 1894, 1895, 1896 and 1898 was an average annual profit of £3,111 15s. 6d. In 1897, the year of the great engineering strike, a loss was incurred of £2,630 0s. 11d., but this has been fully recouped, in part by the undivided profits brought forward from the previous year, and as to the balance out of the profits of the succeeding year. The profit, as above mentioned on the four years named, is equal to the rate of over 10 per cent. per annum upon the share capital and borrowed money employed in the business. The turnover of 1898 was far the largest in the history of the company. The present works have recently been valued by Messrs. Wheatley Kirk, Price & Goulty, as a going concern at £23,785 1s. 8d., and Mr. Wallis Rivers Goulty (who has retired from his firm) has been invited and has joined the board of this company.

The vendor company, who are the promoters, fixed the purchase price at £44,000, to £8,000 preference shares, £26,522 ordinary shares, and balance, £9,478, in cash. Out of the latter the vendor company will pay off the existing debentures. The present issue leaves for new works and plant, £41,954, and for working capital £14,046.

The prospectus of the Electrical Castings and Engineering Company is in circulation, inviting applications for the £30,000 capital in £1 shares, but the directors will not proceed to allotment until the sum of £24,000 has been subscribed. The vendor and promoter of the company is Mr. J. Hardie McLean, whose name is known to our readers as the late managing engineer of the Oxford Electric Company, and more recently as a director of and engineer to Messrs. W. Lucy & Co., Limited, of Oxford. The objects of the company are to carry on business as manufacturers of castings, forgings, and apparatus for electric lighting, power, and, in fact, all electrical and other purposes connected with electrical and general engineering developments and improvements. The prospectus refers to the great and growing demand which exists for castings and forgings for electrical purposes,

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opening out a wide field for making a speciality of this class of work, which is said to have been much neglected up to the present. Mr. Hardie McLean has obtained special knowledge during his service with Messrs. Lucy to qualify him to act as managing director of the new concern in the construction of electrical castings, for Messrs. Lucy carried out lighting and traction contracts for a large number of important towns. The new company will acquire certain works, &c., already equipped, at Wednesfield, and will extend the same at a cost of £6,500. The vendor assigns certain electrical patents and the goodwill of his business as an electrical and mechanical engineer. The total consideration to be paid is £15,350 (£9,350 cash and the rest in shares). Above and beyond this the present issue is intended to provide £8,000 for working capital. Among the directors we observe the name of Mr. Thomas Parker, of Wolverhampton, who will devote a good deal of attention to the company's interests.

The Wiring Company, Limited, prospectus has been published in the Hastings local press, inviting subscriptions for £10,000 share capital (2,500, 6 per cent. preference; and 7,500 ordinary shares, all £1). The company has been formed primarily to work a free wiring contract with the Hastings Corporation. The company acquires in connection with its proposals, certain local installation businesses, and Messrs. Bruce & Wordley, the proprietors thereof, have been appointed managing directors for seven years. Mr. W. M. Mordey is consulting engineer and technical adviser to the company.

The Renewable Electric Lamp Company, with a capital of £150,000, has invited applications for its 50,000 6 per cent. £1 preference, and 100,000 £1 ordinary shares. The list closed yesterday. We refer to the concern in an article appearing in another part of this issue.

Tramways Union Company.—This company announce that the transfer of the Bucharest and Madrid undertakings is expected to be completed shortly, and that the company will then be put into voluntary liquidation. The 4½ per cent. first mortgage debentures of £100 each will thereupon become payable at £110, and the company, having already sufficient funds in hand, offer to pay the debentures off at once at £110 with interest to date on holders making application to the secretary.

Correction.—In our report of the annual meeting of the Langdon-Davies Electric Motor Company last week the word "Car" somehow or other slipped into the heading. Our readers probably noticed the error, as the Langdon-Davies Electric Motor Company does not make motor cars.

Bournemouth and Poole Electricity Supply Company.—The directors have declared an interim dividend on the preference shares at the rate of 4½ per cent. per annum, less income-tax, for the half-year ended June 30th last, payable 15th inst.

Metropolitan Electric Supply Company.—An interim dividend at the rate of 5 per cent. per annum, payable August 14th, is declared.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending July 29th, 1899, were £1,119 10s. 3d.; receipts for week ending July 29th, 1898, £890 3s. 8d.; aggregate, July, 1899, to date, £4,458 11s. 11d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending July 28th, 1899, were £3,404 1s. 4d.; corresponding period 1898, £3,021 1s. 3d.; increase, £383 0s. 1d.

The City and South London Railway Company.—The receipts for the week ending July 30th, 1899, were £958; week ending July 31st, 1898, £994; decrease, £36. Total receipts for half-year, 1899, £4,700; total receipts corresponding period, 1898, £4,757; decrease, £57. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending July 29th, 1899, were £253 8s. 4d.; week ending July 30th, 1898, £204 19s. 5d.; increase, £48 8s. 11d. Total receipts to date, 1899, £5,212 15s. 8d.; corresponding period, 1898, £4,174 6s. 2d.; increase, £1,038 9s. 6d. Miles of track open week ending July 29th, 1899, 8; week ending July 30th, 1898, 8. Car miles run week ending July 29th, 1899, 4,555; week ending July 30th, 1898, 3,967. Number of cars, week ending July 29th, 1899, 11; week ending July 30th, 1898, 10.

The Dublin United Tramways Company.—The receipts for the week ending Friday, July 28th, 1899, were as follows:—D. U. T. Co., horse cars, £2,127 19s. 10d.; ditto, electric cars, £1,367 19s. 8d.; D. S. D. Co., electric cars, £1,175 18s. 5d.; total, £4,671 17s. 6d.; corresponding week last year—D. U. T. Co., horse cars, £2,552 5s. 4d.; ditto, electric cars, £653 3s. 3d.; D. S. D. Co., electric cars, £1,065 18s. 3d.; total, £4,271 6s. 10d.; increase, £400 10s. 8d. Aggregate to date, £18,090 13s. 3d.; aggregate to date last year, £17,865 9s. 11d.; increase to date, £225 3s. 4d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 12 miles electrically, and 30 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending July 30th, 1899, amounted to £1,579; corresponding week last year £1,733; decrease, £136.

The South Staffordshire Tramways Company.—The receipts for week ending July 28th, 1899, were £656 17s. 7d.; aggregate receipts for 30 weeks, £19,220 15s. 3d.; week ending July 29th, 1898, £644 9s. 2d.; aggregate receipts for 30 weeks, £18,890 13s.

STOCKS AND SHARES.

Wednesday Evening.

Had our Market Notes been penned two days ago, it would have been a sorry tale that we unfolded. There has been, since we last wrote, a slump in electric lighting shares which shook the market all over, and caused a flatness among even the soundest descriptions. A general reaction, however, by this time has brought the greater number of shares to much about the same prices as we recorded a week ago, yet the aftermath of the fall remains, and so does the fact of the City of London Company having passed its interim dividend. That was the pivot upon which the market swung downward, the announcement coming as a kind of climax to the company's troubles. For our part, we are inclined to the opinion, which has also found favour in the Stock Exchange, that this unhappy incident has been unduly magnified by those pessimists who foresaw in this step the incipient signs of breaking-up of the City of London Company. But what else could the directors do? Face to face with a formidable competitor in the City, committed to a policy of drastic reduction of charges for lighting; handicapped in every direction by the high-handed action of the Corporation, surely the safest, most prudent, course to adopt was to reserve all the strength they possibly could in view of the unknown liabilities ahead. To have declared a dividend, however well the company could have afforded it, would, under such circumstances, have been an act of stupendous folly, a fact which must be patent to the most irritated shareholder. The directors are doing their best in a difficult situation, and however much they may have muddled matters in the past, their present line of action in striking boldly into the enemy's camp by applying for powers to conduct their operations in the Strand, shows that they mean to leave no stone unturned in their endeavour to redeem their company's old position in the Share list.

Charing Cross shares took part in the general fall, and Metropolitans also declined. It was, however, the declaration of its usual interim dividend by the latter company that helped to rally the general market. Chelsea Electric are still dull, sellers under 8, but Countys have kept their force remarkably well. The 6 per cent. Preference shares are a thought easier, allowing for the dividend of 6s. per share. Westminsters are a welcome exception in the flabby list, the price being 5s. better, as the shares are now ex dividend.

The telegraph market is very quiet, and almost the only changes noticeable are occasioned by the deduction of dividends. Anglo-American Preferred were picked up a little, the idea being that the stock looks cheap, as it returns an investor slightly over 5 per cent. at 114. In several cases the dividend was recovered as soon as it was knocked off, this being notably so with regard to the senior securities of the Eastern Telegraph Company. Eastern Ordinary stock recovered part of the £3 5s. per cent., deducted last Friday, but Eastern Extensions have been very quiet. The number of recorded bargains each day is rapidly dwindling now that the excitement in this section is calming down, but the "markers" in the Stock Exchange find that the decrease in this section is fully made up by the greater activity of the electric lighting market. Great Northern, of Copenhagen, developed weakness early this week on account of a seller having appeared where no demand existed for the shares.

The electrical railway department is characterised by a drop of two points in the price of Waterloo and City Ordinary. Some disappointment is felt that the company should only have paid the guaranteed dividend. Central Londons, too, are out of favour, although there are not many months left before the line must be completed. There is no feature to remark in City and South London. Among other traction shares British Electrics are dull, despite the daily witness that is being borne to the superiority of electric motive power over horseflesh. New General Electrics are 4; Potteries Electric Traction 14—15. At the meeting of the Metropolitan Railway stockholders the other day, the chairman announced that an electrical train would probably be tried within a couple of months on their system. The Metropolitan Districts Company is paying 3¼ per cent. on its 5 per cent. Preference stock, as against 4 per cent. a year ago.

Aluminium "A" weakened on the publication of an excellent showing for the past year, and the shares are looking cheap at their present price. Electric Construction shares quickly added the dividend to their price after its deduction, as did Consolidated Telephone Constructions, which had to recover six-fifths of a penny. National Telephone Ordinary, and the Third Preference shares advanced still further upon the causes to which we alluded last week, assisted by the issue of an excellent report. The Telegraph Manufacturing and Construction shares exhibit no quotable difference.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, July 26th.	Closing Quotation, August 2nd.	Business done during week ended August 2nd, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	62 — 65	61 — 64 xd	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	114 —115	113 —114 xd	114	113
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	13¾— 14¼	13¾— 14¼	14	...
205,151	Brasilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	15 5/16	15
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	108 —112	108 —112	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105½	104¾
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼xd	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,009	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	10½	9⅝
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3¼%	3½%	11¾— 12¼	11½— 12	...	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	151 —156	150 —155 xd	153	149½
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	99 —103	98 —102 xd	100	99
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104	101 —104 xd	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	115 —120	115 —120	...	...
250,009	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14½— 15	14½— 15	14⅞	14
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	116 —121	114 —119 xd	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	103 —106	101 —104 xd	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	4 %	...	...	102 —105%	102 —105%	103	...
180,237	Globe Telegraph and Trust	10	4½ %	4½%	5½%	10⅜— 11¼	10⅜— 11¼	11⅛	10⅞
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15 — 15½	15 — 15½	15⅛	15¼
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	29 — 31	30¼	29½
82,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	⅝— 1	⅝— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½%	6 %	6 %	5½— 5¾	5⅝— 5⅝	5 9/16	5½
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	12½— 13½	13 — 14	13⅜	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	12½— 13½	13 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5½— 5¾	5⅜— 5⅝	5⅝	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	100	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,339	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5¼	4¾— 5¼	...	...
151,783£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	100 —103	...	...
80,008	West Coast of America, Nos. 1—80,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	101 —104	101 —104	...	...
339,521	Western and Brasilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	1 %	2%	...	1½— 1⅝	1⅝— 1⅝	1½	...
84,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10⅝	10½— 10⅝	10¼	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8¾— 9¼	8¾— 9¼	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	103 —106	103 —106	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	9½— 10⅛	10⅛	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
84,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8½	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	112 —114	112 —114	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	12 — 14	11 — 12	13¼	11⅛
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 15	12½— 13½	13½	12¾
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	128 —128	128 —128	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 11½	11 — 11½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13½— 14½	13 — 14 xd	...	...
220,000	Do. 4½% Deb. Stock, Prov. Certs (£80% to be paid) Rd.	...	...	...	...	52 — 54	51 — 53	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5½— 6	5½— 5⅝	5 9/16	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	7½— 8½	7½— 8½	8	7⅝
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	8½— 9½	8½— 9½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 7 xd	6 13/16	6⅝
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	105 —107	106½	106
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15½— 16½	14½— 15½	16	14⅛
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	15 — 16	14 — 15	14	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½— 16½	15 — 16	15⅝	15½
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	16½— 17½	16 — 17 xd	16 7/16	16⅜
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10 xd	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	4⅛— 4⅜	4 — 4¼	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½— 15½	14½—15½ xd	15	14½

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
§ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation July 26th.	Closing Quotation Aug. 2nd.	Business done during week ended Aug. 2nd, 1899. Highest	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3½— 4	3½— 3⅝	3¾	3½
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	18 — 19	17½— 18½	18	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	14 — 14½	14 — 14½	14⅛	13 13/16
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	13¾— 14¼	13⅝— 14¼	14	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	128½	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅝— 2	1¾— 2	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2⅛— 2⅜	2⅛— 2⅜	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	14½— 15½	14½— 15½	15 1/16	14⅞
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10½— 11	10½— 10⅝	10⅝	10½
178,303	Do. do. do. £8 paid	10	...	...	...	8½— 9	8½— 8¾	...	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	2¾— 3½	2¾— 3½	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	5¼— 5⅝	5¼— 5⅝	...	...
630,000*l*	City and South London Railway	Stock	1 1/16 %	1⅞ %	2⅛ %	67 — 69	67 — 69	68½	67¼
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	4⅜— 5¼	6¼— 6⅜	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	3⅝	3⅝
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½ %	6 %	6 %	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½ %	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	96½	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜xd	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½xd	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	101 —104	101 —104	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000 ...	2	...	...	...	⅝— ⅞	⅝— ⅞	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	24½— 25½	25 — 26	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	19 — 21	19 — 21	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21⅜	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞ %	3½ %	3½ %	8¼— 8¾	8 — 8½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½— 14½	14 — 14½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	38 — 42	37 — 41 xd	39	38
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	104½	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9¾	9¼— 9¾	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	104 —107	102 —105	104¼	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 10¼.
British Aluminium, Ordinary, no market; 7 % Pref., no market.
House-to-House, 4½% Debentures of £100, 103—106.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13; 1st Preference Cumulative 6%, £5 (fully paid), 7¼—8. Debentures, 103—105. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 5/16—7/16.
Smithfield Market Electric, 2—3 nom.
*T. Parker, £10 (fully paid), 18¾.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, August 2nd.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	32/-	32/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	37/-	37/-	..
a Ammonia, Muriate (crystal) .. per ton	£26	£26	..
a „ „ .. .. per ton	£24	£24	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. per ton	£26 5	£26 5	..
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a „ White Sugar .. .. per ton	£31	£31	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	8½d.	8½d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
b Aluminium Wire, in ton lots .. per ton	£294	£294	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 8" to 12") basis per lb.	8½d.	8½d.	..
c „ Tube (brazed) .. .. per lb.	10¾d.	10¾d.	..
c „ Wire, basis .. .. per lb.	8½d.	..	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g „ Wire (basis price) .. per lb.	10½d.	10½d.	..
g „ Sheet .. .. .. per ton	£98	£98	..
g „ Rod .. .. .. per ton	£88	£88	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	7/-	6/-	1s. inc.
h India-rubber, Para fine .. per lb.	4/1 to 4/8	4/0½ to 4/1½	inc.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	71/6	75/3	3/9 dec.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£11 5	£11 5	..
g Lead, English Ingot .. .. per ton	£14 10	£14 10	..
g „ „ Sheet .. .. per ton	£15 7 6	£15 7 6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
y Mercury .. .. per bottle	£8 7	£8 7	..
d Mica (in original cases), small per lb.	1½d. to 6d.	..	..
d „ „ „ medium per lb.	1/9 to 2/6	..	..
d „ „ „ large per lb.	3/6 to 7/-	..	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd strip & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£146 10	£146 10	..
g „ foil .. .. per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/10	1/10	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	..
j „ Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j „ Hemp, 8 ply 10 lbs. .. per lb.	8½d.	8½d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£12	£12	..
j „ Manila, 24 thread .. per ton	£32 10	£32 10	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£28 10	£28 10	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons.
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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THE MUNICIPAL ELECTRICAL ASSOCIATION.

Discussion on Mr. Snell's Paper on "Condensers for Electric Light and Power Stations."*

The Chairman (Mr. Rider) said he hoped those engineers who had adopted condenser plant, or were about to do so, would speak, so that they might have a first-class discussion.

Mr. Chamen (Glasgow) thought that the extra column in the table of cost was a very good suggestion. On the broad question of condensing compared with non-condensing he did not think there was much doubt that in all stations of the larger size they would have to use condensers. Apart from the question of economy, there was the nuisance to the surroundings. In Glasgow there had been considerable nuisance already. It had been impossible to prevent artificial rain being poured in considerable quantities into the streets at the time of a heavy load, and he nearly got into difficulty with his committee over it. They wished to know what he could do to prevent it, and he said the only thing was to suggest that people walked down another street. For the information of other engineers who might be in a similar fix, he might say he was not troubled any more. Mr. Snell had mentioned that in some place the pumps were being driven from high speed engines.

Mr. Snell: At Poplar they are about to be.

Mr. Chamen said it was a question which interested all of them very much. He had not seen how to join air and circulating pumps at present. He believed a marine engine fitted with air and circulating pumps only ran 120 a minute. As to evaporative condensers, he quite agreed with Mr. Snell that the difficulty was in having to put them at such a distance from the engine. Everything pointed to best results being obtained by getting the condenser close to the engine. Of course, there was the further practical difficulty, apart from the fact that any current set up in the exhaust leading to the condenser caused a great deal of loss of vacuum, of leakage from any joints which had to be dealt with. He wished Mr. Low had been there to have given information on points of that kind, because he had been experimenting in the matter, and the information he could have given the Association would have been most valuable. The arrangement of the exhaust pipe from the engine to the condenser had everything to do with the amount of vacuum getting inside the cylinder—the mere fact of opening suddenly from the exhaust pipe in the engine into a pipe of larger diameter spoilt the vacuum to a large extent; there was a whirl set up which had the effect of choking the vacuum, and this was got over by putting on a tapered nozzle. About the ejector condensers, Mr. Snell had not specifically mentioned the trouble of the oil getting into the condensing water, and having to be got out of such a large quantity. It was obvious that in the ejector arrangement all the oil in the exhaust steam got into the cooling tank. Another great objection to the ejector condensers, to his mind was, he did not see how they could possibly make tests of the efficiency of the engine plant. One gentleman who was strongly advocating the use of the ejector condenser, tried to explain to him that there was no difficulty whatever, and that it could be done by calculations from the temperature of the water; but he thought that argument was not quite good enough. Mr. Snell made some mention of the oil question, and here again he wished Mr. Low could have been with them. The question of using graphite in the cylinders instead of oil had received considerable attention from various people, and while it seemed successful to a certain extent, the last time he was at Rugby Mr. Low showed him the inside of an engine which had been run experimentally with graphite, and the internal parts were completely rusted out. The fact was that the engine had been left standing a short time, and the absence of all grease of any kind might be aggravated by the presence of graphite, and the result was rust. Mr. Low's conclusion was that if you keep an engine running always you may get on with graphite, but under the ordinary conditions of electric lighting plant graphite appeared to be rather dangerous. As to the type of condenser which they would have to use in future, he had come gradually to Mr. Snell's conclusion, that the cooling-tower arrangement was the best. They did not like to put the condensers on the roof for the reasons he had pointed out, although the arrangement had the advantage of giving them more engine room. He differed from Mr. Snell in one small point—he did not think he should put the condensing plant below the floor. The condensing plant was usually put away out of sight, and if they went down below they would see something they would rather not have seen. He preferred to have it, unsightly as it might seem, in sight of the engineer, just as he intended to have the sanitary arrangements in sight as one walked round. The more these details were open for inspection the better.

Mr. Worthingham (Manchester) said he felt that he could not refrain from complimenting Mr. Snell on the excellent paper he had read. It was thoroughly practical throughout and very useful, and the figures given in it would be useful to many of them. He entirely agreed with Mr. Snell as to the advisability of condensing; he thought the position he took up was quite unassailable. He thought also that he was right in advocating surface condensers as being the best. Quite recently he (the speaker) had had to consider the question of the type of condenser to use, and although the surface condenser was so much more expensive than the other types, there was no doubt its advantages were sufficient to compensate for them. He agreed with Mr. Snell's figures as to cost. The extra cost of surface condensers over jet condensers represented £8,000 at Manchester, but he came to the conclusion that it was worth while to have them. In the case of the large engines—about 3,500 H.P. each, with a considerable upward margin—he had arranged that the surface condensers should be driven from the engines, and each condenser should be in two independent halves, so that if one half broke down they would have another to work upon. Of course, with these engines there was none of the difficulty of high speed. They only ran 75 revolutions a minute. Mr. Chamen asked whether he thought the rise in temperature in the water was sufficient to enable one to determine accurately the efficiency of engines. He did not, and it was one determining factor which made him go in for surface condensers, so that he could measure the steam consumption. He did not believe in putting in tests which he had no possible means of carrying out. The oil filter required a great deal of attention, and he was afraid it was one difficulty in connection with surface condensers. He had put in all sorts of pains and penalties whereby the engine builders had to keep oil out of the boiler. Whether they would do it or not was quite a different matter. He did not believe there was any thoroughly satisfactory oil separator in the market at the present time.

Mr. Ellis (Bolton) also complimented Mr. Snell on his very able paper. This subject was extremely interesting to them at Bolton, inasmuch as they were near a river which measured about 5 feet wide by 9 inches deep. Up to the present time they had been absolutely unable to go in for condensing, but it was now necessary that they should do something in the matter, inasmuch as they were putting in engines of larger size. They had decided to put in a lodge big enough to condense the steam during the hours of light load, and they were at the same time preparing to put on cooling towers to work in conjunction with the lodge during the hours of heavy load. That was the only way in which they could get out of their difficulty at Bolton.

Mr. Barnard (Hull) remarked he was also very much interested in the paper of Mr. Snell, especially in the remarks about ejector condensers—not so much in the arguments for or against as in the practical methods of working which he assumed. He had been trying to work these ejector condensers on the lines laid down—that was, under the water seal—but he had found it preferable to work them without the water seal. He knew that he was working against the instructions of the makers in that matter, but he had found that since he had been breaking the water seal from the condensers he had not known failure in the vacuum, whereas he had failure previously. They did not rely entirely upon the water return valve, but he had put an air cock in the exhaust chamber of the engine, and he started the engine with the air cock open before opening the volume of water to the condenser. When he got a little pressure in the exhaust chamber he opened the water valve, and he invariably got his vacuum immediately. As soon as the vacuum showed in the gauge he closed the air cock of the exhaust chamber. Each engine had its own condenser, and they all discharged into a large iron pipe which had an open end. Another thing that he had not adopted was the automatic atmospheric exhaust. He had not the least objection to shutting off the column of water in their condensers at any moment on full load. The only result was, that they occasionally got a little back pressure in the exhaust.

Mr. J. Klein said that it might be of interest to state that a surface condensing plant, combined with a Klein cooler of the "Tower" type, was working at the Bristol Wagon Works. In this type of cooler the water was only raised to a height of about 20 feet, the tower surrounding the cooling stack being 60 feet high. The difference in temperature between the interior of the tower and the atmosphere outside caused a draught up the tower which supplied the necessary air for evaporating a portion of the water and for carrying away the vapour. Several towers of this type were working successfully in this country, and a large plant to deal with the condensing water for some 3,000 H.P. was being erected for the City and South London Electric Railway. These tower coolers occupied more space than the fan coolers, but their advantage was that there were no moving parts, and the draught was obtained without expenditure of power. Of course, where sufficient space was not available, fans must be used. As to the oil question, it was extremely difficult to separate the oil from the water after condensation. He had found that the best way of removing the oil was by a separator in the exhaust pipe between the engine and the condenser. No trouble was then caused by the oil in the condenser, and the separator was much simpler and more efficient than the filter used for removing oil from the water. The oil was separated from the exhaust steam by changing the direction and reducing the velocity of the steam, the action being similar to that of an ordinary steam separator.

Mr. Ruthven Murray said the author of the paper had told them that Poplar intended to drive surface condensers from high speed engines. They ran about the usual high speed, not the highest speed of all. He daresay they were aware that very often the centrifugal pump was connected directly with the shaft, and air pumps were driven by means of reducing gear. This was the arrangement Mr. Blackman had put in at Poplar. The gear was set at the back of the engine on the extension main shaft, and beyond that again came the circulating pump. He believed two or three makers of high speed engines had expressed approval of the idea and believed it would come greatly into use. The advantage in separate condensers was that they could always obtain their vacuum easily before they started the engine. This was important where they started the plant quickly. The elimination of oil was a difficult matter, and he fancied the process which Mr. Klein mentioned, but he heard the other day that some chemists in London had perfected a process, which was shortly going to be put on the market, by which oil was entirely eliminated from the water in some manner he did not at present know about. He was sure, if it came to anything, they would all be interested in it. It was said to be very cheap and very efficient. In the meantime, having looked at the question carefully, he had come to the conclusion that the best possible way, if they could spare the space, was to treat the condensed water in the same manner as they would if they were dealing with dirty water—put it through an ordinary sand-filter.

* Electrical Review, July 21st, 1899, p. 120.

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Mr. Morley said he quite agreed that the best form of condensing plant was the surface condensing plant. As Mr. Wordingham had pointed out, it was possible to test each engine separately by the discharge of water from the engine into the condenser, provided there was no leakage on the water side. But the difficulty which arose in connection with condensing plant, as had been pointed out, was that the oil got into the water. He believed it was impossible at present to remove all the oil from the water, but when one had seen the condensed steam passed through a filter and eventually pumped into a boiler and used there without any disadvantage, one was led to believe that a slight amount of oil in the water was not always detrimental. Mr. Snell had pointed out that he had at his station engines running with very little oil. There were many marine engines running with no oil at all, and the only time it was used was when entering port, when a little oil was put in the cylinders to keep the parts from rusting. With regard to the lubrication of engines with graphite he must say it had not been successful. They had tried mixing graphite with the oil, but neither had been an advantage. It was difficult to compare the cost. Some stations would require a different length of pipe. The cost of surface condensing plant was often very much increased by the arrangement of pipes.

Mr. Mountain (Huddersfield) remarked that he could not agree with Mr. Snell in his wholesale condemnation of the jet condenser. If they took a lesson from some of the large cotton mills in Lancashire they would be able to get satisfactory results on exactly the same lines as they were doing. Dealing with the beginning of the paper, they would find that the temperature of the incoming water was exceedingly low and the temperature of the incoming steam was proportionately low. Therefore, if they got a high pressure, the results would be better than if they had to use an intermediate metal, which was losing heat. Speaking of marine experience, they were bound to use surface condensers on board a boat, because they could not use sea water. There they could not possibly use oil, otherwise it would get into the condenser, and they would be troubled with the boilers. In Huddersfield they tried the marine dodge, and ran for two years without oil; then they renewed the whole of their pistons and rings and started again on oil. Any engineer of large knowledge would tell them that oil, or a lubricant of some sort, was necessary. Graphite he had tried, and it was not all that could be desired; it got into the passages and bottoms of the cylinders and clogged up the spaces down there. Really it was not much use in its present form.

Mr. Quin (Blackpool) dealt with the question of the separation of oil from the condensed water. He said he had two classes of filter—one sand and coke and the other sawdust. He passed the condensed water through both. He did not know exactly to what extent it did take it out, but he knew there was plenty of oil on the far side of the condenser. A chemical process had been in use in some electrical chemical works in the Midlands which was said to be cheap and efficient, but so far as his experience of filters went, no make at present was cheap or efficient.

Mr. Andrews (Hastings) desired to thank Mr. Snell for bringing this interesting subject before them. At Hastings they had to pay about 9d. per 1,000 gallons of water, so that the ordinary surface condensing was out of the question. They had but little space for cooling towers, and their site appeared to be in a particularly advantageous position for evaporative condensers. Consequently, about two years ago they put up a vertical tube evaporative condenser. During the two years a great deal had been spent in altering that condenser, in order to obtain a satisfactory vacuum. In a recent discussion he pointed out that one of the chief improvements they had been enabled to introduce was the connection of the nests of tubes in series instead of parallel. Another improvement, he thought, was that they drained the condenser by gravity. They connected the bottom of the condensers with the hot well by one or two vertical air pipes, and the vacuum in the condensers sucked up a column of water, which constantly balanced itself. He quite agreed that the chief objection to evaporative condensers was that they were bound to put them on the roof some distance from the engine house. One of their earlies experiences was a vacuum of about 23 inches in the air pump, and about 24 inches in the engine, and now they got about 18 inches in the engine, and 20 in the air pump. The opinion they had arrived at at Hastings was—the larger the condenser, the less the vacuum. They got a better vacuum when working at full load than when working at one-tenth load. There was a difficulty with air leaks which, to his mind, was the only real difficulty in working evaporative condensers with success.

Mr. Fletcher (Ashton-under-Lyne) referred to steamers running without oil, and said he was told the reason of trouble in the cylinders was using a little oil. If they once used a little oil they had trouble. He had seen engines running apparently satisfactorily without oil.

Mr. Highfield (St. Helens) was not clear that the cooling tower system would get rid of the evils. The question of the cylinder lubrication depended mostly upon the quality of the steam put into the engine. No doubt, with wet steam, the cylinders would run fairly well without any lubrication at all, but with superheated steam it was different.

Mr. H. B. Spencer sounded a note of warning as regarded air and circulating pumps worked by the main engine. Some years ago, when he was with an engine insurance company in Manchester, he had occasion to analyse the various breakdowns of engines that had occurred over a considerable period. He found that about 20 per cent. of these were due to failures of air pumps or condensers. He thought that electrical engineers were much more free from accidents with their separate condensing plants than if they had had pumps worked even by slow speed main engines. The advantages of having the condensing plant independent of the main engine were now being recognised, and he might add that his father, Mr. John Fred. Spencer, who had had a good deal to do with the introduction of the surface condenser, had designed, some 30 years ago for Woolwich Arsenal, some independent surface condensers, two of which were working satisfactorily, and had advocated the use of such arrangements for large engines. He questioned whether it was worth while endeavouring to work engines without oil. Although now possible with saturated steam, there could be no question that in a few years' time most of the gentlemen present would be using superheated steam, and oil would then be a necessity. Some years ago he had had to do with an engine at Bristol which was finally worked without oil after several vain attempts had been made to remove oil from the condensed steam by filters. The boiler was of the West India type externally fired, and the entrance of oil into the boiler was immediately followed by softening of the plate over the furnace, thus it was absolutely necessary to exclude it. To enable the engine to work without oil a saddle was fitted over the slide valve on Messrs. Thornycroft's system. This arrangement was successful, but involved a good deal of attention. He believed that the oil difficulty was best solved by the means Mr. Klein had referred to, namely, by separator in the exhaust pipe, which had recently been found successful in several instances.

Mr. Tatts (Southport) remarked that they had two jet condensers which worked satisfactorily. With regard to the cooling towers, they had lately been considering the question, and they decided in preference to construct a reservoir to hold about 1,000,000 gallons of water, which they estimated would be sufficient for their purpose. That reservoir, with the connecting pipes, had cost about £3,000, so that it worked out at a fairly low figure per horse-power.

Mr. Minshall (Croydon) referring to remarks made as to the use of graphite, said he had been informed that when torpedo boats were on their trial trips they used all the oil they could get hold of, and not graphite.

Mr. Sutherland (Worcester) said he had been specially interested in the portion of the paper referring to the circulation of water.

Mr. Snell, in replying upon the discussion, thanked his hearers for the way in which they had received the paper. As he had previously stated, there was nothing new in it, but it had proved a nucleus for an interesting and, he hoped, useful discussion. He was glad that an engineer of such vast experience as Mr. Chamen agreed with him on the question of condensers, but he had been surprised at the statement of Mr. Barnard as to the obtaining of a satisfactory result without using the water seal. He had since learnt that Mr. Rider was also running one without the water seal. His experiences of evaporative condensers had not been of a very pleasing kind, and he could hardly realise anyone going in for the old-fashioned jet condensers. As to the use of oil, he could only say that during the last 18 months they had been running without oil, except a flushing on Saturdays, just to prevent the rusting of the cylinders.

TELEGRAPH RATES TO THE EAST.

The following letter, to which reference was made on p. 169 of our last issue, was inadvertently omitted.—

To the Editor of the "Times."

Sir,—I beg leave to reply to the observations made by Lord Tweeddale at the annual meeting of the Eastern Telegraph Company. My intention is only to deal with that portion of his remarks which relates to the views of the deputation of members of the House of Commons Committee for the reduction of telegraph rates laid before the Chancellor of the Exchequer. For, Sir, the comments which you yourself make upon the whole tenor of the company's defence are so remarkably trenchant and incisive, that we do not consider it necessary to add anything to the statesmanlike view you take in the public interest.

Lord Tweeddale denounces my statements as inaccurate and irrelevant. This denunciation, as I hope to show, categorically, is based upon false premisses and gratuitous assumptions.

1. That I asserted that because the companies were subsidised, the tariff should be very much less. What I said was (and the shorthand report is before me), that their position was not altogether that of a private concern, because of these subsidies, and that the public were therefore entitled to claim the assistance of the Government in regard to obtaining lower tariffs, either by means of pressure on the companies, or by the adoption of alternative routes.

2. That I represented the amount of the Australian subvention as £42,000. What I did say was, in the hearing of the whole deputation, that the companies were in receipt of an amount of £32,000 yearly, to continue for 30 years, thus making, inclusive of a subsidy of £1,000,000 sterling from the Imperial Government, the very considerable sum of close upon £2,000,000 sterling.

3. That I stated the amount of dividend as having been 7 per cent. for a great many years past. What I did say was, that the dividend for nine years ending 1896-97 was 6½ per cent., and the subsequent two years 7 per cent. As throwing a flood of light upon the true inwardness of the real percentage represented by the dividends, I quoted from the report of the Pacific Cable Committee the following extract from the *Economist*:—

"But it must be remembered that these are rates payable on a watered capital, and that they represent considerably higher returns upon the money actually put into the cables. Thus the Eastern capital was watered to the amount of £819,500 and the Eastern Extension to the amount of £472,500, and a dividend of 6½ per cent. on the Eastern capital should read as 8½ on the original capital, while 7 per cent. on the Eastern Extension capital means over 9 per cent. on the capital prior to its being watered. Beyond this, these com-

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panies have worked themselves into a strong position by not dividing to the full extent profits legitimately earned. The dividends have been no guide to the profits made, and if requisite the tariffs would be reduced without affecting the payments to the shareholders."

4. That I vouched for the existence of a special reserve for the purpose of duplicating the cables. Well, Sir, I took the reserve funds of the Eastern and Eastern Extension, which, on the best possible information I was able to obtain, now stand at £2,137,000, at the lowest computation, and, deducting therefrom the 1¼ million at the credit of the ordinary reserve funds, I treated the remainder as representing the special reserve which, by a consensus of opinion in mercantile circles, is assumed to be earmarked for the purpose to which I made reference. If this balance is not wholly sufficient, it is certainly an appreciable nucleus towards that purpose.

5. That I stated that business men of other countries have their messages carried at an enormously cheaper rate. This is perfectly true, but not in the sense in which he interprets it, because, Sir, I was endeavouring to call attention to the disadvantages under which our merchants are labouring, and I now quote *verbatim* from the shorthand report:—

"Our people were forestalled by the business men of other countries being enabled to compete owing to the enormously cheaper level of rates levied by the companies within their possessions. For instance, a Frenchman can send to Tunis or Algeria for ½d. per word; the Russian can send to most of his colonies, even as far as Vladivostok (6,000 miles), for 4d. per word, whereas the merchant in Great Britain pays no less than 4s. to India."

Then, Sir, turning to my statement in regard to the vulnerability of cable lines, Lord Tweeddale tries to rebut our conclusions by instancing the absence of injury to cables during the wars between Turkey and Greece and China and Japan. To demonstrate, Sir, the utter irrelevancy of this, I need but recall to his memory that neither of the defeated nations had at all a reasonably strong navy to attempt cutting cables, whereas in the instance I did mention—that of the war between Spain and America—both the combatants in virtue of the comparative strength of their respective navies, as illustrated by the stubbornness and duration of the struggle, were able to and did most effectually sever the cable in the sphere of their immediate operations.

6. Then, Sir, I drew attention to the glaring inequalities of the rates to the East. To that Lord Tweeddale replies that "it was because the tariffs were practically controlled by the European Governments." Now let us test this assertion. A word to Fao, at the head of the Persian Gulf, passing over German, Austrian, and Turkish Government lines—further, a word to Julfa, passing over German, Russian, or Turkish lines, are the one and the other charged "6½d.," but as soon as the private companies get hold of that word to transmit it further, the rate goes up by leaps and bounds. So that although the chairman's bare statement is literally correct, the inference he seeks to draw from it is fallacious, inasmuch as the European control he insists upon is towards cheapness; the moment that salutary control is withdrawn our troubles begin.

Sir, even an "irresponsible politician" has some notion of logic.

As regards the specially high rates to India upon which the deputation laid so much stress—a view which obtained the hearty concurrence of the Chancellor of the Exchequer—it must be a matter of satisfaction to know that the companies are now prepared to negotiate for a reduction. The public will have learned with still greater satisfaction the newly-born zeal of the companies to contribute to the promotion of telegraphic facilities as evidenced by their proposal to lay a new cable from South Africa to Australia—a proposal all the more meritorious as it is divested of all appeals for Government or extraneous support.

In conclusion, I may be allowed to offer the companies a word of congratulation on their expressed desire to second the efforts of the House of Commons Committee to obtain a full and searching inquiry by means of a Royal Commission, or its equivalent.

I remain, your obedient servant,

EDWARD SASSOON.

Hôtel Métropole, Folkestone, *July 21st.*

THE STANDARDISING OF LIGHT RAILWAYS.

MR. PAIN'S recent paper on this important question before the Engineering Conference did not, it is true, produce much discussion, but it has stirred up a letter from a Westminster engineer which does at least open out the peculiar bent of mind of denizens of that quarter. Writing to the *Engineer*, Mr. Shelford takes an entirely one-sided view of light railways. He can talk about nothing but locomotives, nor can he discuss the light railway, except in its co-relations with steam traction. He appears entirely to shut his eyes to the fact that the future of light railways is far more likely to be bound up in electric than in steam traction. From the subject of light railways, he next bounds off to that of bridges. That Westminster engineers have ruined English foreign-bridge business is pretty surely wrong, but they soon will unless they mend their ways and begin to learn what bridge work is. Mr. Shelford's remarks on this subject merely beg the question, and go a long way to show that the burden laid upon Westminster has not been undeserved. Mr. Shelford's letter is a plea for ringing the changes of design to the uttermost.

It is, perhaps, fortunate for Americans that their bridge builders have been the rolling mills themselves, or pretty closely affiliated thereto. Hence the practical solution they have arrived at whereby the mere consultant, with pupils to occupy on drawings, has not been able to spread himself so freely as he has done here. We do not wish to be understood as standing up for American bridge work. So far as it goes it is sound and good, though it is, perhaps, too finely cut in material. But in its cost per pound it is cheap, and it is an easy matter to secure an American bridge of greater strength by simply specifying for heavier loads. A bridge built for a load we may call 150 would be strong for a load of 100. It is the way they go to work, and the large number of uniform sections that they keep in stock, that enable American bridge builders to compete so successfully, and it is just in these points that Westminster engineers go so far astray.

Nor is it in bridge work alone. In all branches we find specifications issued from Westminster by men who may be perfectly sound in their knowledge of principles, that are a laughing stock to specialist engineers in construction who are equally well versed in principles. As we have before said, the duty of the consultant is to see that his client gets the best value in the market, and not to design things himself unless it is necessary. It is possible that this craze for new design arose from the time when Westminster was the home of the early railway engineers, who were really called on to design. All engineering dealing with the face of nature, such as the drainage of land, the training of rivers, the making of a dam across a valley, finds certain fixed environment, and the works must be specially designed to fit in with nature, and such articles as tunnels cannot be bought by the yard, and may probably form subjects of special design; not so the common brick which lines it nor the dynamo which lights it.

TRIP GEARS AND HIGH SPEED ENGINES

IN a recent communication to the *Mechanical Engineer*, Mr. Jas Dunlop criticises the abandonment of the wrist plate in trip gear for valves. All the earlier Corliss gears employed the wrist plate movement. Our author states that two of the oldest firms in the country as regards Corliss gear, still use the wrist plate. As most of our readers will know, the wrist plate is simply an oscillating disc worked by the eccentric, and carrying four pins, to which are attached the rods of the four valves. By suitable choice of the position of these pins upon the plate the relative angular movement of the virtual crank arms of the wrist plate and of the valves themselves can be so determined as to give very different movements of the valve crank arm and the wrist plate. In this way is introduced a period of waiting, and it is during the waiting period that engagement of the tripping edges must take place. In this way the speed of rotation of a trip gear engine may be made 30 per cent. faster than for an engine in which the wrist plate is not employed.

Our author enters fully into the question, dealing with the actual fraction of a second during which the trip gear must effect its engagement. As regards the mere question of trip engagement, a wrist plate will allow of double the rotative speed being attained that is possible without the plate, though in actual practice this cannot be said to hold good, as there enters into the question the noise and clatter of contact, and this reduces the speed of rotation which is possible apart from these items, which include shock on the contact edges, inertia and valve load due to unbalanced steam pressure. While fully appreciating all that Mr. Dunlop has to advance, we feel inclined to doubt the benefits of trip gear, and the virtue of an extremely square edge at cut-off.

The virtues of the Corliss valve as a mere cut-off valve were very loudly extolled, whereas the real virtue of the original valve lay in its effective cylinder drainage, the Corliss gear being usually applied to horizontal engines, with the exhaust valves below the cylinders. Practical engineers have learned to recognise the folly of carrying to an excessive length all such matters as expansion and superfine valve gears. They realise that most engines are rated at too low a power, that expansion, as aimed at, is still apt to be greater than economy demands. Only recently we found some engines to be very much more economical at loads very considerably above normal than at the rated load, and especially where maximum loading is a question of a few occasional moments only, do we find engines made too large. At the same time we fully agree with the author of the paper under review that the wrist plate motion has perhaps been too lightly abandoned by Corliss gear makers. This has been often done more for the sake of producing an original motion than to obtain any real benefit.

Rheostats.—We have received from the Ward Leonard Electric Company their catalogue of Carpenter enamel rheostats, containing information regarding 125 different standard forms, all of which are customarily carried in stock by the company. There have been large reductions made in the prices, brought about by improved methods of manufacture. The price is now only about the same as when they were first placed upon the market in 1892. The list is so arranged that a rheostat can be selected for almost any possible use on any commercial circuit, for while they are designed for use as field rheostats, the complete data given as to number of steps, ohms, ampere capacity, size, &c., enable one to pick out one suitable for use in connection with ventilating fans, organ blowers, centrifugal pumps, storage batteries, and all such special applications for continuous duty purposes.

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THE WORKMEN'S COMPENSATION ACT: MEANING OF THE TERM WORKMAN.

A case which raises one of the most important and, at the same time, one of the most difficult points upon the construction of the Workmen's Compensation Act was heard on May 31st in the Rotherham County Court. When the Act first came into force employers and employed were alike solicitous to know who was entitled to the benefits which it conferred. It seems to have been hitherto taken for granted that its operation was confined to those injured while employed in actual manual labour, but according to the decision of the arbitrator in the Rotherham case who awarded damages to a colliery deputy, the term "workman" as used in the Act is capable of a wider and more comprehensive interpretation. The facts of the case, which are reported in another column of the present issue, are shortly as follows:—The plaintiff was the legal personal representative of Matthew Allott her husband, who had been employed as colliery deputy by the defendant company, and who was crushed to death on February 24th last. No dispute arose as to whether the accident occurred in the course of the employment, the important issue being whether the deceased man was properly included in the definition of the term "workman" as contained in the Act. By that definition every person who is engaged in employment, whether by way of "manual labour or otherwise," comes within the scope of the Act. For the dependents of the deceased, it was urged that the words "or otherwise" made the Act apply. The nature of Allott's employment may be gathered from the evidence which was given by the witnesses:—He had a standing wage of 35s. a week. He had absolute authority when the manager was not present. He had no manual labour of any kind. In cross-examination, however, it was elicited that the deceased sometimes stirred up the fires of the ventilating furnace, and that he had also lit the fires on a Sunday. At the conclusion of the evidence the arbitrator said:—"The manager of one of our large steel works would not be a workman." After a lengthy argument by the counsel engaged, in the course of which reference was made to cases decided under the Employers' Liability Act, judgment was given in favour of the applicant. The arbitrator said:—"We must take it, generally speaking, that Allott was a man who worked, and that the chief portion of his work was manual and not mental labour. For 14 years Allott had worked as a deputy in the mine, and from the special rules, it appeared that he was a person who had the superintendence of others, and had certain responsibilities in addition, but so far as the special rules were concerned, he was not engaged in actual handicraftsman's work. The real crux of the question is the definition of workman, and I take it that the term "manual labour" is a general expression, and that "or otherwise" means something different from it.

With great respect to the learned arbitrator, it is submitted that this decision is erroneous, and contrary to the rules of construction which are invariably applied to the interpretation of statutes. The doctrine of *ejusdem generis* is well known and was apparently intended to meet cases of this kind. According to that doctrine, where a narrow expression is followed by one which is more general, the latter is to be interpreted in the light of the former. Once depart from this rule, and we have the result which is prophesied by Mr. Ruegg, Q.C., a learned commentator on the Act, who says in his book: "We see no reason why the architect of a building of the kind included in the Act, or the surveyor of an 'engineering work' should not recover compensation from the undertaker, if injured whilst engaged upon the works. Such person could be said to be engaged in the employment, although the contract between him and the undertaker was not a contract of service, but, in the words of the Act, 'an agreement made otherwise.'" Mr. Beven, in his work on the Compensation Act, does not agree with this principle, and with great deference to the better judgment of the commentator who has propounded it, we are inclined to agree with him. By an ancient rule of construction, *verba generalia restringuntur ad habilitatem rei vel personae.* This has been translated by Lord Bacon to mean "that all words, whether in deeds or statutes or otherwise, if they be general, and not express and precise, shall be restrained into the fitness of the matter or person." In Gordon *v.* Jennings (9 Q. B. D. 45) a point of a somewhat similar kind was discussed by the Court. By the Wages Attachment Abolition Act of 1870, it is enacted that after the passing of the Act no order for the attachment of the wages of any servant, labourer or workman, shall be made by the judge of any court of record or inferior court. An attachment had been issued against a judgment debtor who was employed as secretary to a company. It was his duty to attend at their office daily, to keep their accounts, and generally perform the duties of a secretary. His salary was £200 a year. The judge at Chambers had dismissed the case on the ground that the defendant was not a "servant" within the meaning of the Act, and in this he was upheld by Grove and Lopes, J. J. Grove, J., said:—We must construe this word "servant" as used in this Act, having regard to the subject matter and the intention of the Act, and also its collocation with other words. In one sense a Secretary of State is a servant, but obviously the statute cannot be meant to apply to every person who may be called a servant in any sense of the term. The intention of the Act is to abolish the attachment of wages. . . . . Taking the collocation of the word "servant" with "workman" and "labourer," it is obvious that the reasonable application of the Act is to persons of small means—to servants such as labourers and workmen receiving small wages at short periods. . . . . No doubt cases might arise in which it would be difficult to draw the line, but I am clearly of opinion that this case is not within the Act.

By a parity of reasoning, the manager of a mine may well be excluded from the operation of the Workmen's Compensation Act. The whole tenor of the Act, the reasons which caused it to be brought before Parliament in the first instance, and the scale upon which the payment of compensation is founded, all point to its being confined to the working classes. Payment of £300 would in no sense compensate the superintendent for the loss of his sight, nor would the modest weekly award provide for the wants of a highly salaried manager.

In the Employers and Workmen Act, 1875, the expression "workman" does not include domestic or menial servants, but means any person who, being a labourer, servant in husbandry, journeyman, artificer, handicraftsman, miner, or otherwise engaged in manual labour, whether under the age of 21 or above that age, has entered into or works under a contract with an employer, whether the contract be made before or after the passing of this Act, be expressed or implied, oral or in writing, and be a contract of service or a contract personally to execute any work or labour. Had this definition been incorporated with the Workmen's Compensation Act much difficulty would have been saved.

Moreover—to return to the case from Rotherham—it would seem that the decision of the arbitrator is illogical on the face of it, for he himself admitted that the manager of one of our great steel factories did not come within the operation of the Act, and he expressly found that the labours of the deputy "were not those of a handicraftsman." It is hoped that this point, which is admittedly one of a considerable difficulty, may shortly come before the judges *in banc* for satisfactory determination.

PINIONS FOR ELECTRIC MOTORS.

By E. KILBURN SCOTT.

An interesting development of the tramcar motor is the number of small businesses which have sprung up in the United States for the supply of its various accessories. For example, it has for some considerable time been possible to buy a commutator complete, or a new set of commutator segments without going to the manufacturer of the motor. One firm makes a speciality of the brush-holders and carbon brushes. Another sells the suspension springs, whilst the gearing may be bought direct from the wheel makers to suit any motor on the market.

At an early date in the history of electric traction it was

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recognised that it would be to the general advantage to standardise the gear wheels, and the result has been that the following specification will suit practically any single reduction tramcar motor now in use :—

Specification of Standard 4·78 to 1 Single Reduction Gear for Tramcar Motors.

Solid Steel Pinion :—
Number of teeth, 14.
Pitch diameter of pinion, 4⅝ inches.
Outside diameter over teeth, 5⅛ inches.
Face of teeth, 4½ inches.
Bore to be tapered, $2\frac{5}{16}$ at wide end. Standard taper 1¼ inches per one foot.
Keyway, ¼ inch deep, ¼ inch wide.
The teeth to be either pressed out hot or cut in a milling machine and polished.

Split cast-iron wheel, four arms :—
Number of teeth, 67.
Pitch diameter of wheel, 22½ inches.
Outside diameter over teeth, 23 inches.
Face of teeth, 4½ inches.
Boss of wheel, 6 inches diameter, 6¾ inches long.
Standard bore, 3⅝, 3¾, or 4 inches parallel.
Keyway, $\frac{7}{16}$ inch diameter, ·747 inch wide.
Wheel cast in halves accurately machined and bolted together. Teeth machine cut.

The design of the teeth to be involute or epicycloidal, and the efficiency of the gear to be not less than 95 per cent. when new.
Net price of the pinion, 15s. to 20s.
Net price of the cast-iron wheel, 36s. to 45s.

The large wheel is sometimes made of cast-steel, but the best results are given by best grey cast-iron. The quality of the steel used for the pinion, however, varies a good deal. Roughly speaking, the higher the percentage of carbon, the harder and more durable is the steel; but on the other hand, milling out teeth in high carbon steel is exceedingly expensive. The United States Projectile Company (whose agents in this country are Messrs. Laing, Wharton & Down, of New Bond Street, W.) have solved the problem by pressing heated steel through a glass hard die, and thus forming all the teeth at one operation. The pressure exerted is about 500 tons, and the result is that the pinion is very close grained and tough, whilst the hard skin given by the drawing process naturally tends towards a longer life. A specially high quality of steel is employed, having as much as ·3 per cent. of carbon in it, which is about double what could be used were the teeth to be milled out from the solid.

Those who have had anything to do with the application of electric motors to hauling drums, pumps, machine tools, &c., where toothed gearing is absolutely necessary, know how much depends on the satisfactory working of the first motion wheels, and especially on the pinion. All kinds of materials have been used for motor pinions, including phosphor bronze, raw hide, fibre interleaved with sheet steel plates, &c., but there is only one really satisfactory way of dealing with the matter, and that is, to employ a pinion made of hard steel, with accurately shaped straight teeth. Wherever possible, the speed of the motor should be brought down to admit of pinions having the following minimum diameters and widths, and say not less than 13 teeth :—

B.H.P. of motor.	Suggested speed.	Diameter at pitch circle.	Face of teeth.	Suggested minimum number of teeth.
3	680	3½	3½	13
5	630	4	4	13
7½	580	4	4	13
10	550	4	4	13
15	500	4⅜	4½	14
20	470	4⅜	4½	14
25	450	4⅜	4½	14
30	420	5¼	5	15
35	400	5¼	5	15
40	370	6½	5½	17
50	350	8½	6½	19

Where there has been trouble with a motor driving a machine by gear wheels, it has nearly always been traceable to running the motor at a high speed, and having too small a pinion, or else using wheels with roughly cast or improperly shaped teeth. For example, the writer has heard of a wheel being ordered from one firm and the pinion from another without any regard to the contour of the teeth being struck out with the same rolling pitch circle; no wonder such gearing made a noise.

Double helical teeth are sometimes insisted on for motors of so small an output as 10 and 15 B.H.P., but this is a mistake, as the teeth must of necessity be roughly cast (machine-cut double helical teeth are not yet commercially possible), and the vees of the teeth are apt to vary to one side or the other. To remedy this, motor pinions have been so fitted that they could slide laterally on two feather keys, but the feathers soon wear loose, and the shock on the armature from this cause neutralises any improvement given by employing -shaped instead of straight teeth. Strengthening teeth by shrouding is a mistake in high speed gears, as what is principally wanted is plenty of wearing surface, and in increasing the width of the wheel to get this surface, all the required strength is obtained.

The ordinary rules of gear design have been modified a good deal by the successful application of electric power, but in reducing the speed of any motor, the writer would suggest that the following broad rules should be followed :—

(*a*) Keep the speed of the motor as low as possible; two trains of wheels, each four or five to one reduction is the most that should be allowed, and in many cases it will pay to spend more on the motor, and have only single reduction.

(*b*) Employ straight teeth on the first pinion and wheel in all cases, the pinion of hard steel and the wheel of cast-iron.

(*c*) Have the teeth struck out with the same rolling pitch circles, the number of teeth in the pinion to be never less than 13.

(*d*) Fix the pinion rigidly on the motor shaft, which should by preference be tapered so that the pinion can be quickly replaced.

Where it is at all possible the writer would recommend that a standard traction motor gear, as specified above, with pressed steel pinion, should be used. These wheels are turned out in such quantities that it would pay to employ them for motors of only 10 or 15 B.H.P., although experience shows that at their standard speed they are strong enough to transmit 40 H.P. on an emergency.

INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(*Continued from page* 91.)

For heating purposes the coils used are similar to resistance coils, but they have to be entirely free from tension or strain and to be so suspended that in the event of accidental fracture they are held in place and the production of a short circuit is impossible. This is effected by supporting the coils on an asbestos cord passing through their entire length, drawn tight and fastened to the terminal insulators, and in this way the coils can be placed quite close to each

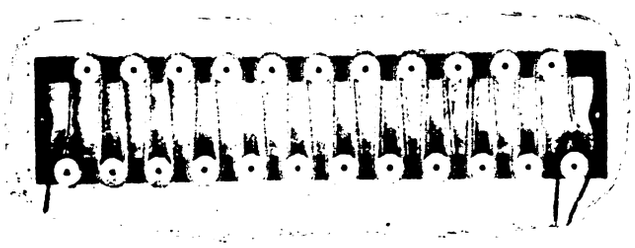

Fig. 53.—Coils.

other without fear of accident. The coils themselves are firmly fastened to the terminal insulators at each end, and the leading out wires are soldered firmly to the coil. The wire is of a special grade of steel which does not alter in resistance with use and is uniform throughout, so that liability to any local increase of temperature and consequent rapid local oxidation and the resulting destruction of the coil, due to slight flaws or imperfections, is reduced to a minimum. The frame is made of light steel carrying on

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steel studs the porcelain insulators, over which the coils are passed, as will be seen by the accompanying fig. 53. The dimensions run from 17 inches to 28 inches in length, 10½ inches to 8 inches in height, and 2 inches to 3 inches wide, weighing only a few pounds, so that conditions 1, 3 and 5 are satisfied. The distribution of the heat is effected in such a way that the principal radiation is from the front surface, so that the loss which would be incurred by fixing the back against the side or floor of the car were the radiation uniform on both sides is avoided. The manipulation is effected by double-break single-pole switches (fig. 54),

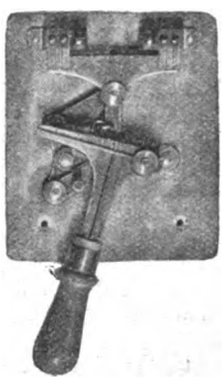

Fig. 54.—No. 1 Switch.

the full throw of the lever being completed immediately on being released, so that there can be no arcing and destruction of the jaws. These switches are made for single circuits and single heats, or for several circuits and any desired number of heats. The variation in heat is effected by having three or more different adjustments of resistance in the coils of each heater, using 3, 5, or 8, &c., amperes as required. If three divisions of heat production alone are used, then the heaters can be operated by a pair of single switches, if more than a pole-circuit or combination switch

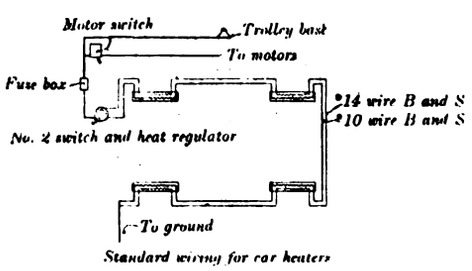

Fig. 55A.—Plan of wiring Four-heater equipment, one No. 2 switch. Three divisions of heat.

is required, the high resistance circuit takes 3 amperes and the low 5 amperes, the latter when operated alone giving the second degree of heat, and the maximum when the two circuits are in parallel; in all cases the manipulation

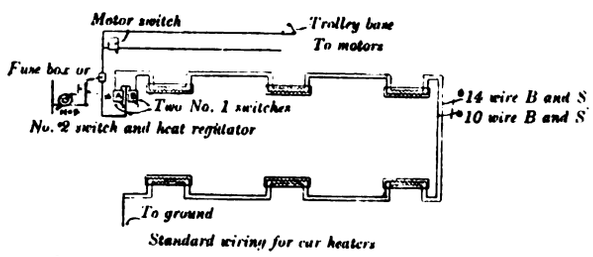

Fig. 55B.—A on, B off = low heat. B on, A off = medium heat. A and B on = full heat. Plan of wiring for Six-heater equipment using two No. 1 switches, or controlled by No. 2 Combination switch. Three divisions of heat.

is most simple, and any degree of heat can be obtained, so that conditions 2 and 4 are completely complied with. The following three plans for a four-heater, six-heater, and twelve-heater wiring respectively, show the way in which the electric heaters are applied in practice to various forms of car (figs. 55A, 55B, 55C.)

With the system of wiring shown above and the coils constructed as described, the cut-out in the circuit is rarely called into operation. Those generally used in connection

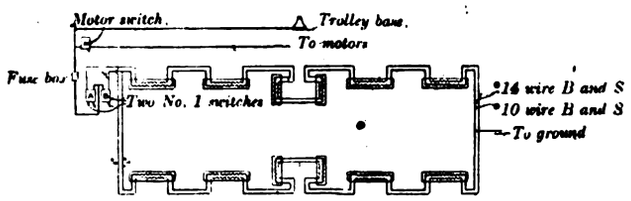

Fig. 55C.—A on, B off = low heat. B on, A off = medium heat. A and B on = full heat. Plan of wiring for Twelve-heater equipment. Three heats controlled by two No. 1 switches.

with a heating installation are perpetual cut-outs not subject to injury however often called into operation, so that burnt terminals and destroyed receptacles become a practical impossibility. The necessity for the use of costly automagnetic cut-outs or the unsatisfactory fusible variety is thus avoided. The use of two mono-current switches admits of the simplest form of wiring.

The following table gives the various types of heater in use, with dimensions and style of car to which they are adapted:—

Heater type.	Dimensions. Length.	Height.	Width.	Used. Fixed to	Type of car.	Remarks.
	in.	in.	in.			
A	27	11	2	Floor under seats.	Longitudinal seats open underneath.	For 16 to 20-foot cars, four heaters of any kind, except types E and C are required, and of these, six.
B	27	10	2	Riser panel on side of car.	Longitudinal seats closed underneath.	
C	22	8	2	Floor or suspended from seat.	Cross seat cars (short).	For 22 to 26 foot cars, six of the former and eight of the latter.
D	33½	8	2	Do. do.	Longitudinal seats open underneath.	A maximum current capacity of 1,000 watts is allowed in American practice for all varieties except E and C, but in Great Britain a maximum capacity of 800 would be sufficient.
E	17	10½	2	Do. do.	Cross seated cars (long).	
F	28	9	3	Panels.	Longitudinal seats closed underneath.	

Figs. 56, 57, and 58 illustrate the A, B, and F types of heater; types C, D, and E being similar to type A in appear-

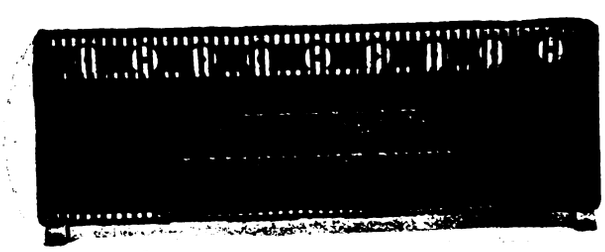

Fig. 56.—"A" Type.

ance. The author is indebted for the information from which the above is compiled to Messrs. R. W. Blackwell and Co.

Lighting.

There can be no question that just as the only reasonable and satisfactory way of heating an electric car is by using

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the current for that purpose, so also the only reasonable and satisfactory way of lighting it is also by using the current. On no properly installed electric tramway need there now be

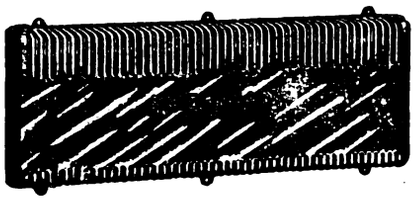


Fig. 57.—"B" Type.

any fear of a sudden drop of voltage, such as would cause an interruption in the light which the cars require both for safety and convenience. In the older installations this was

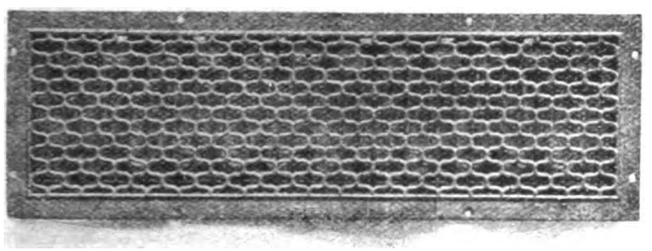
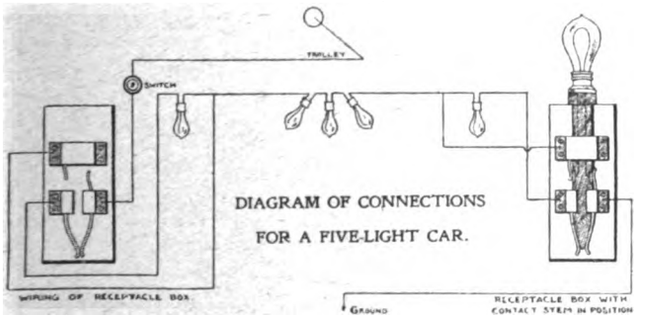
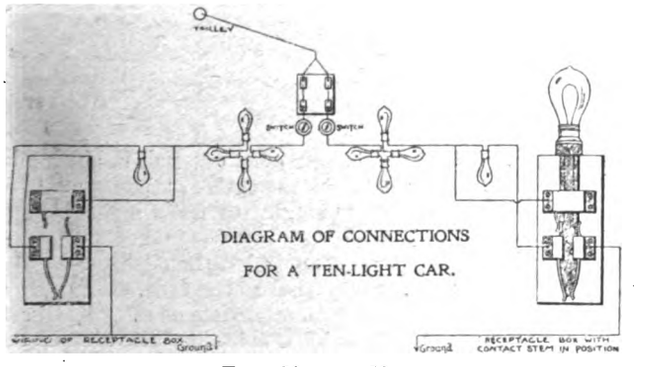


Fig. 58.—"F" Panel Type.

by no means always the case, and the sudden drop in the efficiency of the lights following immediately on starting often made passengers regret their more steady, if less brilliant, petroleum predecessors. These little mischances, however, may be taken as once and for all, removed from the most approved modern working, and this being the case no one will question the superior convenience and merit of electric lighting for all car purposes as compared with any other form of lighting. In point of cleanliness, simplicity, ease of up-keep, and efficiency, the best forms of electric lighting for cars leave nothing to be desired. The two diagrams (figs. 59A and 59B), attached show the method





Figs. 59A and 59B.

of connecting the lights for a 5 and 10-light car respectively, exclusive of the head and tail lights which are additional in every case. Head lights, where the illuminant is oil, are notoriously troublesome as they get very hot, and, when handled in shifting from one end of the car to the other at the termini of the journey, get seriously knocked about on this account. They require constant repairs, their tanks are generally leaky, the smell is offensive, the reflectors are liable to be ruined by the oil, and they are perpetually dim, while the most serious of all, they are always more or less liable to being blown out by the wind. Their cost is also relatively high, as the following very moderate estimate will show :—

Oil per day (say)	1¼d.
Chimneys and wicks, do....	0¼d.
Cleaning, filling and trimming (men's time)	1½d.
Repairs	0¼d.
	3¼d.

= for 365 days to £4 18s. 10¼d.

Against which has to be set the cost of repairs to the electric head light, which is a mere fraction of that for oil lights and the renewal of the time-expired filaments, the whole of which could easily be covered by an expenditure of about £3 10s. per annum, so that in little more than a year the cost of electric head lights could be recouped from the saving effected in maintenance, renewals and repairs of the old oil head lights. The importance of having brilliant and dependable head lights cannot be too strongly insisted upon, especially on electric cars moving swiftly and comparatively noiselessly through the streets, and, if in addition to this, an actual saving is effected by the use of electricity as an illuminant, there can be no question that they are indispensable accessories of electric traction. Fig. 60 shows one of the most

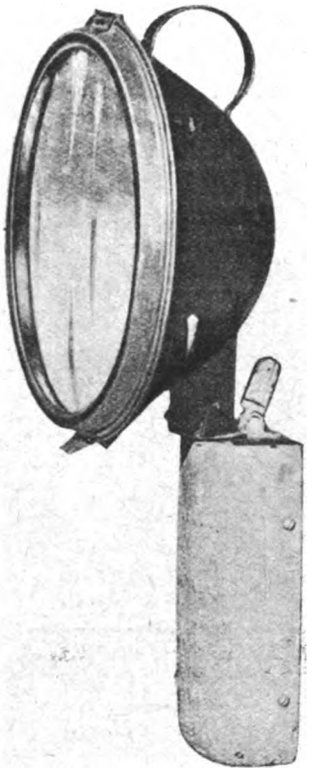


Fig. 60.

convenient forms in use. This is known as the Syracuse changeable electric head light. The chief merit of this form of lamp consists in the ease and rapidity with which it can be shifted from one end of the car to the other and exchanged for the coloured tail light by the motorman and conductor when they change ends at the terminus. Fig. 61 shows the change in progress. In this head light the parabolic reflector is of 99 per cent. pure aluminium encased in steel jacket (22 B.W.G.) with a handle at top, and a 12-inch glass front fitted in a nickel plated solid brass rim with hinge and catch. The lantern is fixed on the top of a waterproofed hickory contact stem with brass contact plates communicating with the lampholder. Cast-iron receptacles 10 inches high and 4 inches wide with square sockets of the dimensions of the contact stem containing brass spring connections, are fixed to the two dash-

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boards at the car ends, and connected with the light circuit in the car, as shown in fig. 62. When the contact stem is inserted in the socket the circuit is complete, and the light,

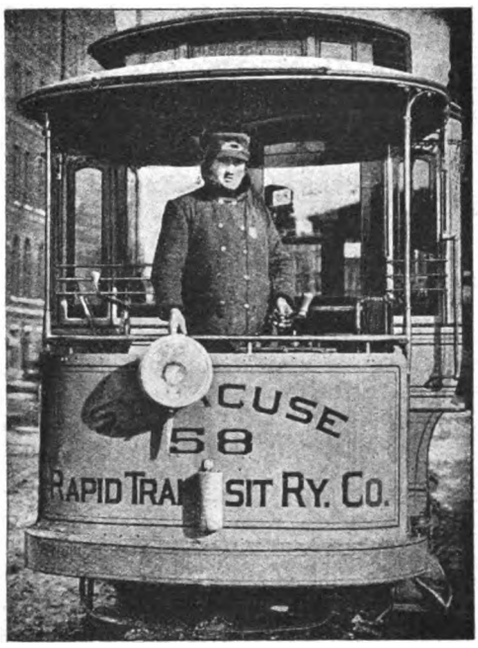
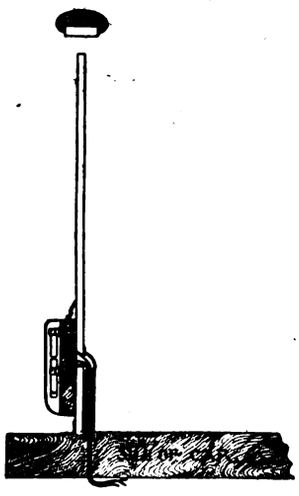


Fig. 61.

if the current is switched on, at once appears. All these head lights are interchangeable, and can be shifted from one car to another if required, as they fit all holders. The same



Section of dash with receptacle in position

Fig. 62.

proportionate economy can be effected in the substitution of incandescent lights for ordinary oil lamps throughout the car interior and in the tail lights.

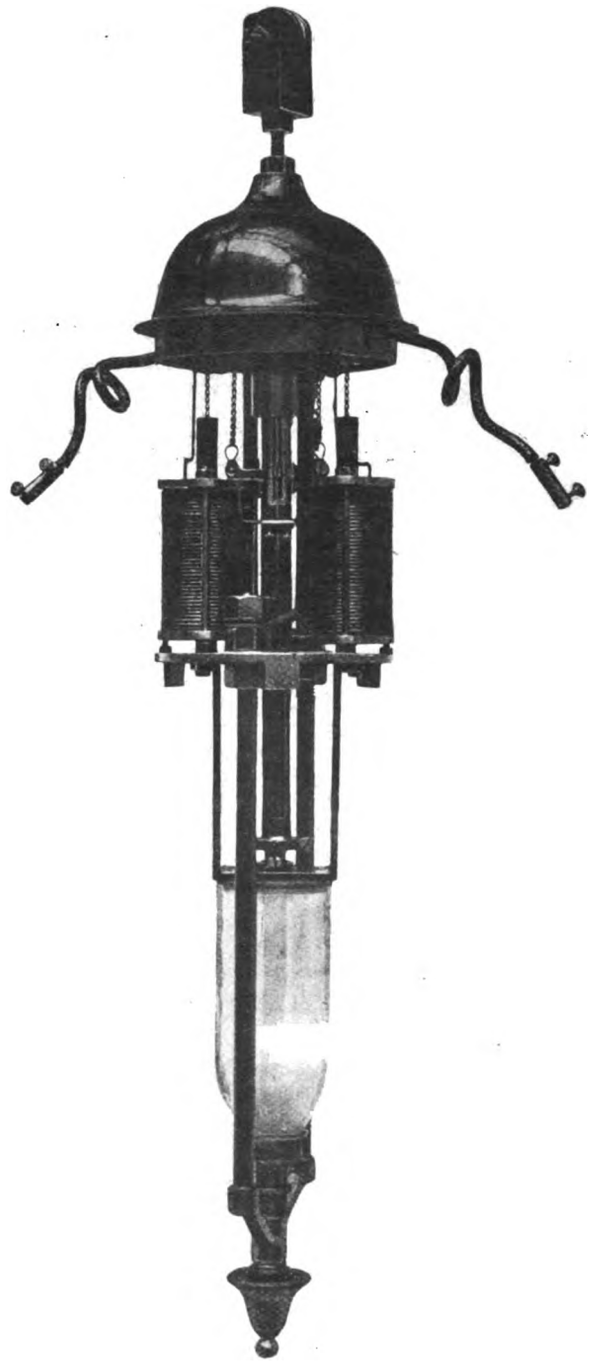
(*To be continued.*)

THE "JAMES" ENCLOSED ARC LAMP.

Simplicity and strength are two of the first essentials of an enclosed arc lamp which is to run satisfactorily, and both of these essentials are to be found in the lamp before us.

Realising that a lamp has to stand a considerable amount of rough usage, often at inexperienced hands, the manufacturers have turned out a lamp which will stand rough handling without getting seriously out of alignment, a fatal defect in some lamps, enclosed and otherwise, which we have seen. The top and bottom plates are solid brass castings, and the rods are solid to allow of a deep-cut screw thread, the result being that the lamp can be rested on end or at an angle without fear of any part bending or distorting.

The corona and cap are copper spinnings, and the corona can be easily removed (by taking out two screws) to get at the mechanism should necessity arise.



By the use of two balanced coils the pull is absolutely straight throughout the lift of the carbon, the dashpot is in dead centre line, and the plunger carries a simple single acting valve.

The top carbon fits into a conical carbon holder, having ample spring contacts, within the centre tube, on the lower end of which the clutch, which we illustrate on p. 215, is fixed.

This clutch is in the form of a split-ring binding on the centre tube with a single screw, and consists of two arms hinged on a lower ring carrying two adjustable screws to grip, and allow for, carbons of slight variation in diameter, and the lift being absolutely vertical, the probability of jamming is reduced to a minimum.

In the event of a carbon breaking in the tube the clutch can be easily removed to permit the removal of the holder and can be as readily replaced in perfect adjustment.

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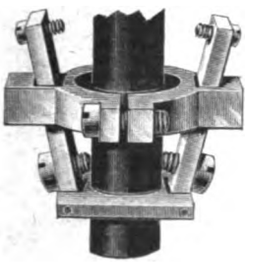
There is an entire absence of springs or of material that can be injured by heat. Our illustration shows a lamp for single parallel, but for series circuits a shunt coil is added and fixed to one of the stays, and the core is carried from an arm attached to the centre tube yoke immediately above the



coils, in no way altering the general construction of the lamp. When required, a special form of automatic cut-out may be added.

There is room in the cap for impedance coils and resistances if required to be so fitted. The lamp runs very steadily and the feed is almost imperceptible.

We understand that two of these lamps have been running satisfactorily in series on 220 volts at a frequency of 40.

In general appearance the lamp is neat, ventilation is duly provided for, and altogether we can congratulate Messrs. James & Mills on the result of their efforts.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS. 1899.

mpiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool; Manchester, and Birmingham, to whom all inquiries should be addressed.

6,125A. "Improvements in and relating to secondary batteries." P. M. JUSTICE. (The Pope Manufacturing Company, United States.) Dated July 20th. (Date claimed under patents rule 19, March 21st, 1899.) (Complete.)

14,668. "Improvements in and connected with movable electric lights." H. O. FARRELL. Dated July 17th.

14,687. "Electro-magnetic brake." P. F. L. R. H. K. VOIGT and W. C. KUSTERER. Dated July 17th. (Complete.)

14,708. "Improvements relating to carbon electrodes for arc lamps." H. BREMER. Dated July 17th.

14,704. "Improvements in electrodes for electric arc lamps." H. BREMER. Dated July 17th.

14,734. "An improved auto copying telegraph." A. C. BROWN and R. BURN. Dated July 18th.

14,736. "An improved winding for dynamos." M. H. HURRELL. Dated July 18th.

14,774. "Improvements in or relating to submarine electric arc lamps." F. G. HALL, jun., and I. E. BURDICK. Dated July 18th. (Complete.)

14,789. "Improvements in electrical locking apparatus for railway signals." G. H. JELFS. Dated July 18th. (Complete.)

14,794. "Improvements in and relating to storage batteries." S. Y. HEEBNER. Dated July 18th. (Complete.)

14,806. "Improved counter or meter for electric lamps, motors, and other electric apparatus." G. DI P. MAGINI. Dated July 18th.

14,826. "Improvements in or connected with apparatus for use in the production of Röntgen rays." W. P. THOMPSON. (The Voltohm-Elektrizitäts-Gesellschaft, A. G., Germany.) Dated July 19th.

14,859. "Automatic electric signalling apparatus for pneumatic dispatch tubes." T. STACEY. Dated July 19th.

14,877. "Sound-proof telephone cabinet." H. P. J. WULFF and J. H. BLUNCK. Dated July 19th. (Complete.)

14,878. "Improvements in covering electrical and other wires and apparatus therefor." W. W. COLLEY. Dated July 19th.

14,892. "Improvements in automatic electric signs." J. D. F. ANDREWS. Dated July 19th.

14,906. "Improvements in fuse blocks for electric circuits." H. P. DAVIS. Dated July 19th. (Date applied for under Patents, &c., Act, 1883, Section 108, January 30th, 1899, being date of application in United States.)

14,907. "Improvements in circuit breakers." H. P. DAVIS and G. WRIGHT. Dated July 19th. (Date applied for under Patents, &c., Act, 1883, Section 108, March 23rd, 1899, being date of application in United States.)

14,908. "Improvements relating to the distribution of electrical power." R. D. MERSHON. Dated July 19th. (Date applied for under Patents, &c., Act, 1883, Section 108, February 1st, 1899, being date of application in United States.)

14,909. "Improvements in dynamo-electric machines." B. G. LAMME. Dated July 19th. (Date applied for under Patents, &c., Act, 1883, Section 108, April 14th, 1899, being date of application in United States.)

14,943. "An improvement relating to the bearing of dynamos and other machines." W. J. LISTER and E. J. S. WHEATCROFT. Dated July 20th.

14,946. "Improvements in or relating to electric meters." J. H. BARKER and J. A. EWING. Dated July 20th.

14,966. "The automatic electro-dynamatic ventilator." H. A. F. HAND. Dated July 20th.

14,973. "An improvement in electrical glow lamps." E. STERNE. Dated July 20th.

14,981. "Means for intercepting vagrant earth currents in electrical traction." W. CRAMER. Dated July 20th.

14,997. "Improvements in switches for electric circuits." G. WRIGHT and C. AALBORG. Dated July 20th. (Date applied for under Patents, &c., Act, 1883, Section 108, January 30th, 1899, being date of application in United States.)

14,998. "Improvements in fuse blocks for electric circuits." H. P. DAVIS. Dated July 20th. (Date applied for under Patents, &c., Act, 1883, Section 108, March 23rd, 1899, being date of application in United States.)

15,009. "Improvements in electric arc lamps." J. B. BARTON and THE JANDUS ARC LAMP AND ELECTRIC CO., LTD. Dated July 20th.

15,017. "Improvements in electric accumulators or secondary batteries." H. WEYMERSCH. Dated July 21st.

15,019. "Improvements in and relating to telephone switches and switch-boards." G. GILLMORE. Dated July 21st.

15,066. "Improvements in systems of electrical distribution." B. G. LAMME. Dated July 21st. (Date applied for under Patents, &c., Act, 1883, Section 108, January 30th, 1899, being date of application in United States.)

15,078. "A new method of manipulating ether waves for wireless electric or electro-magnetic telegraphy." J. LAISTER. Dated July 21st.

15,128. "Improvements relating to plug contacts or contact plugs for electric circuits." O. D. LUCAS. Dated July 22nd.

15,135. "Improvements in electrical clock arrangements and apparatus." F. T. HOLLINS and F. W. LEAK. Dated July 22nd.

15,138. "Improvements in electrical machines." B. G. LAMME and J. P. MALLETT. Dated July 22nd. (Date applied for under Patents, &c., Act, 1883, Sec. 108, February 6th, 1899, being date of application in United States.)

15,139. "Improvements in automatic circuit breakers." G. WRIGHT and C. AALBORG. Dated July 22nd. (Date applied for under Patents, &c., Act, 1883, Sec. 108, March 23rd, 1899, being date of application in United States.)

15,143. "An alternative electric bell and telephone system." G. E. O. POLLAND. Dated July 22nd.

15,147. "Electrical apparatus for indicating the names of stations in railway and tramway vehicles." SIEMENS BROS. & CO., LIMITED. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated July 22nd. (Complete.)

15,148. "Improvements in junction boxes for underground electric conductors." SIEMENS BROS. & CO., LIMITED. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated July 22nd. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

10,884. "Improvements in electric arc lamps." F. S. Worsley. Dated May 3rd, 1897. Arc lamps.—Brake mechanisms for striking and feeding are constructed as follows:—A lever is fitted co-axially or nearly so with a brake-wheel, the rim of which is grooved circularly. The lever carries a box containing two rollers, which support a wedge-shaped brake block, padded with rubber, against the rim of the brake wheel. The wheel thus moves with the lever, unless the latter is turned so that the wedge bears on a fixed stop. The lever may be connected with the core of a shunt solenoid or other controlling device, and the brake wheel is geared to the movable carbon or carbons. Other forms of brake block may be used. In a modification, the brake wheel is channelled circularly to receive two brake blocks, hinged together and hung by a wire from a bent support. A pin projects laterally from the lever between the blocks. The brake may otherwise act directly on a carbon holding rod, the wheel being dispensed with. 3 claims.

10,885. "Improvements in carbon holders for electric arc lamps." F. S. Worsley. Dated May 3rd, 1897. Arc lamp.—In order to secure carbons of various sizes in a circular or other socket made for a large carbon, bushes of suitable bores are fitted therein and secured by screws. The bushes are slotted to pass the screw by which the carbon is clamped. Small bushes may fit concentrically in larger ones. 2 claims.

11,017. "Improvements in telegraph cables or the like." J. J. Hall. Dated May 3rd, 1897. Cables formed of bundles of conductors enclosed in a lead sheath. Each conductor is enclosed in a loose layer of leno, muslin, or other netted fabric, held in position by a cord. 3 claims.

11,118. "Improvements in telegraphic apparatus." C. F. Eaton. Dated May 4th, 1897. Consists of a system of telegraphy in which the transmissions sent from a perforated strip are visibly shown or photographically recorded at the receiving station. The message is perforated in a strip and passed over a cylinder upon which ride a number of contact fingers corresponding to the allotted number of signals. The fingers are connected to contact points on the outer ring of a distributer, the arm of which is mounted on the shaft of the motor. The cylinder is moved one step by a ratchet and pawl for each revolution of the shaft. The contacts are grouped to radially correspond with insulating spaces on the middle ring of the distributer, whilst the inner ring is uninterrupted, and is connected to the line. The middle ring is connected to the shunt, including the magnet, and the outer ring is connected through the cylinder and shutter coil to the dynamo. The magnet operates a commutator for putting the battery in either direction to the field coils of the motor. The receiving apparatus consists of a disc mounted on a shaft and having a number of perforations corresponding in form to the signs transmitted. These pass in order in front of an opening in the end of an optical shutter, which, when open, allows the signs to be seen or to be recorded photographically on a sensitive surface, which is rotated similarly to the cylinder. The optical shutter consists of a tube containing two polarising prisms, set at right angles, and having between them a tube containing a liquid such as carbon bisulphide. The coil surrounds this tube. Beyond the tube is a source of light which on the receipt of a signal can pass through and either show or record such signal. Dynamos or transformers are arranged in series in the line so as to produce currents of sufficiently high potential for actuating the apparatus. 4 claims.

11,124. "Improvements in electric lampholders." E. L. Joseph. Dated May 4th, 1897. Incandescent lamps.—Holders for bayonet-capped lamps are provided with porcelain or other insulators, fitting loosely in them and on the contact plunger sockets. In a modification the insulator also covers the screw portions of the sockets, the plungers only being uncovered. The insulator may be in two or more parts. 2 claims.

14,254. "Improvements in or relating to ampere-hours electric meters." S. Hummel. Dated June 11th, 1897. Relates to quantity meters for continuous currents.—A coil is suspended between the pole pieces of a permanent or constant electro-magnet and connected by a reversing switch with the ends of a resistance carrying the main current. Thus resistance is made of a material having a low temperature resistance coefficient. The reversals of the shunt current cause the coil to oscillate. The oscillations are limited by a short arm on the coil touching either of two fixed springs, such contact short circuiting one or other of two electro-magnets, which are connected in series between the two main conductors. These magnets act on an armature carrying the movable part of the reversing switch, which remains in the position where either magnet places it until this magnet is short-circuited. The coil surrounds a conducting cylinder which is retarded by moving in the gaps between the magnet and an iron core. Iron pins on the pole pieces act on an iron cross piece, or an electro-magnet supplied with reversing current on the axle to assist the motion of the coil at the end of its oscillations. The movements of the axle or the reversing switch are communicated to a counter. The coil and damping cylinder are of copper or other material having a large temperature resistance coefficient, in order that the variation of the shunt current in the coil may compensate for the variation of the damping, owing to changes of temperature. 4 claims.

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14,272. "Improvements in compositions containing casein for electric insulating and other purposes." P. H. Hansen and J. K. Westengaard. Dated June 11th, 1897. Compositions are formed of casein worked up with India-rubber dissolved in benzol and asphalt. Colouring matter, ground bone, kaolin, gypsum, and graphite may be added. The casein may be prepared by kneading milk curds or cheese in hot water, or by the process described in specification No. 1,550, A.D. 1897. The material can be used as a substitute for ebonite, &c., or as an electric insulating composition. 1 claim.

17,081. "Improvements in and connected with electrical furnaces." W. H. Monk. Dated July 20th, 1897. In an arc or incandescence furnace, the arc, or the current traversing a fused mass, is made to travel round by producing a rotating magnetic field in the furnace. In one form shown arcs are produced from concentric hollow carbons to a solid electrode resting on an iron plate. A surrounding iron ring, wound continuously, is supplied by four connections with two alternating currents in quadrature, to produce the rotating field. The ring is protected by an asbestos, mica, firebrick, or other lining, or by an upstanding edge on the lower electrode. The materials are supplied through the hollow carbons which may be raised or lowered by supports on a screw. A single hollow carbon may be used similarly, or a solid upper carbon may enter a hollow in the lower one. In an incandescence furnace, in which the current passes at first through a thin carbon rod, and afterwards through a fused mass of the product, the rotating magnetic field directs the current to one side of the fused mass, and causes it to revolve round the axis of the mass. 7 claims.

17,099. "Rheostats." O. H. Pieper and A. F. Pieper. Dated July 20th, 1897. A divided resistance is made by enclosing a copper or other support between two wider insulating strips, and placing on these alternating conducting plates and insulating washers with thicker end plates secured by pins. The conducting plates may be placed between mica plates. A continuous insulated wire is wound into the spaces thus formed, crossing from each space to the next over the intervening plate; the crossing parts are then bared and soldered to the plates. Such a resistance may be mounted in a circular case. The resistance is formed into a ring, the end plates connected together by screws the remaining spaces filled up with insulating material, and the inside surface smoothed. The ring is secured by clips on arms of a metal frame. A contact spring is carried by an arm of a hollow shaft carrying a knob by which the arm and spring may be turned in contact with the inside of the ring. A pointer on the shaft indicates its position on a dial. The shaft carries also a sliding disc which may be clamped against another disc by tightening a nut on a bolt. The disc is attached to a wheel in gear with a worm on a shaft which may then be turned by hand to turn the contact arm slowly. The apparatus is applicable for use in cataphoric dental operations. The generator terminals are then connected with the ends of the resistance wire; the instrument terminals are connected with one end of the resistance and the contact arm. 10 claims.

17,113. "Improvements in underground systems of electrical distribution for electric railways and the like." W. L. Wise. (A. S. Krotz, W. P. Allen, and O. S. Kelly, United States.) Dated July 20th, 1897. Relates to electric railways and tramways on the conduit system. Conduits, conductors, insulation.—The upper parts of the yokes are reinforced by pairs of webs or ribs between which the insulators are supported by rods. These insulators carry the contact rails and a line of pipes in which the main conductor is laid. The pipes may be lined with insulating material and have water excluding hoods where they open into the manholes. At these points the pipes are interrupted and the conductor is carried round the sides. Feeders which connect the conductor to the contact rail may be made as fuses and can be connected by means of a screw stud with an insulating handle. The contact rail is of angle section, either right or obtuse angle, and is bolted to the insulators with play for expansion and a flexible connection to adjacent lengths. Other modifications are described. 15 claims.

17,142. "Improved electro-mechanical apparatus for the control of electric motors." J. Dalait. Dated July 20th, 1897. Relates to apparatus for starting, stopping, and reversing electric motors, particularly applicable to the control of electric lifts. Consists of three-push contacts for effecting the ascent, stoppage, and descent of the lift, a battery, and a resistance switch in the armature circuit. On making contact at one of the push contacts an electro-magnet attracts a lever carrying plungers which enter mercury cups on the armature leads and forming part of the reversing switch; at the same time contacts are brought together by the lever, and the electro-magnet becoming excited, attracts a lever which closes at the field excitation circuit. Solenoids in the field circuit then actuate the lever of the resistance switch, and the armature is supplied with current, the resistance being gradually cut out. In order to stop the motor, contact is made. On doing this an electro-magnet is excited, a lever released, and the excitation circuit broken and made in such a manner as to prevent sparking. The solenoids are now inactive, and the switch lever is retracted by a spring, thus throwing the armature out of circuit. On the switch-lever making contact the current passes through the releasing magnets of the reversing switch, and, finally, on making contact the magnet actuates the lever and short-circuits the motor. For bringing about the descent of the lift, contact is made on which the magnet is excited and actuates the lever of the reversing switch, so as to supply current to the armature in the opposite direction. 2 claims.

17,169. "Improvements in electric batteries." W. Rowbotham. Dated July 20th, 1897. Relates to batteries of the kind described in specification No. 2,378, A.D. 1897, in which the cells are arranged in a series through which the liquids circulate, and consists in utilising the nitrous vapours or other gases given off in the battery to effect the circulation of the depolariser, and at the same time to effect a saving of the depolariser. In the case where the depolarizer consists largely of nitric acid, it is contained in the smaller compartment of a tank connected by a valve with a larger compartment containing dilute sulphuric acid, in which is a jointed pipe connected to a float and to a pipe, by which the nitrous vapours from the battery are caused to bubble through the sulphuric acid, into which air may also be admitted to decompose the vapours. The battery is supplied from the compartment, and as the pressure in the compartment increases, it ultimately opens the valve and a portion of the liquid from the latter compartment flows into the former. 1 claim.

17,208. "Improvements relating to the starting switches of electro-motors." F. G. Robinson. Dated July 22nd, 1897. A starting switch for electric motors is provided with means for ensuring a slow "on" movement and a rapid "off" movement, which in the latter case may be actuated either automatically or by hand. The switch arm moving over contacts in connection with resistances is mounted on a spur-wheel actuated through slow-speed gearing by a hand-wheel or knob. As the arm moves from the "off" to the "on" position, a volute spring on the axis of the spur-wheel is wound up, the wheel being prevented from returning by a pawl held in engagement with a ratchet by an electro-magnet in the field circuit of the motor. On the failure of the current, or by pressing a knob acting on an extension of the pawl, the pawl is retracted by a spring, and the switch arm is rapidly returned to the "off" position by the spring; or the pawl may be disengaged from a distance by an electro-magnet in parallel with, and acting against, the magnet. The switch arm has a forked end which passes between the contacts and a continuous metal plate separated by insulating material and forming terminals in the path of the current supply. When an additional electro-magnet is employed, there is a second continuous metallic plate behind or below the plate for connecting this magnet in shunt with the magnet. 3 claims.

17,314. "Improvements in and relating to motor vehicles for electric railways." H. H. Lake. (W. A. McGuire, United States.) Dated July 22nd, 1897. Relates to bogies and axle-trucks and brakes for electric motor vehicles. The bogie or truck carries a motor which is supported by sleeves on the driving-axle and a trunnion in a cross-bar forming a part of the equalising frame. Bars support the motor in the event of the driving-axle breaking, and enables the car to be removed for repairs without risk of further damage. The equalising frame consists of two pairs of side plates connected by end bars and resting on springs. In a modification springs are placed at the side of instead of on the top of the axle boxes. The car-supporting frame consists of beams tied by a cross-girder, and having horns to embrace the axle boxes. It rests on springs on the equalising frame and is capable of lateral movement between ribs and on the axle boxes under the control of springs. These springs are secured to caps capable of rocking movement on bases bolted to the side plates and bars respectively. The cap preferably telescopes into the other. The current is supplied by a third rail, and is collected by a shoe carried by a wooden bar secured to the axle boxes by bolts passing through slots in the bar. The brake blocks are hung on bars and are actuated by levers connected by rods. The two levers are pivoted to brackets bolted to the cross bar. The other pair are connected by links to a curved bar which is actuated by the brake rod carrying a roller. 30 claims.

17,316. "An improved process for electrolytically purifying and filtering saccharine liquids or solutions." C. A. Meygret. Dated July 22nd, 1897. Saccharine solutions are electrolysed for the purposes of purification by the means of an electric current; the solutions are caused to circulate between electrodes. A tank is divided into compartments by vertical partitions formed of canvas steeped in fish glue, then dried, and afterwards dipped in a solution of tannin in chromic acid. The compartments are filled with water, and the intermediate compartments are filled with the sugar solution. The electrodes in the compartments are preferably of iron, and those in the compartments are of carbon. A series of tubes connects the water compartments, and a second series connects the sugar compartments. 2 claims.

17,316. "Improvements in electric accumulators." L. G. Garcia. Dated July 22nd, 1897. The electrodes consist of a number of lead bars separated from each other by cross-shaped strips of ebonite; the bars of the same polarity are connected together by strips diagonally arranged as shown. The bars are in the shape of a rectangular prism, and are pierced with a large number of fine intercommunicating holes or passages. The mould consists of a casing held together by clamps and closed at its end by end pieces in which are respectively an opening for the admission of the molten metal and an exit for air. The pieces which almost close one end of the mould serve to form the upper pyramidal end of the bar and the conducting tang. Wires cross the mould in opposite directions to form the holes in the bar. 1 claim.

17,410. "Method of and means for producing the synchronous rotation of two axes situated a considerable distance apart." C. D. Abel. (La Societe Anonyme pour la Transmission de la Force par l'Electricite, France.) Dated July 23rd, 1897. Axes situated at a distance apart, such as those employed in telegraphy or multiplex telephony, are synchronised by employing a specially arranged motor, the armature of which is shunted by the armature circuit of an alternating current generator and a resistance. There is a series of three alternators the armatures of which are all arranged on the axis; the armatures of the earlier alternators feed the magnets of the following one of the series. A fly-wheel may be mounted on the axis. A special form of driving motor is described, in which the field magnet ring is doubly wound, two fields being provided at right angles, the armature is in series with one of the field windings. The armature is wound in two series of alternating sections, the even-number sections being connected to the even-number commutator bars, and the uneven-number sections to the uneven-number commutator bars. 1 claim.

17,470. "Automatic transformer-switch apparatus." A. Schlatter. Dated July 21st, 1897. In alternating-current transformer systems means are provided for cutting out the transformers when there is no load. An arrangement is shown which consists of a primary network, the secondary and the transformer of group of transformers. There is an auxiliary transformer for controlling the electro-magnetic switches. Differentially wound magnets and their armatures connected to levers carrying contacts are shown. A hook is carried by the lever, and engaging with a catch controlled by the electro-magnet. When a translator is put in the circuit a current flows from the transformer through the magnet coils, the armature is attracted, and the lever moved to complete the circuit so putting in the transformer and breaking the circuit of another transformer. When the circuit is again broken the magnet is no longer excited, and the lever falls again to its original position. This arrangement, with one magnet may be used with small consumption of current, but in larger installations additional magnets are required. These magnets successively come into action as the current increases, the first magnet being cut out but the lever being held down by the catch, &c. Where there are several transformers, each to be controlled separately, additional switches are employed. The lever is fitted with a tube containing a liquid, such as mercury, which prevents oscillation with slight changes of current. 5 claims.

17,471. "Improvements in electrical furnaces." C. D. Abel. (Siemens and Halske, Germany.) Dated July 24th, 1897. The acting surface of the electrodes are made conical or of wedge shape, in order that the materials may fall through the arc. Caking is prevented by flanges on the upper electrode, the regulating movements of which stir up the materials. In one form the flanges are on the iron supports of carbons at some distance from the main electrode, spaces for the escape of gases being thus provided. Otherwise the powdered materials may be moulded with pitch or other substance into blocks, between which the gases evolved can escape. The fused product may be discharged through a hole in the lower electrode, a block at some distance below retaining the unacted-on materials. Or some of the product may be allowed to solidify on the lower electrode so that it forms a receptacle for the fused product, which may be tapped by boring from one side or below, the lower electrode being arranged to permit this. The lower electrode may consist of sloping plates, outside of which are combustion chambers for preliminary heating of the furnace. 7 claims.

17,523. "An improvement in or relating to coin-freed electrical meters." F. J. Beaumont. Dated July 26th, 1897. The current flows through a sector which is gradually turned by the meter until it leaves the terminal and makes contact with the terminal, so directing the current through a resistance which diminishes the light as a warning that the current is about to be cut off altogether. 3 claims.

25,078. "Improvements in and connected with the electrical propulsion of barges and boats on canals and rivers." H. W. Hancock and A. H. Dykes. Dated October 29th, 1897. Screw propellers, rudders, driving gear, electric propulsion, supplying currents for: detachable propelling barge. Relates to means for propelling boats and barges on canals and rivers after the manner described in specification No. 22,276, A.D. 1897. A frame carrying an electric motor is secured to a buoyant rudder, consisting of a hollow blade carried in a frame, and pivoted so that the variable draught of the vessel has no effect upon it. Propeller shafts journalled in the frame, carry screw propellers driven from the motor by sprocket wheel gearing. The current is supplied from the main wires by a trolley and connection. A switch on the tiller regulates the speed of the motor. In a modified arrangement, the propelling device may be carried on a detachable propelling barge, and a cover may be placed over the screw propellers to render the depth of immersion more uniform. Paddles or hydraulic propellers may be used instead of screw propellers. 4 claims.

25,205. "Improvements in coin-freed electric shock machines." G. Poore. Dated October 30th, 1897. Coin action, electricity, administering; fraud preventing. The coin dropped down a shoot enters a loop which extends from an arm over a pair of curved shelves. The arm is provided with a handle for turning it, but is normally prevented from more than a certain amount of play by means of a detent. Owing to the play the coin disengages the detent, and the handle can be turned till a contact arm turning with it reaches a stationary contact. The coin falls out of the loop when clear of the shelves, but the operator receives the current so long as he holds the aforementioned handle and a similar one by turning which the core of the induction coil is shifted to modify the shocks. Coins of insufficient size fall between the shelves. 1 claim.

25,245. "An improved method for varying the speed of electric motors or the electromotive force of dynamo electric machines." H. H. Lake. (E.Cantano, Italy.) Dated October 30th, 1897. Relates to a method of varying the speed of electric motors or the electromotive force of dynamo electric machines by varying the air space between the armature and the field magnets. The pole pieces are connected by a sliding dovetail joint to the magnets. The pole pieces are moved towards or from the armature by right, and left-handed screws on a shaft operated by a wheel. The specification also describes a small motor in which the induced armature may be moved towards or from the inductor coil by means of a movable screw head attached to the armature shaft by ball bearings. 2 claims.

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THE SOUTH STAFFORDSHIRE POWER SCHEME.

THE South Staffordshire power scheme has entered upon a new stage of its somewhat chequered career in being bought up by a company, which has Mr. Atherton for its principal backer. As some of our readers well know, this gentleman has come much to the front of late in connection with the British Insulated Wire Company, of Prescot, and we may now confidently expect that there will be a rapid development of the powers which the Transmission Company undoubtedly possess. South Staffordshire is practically one huge town, and the multitude of small and varied industries which will always be carried on, combined with the proximity of all raw materials, makes this area one of the most promising in Great Britain for the application of electric transmission of power. If the distribution of electrical energy from a steam-driven central station is to pay at all, then surely South Staffordshire is the place. The various local authorities have been exceedingly perverse in one or two cases, the opposition shown being apparently inversely proportional to the importance of the township, but we cannot help thinking that our friends across the water or the Swiss or Germans, if they had had such a plum in their midst, would have had the alternators turning round before now.

However, we must give Mr. Addenbrooke, and those associated with him, credit for having done their best to pioneer the company through its early stages as quickly as was possible under the circumstances. What is wanted now is some bold financing on the American and German lines, and Mr. Atherton's entrance at this stage is a sign of good omen. It practically means, of course, that the cables will be made at Prescot, and as the cable manufacturer has the greatest stake in a matter of this kind, naturally the promoter will see that the cables are made by the company in which he is interested.

We learn that Messrs. Kincaid, Waller & Manville are appointed consulting engineers, and as this is one of the firms who keep a capable electrical engineering staff, we feel sure that the drawing up of the specifications is in good hands.

Mr. Thomas Parker is, we understand, connected with the new company, but although high tension continuous current has been talked of in connection with the scheme for some time, it is now definitely shelved in favour of multiphase alternating current. Four units of 2,000 KW. and two of 1,000 KW. are to be laid down as a start, and we can only hope that by the time the work is given out to tender, some of our British firms will have got their new shops finished and be in a position to deliver these large units within a reasonable time. It will only be human nature to find that after spending four years in talk, South Staffordshire Bumbledom will look for all the machinery to be delivered and erected in as many months after date of order. Perhaps, however, as some of the directors are manufacturers them-

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selves, the delivery and penalty clauses will be reasonably drafted, and with a view to placing the work in this country.

We note that the new company has not seen its way to retain Mr. Addenbrooke's services. His cautiousness is perhaps too strongly developed for work which, if it is to be done at all must be tackled boldly, but having once decided to go right ahead on certain definite lines, there were a good many minor points requiring local knowledge, in which the late consulting engineer could have materially assisted the company. The inception of the idea of supplying South Staffordshire with electric power was due to Mr. Addenbrooke, and in the days when some of those now closely interested thought it a Utopian idea, he and Mr. E. Kilburn Scott were laboriously collecting together all the information available and preparing estimates of costs, &c., in such a way that they would appeal to those able to give the necessary financial support.

With good management we are sure that power transmission on a large scale from a steam-driven plant will succeed, and we look forward to the time when we shall be able to describe and illustrate the plant laid down for the wholesale distribution of electrical energy in South Staffordshire.

ELECTRIC TRACTION PROGRESS IN LONDON.

The decision of the London County Council to *experiment* with electric traction renders the present a very fitting opportunity for reviewing the important electric traction projects under construction in the metropolis.

In the course of a few months the City and South London Railway extensions to Moorgate Street and Clapham will be completed, and we hope that the anticipations which have been cherished by the board, of enormous traffic bringing increased dividends to the ordinary stockholders, will be fully realised, for the patience which they have shown year after year with the small interest declared, deserves to be well rewarded. Furthermore, the cordial way in which shareholders of this undertaking meet their directors at half-yearly meetings affords very powerful evidence that they are satisfied that no stone has been left unturned to bring things to a successful issue. The very interesting percentage figures which have been produced by the chairman with clockwork regularity at every meeting, showing the steady decrease in working expenses and the continual increase in receipts per train mile and per passenger, have been an eloquent testimonial to excellent management. The capital outlay upon such lines as the company is now completing is, of course, very heavy, but we are hopeful, when the Bank connection with other railway systems is working and the Islington extension—just commenced—is bringing in the very large receipts which may be reasonably expected, that the small dividend declared for the first half of the present year, viz., 2¼ per cent., will be doubled or trebled.

Turning to other lines, the date for the inauguration of the Central London Railway to Shepherd's Bush seems to be as uncertain as ever. The directors' statement, of course, shows progress in the carrying out of the various works connected with the power station and line work, yet, though things are in a forward state, we shall not for some months be able to announce the opening of the railway for traffic. The undertaking possesses many extremely interesting features, as has been already indicated in our columns, and English electrical engineers will welcome its completion with as much enthusiasm as will the travelling public, to whom it cannot fail to be of great convenience.

The Great Northern and City Railway Company announced last week that contracts for the necessary tunnelling works had been placed and these are making progress. But among the more interesting works of the underground kind is the experimental electrical section of the Metropolitan and Metropolitan District Railways. The managing director does not wish it to be thought that the electrical equipment of the entire lines can be taken in hand immediately, but a couple of months will witness the completion of the experimental line, and that is something to be thankful for. The ultimate result is pretty certain. Let us hope that when the work is taken in hand in earnest, English contractors will carry off the contracts. The two underground electric lines now running—the City and South London, and the Waterloo and City (as yet undescribed by the electrical journals)—have shown what English manufacturers can do in the direction of traction plant. The Metropolitan experimental machinery is of English make, and we do not doubt that the subsequent equipment will be also of home manufacture.

Developments, however, are not confined to underground railways, for the very interesting undertaking of the London United Tramways Company is, so to speak, on the eve of completion. Had there been no London County Council, we should have had many miles of electric tramways running in London years ago, and what that body has not done to oppose the application of electric traction has not been worth the doing. While the London United has been actually constructing its West London lines, the Spring Gardens company has been deliberating as to whether the time had arrived even for *experimenting!* It is a pity that the necessary experimenting was not taken in hand several years ago, when councillors were pleased to fling their diatribes at the overhead trolley system; we might now be reaping the benefit instead of wasting time experimenting with surface contact systems and equipping a trial conduit section. But there, we must be thankful that the Progressive body has at last made progress, though that progress may be very small. The conduit and surface contact system for which the Council's officials are now preparing plans and estimates at a cost of £10,000 will be of great interest to electrical engineers and tramway men both during construction and on completion, but we are afraid that there may be still a feeling in the Council that the equipment of other lines should not be taken in hand until the permanent experimental line has been operating for some months. This may apply to the central thoroughfares, but there seems no earthly reason why the Council should not proceed forthwith with the trolley equipment of the lines on the outskirts. There are rumours of a proposed outlay of a million sterling very shortly. We hope there is truth in the rumour, and that the London Council, which exercises its influence in so autocratic a fashion in labour clauses on behalf of the British workman, will see that English contractors are allowed to carry out the greater share of the work in English electrical factories, thereby benefiting the electrical industry of this country, and, in consequence, the workmen engaged therein.

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THE GENERATION OF POWER FOR ELECTRIC TRACTION.

By J. GRAY SCOTT.

(*Continued from page* 80.)

THE regulations issued by the Board of Trade under the provisions of the Tramways Act have already been mentioned, and in conjunction with these, a special panel of the switchboard is usually reserved, and equipped with the necessary instruments.

While these regulations are sometimes considered too stringent, there is no doubt that their requirements may easily be met in any well-constructed tramway system—their observance practically resolving itself into a guarantee of the proper equipment and construction of the line.

The principal trouble, to obviate which these regulations have been framed is, of course, electrolysis; but generally speaking, this has become a thing of the past.

The earlier experiences are too well known to need recapitulation, but the fact that the advantage of thoroughly sound construction assumes *practical* importance is borne out by the following extract from a report by a special commissioner of the *Glasgow Herald*, who visited America a few years ago with the express purpose of investigating the question of electric traction.

As the matter is more or less of direct interest, the author quotes the paragraph *in extenso*:—

Mr. A. Langstaff Johnston has been engineer for the equipment of a number of electric street lines, and his views are important.

He was engineer of the original Richmond (Virginia) electric line, which was the first practicable thing of the country.

It was built in 1887, and equipped by Mr. Frank Sprague.

There were 12 miles of track and 40 cars.

This was the example of the new style of traction which engineers from all over the world came to see.

Mr. Johnston was connected with the equipment, in 1892, of the New Orleans and Carlton road.

In 1891, the gross receipts from horse traction were $175,000. In 1893, when electricity had been installed, the takings rose to $429,000 for the same length of track, viz., 20 miles.

The total expenses, meantime, despite the increase of business, rose only about 25 per cent.

On the question of working expenses, Mr. Johnston is firmly convinced that many companies are still losing a lot of money through defective return circuits.

On one line, 10 miles long, he found, three years ago, that at the fastest speed obtainable, the journey took an hour.

By improving the rail bonding and feeder system, *the time was cut down to 20 minutes, and there was a saving in the coal bill of* $300 *per month*.

The road, it is hardly necessary to say, was a suburban one, but the lesson is the importance of perfect construction, and of employing experienced men.

Presuming this to be an extreme case, it is nevertheless quite apparent that the efficiency of the system must largely depend upon the sound construction and percentage conductivity of the return circuit.

The *raison d'être* of the special panel will be best explained by the following extract from the regulations issued by the Board of Trade:—

2. One of the two conductors used for transmitting energy from the generator to the motor shall be in every case insulated from earth, and is hereinafter referred to as the "line;" the other may be insulated throughout, or may be uninsulated in such parts, and to such extent, as is provided in the following regulations, and is hereinafter referred to as the "return."

3. Where any rails on which cars run, or any conductors laid between or within 3 feet of such rails form any part of a return, such part may be uninsulated.

All other returns, or parts of a return, shall be insulated, unless of such sectional area as will reduce the difference of potential between the ends of the uninsulated portion of the return below the limit laid down in Regulation 7. . . .

5. When any part of a return is uninsulated, it shall be connected with the negative terminal of the generator, and in such case the negative terminal of the generator shall also be directly connected, through the current indicator hereinafter mentioned, to two separate earth connections, which shall be placed not less than 20 yards apart. . . .

The earth connections referred to in this regulation shall be constructed, laid, and maintained so as to secure electrical contact with the general mass of earth, and so that an electromotive force, not exceeding 4 volts, shall suffice to produce a current of at least 2 amperes from one earth connection to the other through the earth, and a test shall be made at least once in every month to ascertain whether this requirement is complied with. . . .

6. When the return is partly or entirely uninsulated, the company shall, in the construction and maintenance of the tramway (A) so separate the uninsulated return from the general mass of earth, and from any pipe in the vicinity; (B) so connect together the several lengths of rails; (C) adopt such means for reducing the difference produced by the current between the potential of the uninsulated return at any one point and the potential of the uninsulated return at any other point; (D) so maintain the efficiency of the earth connections specified in the preceding regulations as to fulfil the following conditions, viz:—

(i.) That the current passing from the earth connections through the indicator to the generator shall not at any time exceed either 2 amperes per mile of single tramway line, or 5 per cent. of the total current output of the station.

(ii.) That if at any time, and at any place, a test be made by connecting a galvanometer or other current indicator to the uninsulated return and to any pipe in the vicinity, it shall always be possible to reverse the direction of any current indicated by interposing a battery of three Leclanché cells connected in series if the direction of the current is from the return to the pipe, or by interposing one Leclanché cell if the direction of the current is from the pipe to the return.

In order to provide a continuous indication that condition (i.) is complied with, the company shall place in a conspicuous position a suitable, properly connected, and correctly marked current indicator, and shall keep it connected during the whole time that the line is charged. . . .

7. When the return is partly or entirely uninsulated, a continuous record shall be kept by the company of the difference of potential during the working of the tramway between the points of the uninsulated return furthest from and nearest to the generating station.

If at any time such difference of potential exceeds the limit of 7 volts, the company shall take immediate steps to reduce it below that limit. . . .

10. The insulation of the line, and of the return when insulated, and of all feeders and other conductors, shall be so maintained that the leakage current shall not exceed one-hundredth of an ampere per mile of tramway.

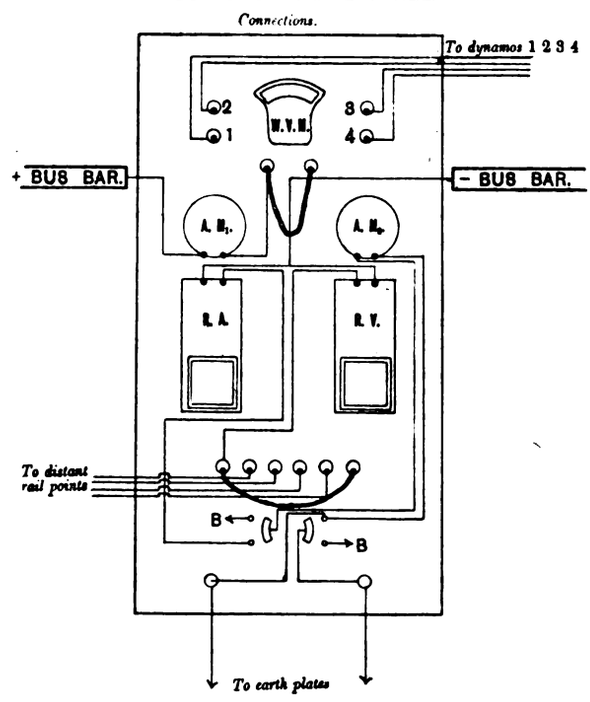
The leakage current shall be ascertained daily before or after the hours of running, when the line is fully charged.

If at any time it should be found that the leakage current exceeds one-half of an ampere per mile of tramway, the leak shall be localised and removed as soon as practicable, and the running of the cars shall be stopped, unless the leak is localised and removed within 24 hours. . . .

11. The insulation resistance of all continuously insulated cables used for lines, for insulated returns, for feeders, or for other purposes, and laid below the surface of the ground, shall not be permitted to fall below the equivalent of 10 megohms for a length of 1 mile.

A test of the insulation resistance of all such cables shall be made at least once in each month.

BOARD OF TRADE PANEL.



The accompanying diagram, though not to scale, shows the general arrangement of the panel, and the connections of the various instruments thereon.

W V M indicates the main station voltmeter, which was temporarily fitted in this position, but, as already mentioned, has now been erected on a swinging bracket at the right hand extremity of the board.

This voltmeter is of the Weston type, and ranges from zero to 600 volts.

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Immediately below this instrument will be noticed a plug fitting and flexible connected through A M_1 to the + bus bar.

The plug may be inserted in any of the four contacts numbered 1, 2, 3, 4 respectively, and each connected to the + pole of the corresponding generator.

The test is made with the generator at proper voltage but with main switches off, when the reading on the ammeter gives directly the line leakage, and indirectly the insulation resistance of the system.

Precautions should be taken, of course, to have all lamps switched off and trolley poles removed from contact with the line.

The ammeter has two ranges, viz., 0—·05 and 0—·5 respectively.

This test is taken in accordance with Regulation 10.

A M_2 is an ammeter reading 1—10 amperes, and deals with Regulations 5 and 6 (i.).

The former stipulates that the contact of the earth plates with the general mass of earth should be such, that an E.M.F., not exceeding 4 volts, shall suffice to produce a current of at least 2 amperes from one earth connection to the other.

The necessary E.M.F. may be procured by two ordinary Leclanché cells, mounted on a bracket behind the board, and connected (in series) with the two contacts of the two-way switch indicated by B B.

This two-way switch is arranged with a contact block and two contact studs on either side; the contact blocks are always in circuit, and are connected with each of the two adjacent studs in turn.

For the first test (Regulation 5) the position of the switch would be diagonal, as indicated across B B, and presuming B on the left to represent the + pole of the battery, the circuit would be as follows:—

From B (left) to contact block, through A M_2 to left earth plate, thence to right-hand earth plate, and from the other contact block to B (right), which is negative pole of the battery.

To take the other test (Regulation 6, i.), we simply turn the switch to the other diagonal position, bringing into circuit the recording ammeter, R A, and simultaneously putting the earth plates in parallel with each other.

It will be well to follow out the connections:—Starting at the two earth plates, the current passes through A M_2 as before, thence to the left contact block and lower contact stud through the recording ammeter, R A, and so to the — bus bar.

The recording voltmeter, R V, is required by Regulation 7 to give a continuous indication of the drop in volts between various points on the rails and the — bus bar at the station.

The four plug contacts shown are connected to the furthest and nearest points and two intermediate points on the return.

The two recording instruments, which are of Messrs. Elliott Bros. latest pattern, are each of range 0—10.

These give a continuous record of the required tests, and as already pointed out, there is no difficulty in keeping within the prescribed limits in a properly contructed system.

(*To be continued.*)

INSTALLATION ESTIMATES.

(*Concluded from page* 167.)

TABLE II. gives the extra cost if accumulators are used. For installations at home glass boxes are used, but for shipping orders lead-lined teak boxes are necessary. The sulphuric acid must be quite free from chlorine, nitrogen, iron, arsenic or zinc, and it is generally advisable to send it out with the battery rather than trust to local merchants. The price at home is about 3½d. per gallon, but the freight and insurance rates on carboys of acid are very high, and therefore before deciding on whether to use a battery abroad it is necessary to inquire fully into the question of freight, and the kind of handling that the material will get at its destination.

TABLE II.—ADDITIONAL PRICE IF ACCUMULATORS ARE REQUIRED.

		25 lamps.	50 lamps.	75 lamps.	100 lamps.	150 lamps.	200 lamps.	300 lamps.
Cells ...	One set of 58 cells capable of supplying 16 C P 110-volt lamps. Complete with acid, bottom blocks, glass fluid insulators and oil, connecting bolts; and also wood supporting strips and hydrometers.	For 20 lamps for 6 hours.	For 32 lamps for 6 hours.	For 50 lamps for 6 hours.	For 60 lamps for 6 hours.	For 80 lamps for 6 hours.	For 115 lamps for 6 hours.	For 155 lamps for 6 hours.
Dynamo ...	Dynamo to be shunt-wound and increased in size to give 140 volts for charging the battery; also shunt resistance.							
Switchboard	The switchboard to have added to it:—One charge and discharge switch, 12-way; one ammeter switch, 2-way; one automatic cut-out, and one single-pole battery fuse.							
Cable ...	The following additional cable, casing, &c., will also be required:—							
	Insulated cable...	220 yds. 1/8 350 ft. 2 ins. 4 gross.	220 yds. 1/4 350 ft. 2½ ins. 4 gross.	220 yds. 1/8 350 ft. 2½ ins. 4 gross.	220 yds. 1/7 350 ft. 3½ ins. 4 gross.	220 yds. 1/8 350 ft. 3½ ins. 4 gross.	220 yds. 1/8 350 ft. 4 ins. 5 gross.	220 yds. 1/8 350 ft. 4 ins. 5 gross.
	Casing and capping							
	Assorted screws							
	Total extra price ...	£105	£125	£150	£175	£200	£240	£300
	Total weight of above material	38 cwts.	45 cwts.	60 cwts.	75 cwts.	90 cwts.	105 cwts.	140 cwts.

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Cost of Wiring, &c.

The cost of wiring is a very variable quantity on account of the labour in drilling through walls and making good, &c. The larger the installation the less is the price per point; this is shown in fig. 6 which gives an average price. Fig. 7

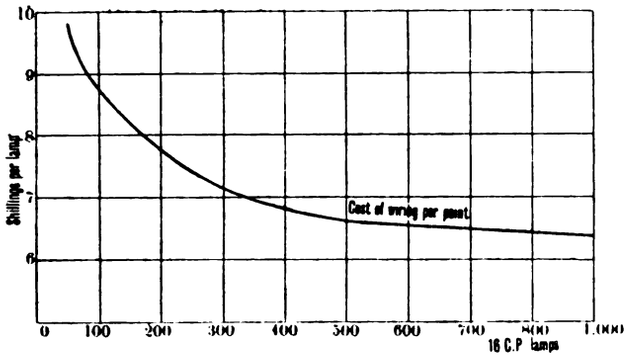

Fig. 6.

gives the total cost, and is taken from the price per lamp in the previous figure, cutting away and making good mouldings, &c., being extra.

Assuming the cost of wiring of an ordinary private house to be unity, then the price for other buildings, &c., compares roughly as follows:—

Private houses	1·00
Textile factories	·75
Printing offices	·80
Engineering and machine works	·90
Breweries	·92
Paper mills	·96
Theatres and music halls	1·00
Hotels and restaurants	1·10
Dye works	1·15

Cutting away and making good decorations, parquet floorings, and other special work should be done by builders and decorators skilled in such work.

With regard to the cables, it is just as well to inquire whether any of the situations in which lamps are to be placed

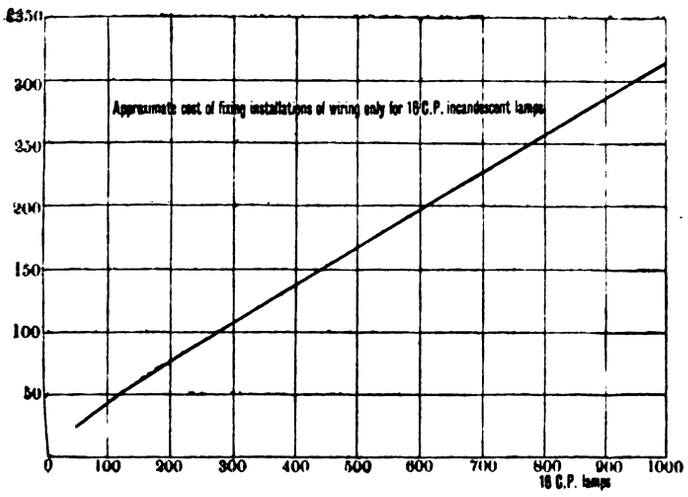

Fig. 7.

are wet. 600-megohm cable is generally employed, but in damp places special precautions must be taken. In estimating for large installations where there are several detached buildings, it is necessary to know beforehand from the proprietor whether he would like the wires carried overhead or underground. In the latter case lead-covered and armoured cable would have to be employed, and it is of course very much more expensive.

The actual cost of cable and casing can, of course, be ascertained by actually measuring along the route to be taken, but most estimates have to be made from rough sketch plans only. About 7s. per lamp will generally cover the wire and 1s. 6d. per lamp the white wood casing, but much depends on whether the lamps are grouped together. Grouping by means of electroliers, &c., reduces the price of the wire and casing and increases the price of the fitting. For ordinary plain electroliers the one will about balance the extra expense of the other. If the casing has to be painted allow 1s. per lamp or point extra. Circuits for heating and cooking appliances should be run independently.

The cost of foundations, mason, and carpenter's work in connection with the generating plant generally costs about 4 per cent. of the total price of the plant.

The cost of erecting the generating plant, including fixing the switchboard and the piping, if quite simple, is about 12 per cent. of the total cost of the plant.

In the above estimates nothing is allowed for spares, these are usually introduced in the form of extras, and may tot up to from 3 per cent. to 5 per cent. on the total contract price.

Working Expenses and Maintenance.

Having dealt with the cost of the installation, there now only remains the question of working expenses and maintenance. Assume that a warehouse has an electric light installation of 200 16-c.p. incandescent lamps of 60 watts each, and that when the number of hours of the lamps burning are all averaged up together they equal, say, three hours per day for 300 days in the year. The total H.P. absorbed at the lamps will be

$$\frac{200 \times 60}{746} = 16 \text{ E.H.P.},$$

or allowing for 2½ per cent. loss in mains, 10 per cent. loss in dynamo, and 5 per cent loss in the belt; the B.H.P. of the engine will equal

$$\frac{16}{\cdot 975 \times \cdot 90 \times \cdot 95} = 19\tfrac{1}{4} \text{ B.H.P.}$$

Multiplying the number of hours by the B.H.P., we get the total number of B.H.P.-hours per annum at 17,400 B.H.P.-hours.

$$3 \times 300 \times 19\tfrac{1}{4} = 17{,}400 \text{ B.H.P.-hours.}$$

If now we multiply this by the pounds of coal per B.H.P.-hour which is consumed by the engine, we shall get the amount of coal consumed in the year, and this at 20s. or whatever the price may be a ton delivered in the stokehole, gives the cost of fuel consumed.

Maintenance expenses are made up of the following items:—

Fuel.—If a steam engine and boiler is used, allow 6½ lbs. of coal per B.H.P.-hour for a simple engine, and 4 lbs. of coal per B.H.P.-hour for a compound engine. In addition to this allow ½ lb. of coal per square foot of heating surface of boiler for as many working days a year as the boiler is running. The price of fuel varies with the locality; cartage and all other charges should be included.

Oil, Waste, Water, and Stores.—Take the total cost of these items at 20 per cent. of the total cost of the fuel. In certain cases the water would not cost anything, and if a filter was used, the oil could be used many times over.

Attendance.—For an installation up to 300 lamps, one man at, say, 35s. per week would be sufficient in this country. From 300 to 900 lamps, allow for one man at 40s., and an assistant at 20s.

Renewals.—It is usual to calculate that incandescent lamps require renewal after about 800 hours. Of course, some will give a good light for a longer period, but these are balanced by breakages, &c. The price of a 16 c.p. 110-volt lamp can be now taken at 9d. The lamp tops can be afterwards sold for the platinum.

Repairs.—This item should be taken at 2½ per cent. on the total capital cost of the installation.

Depreciation.—Taken at 5 per cent. on capital cost.

Interest.—Taken at 5 per cent. on capital cost.

Notes on Arc Lamps.

For outdoor illumination about 1 c.p. per 10 square feet. The usual method is to place the arcs a certain number of yards apart, say 50, and 22 feet high. For indoor lighting allow 2½ c.p. per 10 square feet, the inverted arc is the best to use for indoor work.

The usual sizes for arc lamps are 750 c.p., 1,000 c.p.,

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1,500 c.p. and 2,000 c.p. The first two can be used for the illumination of halls, stores, lofty warehouses and yards, whilst the last two are for the lighting of streets, railway yards, carriage drives, &c.

The price of one 1,000-c.p. arc lamp installed complete at, say, 100 yards from the dynamo would be about £7; a lamp-post would cost extra.

If of wood	15s.
Ordinary iron post	£3
Lattice poles 50 feet as used in railway yards	£18
Wall bracket	£2

The cost of carbons for a 1,000 c.p. lamp is ¼d. per lamp hour burnt.

In calculating the power required for ordinary open arc lamps working on a 110-volt circuit, it is necessary to note that when there is an odd number the odd lamp will require as much energy as two lamps, the extra amount of power being absorbed in the resistance in series with it. With enclosed long burning lamps which must of necessity be arranged singly across the 110-volt wires this does not apply.

RETURN FEEDERS FOR ELECTRIC RAILWAYS.

(*Continued from page* 181.)

IV.—Graphic Determination of the Cross-Sections.

If only one end cable is used, the expression for the volume of copper, as we have seen above is:—

$$\Sigma\,(\text{vol.}) = \frac{C\,L^2}{3\,K\,\Delta} + \frac{C\,L^2}{6\,K\,\Delta} = \frac{C\,L}{2\,K\,\Delta}\,L = \Sigma\,(s)\,L.$$

When there are an infinite number of cables, the second member of the expression vanishes, and

$$\Sigma\,(\text{vol.}) = \frac{C\,L^2}{3\,K\,\Delta} = \frac{2}{3}\,\frac{C\,L}{2\,K\,\Delta} = \frac{2}{3}\,\Sigma\,(s)\,L.$$

The first volume can, therefore, be represented by the area of a rectangle whose sides are $\Sigma\,(s)$ and L; and the second by a parabola enclosed in the rectangle. The volume of a finite number of cables lies between these two areas.

This representation of the two limiting volumes furnishes us with an exceedingly simple graphic method of determining the section of each cable, whatever number of cables are used.

The process is as follows: the $\Sigma\,(s)$ is determined by the formula, and with this value, and L the length of the line, a rectangle is drawn (fig. 3). The parabola is drawn with the formula $y^2 = 2\frac{L\,K\,\Delta}{C}\,x$, which gives the final values of x and y as $\Sigma\,(s)$ and L respectively. Upon the length L_1 points are marked where the intermediate cables are connected. Let two be connected at 6 and 12 kilometres. From the point 6 a parallel is drawn to the axis X, cutting the line O R in the point N. If $N_1\,P_1$ is made equal to $P_1\,N_1$ then N N_1 represents the section of the first cable. Draw now, through the point N_1 a line N_1 M parallel to the line A E, and draw from the 12 km. point a line parallel to the axis X to cut the line N_1 M in M. Choose the point M_1 so that $M_1\,P_2$ is equal to M P_2; then M M_1 will represent the cross-section of the second cable. The remaining part of the line, S E, gives the cross-section of the end cable.

Before giving the proof of the correctness of this construction we shall show, by an example, that the cross-sections obtained agree with those obtained by the general formula.

If we designate the co-ordinates of the points of the parabola, $P_1\,P_2$ E by $x_1\,x_2\,x_3$ and $y_1\,y_2\,y_3$, then according to the construction

$$s_1 = 2\,x_1,$$
$$s_2 = 2\,(x_2 - s_1) = 2\,(x_2 - 2\,x_1),$$
$$s_3 = x_3 - (s_2 + s_1) = x_3 - 2\,x_2 + 2\,x_1.$$

The value of the ordinates, y, corresponding to the values of the abscissæ $x_1\,x_2\,x_3$ are $\frac{L}{3}$, $\frac{2}{3}$ L and L_1, and from the equation to the parabola we deduce

$$x_1 = \frac{1}{9}\,\frac{C\,L}{2\,K\,\Delta} \text{ and } s_1 = \frac{2}{9}\,\frac{C\,L}{2\,K\,\Delta},$$
$$x_2 = \frac{4}{9}\,\frac{C\,L}{2\,K\,\Delta} \qquad s_2 = \frac{4}{9}\,\frac{C\,L}{2\,K\,\Delta},$$
$$x_3 = \frac{C\,L}{2\,K\,\Delta} \qquad s_3 = \frac{3}{9}\,\frac{C\,L}{2\,K\,\Delta}.$$

From this, volumes come out

$$v_1 = \frac{2}{9}\,\frac{C\,L}{2\,K\,\Delta}\cdot\frac{L}{3},$$
$$v_2 = \frac{4}{9}\,\frac{C\,L}{2\,K\,\Delta}\,\frac{2\,L}{3},$$
$$v_3 = \frac{3}{9}\,\frac{C\,L}{2\,K\,\Delta}\,L;$$

adding these

$$\Sigma\,(v) = \frac{C\,L^2}{2\,K\,\Delta}\left\{\frac{2}{27} + \frac{8}{27} + \frac{9}{27}\right\} = \frac{C\,L^2}{2\,K\,\Delta}\cdot\frac{19}{27}.$$

This value can be split up into

$$\frac{C\,L^2}{3\,K\,\Delta} + \frac{C\,L^2}{6\cdot3^2\,.\,K\,\Delta},$$

or in terms of the general formula, when $m = 2$,

$$\Sigma\,(v) = \frac{C\,L^2}{3\,K\,\Delta} + \frac{C\,L^2}{6\,(2+1)^2\,K\,\Delta}.$$

We see, from this, the values for the volume of the copper obtained from the diagram agree with those obtained from the general formula.

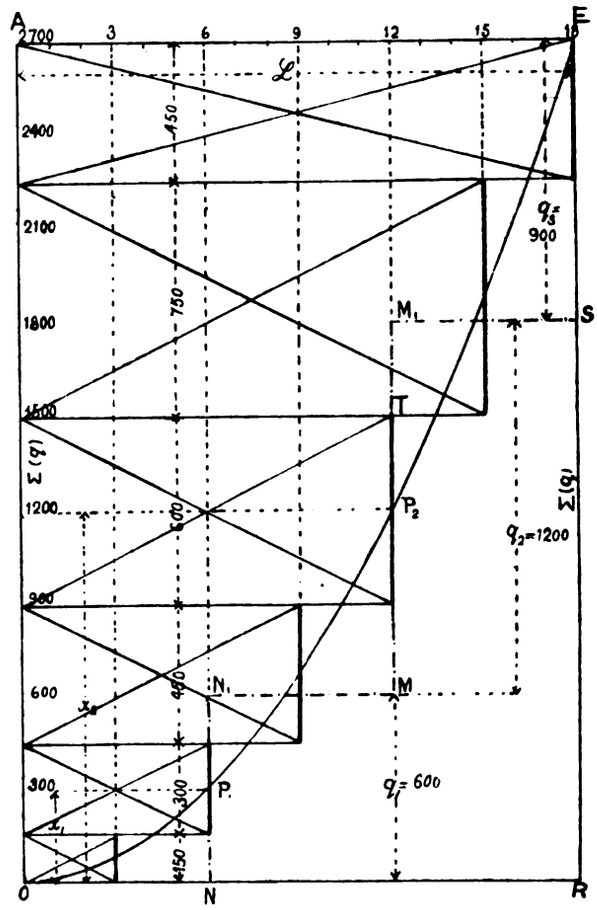

Fig. 3.

It now remains to show that the section obtained by the diagram for each separate cable is correct. Of course, with assumption of constant potential drop and current that has been made, the cross-sections are proportional to the lengths of the cables, so that if l, 2 l, 3 l . . . . are the lengths of the cables, $s_2 = 2\,s_1$, $s_3 = 3\,s_1$ . . . . $s_r = r\,s_1$. Consider now the cross-section of the cable, of which the length is $r\,l$. As is evident from fig. 3, half the sum of the cross-sections of the rth and $(r-1)$th cables, is equal to the difference of the abscissæ x_r and x_{r-1}, *i.e.*,

$$\tfrac{1}{2}\,(s_r + s_{r-1}) = x_r - x_{r-1}.$$

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Since the cross-sections are proportional to the lengths,

$$s_{r-1} = s_r \frac{r-1}{r},$$

therefore $$\tfrac{1}{2}\left\{ s_r + s_r \frac{r-1}{r} \right\} = x_r - x_{r-1},$$

or $$\tfrac{1}{2} s_r \frac{2r-1}{r} = x_r - x_{r-1}.$$

Now according to the equation to the parabola,

$$x = \frac{y^2 C}{2 L K \Delta}.$$

Since for x_r, $$y = \frac{L}{m+1} r,$$

and for x_{r-1}, $$y = \frac{L}{m+1}(r-1),$$

$$x_r = \frac{L^2}{(m+1)^2} r^2 \times \frac{C}{2 L K \Delta}$$

and $$x_{r-1} = \frac{L}{(m+1)^2}(r-1)^2 \times \frac{C}{2 L K \Delta}.$$

These values, substituted in the above equation, give

$$\tfrac{1}{2} s_r \frac{2r-1}{r} = \frac{L C}{(m+1)^2 2 K \Delta}\{r^2 - (r-1)^2\},$$

or $$s_r \frac{2r-1}{r} = \frac{L C}{(m+1)^2 K \Delta}(2r-1),$$

therefore, $$s_r = \frac{C L}{(m+1)^2 K \Delta} r.$$

This expression is the desired cross-section. The current in the end cable is only half that in an intermediate cable, therefore the line representing its cross-section stops at the parabola (E, fig. 3).

In fig. 3 the construction for five intermediate cables and one end cable is also shown. The cross-sections obtained are 150, 300, 450, 600, 750 and 450 mm². The area of the crossed rectangles represent the copper volume of each cable.

It is evident from the graphic construction that it makes no difference to the total cross-section of the cables, where the cables are connected to the line. The cross-section of the end cable is (see above) $s_e = \frac{C L}{2 \Delta K (m+1)}$. It depends, with the given conditions of working only on the value of $(m+1)$, that is upon the current $\frac{C}{m+1}$; it makes no difference whether the sum of the other currents is taken by several or by one intermediate cable, if the connection points of the latter are chosen so as not to change the current in the end cable. If there are m intermediate cables, the last cable connects to the line at a point $\frac{L}{m+1}$ from the end cable. Now, the expression for the cross-section of the end cable can be written

$$s_e = \frac{C L}{2 \Delta K (m+1)} = \frac{\Sigma(s)}{m+1}.$$

Therefore the cross-section of the end cable is proportional to its distance from the last intermediate cable.

If, for example, one intermediate cable is connected at 12 km., the length, $\Sigma(s) = 2{,}700$ mm², is to be divided in the ratio of 6 : 12, and the shorter length $2{,}700 \times \frac{6}{18} = 900$ is the cross-section of the end cable. The remaining 1,800 mm² of cross-section falls to the share of the single intermediate cable at 12 km., or to any given number of intermediate cables connected at equal intervals, whose sections may be determined by the graphic construction as already described. If, for example, cables were connected at 4 and 8 km., the section for these comes out 266 and 534 mm². Since 900 mm² fall to the share of the end cable, 1,000 mm² is left for the 12 km. cable as the construction shows.

(To be continued.)

THE REPORT OF THE PACIFIC CABLE COMMITTEE.

(Continued from page 184.)

Sir W. H. Preece gives the average number of letters per word in trans-Atlantic traffic as 7·3; this figure was arrived at by actually counting the words in the body of every message for the Anglo-American Company which passed through several postal telegraph offices, for two hours during six days, and should therefore be a very useful figure; making allowance for spacing, the word is taken for sending purposes as consisting of eight letters, and the non-paying words are given as about 48 per cent., a percentage of loss which it appears would increase as the clerks grew tired. Mr. Lucas says that "70 letters per minute would give you on the section from Vancouver to Fanning Island something like four or five paying words per minute, not more." Assuming these to be words of eight letters, this means a "dead" traffic of about 50 per cent. Dr. Muirhead, after premising that he is calculating on the basis of the experience of the Eastern companies, according to whom he says "as much time is given to preamble, &c., as to messages," goes on as follows: "on the assumptions, (1) that only average operators are employed; (2) that the average length of code words is nine letters; (3) that half the time of transmission is occupied with preambles, calls, services, and other unpaid matter; and (4) that duplex automatic curb transmission is adopted, a cable 3,600 knots in length of a core weighing 500 lbs. copper and 320 lbs. gutta-percha per knot would earn eight paying words per minute. The same length of 552 copper and 368 gutta-percha core would earn nine paying words per minute." From the above we gather that as the core 500/320 will, according to a previous answer given by Dr. Muirhead, carry 140 letters per minute under conditions similar to those explained above, the non-paying words amount to about 50 per cent. of the traffic. It must be borne in mind here that Dr. Muirhead is not basing this figure on his own observations.

There is a considerable discrepancy between the figures given by the two groups of witnesses as representing the proportion of non-paying traffic; some of these are not expressly stated, and we have had to deduce them from various portions of the evidence, but those representing the Anglo-American Telegraph Company, the Commercial Company, the South American Cable Company, and the Indo-European Government Telegraph cables, all agree in giving the proportion of "dead" traffic transmitted as being between 10 and 16* per cent. of the total; whereas the Eastern Telegraph Company make this about 75 per cent., and the Post Office officials give about 48 per cent. at the lowest valuation. It is obvious that as far as estimating the "profit-earning" capacity of a cable is concerned, it is important that the line should be worked under the most economical system of management, and in the absence of fuller explanations we prefer to accept the figures given by the group of companies above mentioned; always bearing in mind that in the case of the Pacific cable, the messages in transit between England and Australia, which will undoubtedly form the bulk of the traffic, and which will pass through Canada, there will not be that necessity for the lengthy indications which, as Mr. Lamb points out, are used for purposes of International account, &c., on lines which pass through various foreign countries. Mr. Lamb expresses an opinion that every one of such indications would have to be sent on a Pacific cable, because the Australian Colonies are parties to the International Convention, but in question 2,255, this witness says, in reference to the creation of competition in charges between existing routes, "where States are concerned, the intention of the International Telegraph Convention is that one set of States shall not disregard the interests of another. In this case I think it might be shown that the Mother Country and the Australian Colonies—who are all parties to the International Convention—would be disregarding the interests

* In their report the Committee state that the non-paying traffic is given as 15 per cent. in the case of Mr. Carson, and 17 per cent. in the cases of Messrs. R. Kaye Gray and Finch, but an examination of the evidence will show that the figures which we have used more accurately represent the evidence given.

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of India, which is also a separate member of the International Union."

In Mr. Ffinch's evidence we find the following in a letter from the Secretary of State for India:—"I am to enclose, for the information of Mr. Chamberlain, a statement showing the extent to which the Indian revenues are concerned in the existing lines; but, having regard to the considerations represented in your letter, Lord George Hamilton is not disposed to make this a ground of preliminary objection against any scheme for an alternative route to which Her Majesty's Government may attach commercial or strategic importance." This does away with the fear of any objection from India as an adherent to the Convention.

As regards the amount of traffic which would probably be directed over the Pacific cable, Sir Sandford Fleming has assumed this amount to be equal to half the existing traffic between Europe and Australasia; and this seems a very fair assumption, as, given equal rates over the Indian Ocean and the Pacific Ocean cables, and supposing both of these to be equally efficient, the Pacific cable has the advantage of landing in the vicinity of the business centres of Australia, the joint population of New Zealand, New South Wales, Queensland, and Victoria being 3,700,000, as against the 530,000 in Western Australia and South Australia, where the existing cables land, at Roebuck Bay and Port Darwin respectively. These latter landing places are connected to the first-named group of colonies by very long landlines, which do not give a satisfactory service. The land distance from the Port Darwin landing to Sydney is about 3,000 miles, while the length of landline from Roebuck Bay to Sydney is about 3,800 miles. For the above reasons, and also because the majority of the unrouted traffic will probably be sent *viâ* the Pacific, it appears to us that Sir Sandford Fleming has not been over sanguine in claiming 50 per cent. as the amount of traffic which will probably accrue to the Pacific cable. The total number of words transmitted between Australia and Europe in 1896 is given as 2,326,984. The representatives of the Eastern Extension Company assume that their line would retain all the West Australia and South Australia traffic, also one-half of that of Victoria and Tasmania, and one-quarter of the messages to and from New Zealand and New South Wales. We must say we cannot see on what foundation this reasoning is based; such a division seems an extremely hopeful one on the part of the company. Sir W. H. Preece goes into an interesting calculation, by which he shows that assuming a cable which can only transmit three (paying) words per minute, and which is only worked for 10 hours per day, owing to the clerks being "tired," and only 300 working days in the year, then such a cable will not carry more than 540,000 words in 12 months. As the particular cable referred to was calculated by Dr. Muirhead and given when working duplex 20 eight-letter words per minute, and as the evidence shows that 25 per cent. is a very liberal deduction to make for non-paying traffic, we get 15 words per minute instead of three, and by the simple process of doubling the 10 hours (and Sir W. H. Preece gives no good reason why this should not be done), we get 20 out of the 24; this, at the narrow estimate of 300 days to the year, gives us 5,400,000 words per annum. Sir W. H. Preece seeks to reduce the possible working day of this cable to 10 hours by such reasoning as the following, in reply to Lord Selborne:—

1,370. I will assume your three words per minute, but I want to go very closely into this question of 10 hours. Ten hours, you tell us, is by practical experience what these telegraph cables work at?—It was my practical experience of the work of telegraphs generally. I want particularly to consider this part of the business as absolute estimate, and I want to have it confirmed or upset.

1,371. All business that comes to the telegraphs over which you have control can be cleared in 10 hours' working?—Yes, certainly. That is much more than our telegraph experience in England. It will be more like four or five hours.

1,372. Then supposing the work to be double, would it not be merely a question of staff to work 20 hours a day?—It would be a question of business more than staff, because you cannot attract it.

1,373. I said suppose the business to be doubled, could not that business be worked off on the same line in 20 hours by merely increasing the staff?—No, because I have assumed that the high pressure of course with this work cannot be maintained during the 24 hours, even with a fresh staff of clerks.

1,374. Why not?—For the reason that I gave, that clerks tire, and you cannot maintain high pressure for a long period.

Mr. Murray.

1,375. And you cannot get the work at the right time?—That is another element. That is where the work does not come; it only comes in driblets, as a matter of fact.

Chairman.

1,376. But supposing one office, we will say going to America, suppose on some great occasion an immense amount of work comes in during the day, that would be worked off during the night?—Of course.

1,377. And customers do not complain, as a general rule, because their telegrams may be delayed an hour or two?—No.

1,378. Is it your experience that they do?—I beg your pardon.

1,379. Is it your experience that if a telegram is handed in for Australia, we will say to-day, is the public fairly satisfied if they get an answer within a certain number of hours?—I think so. I think very well satisfied if they get an answer in 24 hours.

1,380. In 24 hours?—Yes.

1,381. And therefore, at a stress, arrears could be worked off during the night?—Yes.

1,382. That being so, I do not understand why you are of opinion that we are obliged to reckon the working of any cable at 10 hours as the only time at our disposal?—Because these calculations are based on the assumption that our maximum speed is obtained under great pressure, and that this great pressure cannot be maintained for reasons that I have given. You must not take a maximum speed as your working speed, but you must take a mean speed. That has varied very much by the companies I gave you.

1,383. But you cannot be accused of taking a maximum speed. You have, by a process which has interested the Committee very much, reduced the working speed down to three words a minute?—Yes.

1,384. That you do not consider a maximum speed?—No; I call that the ordinary working speed.

1,385. The ordinary working speed. Then why cannot that speed be maintained for as many hours over the line as you can find staff to work it?—So you could if you had the work.

CORRESPONDENCE.

The Direct Reading Ohmmeter.

I note in your issue of July 14th, that Mr. N. C. Woodfin, of Patterson, Cooper & Co., recites his experience with the direct reading ohmmeter.

With reference to what he says concerning the use of the instrument in a noisy place, I would say that I have been able to secure quite accurate results by noting the places on either side of the silence point where the noise begins and bisecting the distance between them. The noisier the place the wider this gap will be, but with care and a little practice I have been able to secure almost as accurate results in moderately noisy places as in silent ones. I have also found it necessary to keep the dry batteries in the bridge in good order, and when the click on the instrument becomes faint it is best to renew the batteries, which can be done at a cost not exceeding 3s. With these precautions well in mind I have had no difficulty in attaining the claims of the makers of the instrument.

It is perhaps well to state that in the measurement of very high and very low resistances the accuracies of ½ per cent. are exceedingly difficult if not impossible to attain with an instrument of the Wheatstone bridge type. With high resistances, such as insulation resistances and the like, I find that the insulation resistance seems to be proportional to the very variable and erratic function of the temperature and of the voltage applied, and the possibilities of measuring such an elusive resistance with anything like accuracy are very remote. This, however, is not the fault of the instrument, for it is doubtless theoretically correct at those points. The scale is laid out according to a mathematical law, and there is no reason why this should not be so.

With reference to the measurement of low resistances, that is to say, exceedingly low resistance such as armature coils or armature resistances, I would say that I find that the difficulty of making connections of negligible resistance, limits the accuracy of the instrument. In measuring the resistance of armatures it is difficult to obtain connections to the resistance to be measured of lower resistance than the armature itself. This, again, is no fault of the instrument, but rather due to the fact that the instrument is out of its class. I have always obtained my best results in measuring very high resistances with the aid of a voltmeter and a substantial voltage of 110 to 500 volts, and the low resistances I find are best measured by a fall of potential method. For the measurement of intermediate resistance I have found the ohmmeter exceedingly accurate and satisfactory.

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With regard to portability I would say that I have a leather carrying case with a strap, which seems to answer every requirement, and also prevents the box from being marred.

Geo. T. Hanchett.

The Pacific Cable.

It has been brought to my knowledge that you have been defending me against the chairman of the Eastern Telegraph Company in respect of strictures by him on an opinion incidentally expressed by me as to the vulnerability of our great telegraph routes in time of war. I did not answer these remarks because the matter was, as I say, only an incidental one in my speech on the deputation to the Chancellor of the Exchequer, and I was, in fact, only engaged in replying to some observations in the other sense which had been previously made by Lord Tweeddale. The subject is one which will sooner or later come up for debate in Parliament, and, if necessary, I shall be able there to express my views. My main statement was that all our communications with the East, and, indeed, with our leading strategical points generally, are within the control of possible enemies, in Russia, Turkey, or Persia, or else touch at Lisbon. In many cases they both touch at Lisbon, and also pass through one of the three countries named. Lord Tweeddale appeared, in his reply, to throw doubt upon the accuracy of this statement, and to suggest that he knew of some direct British route to Gibraltar at least. But no such route is marked on the latest cable maps.

Charles W. Dilke.

Electrolytic Extraction of Zinc.

In examining the papers which have recently reached me, I find two numbers of the ELECTRICAL REVIEW, the one dated July 7th, and the other July 14th last; at the pages 36 and 37 of the first number and at the page 43 of the second, I noticed two articles concerning the electrolytic extraction of zinc (by the Hoepfner and the Cowper-Coles processes).

Both methods seem to be characterised by the application of the rotary cathode, claimed by me in my English patent dated April 1st, 1892, No. 14,892. Everybody may look into the same patent at the Patent Office. The United States patent which has been granted to me for the same object on September 24th, 1892, under No. 446,775, may also be looked at.

I wished to draw the attention of the readers of the ELECTRICAL REVIEW to the fact that up to the present date no one has been able to oppose any anteriority whatever to my rotary cathodes, not even the patentamt of Berlin.

As you publish the descriptions of processes in which rotary cathodes are used, I rely upon your impartiality and your courtesy to insert the present letter.

D. Tommasi.

Paris, *August 1st*, 1893.

Re The Patent Renewable Glow Lamp.

Anent your remarks on above in last week's issue of your enterprising journal, will you permit an old reader, and a friend of the patentees, and one cognisant of the incomparable advantages of which the above lamp is alone capable, to clear the ground of certain misapprehensions in this relation? First let me say that, had I space and your permission, to give in detail the unique capacity of this lamp to prolong its utility, at such a small outlay of material, time, labour and money, and to explain *how* through the continuous interchangeability of its filaments the thorough utilisation of *all* its material is effected to the utmost extent, the commercial value, and complete public service claimed for this innovation by those of the highest repute and honour as practical experts, who have submitted it to the most crucial tests, would be so manifest that, even your hypercritical correspondent, "Experientia Docet," would admit the justice of the claim that this lamp will not only be the salvation of the enclosed globe, but supplies the long felt public want among consumers of the current, by revolutionising the present system of lamp replacements, and doing away with the practice of having *new lamps, and paying full prices for same.*

And so far from efficiency being sacrificed for cheapness, it will be found, by comparison, that it is the highest ever recorded so soon as the lamp is on the market.

Surely it must be a great commercial achievement in any industry *to reduce maximum waste of material and labour.*

As instanced in the glow lamp industry at present, incomputable and broadcast waste of glow lamps takes place the moment the lamps at present in use reach the end of their first and only life.

True, many have tried to solve the problem of interchangeability of filaments, even Westinghouse with his glass stopper, &c. How impracticable these devices were doubtless you are aware, sir, but none hit upon the simple design of a tubular neck and expeditious method of exchanging filaments devised by C. Howard.

Depend upon it, sir, if the advantages claimed were not genuine, and had not been actually demonstrated, neither Sir W. H. Preece's nor Major Cardew's name would have been on the front page of the prospectus to bear testimony to the same. Neither would Mr. Jacob Atherton, of the British Insulated Wire Company (a most successful company), have been identified with it unless it was the inimitable lamp the inventor asserts it to be. The economy claimed will, on comparison, be found to be actual and enduring, and be assured that it has come to stay, despite "Experientia Docet," whose friends will find shortly that their large stock of lamps, &c., &c., are obsolete and unsaleable. Without attempting to answer his assertions, let me say that all his objections have no relation, or bearing, to the above lamp, and prove conclusively "how little" he knows of the invention.

In conclusion, let me add that (1) the company only claim to renew their own lamps, it's impossible to renew any other. (2) The filaments are of that peculiar kind that the bulbs are free from deposited carbon. (3) The glass, too, is unique, and manner of opening and fusing so practicable that breakages will be very rare. (4) The detachable socket has withstood the most severe tests, and is a perfect success, and will admit of being used perpetually. (5) In all other lamp factories there is a certain loss of between 25 and 30 per cent. on lamps made, through some non-glowing defect, broken filaments, &c., in the manufacture of this lamp *such loss will be unknown*, as the least, or most serious, defect can be at once rectified by opening at neck where renewal of filaments takes place. That the economising and prolonging utility of this lamp is without parallel in this electrical age, goes without saying, and consumers will ere long have the opportunity of verifying.

I could add to what I've said, but for fear of incurring your displeasure, Mr. Editor. Thanking you in anticipation of your inserting this, and apologising for its length, I remain faithfully yours,

Charles Clifford.

[This letter leaves us little the wiser, but so that we may be further enlightened our "space and permission" are both at the writer's disposal.—EDS. ELEC. REV.]

Gas Engines v. Electro-Motors.

Why, in your issue of 28th ult., do you discredit the 20 cubic feet per B.H.P. per hour gas consumption of the Stockport gas engine, while giving prominence (and credence) to the 16·78 cubic feet per B.H.P. per hour gas consumption of the Westinghouse engine?

Of course, your notice does not state the consumption of the Westinghouse engine in terms of the B.H.P., but that is what 1,000 cubic feet giving 40 KW.-hours means at 90 per cent. dynamo efficiency.

Judging from my own experience of gas engines, neither result is in any way extraordinary. On one of Messrs. Crossley Bros'. new designs I obtained a B.H.P. for 13·5 cubic feet of 700 B.T.U. gas per hour—a result which, at the time, I considered a record, and which, I believe, can be repeated at any time. As this gives a thermal efficiency of 27·1 per cent., you will appreciate my belief in the record; but, unfortunately, I found in the *Railroad Gazette* particulars of a test made on a 6 × 11 two-cylinder "Pittsburg" (*i.e.*, Westinghouse) engine that eclipses my result completely. This engine gave 9·1 B.H.P. for a consumption of 165 cubic feet of 434·3 B.T.U. gas per hour. The consumption per B.H.P. is thus 18·13 cubic feet per hour, but owing to the low calorific value of the gas, this gives the extraordinary thermal efficiency of 32·3 per cent. From this it must be considered that the Westinghouse

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engine is 16·6 per cent. more efficient than the Crossley engine. I will not attempt to account for this extraordinary superiority of the Westinghouse engine, but I may point out that it is in no way due to the fact that the Westinghouse engine governs on a reduced compression charge (*i.e.*, by throttling), while the Crossley engine governs by cutting out charges, and maintains a constant compression, for both engines were then working at full load igniting every time. In conclusion, I would remark that the Westinghouse engine is "not" the only engine that governs by throttling its charges. There are large numbers of engines working in this country with stepped air and gas cams under control of the governor, which operate exactly in the same way as the Westinghouse engine; but these, on the whole, have not been found to compare at all favourably with engines governed on the "hit-and-miss" principle. The superior economy of the engines governed on the latter principle is such as to admit of the slight sacrifice of mechanical efficiency due to the use of the heavier fly-wheels necessary to give equal steadiness of running in both types, and still be superior in thermal efficiency.

Jas. Dunlop.

Gorton, Manchester.
August 4th, 1899.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending Aug 9th, 1898		Week ending Aug. 8th, 1899	
Adelaide	Value £146	Adelaide	Value £349
Alexandria	58	Aden. Teleg. mat. ..	45
„ Teleg. mat. ..	20	Amsterdam	100
Amsterdam	205	„ Teleg. mat. ..	245
Antwerp	329	Bangkok	86
Auckland	166	Boca	284
Bergen	7,518	Bombay	107
Bombay	200	Boulogne	90
Bolougne	82	„ Teleg. apparatus ..	2,900
Bremen. Teleg. mat. ..	150	Brisbane. 50 tons iron teleg. poles, value not declared.	
„ Sub. cable ..	180	Buenos Ayres	524
Buenos Ayres	6,555	„ Teleg. wire ..	161
Calcutta	2·3	Calcutta	929
Cape Town	602	„ Electric launch ..	88
Copenhagen	19	Cape Town	2 4
Durban	2,838	„ Teleg. stores ..	16
East London	81	Colombo	19
Fremantle	30	Copenhagen	14
Hamburg	210	Delagoa Bay	28
Helsingfors	29	Durban	10
Kolding. Teleg. cable ..	252	„ Teleg. mat. ..	31
Liban	54	„ Teleph. mat. ..	44
Lyttleton	47	East London	606
Madras	86	Flushing	25
Marseilles	50	Genoa. Teleg. mat. ..	35
Melbourne	40	Gibraltar	61
„ Teleg. mat. ..	410	Halifax (N.S.). Teleg. cable ..	555
Montreal	25	Hamburg. Teleg. mat.	170
Odessa	130	Hong Kong	285
Penang	25	Jersey and Guernsey	50
Port Elizabeth	819	Launceston	140
Rangoon	55	Malta	30
Rockhampton	174	Melbourne	103
St. Petersburg	14	„ Teleg. mat. ..	180
„ Elec. launch ..	1,300	Ostend	65
Shanghai	260	Paris	348
Stockholm. Teleg. wire ..	72	Penang	583
Sydney	680	Perth	29
„ Teleg. mat.	90	„ Elec. tram machinery ..	598
Townsville. Teleg. mat. ..	125	Port Elizabeth	26
Wellington	37	„ Teleg. mat. ..	283
Yokohama	27	Port Said	101
„ Elec. cable	480	Rio Janeiro	166
		Rosario. Teleg. wire	17
		Rouen	160
		Santos	132
		Singapore. Teleg. cable ..	42,000
		St. Petersburg. Teleg. wire ..	88
		Sydney	2,118
		„ Teleg. mat.	844
Total ..	£24,711	Total ..	£55,986

Foreign Goods Transhipped.

Batavia. Teleg. mat. .. Value £11

Asbestos.—The Admiralty contract for asbestos goods for the ensuing 12 months has again been awarded to the United Asbestos Company, Limited. This is the 14th year in which the company have been awarded important contracts by the Lords of the Admiralty.

Bankruptcy Proceedings.—The public examination of Alec Gavin Inrig, electrical engineer, 44 and 46, White Post Lane, Victoria Park, trading as the Globe Electrical Company, was held last week at the London Bankruptcy Court. The debtor has filed accounts showing liabilities £4,514 3s. 5d., against assets £330. In the course of his evidence the debtor stated that he came over from Antwerp in September, 1895, with a capital of £1,000, and started the above business. Four months later he was joined by a Mr. Chester, and they converted the business into a company styled Inrig and Chester, Limited, with a capital of £2,000. As vendor witness received £500 in fully paid shares, and he acted as joint managing director at a salary of £200 per annum, until the company went into liquidation at the end of 1896. The petitioning creditors next purchased the concern from the Official Receiver, and agreed to sell it to witness under a hiring agreement, but nothing further was done, and he managed it on their behalf at a salary until last November, when they refused to make any further advances. He subsequently carried on the business upon his own account until they (the petitioning creditors) brought him to the court early in June. To the action of those creditors, witness entirely attributed his failure. The examination was ordered to be concluded.

The examination in bankruptcy of John Lumsden Sloan, as sole partner of the firm of Wilks, Sloan & Co., electrical and consulting engineers, 112, Bath Street, took place in Glasgow on 7th inst., before Sheriff Balfour. In reply to Mr. George S. Robb, for creditors, bankrupt stated that he was interested in the reversion of the estate of Sir James Lumsden. In January a loan of £300 was obtained from a firm of money-lenders in Edinburgh, and he and Mr. Wilks and the cautioner signed a bill for £450. At this time he was drawing nothing from the business. The bulk of the loan was handed to Mr. Wilks, who was being pressed, to cover his private liabilities, and between £10 and £20 went into the business. A loan of £300, entirely for Mr. Wilks' benefit, was got from bankrupt's brother, who was to have a percentage on the money, and to have the option of becoming a partner at any time within three years. Before this Mr. Wilks had overdrawn his interest in the firm to a considerable extent, and any sum that went into the firm was to repay what he had overdrawn. Bankrupt put £250 into the business, and his loans to the firm and Mr. Wilks amounted to £750. The examination was adjourned.

Catalogues, Lists, &c.—From the Prentiss Clock Improvement Company, of New York City, we have received a pamphlet describing their improvements in long-running clocks and automatic perpetual calendars, also their synchronising and electrical controlling devices.

Messrs. Nalder, Brothers & Co., of Westminster, have issued a new edition of their catalogue of scientific instruments, in which they give capital illustrations, and neatly arranged data of their various instruments for electrical testing, also for engineering, mathematical, optical and other purposes. The opening page has a reproduction from a Röntgen photograph of the N.C.S. four-coil Kelvin galvanometer, showing the internal arrangements and connections. The class of apparatus made by Nalders is so well known that it is quite unnecessary to detail here the numerous instruments which find a place in this catalogue, which is a credit to compiler, illustrator and printer.

A new issue of the Concentric Wiring catalogue of Messrs. J. D. F. Andrews & Co., Limited, is to hand. It shows many new appliances and improvements.

A second edition of the Brush Electrical Engineering Company's Universal Engine Book has lately been brought out, giving some excellent sectional and general illustrations of the engine and parts, and describing the chief features.

From the Taper-Sleeve Pulley Works, of Erie, Pennsylvania, we have received an illustrated list of their solid-web, iron-centre, hardwood dynamo, motor and generator pulleys, with copies of testimonials, code, &c.

The Western Telephone Construction Company, of Chicago, sends a copy of its catalogue of switchboards and apparatus required in connection with telephone exchange systems. Views are given of the various departments at the works, also of exchanges fitted with the company's manufactures, and there are also a number of illustrations of the apparatus described.

An incandescent lamp list, printed in English, French, and German, comes to hand from Mr. Paul Goldschmidt, of Featherstone Buildings, W.C. It contains particulars of the manufactures of Messrs. P. & M. Herre, of Berlin, who are specialists in small and fancy lamps. We understand that the factory equipment at Berlin is quite up to date, and includes the newest and best air pumps which are worked by motor. The list before us contains details regarding a large variety of fancy lamps of all designs, shapes, and sizes; also holders, switches, brackets, Geissler tubes, Crookes tubes, Ruhmkorff coils, &c.

The Electrical Company, Limited, has issued a new price list of carbons for "Luna" arc lamps.

Change of Address.—Mr. E. O. Sachs has moved his general and private offices from No. 11 to No. 3, Waterloo Place, Pall Mall, S.W.

Copper.—The *Financial News* says that some of the strength has departed from the statistical position of copper; for Messrs. Merton's figures show that the visible stock at the end of July had risen to 33,019 tons, compared with 28,515 tons a fortnight earlier, and 29,009 tons a month ago. Supplies were larger in July than for several months, and consumption has been checked—whether temporarily or not it would be difficult to say; for the jump from deliveries of 16,074 tons in May to 19,077 tons in June and the fall to 16,327 tons in July show an irregularity that puts generalisation at a discount. The supplies were 20,342 tons against 17,925 tons in June, and that in spite of a reduction of 4,100 tons in the arrivals from North America. "Other countries," which represent a variable quantity in the supplies, and cover all the copper-producing countries save North America, the Peninsula, Australia, and Chili, sent 6,767 tons in July, against 2,126 tons in June, and shipments from Chili were nearly 2,000 tons greater.

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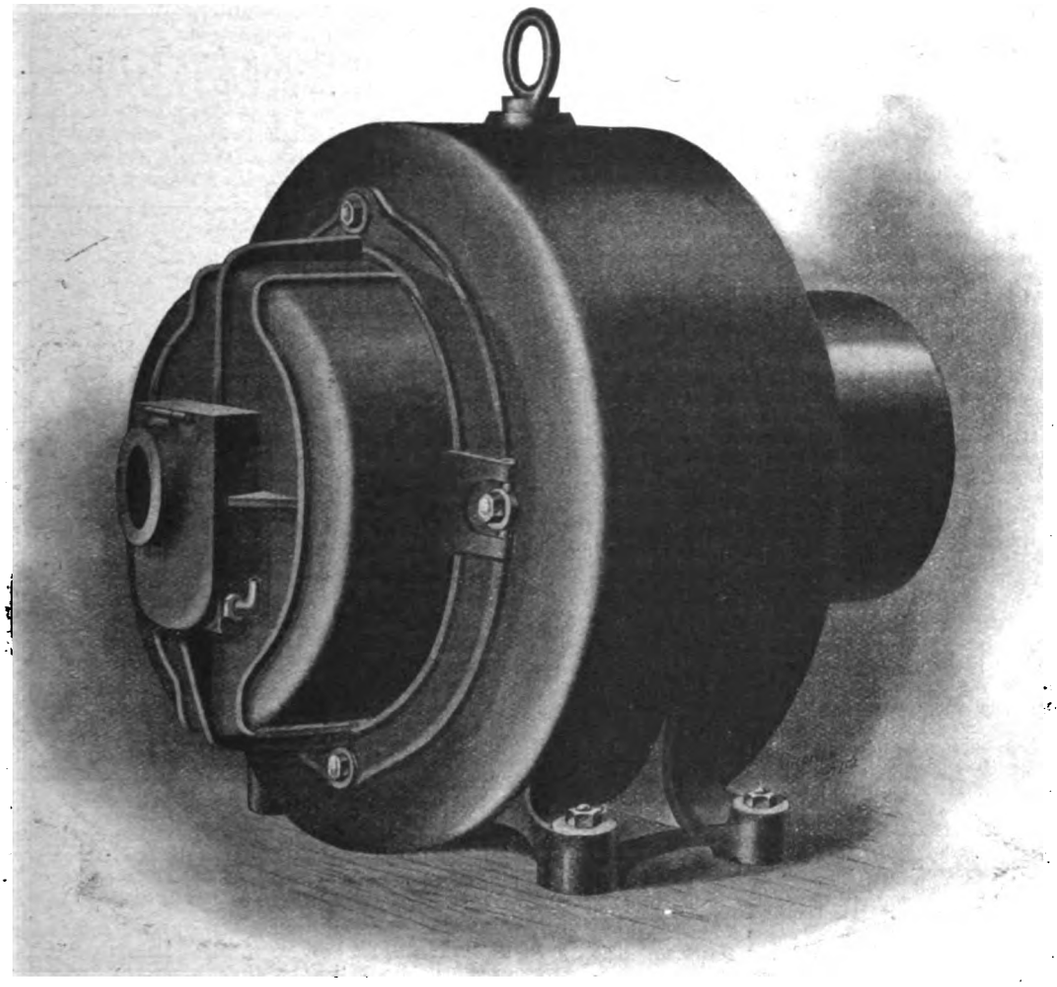
Coal Cutting.—Mr. E. W. Parker, of the United States Geological Survey, gives the following data with regard to the progress of mechanical coal cutters in America:—

Year.	No. of machines at work.	Tonnage mined by machinery.	Average prices at mines.
1891	545	6,211,730	4s. 10d.
1895	1,446	12,649,220	3s. 4d.

A breast cutting chain machine, such as is used very largely in the States, is officially stated to have undercut 1,700 square feet in 9½ hours, or 7½ minutes to each cut 6 feet deep and 44 inches wide, including the moving and setting of the machine.

Messrs. D. Bruce Peebles & Co.—We hear that this firm has secured the following municipal contracts:—Barrow-in-Furness, steam dynamo and accessories, total value of contract, £3,154; Southampton Corporation, balancers and boosters (section A), amount of contract, £2,070; Warrington Corporation, steam dynamos, Willans engines, total amount of contract, £6,788.

The Lancashire Dynamo and Motor Company, Limited.—As announced a fortnight ago, we have received a catalogue from the Lancashire Dynamo and Motor Company who are building a large works in Trafford Park, Manchester. This company was registered on April 11th, with a capital of £100,000 privately subscribed. The general manager is Mr. A. P. Wood, who, until recently, was an engineer with Messrs. Mather & Platt, Limited, in whose employ he had a considerable amount of experience both in this country and abroad. The company will manufacture continuous current and polyphase generators up to 3,000 H.P. in size, tramway motors, rotary converters, balancers, boosters, enclosed motors, &c. The latter, up to 50 H.P. in size, will be manufactured to stock on the interchangeable plan, all parts being sent to the stores to be tested on the measuring machines, and afterwards assembled as required. This system ensures uniformity in the various parts, so that should any breakage occur, the defective portion can be sent on receipt of a wire, and will *fit* into its place. These motors have been specially designed to meet the demand for a first-class reliable machine. They are especially suitable for working in damp and dirty places, and can be secured in almost any position. The motor can be readily fixed on the floor or the ceiling as required; in the latter case the end bearings are simply turned round, so that the oil wells are below. They may be used in oil mills, cotton mills, flour mills, dye houses, coal mines, iron foundries, shipbuilding yards (out in the open), and for cranes and hoists of all descriptions, &c. The armatures are slot drum wound of the straight cut type, each coil being separately wound on a former and taped up before being fixed in position on the armature. The windings at the back are protected by a brass shield, so as to effectually exclude oil or dirt. The commutator bars are of hard drawn copper insulated with specially selected mica. The bearings are of the swivel self-oiling type, each fitted with two oil rings. Special attention has been given to the design, so that oil cannot travel inside to the armature. The brushes are of carbon, and run sparklessly at all loads without being moved. The magnets are of cast-steel with laminated pole pieces to reduce eddy currents. The windings are former-wound and taped, dipped in insulating composition and baked. The machine tools and labour-saving devices, which will be all electrically driven, are the best that can be purchased, and the arrangement of the same will be such that work of the highest class can be expeditiously, accurately, and economically turned out. The works will be ready and completely equipped in six months' time, the contractors for the various portions being under a heavy penalty to complete in this period. Owing to the large number of orders on the books, it has been found necessary to commence manufacture in temporary works. The company's offices are located in Corn Exchange Buildings, Fennel Street, Manchester, pending the completion of the more commodious premises in Trafford Park.



Lancashire Dynamo and Motor Company's Motor.

Easton, Anderson & Goolden, Limited v. New Brighton, &c., Tower Company, Limited.—In the High Court last week this case came on for hearing. The plaintiffs claimed £4,794 for supplying electric lifts and a pump for the New Brighton Tower, already described in the Electrical Review. According to a report of the case in the *Times*, defendants admitted the greater part of the claim, subject to a counterclaim by them for £5,264 as damages for delay in completing the machinery which plaintiffs had contracted to erect. The case occupied the whole of the 3rd inst., and on the 4th a settlement was arrived at, in accordance with the terms of which the jury returned a verdict for the plaintiffs for the amount claimed; and they also gave a verdict for the defendants on the counterclaim for £600.

Electric Construction Works.—The directors of the Electric Construction Company, Limited, have just commenced extensive and important additions to their works at Bushbury, near Wolverhampton.

Electric Light Fitting.—The Edison & Swan United Electric Light Company send us a pamphlet respecting a new automatic wind-up apparatus (Killingworth Hedges' patent), which they

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have just brought out. It is claimed to meet the general demand for a simple and reliable method of raising or lowering lamps suspended by flexible cord, so that, according to the requirement, the light may be brought to any desired position, and to bear upon any particular object. This facile movement is obtained without the use of "counterweights" or the arrangement of lengths of flexible cord. It is also well adapted for use with table and floor standards. The winding gear consists of a porcelain drum, on the ends of which are mounted the brass terminal plates to which the flexible cord is connected The drum is used in connection with and revolves centrally on a porcelain base, the latter being provided with terminals to which the leading-in wires are brought and which form the supports for the drum when connected with the terminal plates fixed on its ends. The flexible wire is wound up on the drum by means of a spring, and is controlled automatically by a small stop or peg fixed on one end of the drum and caught by means of a small ratchet wheel. When the flexible cord is withdrawn from the fitting to the desired length, all that is necessary is to allow the same to slowly and gently slide back with the guidance of the hand, when it will be found that the ratchet wheel has caught the peg or stop, thus preventing the drum from winding further. The same operation is repeated when a further length of flexible cord is required to be withdrawn. When desired to wind up the flexible wire a short pull of the flexible releases the peg or stop from the ratchet wheel, when it will be found the cord will fly back and re-wind itself round the drum. This form of wind-up can also conveniently be used in connection with hand lamps or similar portable fittings, as the fitting can be hung by the side of the wind-up apparatus when not in use, taking up little space and doing away with the necessity of a loose coil of flexible wire, which is invariably in the way.

The Electric Welding Company, Limited.—In the Chancery Division of the High Court of Justice on Friday (August 4th) Mr. Farwell, Q.C., said he had a motion to rectify the register of this company, but there was a possibility that the case would be settled, and he therefore asked that the motion should be allowed to stand over generally, with liberty to restore it upon application. Mr. Justice Byrne assented.

Fan Motors.—The Stewart Electrical Syndicate, Limited, send us a price list of the "Hurricane" fan motors (direct current) for which it has just been appointed sole agents in the United Kingdom. No extravagant claims are made for high efficiency, but it is being put on the market as a thoroughly good and reliable piece of apparatus, cheap, strong, and simple. The fan and motor rest on a universal ball joint, which is controlled by a screw sufficiently large to be conveniently operated by hand. The simplicity of this device permits the fan to be easily directed toward any point where it is most desirable at the time to throw the breeze.

Fire.—We are glad to learn that the fire at Henley's Telegraph Works was limited to the submarine cable department, and will not cause more than a week or two's delay in the execution of work of that particular class. The company are to be congratulated upon the efficiency with which they have organised their workmen to deal with fires either by night or day. The fire in question occurred late on Saturday night, and it was mainly due to the promptitude with which the workmen brought the hydrants and pumps to play, that the scope of the fire was limited to the one shop, and the work of the Fire Brigade in finally extinguishing the flames was thus rendered considerably easier.

High Speed Engines.—Messrs. Reavell & Co., Limited, of Ipswich, send particulars of their high speed enclosed constant thrust compound engines (Scott's patent). In the front of the list is an illustration of one of their two-crank engines coupled to a Crompton dynamo at the Islington Vestry electricity works. Messrs. Reavell have recently erected extensive and well-equipped works for the construction of these engines which are made in standard sizes, single and two-crank, and also as a three-crank engine. They are claimed to be specially suitable for direct coupling to dynamos, for electric lighting, traction, and other electric power purposes. We understand that a good number of these engines are now running in public and private installations. Instead of employing two cylinders as in an ordinary compound engine, the feature of the Scott engine is that the first stage of expansion takes place on the top of the piston, and the second stage on the bottom of the piston in one cylinder. Facilities are afforded at the works for the complete testing of the engines with purchaser's dynamos, at full load. The list before us gives a general description accompanied by an explanatory illustration of a single-crank engine. We do not doubt that Messrs. Reavell will be pleased to send a copy of the pamphlet to all inquirers.

Holiday Tours.—Those of our readers with whom the holidays are among joys yet to come, are recommended to peruse an interesting little pamphlet issued by the Great Eastern Railway, which gives views of some charming scenery in the Thuringian Mountains, and the Harz, including the sacred spots which once knew the tread of the celebrated Luther, and where some of his relics are yet to be found.

The L. B. & S. C. Railway is also circulating a very attractive "South Coast Quarterly," in which are illustrated some of the best coast line and "cross country" resorts within the area of that railway's service, where one may while away the idle hours of the holiday vacation.

Liquidations, Dissolutions, &c.—A meeting of the Improved Incandescent Electric Lamp (Foreign Patents) Syndicate, is to be held at 20, Jewry Street, E.C., on Saturday, September 9th, to hear an account of the winding-up from the liquidator, Mr. R. Ballard.

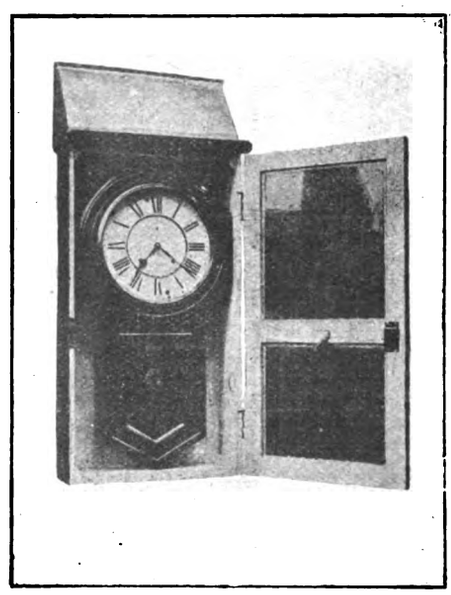
On Wednesday the petition filed by the Electric Construction Company for winding up the Madras Electric Tramways, was heard in London, and was ordered to stand over until the first petition day in November. If nothing has been done in the meantime, a compulsory order will be made.

New Electrical Works.—It is stated in the *Manchester Courier* that Messrs. Mather & Platt, Limited, the well-known electrical engineers of Salford, have taken over 40 acres of land near the canal and railway at Agecroft, in the township of Pendlebury, for the purpose of erecting modern workshops to meet the increasing demand for their various specialities in electrical plant. The proposed new works are situated near the Agecroft Collieries.

Personal.—It is stated in an American contemporary that Col. J. C. Bonner has left Toledo for England, in the interests of his rail waggon, a number of which have already been shipped to the Isle of Man. This order is considered to give the waggon a foothold abroad, and Mr. Bonner intends to see that they are placed in good working order and given a fair trial. Our contemporary adds:—"An effort is also being made to establish the waggons on an electric line in Birmingham, and this matter will take Col. Bonner to that city."

Smoke Nuisance.—The London County Council, it is announced, is to take action in regard to the smoke nuisance in London by taking steps for enforcing Section 114 of the Railway Clauses Consolidation Act, 1845, which requires that every locomotive shall be constructed to consume its own smoke, and Section 19 of the Regulation of Railways Act, 1868, which provides that if a locomotive is constructed to consume its own smoke, but fails to do so as far as practicable at the time charged in the complaint, the railway company owning such locomotive shall be deemed guilty of an offence against the section first named.

Time Recording Clock.—Mr. F. J. Borland, of Leeds, is now putting on the market a time recording clock to supply the evident need for a cheap form of apparatus for checking in workmen. The time checks are simply dropped through a funnel which delivers them into compartments of a receiver, the position of which is varied



by gearing connected with the works of the clock. An electrical attachment to ring a warning bell can also be attached when required. The whole arrangement is simple, and as long as the clock is going, cannot fail to act. The price is extremely moderate.

Trade Announcements.—We are informed that Mr. H. Binko, late managing director of Binko, Ridsdale & Co., Limited, has resumed his old established business as electrical engineer and manufacturer, at 34, Leadenhall Street, E.C., under the former style of H. Binko & Co.

Messrs. H. W. Sambidge & Son, of Birmingham, manufacturers of electric light fittings in brass and wrought-iron, have opened London showrooms at 19, Farringdon Avenue, E.C. We have received a small fittings circular such as the firm is sending out to its customers.

The London Battery Company, of Westminster, announce that they have disposed of their business to the Atlas Carbon and Battery Company, Limited, Ewer Street, London, S.E.

Messrs. Geipel & Lange notify that owing to the rapid increase of their business, they are removing to new and larger offices at Parliament Mansions, Westminster, to which all communications should in future be addressed. The same remarks apply to the trading and contract business of Messrs. Paterson & Cooper, which was taken over by Messrs. Geipel & Lange, and forms a part of their business.

Waverley Electric Car.—In our recent review of the motor-carriage exhibits at the Royal Agricultural Hall Exhibition, we omitted to notice the Waverley "Ran about" of the Automobile Association, Limited. We are given to understand that this car is

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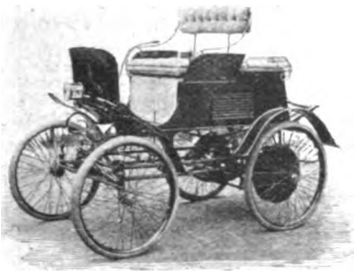
able to take gradients of 1 in 10, to run an average of 40 miles with one charge and at speeds up to 16 miles an hour. It is claimed to be silent, economical, and low priced. The "Run-about" weighs 12 cwt. and the "Stanhope" 13½ cwt. The motor is of the multipolar type carefully designed for overloads, it is rigidly hung to the frame of the running gear, and it and all gears are carefully covered, amply protecting them from dust and water, so that in cleaning the carriage only moderate care need be exercised. The motor shaft is geared directly to the two rear wheels by a single reduction. Each rear wheel is made to revolve independently of the other by compensating



gears placed in line with the motor shaft. The motor is of 1½ H.P. and the battery employed, said to be covered by broad patent claims, is of a new type, and less than half the weight of the storage cells used in other cars of the same capacity. The normal discharge rate of the battery is about 15 amperes, at which rate the car runs at a speed of from 12 to 14 miles an hour. One simple ratchet lever is all there is for the manipulation of the car, five ahead and three astern speeds being provided. The controller contacts are sliding and self-cleaning, and so constructed that burning at these points when shifting the speed circuits is prevented. A band brake will stop the vehicle in its own length at full speed. The frame work is tubular, all wheels have ball bearings, pneumatic tyres, and wire spokes, and the whole car runs therefore as easily as possible. This car is turned out as "Run-about," with seating capacity for three, and as "Stanhope," for two persons, with hood.

X Rays on the Stage.—In a melodrama recently produced in suburban London, entitled "Thou shalt not kill," the X rays are employed to locate a bullet. As the conditions of the theatre are not exactly suitable for the actual use of coil tube and screen, Messrs. Harry W. Cox, Limited, were entrusted with the work of devising an efficient substitute. This they have achieved most successfully, and the effect was quite easy to mistake for the real thing. The manager of the company carries round a complete X ray outfit, which is exhibited during the day, tickets being distributed at the evening performances.

ELECTRIC LIGHTING NOTES.

Barnsley.—The Town Council will apply to the Local Government Board for sanction to a loan of £3,000 for extensions of the electricity works.

Blackburn.—Major-General Crozier, R.E., an inspector of the Local Government Board, held an inquiry on August 1st, relative to the application of the Blackburn Corporation for power to raise loans of £25,000 for the purpose of electric lighting.

Bolton.—The electrical engineer, Mr. A. Ellis, has reported to the Electricity Committee on the subject of street lighting. He prefers the rectifier system for Bolton, with the arc lamps mounted on every second pillar, 80 yards apart, and two 16-C.P. lamps on every post, 40 yards apart. The latter would replace the arcs at midnight. The price per annum would be £18 per arc at 80 yards, £16 at 60 yards, and £15 at 40 yards; while the glow lamps would cost £2 2s. per annum per 16 C.P., including renewals, as against £2 5s. for gas.

Bristol.—On August 3rd an accident occurred at the Central Electric Lighting Station to H. J. Arnold, a linesman in the employ of the Corporation. He was engaged in some work on the switchboard at the time, and it is assumed that in reaching for something he inadvertently touched the high pressure terminal and received a shock, resulting in severe burns. Artificial respiration was resorted to successfully, and the injured man, who had also had a bad fall, was removed to his home. It is intended to find accommodation for him in the General Hospital, and it is hoped that he will speedily recover.

An exciting incident took place last week in Nelson Street, where the electric cable is being laid. The workmen had left one of the drums standing in Broad Street, and by some means or other it started rolling down the slope, and crashed into a public house, completely demolishing the front of the premises. Several persons had narrow escapes, but fortunately, no one was injured.

Carlow.—The overhead wires of the electric supply network have been replaced by underground cables by Major Alexander, the proprietor of the works.

Ceylon.—The Colombo Council has accepted Messrs. Boustead Brothers' undertaking for the electric lighting of the tramway routes, and a contract has been entered into. Messrs. Boustead Brothers undertake to supply and erect, at their own cost, an installation of 88 arc lamps, of 10 amperes capacity each, along the Grandpass and Maradana tramway routes, commencing in each case from the point where the Fort arc lighting ends. These lamps will be mounted on carriers on the top of the tramway posts, and will be an average distance of about 120 yards apart over some six miles of streets, which will afford a very efficient and handsome illumination of the roads in question. The firm also undertakes to supply the current for these lamps, carbons, trimming and attendance, all supervision, maintenance and repairs, for the sum of 13 cents per lamp per hour, provided the Council agrees to the following conditions:—(1) Agreement to be for period of tramway agreement. (2) The Council to have the option of acquiring the installation and the necessary plant from us at the expiry of the agreement. And (3) the Council, in the event of its being decided to take over the tramways, to further agree to take over this installation and the necessary plant also in good order and condition, it being held to be reasonably modern and up to date. This point to be decided upon by arbitrators appointed for the purpose in the usual manner, and such arbitrators shall also value the plant and installation, should it be decided that the Council shall acquire the same. Messrs. Boustead Brothers have been granted permission to run electric launches on the Colombo Lake and to erect landing stages at different points.

Cleethorpes.—The District Council has resolved to procure a provisional order for the supply of electricity for lighting and traction.

Clewer.—The Parish Council is considering an application from the Windsor Electrical Installation Company to lay cables in their parish.

Continental Notes.—FRANCE.—The establishment of a central station in the town of La Mothe-Saint-Keraye (Deux Sèvres), has just been decided upon.—A company has been formed at Lyons (11, Rue de l'Hôtel de Ville), with a capital of £110,000, to be known as La Société Electro-Chimique de la Romanche.

GERMANY.—According to the official statistics of the empire, just published, it appears that 13 per cent. of the cities of Germany practice municipal ownership of electric light plants. Of the cities with a population of more than 10,000, 517 in number, 120, or more than 23 per cent, own their own electric lighting plants. Of the 2,700 smaller cities, 300, or 11 per cent., have municipally-owned plants.

Derby.—The Town Council has reduced the charges for electricity from 6d. per unit for the first 1½ hours of maximum demand and 3d. afterwards, to 6d. for the first hour and 3d. afterwards. The £400 deficit of last year has been changed to a surplus of £789, and the demand is increasing rapidly.

Dover.—The trolley wires were struck by lightning recently during a heavy storm. Beyond throwing out the circuit-breakers and stopping traffic for a few minutes, no harm was done.

Dudley.—The Town Council, at a special meeting on August 2nd, adopted the recommendation of the Railway, Tramway, and Electric Lighting Committee to obtain a loan of £33,000 to carry out a scheme of electric lighting for the borough.

Durham.—The electric lighting provisional order having been confirmed by Parliament, the Town Council has resolved to consult Mr. Hawtayne on the subject, and to negotiate for the transfer of its powers to a company.

Eton.—After a battle, which has lasted upwards of two years, the advocates of electricity for street lighting on the Urban District Council have defeated the opposition, several of whom are shareholders in the Gas Company, and on Thursday, last week, the tender of the Windsor Electrical Installation Company was accepted to light Eton with the electric light. Originally, Eton was supplied with 72 gas lamps with a candle-power of 1,460 at an annual cost of £303 18s. This will be replaced by 12 500-C.P. arc lamps and 42 16 C.P. incandescent lamps, equivalent to 6,672 C.P., at a cost of £336 5s. Thus, for an increased expenditure of £32 7s. per year, there will be an additional candle-power of 5,212.

Exmouth.—On Mr. Hammond's advice, the District Council has decided to apply for a provisional order.

Fife (N.B.).—At a meeting of the St. Andrews District Committee of the County Council on July 31st the Tayside Electric and Gas Light Company and the Newport Gas Light Company gave notice that they intend to apply to the Board of Trade for a provisional order to authorise the supply of electricity within the parish of Forgan.

Godalming.—The Town Council has accepted the offer of Edmundson's Electricity Corporation, Limited, to take over the Council's provisional order for public and private electricity supply. The Council has the option of purchase at the end of seven years for a sum equal to four-thirds of the capital expended, or after 14 years for five-fourths of the capital, or any time after seven years upon payment of the capital plus a sum sufficient to make up the dividends paid by the company to 10 per cent. per annum from the start down to the time of purchase.

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Hampstead.—The annual report and statement of accounts of the Hampstead Vestry's electric lighting installation shows that the total capital raised was £126,570; during the year 1898-99 over £11,000 was spent on new machinery and nearly £7,000 on new mains, together with £2,200 on new buildings. The income for the year was £24,377, an increase of 53 per cent. on the preceding year. The gross profit was £13,014, and the net profit £8,339, or 6·65 per cent. on the total capital expended. It is proposed to invest £7,500 of this in Government stock as the nucleus of a reserve fund.

Hereford.—The County Council proposes to supply electricity on the following terms:—For the first two hours per day, 6d. per unit; for each hour afterwards, 4d. per unit; for motive power, 3d. per unit; for hire of meter and M.D. indicator, 4s. per quarter.

High Candle-Power Incandescent Lamp.—According to the *Marine Engineer*, the Bryan Marsh Company of New York has been experimenting with incandescent lamps, which are greatly superior to arc lights in a fog, since the yellow rays of the incandescent light are not so easily damped out and absorbed as the rays of the arc light. The company made a lamp of 5,000 C.P. with two filaments, each taking 236 volts and about 3 watts per candle; the lamp thus took about 15 KW. It burned out in three nights, due probably to the intense heat at the neck.

India.—Part of the Madras General Hospital is being lighted with electricity as an experiment.

Mr. B. N. Sen, a native of India, formerly a student of the Sibpur Engineering College, and later engaged with Messrs. Kilburn & Co., has been appointed chief engineer of the Calcutta Electric Lighting Co.

Islington.—The long outstanding dispute between this Vestry and the St. Pancras Vestry on the subject of laying mains on the boundary line of the parish was practically settled at a meeting of the Islington authority on Friday. In a report on the subject the General Purposes Committee stated that, in view of an intimation received from St. Pancras that it proposed to lay mains in Brecknock and York Roads for the purpose of supplying current to consumers in St. Pancras, the Vestry referred the matter to the vestry clerk and the solicitor, with instructions to obtain an injunction prohibiting the work being commenced, or to take such other steps as might be necessary for preventing the Vestry from interfering with the roads in Islington; and that subsequently a communication was received from St. Pancras stating that, after reconsideration, it had decided not to give effect to its previous intention of interfering with the roads without permission, but that it was desirous of sending a deputation with a view to some arrangement being come to in the matter. The General Purposes Committee further stated that the deputation duly attended, and admitted that St. Pancras had no statutory power to lay mains in Islington, and that the Vestry had no authority to accord permission to do so. The committee were nevertheless of opinion that too much importance should not be attached to the point, and had consulted the solicitor as to how the Vestry's interest could be adequately protected if the application were acceded to. The solicitor had advised the committee that the matter might be met by the Board of Trade granting a license to the St. Pancras Vestry to supply electricity in the roads in question under Sec. 3 of the Electric Lighting Act, 1882. On the recommendation of the committee the Vestry unanimously resolved to inform St. Pancras Vestry that if it deemed it advisable to apply for such a license the Vestry would be prepared to give consent to its being granted.

Kirkwall.—The Town Council has appointed a committee of inquiry into the question of electric lighting. Mr. Drever moved that it be remitted to a committee to inquire and report whether it be advisable for the Corporation to introduce into the burgh lighting by electricity. He had, he said, no opinion, had no right to have an opinion in view of want of information on the subject, and he approached it with an entirely open mind. He might approve of introducing electric lighting or he might not, but he would like information, and he thought the community would like it. Other communities, including Lerwick, were looking into the subject. The motion would also let the outside public and others know that the subject was being looked into, and would keep private interests from intruding themselves, which, in these days of corporation enterprise should be avoided. Mr. Drever then referred to a letter which had been received by a gentleman in town from Mr. York, the electrical engineer who had charge of the installation of electric light in Fort William, offering to supply any information on the matter. Information might also be got from Lerwick. Dean-of-Guild Flett seconded the motion, which was agreed to, and the following committee was appointed:—Bailies White and Sclater, Dean-of-Guild Flett, and Messrs. Sutherland, Baikie, and Drever—Mr. Drever to be convener.

Llanelly.—The Council has received various proposals for the supply of electricity for lighting and traction, and is considering the question of terms, &c.

Manchester.—A gas explosion occurred in an electrical conduit in King Street on August 8th. No serious damage was done.

Newport (Mon.).—The manager's quarterly report shows cost of generation and distribution per unit, 3 11d., against 4 78d. last year, and total revenue, £1,351 0s. 7d., against £863 4s. 5d. last year. The number of lamps connected and on order is equivalent to 30,318 8-C P.

Paris.—A daily paper says that two offers to light the Bois de Boulogne by electricity have been laid before the Council by private individuals, M. Mildé and M. Tavernier. M. Mildé proposes to set up an electrical installation, but not at his own expense, the cost to be spread over 14 years. For furnishing the light and maintaining the works he asks for an annual subsidy, much smaller than the amount which the city would have to lay out if it undertook the work itself. M. Tavernier asks for a similar subsidy, but is willing to erect the necessary plant at his own expense. The cost of lighting the Bois is estimated at about £2,000 a year.

London, E.C.—The chairman of Milner's Safe Company, Limited, last week told the shareholders that they had carried £7,000 to reserve for the electrical equipment for which they had contracted. It was a large outlay, but was necessary to keep the works up to date. A large saving would result by the introduction of electricity for driving all the machinery and lighting the buildings.

The following letter appeared in the *Pall Mall Gazette* on 3rd inst.:—

Sir,—The report of your interview with the City Company gives a fair idea of the situation created by the decision of the House of Lords giving the right to compete to the Charing Cross Company. That decision has brought about—perhaps somewhat prematurely—a condition which I foreshadowed in a letter published on June 20th, which, after referring to the immense outlay necessary, goes on—

Then what happens? The Charing Cross Company will offer for 5d. what the City of London Company offers to supply in January for 6d. But when the former company is ready, the latter will then come down to 5d. The effect of this would be to ruin the Charing Cross Company by rendering their outlay unproductive, for is it likely that City consumers will put up with all the nuisance involved in changing over to a new company when they will be having the same thing at the same price from the old company?

The City Company has taken a much bolder step than I anticipated. It has come down to 4½d., and that, too, before the Charing Cross Company has laid out 1d. in the City. This move has entirely knocked the bottom out of any hope of success that may have hitherto buoyed up the Charing Cross Company. But a far graver issue has yet to be fought—namely that of the validity of the contracts between the Corporation and the City Company. If they are valid, competition is impossible. If they are not, an action for damages will lie against the Corporation by the City Company.

The City Company has given the Corporation the opportunity of getting out of this "cleft stick" by buying up the whole concern at a price which will yield about the same figure to the ordinary shareholders as that at which the last issue of shares took place—namely, £ 8, and at an immediate profit to the ratepayers of £45,000 per annum. It is a pity the Corporation does not avail itself of this offer.

J. W. Martin.

The *Pall Mall Gazette* has now interviewed the Charing Cross and Strand Electricity Supply Corporation with a view to hearing its side of the City electric lighting question. The interviewer found the company in a state of restrained triumph. The action of the City Company in reducing the charge to 4½d. per unit seemed premature by at least 18 months; it seemed like cutting off the nose to spite the face. But the suggestion that the Charing Cross Company will be thereby deterred from following out its design is far-fetched and unfounded.

When the Charing Cross Company has made up its mind, it is not in the habit of changing it. The company, our representative was assured, means to go into the City. Its entry to the Strand proved a good thing for all parties: the reduction in the price of electricity led to an enormous increase in the number of lamps. Why should not something of the same sort happen in the City?

As for anything in the nature of collusion between the Corporation and the Charing Cross Company, our representative was assured that there had been nothing whatever of the kind. On the contrary, the Corporation attempted to impose conditions by no means favourable to the company. In some instances, the Corporation was successful, but in the case of the restrictive conditions proposed by the Board of Trade, not one of them was allowed to stand. In everything, except the calling of witnesses, the Corporation behaved kindly to the City Company. To talk of the Lords' decision being upset in the Law Courts is absurd. The Charing Cross Company is working under Act of Parliament, a sort of thing which is not usually upset in the Law Courts.

Had it been decided that the agreement between the Corporation and the City Company was valid, the Electric Lighting Act of 1888 would *ipso facto* have been stultified. That Act specifically precludes monopoly. Moreover, the very fact of the Corporation having tied its hands by entering into this agreement precluded it from being in a position either to give or withhold its consent to the introduction of competition. The very words, "so far as we are able," with which the Corporation qualified the undertaking to exclude competition should have enforced these facts upon the attention of the City Company's directors. Also, that limitation should have been brought under the notice of intending shareholders.

Throughout the contest the Charing Cross Company has behaved in a scrupulously fair and straightforward manner; there has been nothing whatever in the nature of backstairs procedure, and nobody has been able to suggest that there has, let alone support the suggestion.

Rio de Janeiro.—The gas company of Rio de Janeiro has been successful in securing an extension of its privilege for the lighting of the city by gas until the year 1940. From July 1st it also secures the right to supply electricity to the year 1915. The distribution of electricity is to be by underground cables, and the public lighting will be by arc lamps.

Ripley.—The District Council has received two tenders from experts for surveys and reports on the electric lighting of Ripley; that of Messrs. Page & Medhurst, of Manchester, for 30 guineas, was accepted. Has it come to this, that consulting engineers nowadays bid against each other, cut prices, and so on? How are the mighty fallen!

Sheerness.—The District Council has resolved to offer no opposition to the Electrical Power Distribution Company's application for a provisional order for the installation of the electric light at Sheerness.

Sevenoaks.—The District Council is considering the question of electricity supply in the district.

Sheffield.—The trade unions continue to pass resolutions hostile to the Lighting Committee's contract with Messrs. Ferranti; we sincerely trust that the committee will stand fast, and that the Council will support its views of what constitutes "a fair contract." All honour is due to Messrs. Ferranti for their stubborn resistance to what is really an underhand renewal of the question of the strike—shall an employer be master of his own workshops?

The difficulty arose through the refusal of Messrs. Ferranti to insert the so-called "fair wages" clause in their contract for electric lighting machinery for the City Council. This clause has been included in all municipal contracts in Sheffield for several years, but

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the Electric Lighting Committee decided to make an exception in this instance. The clause enforces the standard rates of wages and hours recognised by the local trade unions for all work done in Sheffield, and, for work done elsewhere for use in Sheffield, the minimum standard rates recognised by the societies where the work is done, under penalties. It should be observed, however, that a clause enforcing the hours and wages recognised by the Masters' Federation and the Men's Trades Unions for the Oldham district was embodied in the contract, with free access to works and wages books on the part of the engineer to the Corporation. The present contract is for a 1,000-KW. steam alternator costing £9,500, and a new switchboard, which is to cost £1,500. Messrs. Ferranti have already supplied plant of about 1,800 H.P. to the city.

As we go to press we hear that the Council has endorsed the action of the Committee by a majority of three votes. We congratulate Messrs. Ferranti on their victory.

Southend.—At a Council meeting held on July 12th, it was decided to refer to the ratepayers and residents the proposed transfer of the electric lighting powers to Mr. A. H. Gibbings, whose terms were considered to be more favourable than those of any other party offering. The Council voted 9 in favour of deferring the matter, and 11 against, after which the resolution was agreed to calling upon the town to express its opinion, and referring the matter back to the committee for that purpose. The public meeting was duly held last week, 120 persons being present, and by 40 votes to 30 it was resolved "that it is in the best interests of the town that the Corporation should carry out the order *if carried out at all*." It seems that there was no one present who knows much about the matter, or the absurdity of the last five words would not have escaped attention. The ratepayers, fortunately, are not the controlling authority, and the Board of Trade will, in keeping with its recent vigorous policy, see that the Council is not permitted to sit indefinitely upon its order, while private parties are willing and anxious to turn it to account. There is nothing more unsatisfactory than calling public meetings to settle such a question as electric lighting, particularly in the height of the seaside season, when there is difficulty in getting the right people together. A general poll is better, but not much, for we question whether 9 out of every 10 residents are well enough informed to vote wisely. We do not know to what extent the Council will consider itself bound to abide by the ruling of its constituents, but whoever does the work, it is to be hoped that the delay will not be further prolonged. A good deal of nonsense was said about Mr. Mitchell, the borough electrical engineer, having been connected with Mr. Gibbings at Bradford. The fact is, that Mr. Mitchell was chief assistant electrical engineer at Bradford from 1889 to 1894, and Mr. Gibbings was not appointed to Bradford until 1895.

Stalybridge.—The District Council proposes that a joint scheme of lighting and traction should be entered into by Ashton, Stalybridge, and Dukinfield.

Surbiton.—The District Council has decided to lease its provisional order to Callender's Cable and Construction Company, Limited. The Council will find the capital, and the company, in return, will pay interest on the sinking fund. The Council has the option of taking over the undertaking at the end of five years, paying a premium of 2 per cent. per annum.

Torquay.—The Princess Pier and Gardens and the Haldon Pier are to be electrically lighted at a cost of about £620.

Wallsend.—The Royal assent has been given to the Bill of the Walker and Wallsend Gas Company to authorise them to supply electricity in Wallsend, Willington and Willington Quay.

Warrington.—Tenders amounting to £50,986 2s. 6d. for the construction of the new destructor premises and plant, the new electric lighting premises and plant, and other works in connection therewith, were accepted by the Town Council last week, subject to the approval of the Local Government Board.

West Bromwich.—The Electric Lighting Committee having appointed Mr. R. C. Quin, of Blackpool, as their consulting engineer, he has prepared a report showing a scheme for the supply of electricity within the compulsory area. The committee recommends application to the Local Government Board for sanction to borrow £30,000 for the purpose of laying down plant and mains.

The Mayor made an important statement at the last meeting of the Council. After congratulating the Council upon having retained their right to supply electricity, he pointed out that had they once parted with that power it would have taken an enormous amount of money to have obtained it again. The demand for electricity in the borough was very encouraging, and they found that in the compulsory area of supply 300 H.P. would be required for generation purposes. For lighting purposes the demand was 171,000 units, and for power purposes 100,000, thus making a total of 271,000 units, but that did not include the quantity that would be required for working the trams. They had a double track extending for five miles, and for that 300,000 units of electricity would be required, whilst another 50,000 would be utilised on the Spon Lane and Bromford Lane routes. After referring to the proposed charges to consumers, he said that there was a good demand for electricity outside the compulsory area, and that the prospects of the success of the scheme were very bright.

Worcester.—Mr. E. A. S. Fawcett, A.M.I.C.E., Local Government Board Inspector, held an inquiry last week into the application of the Council to borrow, with other loans, a sum of £3,000 for electric lighting purposes.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Barnsley.—An inquiry was held at Barnsley on August 2nd, by Mr. G. A. R. Fitzgerald and Col. Boughey, Light Railway Commissioners, into the application of the British Electric Traction Company, Limited, for powers to construct light railways in the district. Evidence having been given, the Commissioners announced that the application was granted with regard to railways from Barnsley to Worsborough and Monk Bretton, but a third railway, to Huddersfield Road, was struck out on account of the narrowness of Church Street, through which it would have passed.

Birmingham.—Messrs. Brown, Marshalls & Co., Limited, have adopted electrical driving in place of steam.

Bombay.—The Bombay Tramways Company contemplates an early application of electricity upon its lines. The overhead trolley system, which is stated to have worked for three years at Madras and Colombo, and is about to be introduced at Calcutta, is proposed. The managing director of the company has addressed a letter to the Municipal Commissioners extolling the virtues of the trolley as compared with the other systems of traction. A correspondent at Bombay writes to us expressing the opinion that this is a fitting opportunity for electrical firms to start there. An agent of Messrs Siemens is arranging to start electric lighting there as soon as he can obtain the Government sanction, he having received a number of promises to take current from hotels, &c, and there is every prospect of the concern being a success. Bombay is anxious not to be behind Calcutta and Madras. The gas company has at present a good hold on the town, though there are some 30 or 40 separate electrical installations, besides a large number of cotton mills which have their own plant.

Bristol.—The Bristol Tramway Company has recently signed a contract with the British Thomson-Houston Company, Limited, in connection with the large extensions now in progress. The order includes four 500-KW. tramway generators coupled direct to vertical cross-compound engines of the Corliss type, together with three 30 KW. motor generators, and two 50-KW. lighting machines; a complete switchboard for this machinery, and 150 single truck double-deck cars complete, each of which will be equipped with two G.E.-52 motors, series parallel controllers and magnetic brakes.

Burgdorf-Thun Electric Railway.—Switzerland possesses electric tramways as well as electric mountain cable railways in plenty, but a full-gauge railway worked by electricity, capable of accommodating a considerable passenger and goods traffic and over whose lines the through traffic from other railways can pass, forms a new departure. This line, which runs from Burgdorf (on the Great Central Railway) to Thun, in the Bernese Oberland, was opened for traffic last month. The gauge is the usual one for all Swiss through lines—namely, 1·435 metres—so that all the rolling stock of other lines can pass over it. The motor-cars, with accomodation for passengers, weigh 32 tons; the ordinary light passenger carriages, to be drawn by either motors or electric engines, weigh a little over 10 tons. The contact between the car and the overhead cable, which works at a pressure of 830 volts, is effected by a stirrup, held up by two poles. The power is supplied by an overhead line at 15,000 volts, from the new electric power works on the river Kander, in the Bernese Oberland. The 12 trains which pass over the new line in either direction daily consist usually of a motor and a light car. The electric engines, which on emergency can also be used for passenger trains, are intended to cope with the goods traffic, and are capable of drawing 120 tons over the whole line, including gradients up to 1 in 40. The journey from Burgdorf to Thun takes 1½ hours, and opens up some fine hilly country, studded with prosperous farmhouses and rich villages, hitherto almost unknown to the thousands of tourists who visit Switzerland every year.

Canadian Niagara Power Company.—The Government of Ontario has ratified a new agreement with the above company, under which the monopoly clauses are cancelled, and a new rental has been fixed. Other companies are now free to enter the field, and five or six are already organised for that purpose. According to the new agreement the company must have completed by July 1st, 1903, water connections for the development of 25,000 H.P., and must have 10,000 H.P. actually available. The rental will be a minimum of £3,000 yearly, together with 4s. per annum per E.H.P. generated up to 20,000 H.P., 3s. for each additional H.P. between 20,000 and 30,000, and 2s. above 30,000. The company proposes to lay down plant for 100,000 H.P. at least. In the meantime power will be generated and distributed from the Niagara Falls Park and River Railway Company's works, which are the property of the Canadian Niagara Power Company.

Continental Notes.—RUSSIA.—La Société de l'Industrie Minière de Zyrianowsk is installing a large electric power transmission plant at its mines at Zyrianowsk (Alta du Sud). Water-power is being utilised.

HOLLAND.—An electric tramway has been completed and opened for traffic between Haarlem and Zandvoort. The line, which has a length of about 10 miles, has been constructed by Messrs. Siemens and Halske, of Berlin. The plant at the generating station comprises three 170-H.P. steam dynamos.

ITALY.—A contract has been placed with Messrs. Felix Singer and Co., of Berlin, for the construction of about 30 kilometres of electric tramways in and about the town of Catania.

Cradley Heath.—Messrs. Holt & Willetts, engineers and large chain manufacturers, have laid down a plant in their works for electric power to take the place of steam power.

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Darlaston.—A sub-committee has been appointed by the Urban District Council to consider the desirability of acquiring the portion of the South Staffordshire tramways running from the Bull Stake to Moxley within the Council's district, and to report as to the best means of dealing with the same. A communication has been received by the Council from the Midland Electric Corporation with reference to the supply of electricity, but the clerk has informed the Council that he does not see how it affects them as they do not propose to work their tramways.

Darlington.—The Town Council on August 3rd approved of the scheme of the Imperial Tramways Company for light railways in and about Darlington. The Council has power to purchase the undertaking at the end of 25 years at its then value.

On August 4th an inquiry was held by Colonel G. A. R. Fitzgerald and Colonel Boughey, C.S.I., Light Railway Commissioners, and Viscount Emlyn, assistant secretary of the Commission, into the application of the Imperial Tramways Company for a provisional order for the construction of light railways in and about Darlington. The proposed system would have 9 miles of line, 3 feet 6 inches gauge, and would cost £77,000. The company also applied for a provisional order to lay cables for transmitting power from Stockton to Darlington to work the tramways at 5,000 volts. The County Council, the North-Eastern Railway Company, the Stockton District Council, and the Stockton and Darlington Corporations, were all favourably disposed to the company's application. Mr. Clifton Robinson, managing director of the company, explained the details of the scheme to the Commissioners. An unexpected opposition cropped up on the part of certain ratepayers, who advocated municipal control. A Sunderland lawyer, who claimed to be an expert in electric tramways, was crushed amid laughter by the question: "What is the difference between an alternating and a direct current?"

On August 5th, at Middlesbrough, the Commissioners announced their decision, to the effect that the order would be granted; but they thought that arrangements should be made for the supply of power by the Corporation, in place of transmission from Stockton. The company undertook to endeavour to carry out such an arrangement.

Dewsbury and Spen Valley.—On August 1st Mr. G. A. R. Fitzgerald and Col. Boughey, Light Railway Commissioners, held a public inquiry at Dewsbury into the application made by the British Electric Traction Company, London, for powers to construct electric tramways from Dewsbury to Heckmondwike, Liversedge, Cleckheaton, and Ravensthorpe. The inquiry opened at 10 o'clock in the forenoon, and was not concluded until 6 o'clock in the evening. Ravensthorpe, Liversedge, and Gomersal District Councils supported the application. The Corporation of Dewsbury and Batley and the District Councils of Heckmondwike and Cleckheaton opposed. It was stated that Dewsbury, Heckmondwike, and Cleckheaton had agreed to promote a scheme of their own in the event of the company's application failing. After hearing counsel for each authority interested and a large number of witnesses, Mr. Fitzgerald said it seemed to be admitted on all hands that a light railway would be useful to the districts. They did not ignore the weight which ought to be attached to the views of the local authorities, but, having regard to the division of opinion which existed, they were prepared to grant the order to the company. The company, however, should consider the desirability of conceding to the local authorities the right to break up their own streets where it was desired, and in other respects the Commissioners felt that the company, in adjusting details, should pay regard to the wishes of the various authorities. An undertaking in accordance with the Commissioners' suggestion having been given by Mr. Balfour Browne, the inquiry terminated.

The Dublin Trolley Mishaps.—In the House of Commons last week Mr. Patrick O'Brien asked the President of the Board of Trade whether he was aware that three passengers on an electric tramcar in Dublin on Sunday last were injured by the breaking of the electric wires, which was caused by a passenger pulling the trolley rope in mistake for the bell rope to stop the car; whether he was aware that Mr. Mahony, the magistrate before whom a police charge was brought arising out of the accident, censured the tramway company for exposing the public using the trams to the danger of pulling the trolley rope by mistake for a bell rope, and also censured the Board of Trade for having sanctioned such a dangerous arrangement. Mr. Long (for Mr. Ritchie) replied: "The Board of Trade have entered into communication with the company with reference to this matter. When their reply is received I will decide whether an expert inquiry will be useful. In the meantime I can express no opinion on the subject."

Farnworth.—The District Council has definitely refused to accept the terms offered by the Bolton Corporation for the supply of electrical power for purposes of traction and for lighting, and has decided by a large majority to put down an installation of its own and work both.

France.—Five new lines of electric tramways are about to be constructed in the town of Rouen.

Gateshead Tramways.—At a meeting of the shareholders in the Gateshead Tramways Company, on August 2nd, it was resolved that the proposed Gateshead and District light railway order, 1899, a draft of which had been submitted to the meeting, should be approved.

Glasgow.—A deputation of six or seven members of the Glasgow Corporation visited Dublin last week for the purpose of inspecting the working of the electric tramway system of the Dublin United Tramway Company.

Hull.—The City Council has passed a resolution that the tramcar service be discontinued on Sundays.

Jungfrau Railway.—A further section of this remarkable engineering undertaking has been completed, and was formally opened on August 1st. The tunnel has now been driven through the Rothstock, the rails laid, and the electric conduit fixed for a length of 763 yards from the tunnel mouth below. To make room for a station the rock had to be blasted to the right and left of the upper end of the tunnel. Galleries similar to those in the well-known gorge of the Aare, near Meiringen, have been built outside the Rothstock on its eastern face, so that passengers may enjoy the panorama. The work, says the *Westminster Gazette*, is being continued from the Rothstock right inside the Eiger, and in a year's time the engineers hope to drive the tunnel up to the third station, called beforehand the "Grindelwaldblick."

Lambeth.—The Vestry at the last meeting considered a letter from the London County Council asking for consent to the Council applying to the Board of Trade for a license to introduce the conduit and surface contact systems on the tramways between Westminster Bridge and Tooting. After some discussion it was decided to give the desired permission, on the understanding that all disturbances of the roads were to be subject to the approval of the Vestry's surveyor, and "the pattern subject to the approval of the Vestry."

Leeds.—The Tramways Sub-Committee has decided to request the consulting engineer to invite tenders for 50 more cars, to keep pace with the extensions of the works. There are many cars on order already which have not yet been delivered, owing to the great demand at present existing.

Lincoln.—Mr. Vesey-Brown, the city electrical engineer, has reported to the Town Council on additions and alternatives to the tramway routes on which he reported in May last. The extra cost is estimated at £5,500, additional to the original estimate of £11,137. The Council will apply to Parliament for powers to carry out the scheme.

London United Tramways.—A contract has been signed with the British Thomson-Houston Company, Limited, covering the electrical equipment, engines, cars, trucks, &c., for that portion of the London United Tramways upon which it has been resolved to introduce electric traction, in Hammersmith, Chiswick, &c. The contract includes six 250-KW. 550-volt direct current traction generators and one 94 r.p.m. 5,000-volt three-phase generator, driven by vertical Corliss engines; 13 75-KW. 5,000-volts primary, 330-volts secondary, static oil-cooled transformers; four 200-KW. 500 r.p.m. 530-volt rotary converters; one motor generator set, consisting of a 550-KW. three-phase synchronous motor direct coupled to two 250-KW. direct current generators on combination bed-plate; two 75-KW. 400 r.p.m. 525-volt direct current generators for lighting purposes; and also complete switchboards for the whole plant. One hundred cars of top-seat pattern, each mounted on two trucks and equipped with two G.E. 58 motors. Series parallel controllers and magnetic brakes are also included in the contract. It is intended to have the new service in operation next June.

Manchester.—Messrs. Isaac Storey & Sons, of the Empress Foundry, Manchester, have recently considerably enlarged their works, and have adopted electric driving throughout. The whole of the new arrangements have not yet been completed, but at present there are two main dynamos of 200 amperes at 230 volts each, both being driven from one countershaft with clutches, so that they can be used either separately or together. The engine is of the Proell-Corliss type, of 100 H.P., made by the firm. There is also to be put down a direct coupled plant of about 100 amperes for office lighting and to meet the requirements of overtime working in a small section of the establishment.

Middlesbrough.—Cols. Fitzgerald and Boughey, Light Railway Commissioners, and Lord Emlyn, assistant secretary, held an inquiry on August 5th into the application of the Imperial Tramways Company, Limited, for powers to carry out extensions of their tramways at Middlesbrough. The present application was to run the line through Ormesby, Normanby, and South Bank, nearly to Grangetown. The opponents to the scheme were local landowners. The inquiry was adjourned *sine die*, in order that the parties might arrange terms.

Nottingham.—Messrs. A. Brown, city engineer, and H. Talbot, electrical engineer, have issued their report to the Council on their return from inspecting tramway systems in America. The report contains little that has not already appeared in the technical press, and, as the authors say, "engineers in England have nothing whatever to learn in America as regards the construction of the overhead work of the trolley system." We should like to know why, therefore, do English engineers persist in going to America, when there are first-class overhead systems to inspect at home? Some interesting details of the new power station of the Metropolitan Street Tramways Company, of New York, are given in the report. The estimated cost of the station is about £1,000,000, and it will contain generating plant of 66,000 H.P. There are 87 Babcock and Wilcox boilers, of 500 H.P. each, in three tiers; the chimney shaft is 353 feet high, 22 feet diameter at the top, and weighs 8,840 tons. Storage is provided for 10,000 tons of coal, which will be handled by mechanical conveyors. There will be 8 or 10 sub-stations, transforming from 6,000 volts three-phase to 500 volts direct.

(*Continued on page* 241.)

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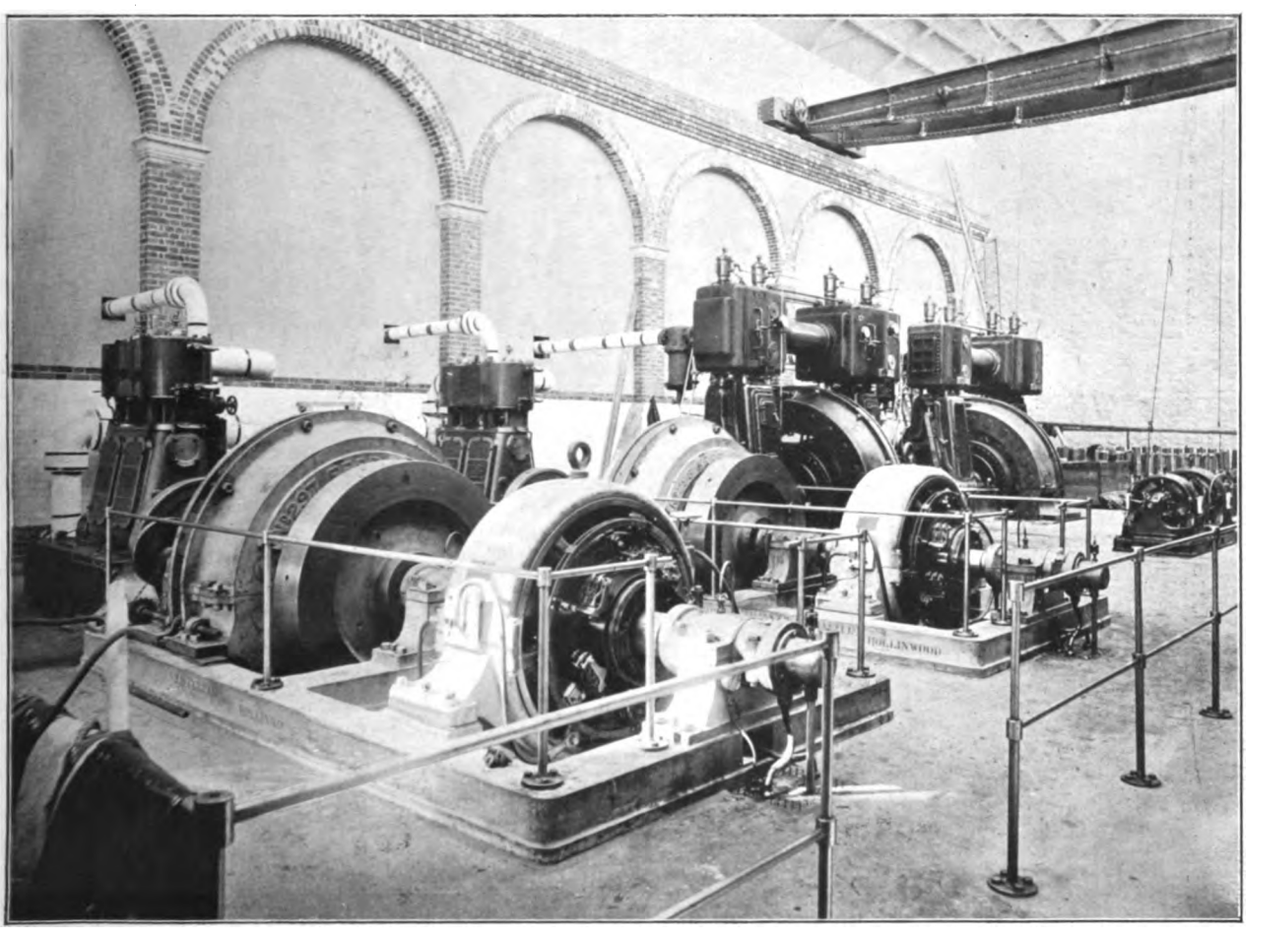
PLYMOUTH LIGHTING AND TRAMWAYS.

At the present moment unusual interest attaches to combined lighting and tramway systems, and though the Plymouth system, which we have recently had the pleasure of inspecting, is not in the front rank as regards size, yet it possesses special engineering features which render it one of the most important plants erected in this country. We believe that the Plymouth combined system was the first proposed in England; at any rate, Mr. Rider, the borough electrical engineer, was one of the first municipal engineers to advocate combining electrical machinery both for lighting and tramway purposes, and on different occasions he has both in the public press and elsewhere advanced the claims of such



General View of Engine Room.

methods. It need hardly be pointed out that opinions are very much divided amongst engineers as to the advantages of placing the necessary machinery for lighting and tramways under one roof and under one management. Much can be urged on both sides of the question. It would seem that the generation of electricity, whether required for lighting or tramway purposes, could be better carried out in one place rather than by duplicating works. In the opinion of some, the force of this argument may appear less from the fact that one of the most important tramways and lighting systems in the kingdom—that of Glasgow—is carried out under distinctly separate managements, and by works which have nothing in common with each other. On the other hand, equally important systems, such as Manchester and Liverpool, are being carried out on contrary methods. It is urged by opponents of combined stations that the tramway system is too important to tack on to a lighting system; but it seems to us that if the electric lighting of any town is properly developed the demand for current for this purpose may be greatly in excess of that required for merely tramway purposes. Moreover, the development of electricity works is in the direction of supplying energy for motors, and in some cases where this has been done signal success has been achieved. Tramway service has much in common with electric motors used for industrial purposes; there is the same proportional fluctuation in the demand, the question of the motor load and lighting load overlapping arise in the same way, and if these difficulties can be successfully met under such conditions, we do not see why the peculiar demand necessary to operate the tramway service should not be equally successfully met. From a municipal point of view, it may be desirable that the management of the tramway system should be distinct from that of electric lighting works; but the most reasonable arrangement would be for the tramways to be managed by a special tramway committee, the lighting committee being responsible, as far as the tramways are concerned, for merely supplying electrical energy. Following on the same lines, it would appear that the electrical engineer should be responsible for the supply of energy and for the supervision of the electrical details of the tramway. The advocates of combined systems have hardly gone beyond that, and it is to be sincerely hoped that

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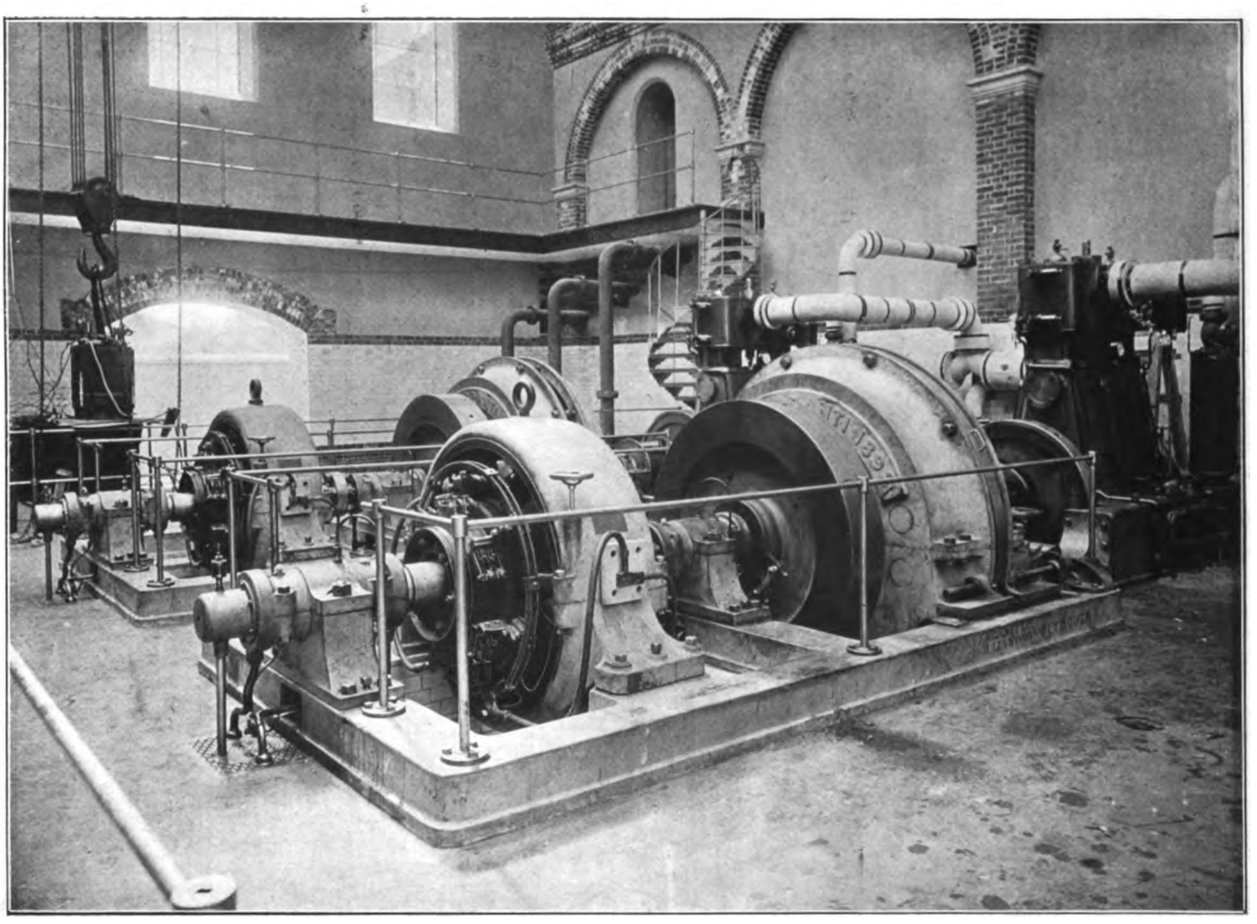
the development of municipal tramways will be carried out on somewhat similar lines. We admit that there may be some difficulties in allocating the expenses of generation and distribution, but they are not insurmountable. One important fact is that when a municipality is undertaking electricity supply services (and as they ostensibly work for the common good) no possible harm can accrue from generating electricity for both purposes in one works, assuming the location of the station to be equally good for each.

The Plymouth system, as we have said, is not remarkable for its size, but it possesses, nevertheless, some distinctly interesting details, not only in the arrangement of the generating plant, but also on the tramway side of the undertaking. The lighting of the town is carried out by alternating current machinery, and the necessity of adopting that system has led to a novel arrangement of machinery to which we will refer subsequently. Considerable delay has arisen in starting the works, but the delay has been created through difficulties of the most exceptional character. The site for the works is on the banks of the Cattewater, in close proximity to the famous Prince Rock. The difficulties alluded to arose in making the foundations for the buildings, every single foot of ground being of solid rock and necessitating extensive blasting operations. The station is about 1½ miles from the centre of supply, the building being of plain and substantial structure most conveniently situated both for coal and water. As we have already indicated, the works abuts on the Cattewater, and in addition to enjoying facilities for receiving coal by water, it is connected to the London and South-Western Railway system, a siding in fact being just outside the works.

In a general way the coal for the works will be delivered at the wharf by boat, it being possible for fairly heavy colliers to come alongside. It is the intention of the engineer to erect an automatic coal conveyor, which will carry coal from the wharf to the stores; the latter are arranged in proximity to the boiler house, coal being fed to the boilers by means of shoots and mechanical stokers. The coal will be delivered into the wharf stores, which will have considerable storage capacity, the rest of the operation being carried out by the conveyor. Sea water from the Cattewater is used for condensing purposes, the water from the Corporation mains being used for the boilers. The town's water, by the way, is exceedingly soft, thus differing in character from the water generally obtained on the South coast.

A special advantage possessed by the present site is the ample room provided for extensions, and without the necessity of carrying out any further blasting operations, the present structure could be materially added to. The buildings, erected by Messrs. Pethick Bros., Plymouth, are arranged with the offices in front, the engine house and the boiler house being behind. The engine room is 100 feet long × 40 feet wide, and the boiler house is 100 feet long × 54 feet wide. We may emphatically state that we have seldom inspected any electricity works in this country that are better designed than those at Plymouth; the engine room is unusually lofty, the machinery is not cramped in any way,



General View of Engine Room.

and the switchboard arrangements have been exceedingly well thought out. Moreover, the office portion has been designed in no niggardly spirit, the staff being well provided for both in the way of office and mess accommodation.

The steam raising plant at the present moment in use, for which Messrs. Musgrave & Sons, Ltd., are responsible, comprises three Lancashire boilers, each of which will develop steam for 350 I.H.P. They are 30 feet long and 7 feet 6 inches in diameter, and have each 3 feet furnaces. Vicars' mechanical stokers are fitted to each boiler, and are driven by means of an electric motor, the same motor being also employed for driving the Green's economiser. As we have already indicated, the coal is fed from the store, which is carried over the length and breadth of the stoking floor. The water is fed to the boilers by means of Hayward Tyler's three-throw ram pumps, which are driven by electric motors. These pumps draw water from a storage tank, which is placed on the top of the coal store, having a capacity of 28,000 gallons of

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water. It may been mentioned that over the coal store two tanks have been erected, one for the condensing water, and the other for the boiler feed water. Each tank measures 80 feet long by 25 feet wide, and is about 7 feet deep inside. They are built up of cast-iron flanged plates, and access to the tank floor is obtained by means of a ladder leading from the coal store. In addition to the three pumps there is also provided a Gresham's self-acting injector which is capable of delivering 4,400 gallons of water per hour, against a steam pressure of 130 lbs. per square inch. An economiser consisting of 256 pipes arranged in two blocks, each eight pipes wide, has been provided, and is of the latest type, complete with deflectors, scrapers, and gearing. The steam piping is exceedingly well arranged and is probably one of the most interesting features of the works. It is of lap-welded wrought-steel with wrought-iron flanges secured and brazed on, the bends being of solid drawn copper with flanges of the same material brazed on. The piping is so arranged that while, generally speaking, each boiler feeds its own engine, it is possible to cut out any boiler and obtain steam from the others. This arrangement is carried out by means of an auxiliary main passing along the back of the boilers with a T junction to each of the mains from the boiler to its engine. It is evident, from an inspection, that the design permits of a short length of pipe, and, moreover, gives the necessary duplication. Hopkinson fittings are used throughout the steam piping. Korting ejector condensers are employed and are placed under the engine house. The condensing water is carried from the Cattewater through the inlet pipe, which is pushed forward into the stream, and from thence passes under the roadway in a trench. There are three centrifugal pumps of the Gwynne type having 6-inch suction and discharge pipes. They are driven by motors of the Electric Construction Company's manufacture. The whole steam, exhaust and other pipes are covered by magnesia non-conducting material, and an arrangement has been adopted which materially adds to the appearance of the boiler house, and may possibly affect the efficiency to some extent. The whole of the boilers and the top of the economiser are covered by a floor upon which is laid magnesia covering to a depth of about 3 inches; this undoubtedly permits of easy inspection and operation of fittings and valves, and guards to some extent against radiation losses.

Car on Line.

Coming now to the engine room plant, the machines that merit first consideration are the combined plants. They have been termed steam dynamo alternators, and as will be seen from the illustrations, they consist of an engine driving an alternator and a continuous current dynamo arranged in line on a shaft, the whole of the plant being upon a combination or coupled bed-plate. There are two of these sets; the steam engines are made by Messrs. Belliss and Co., of the enclosed vertical type to run with two cylinders arranged for compound working, and capable of giving off continuously 150 B.H.P. The alternator is placed between the engine and the continuous current machine, and the functions performed by these machines render necessary a special arrangement of clutching devices. Mr. Rider, in advising this combination, has had in mind a combination of arrangements which he suggested some time ago, viz. :—

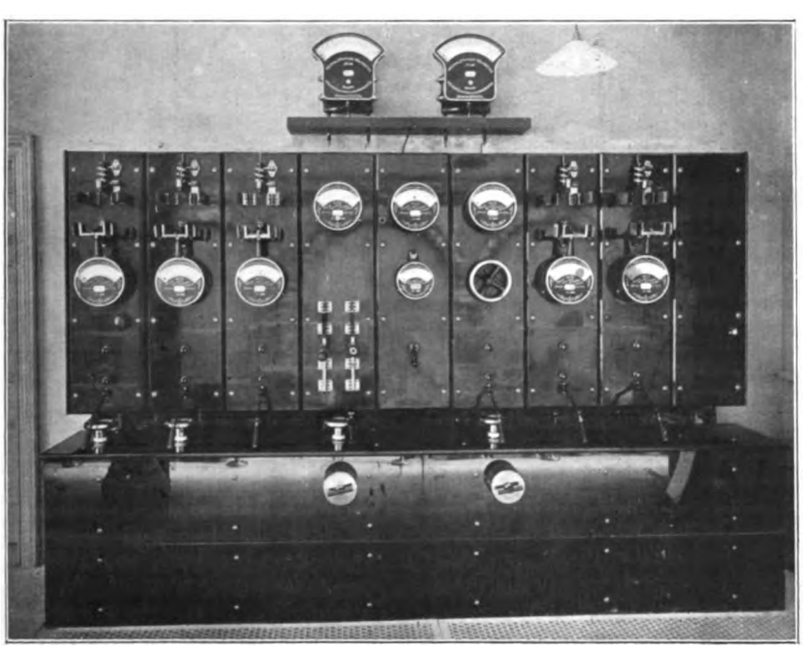
(*a*) Engine driving both alternator and dynamo, one for lighting and the other for traction.

(*b*) Using the plant for tramway work alone; that is, the alternator being uncoupled.

(*c*) For lighting work only, the continuous current dynamo being uncoupled.

(*d*) The engine being uncoupled, and the machine running as motor-generator for traction, the current in this case being obtained from bus bars to work the alternator as a motor.

(*e*) Engine uncoupled, machine running as motor-generator for lighting, in this case the continuous current machine is driven by the accumulators.



Traction Switchboard.

A consideration of these will show the great variety of functions that can be carried out by this plant. It may be said, however, that the success of the arrangement depends entirely upon the clutching devices, for the question of efficiency when the engine is driving only one machine can be left out of account. The type of clutch adopted is of the Lindsay coil pattern, and may be said to be a steel spring held at one end and coiled round a chilled iron sleeve, the other end being free and twisted over. To meet any

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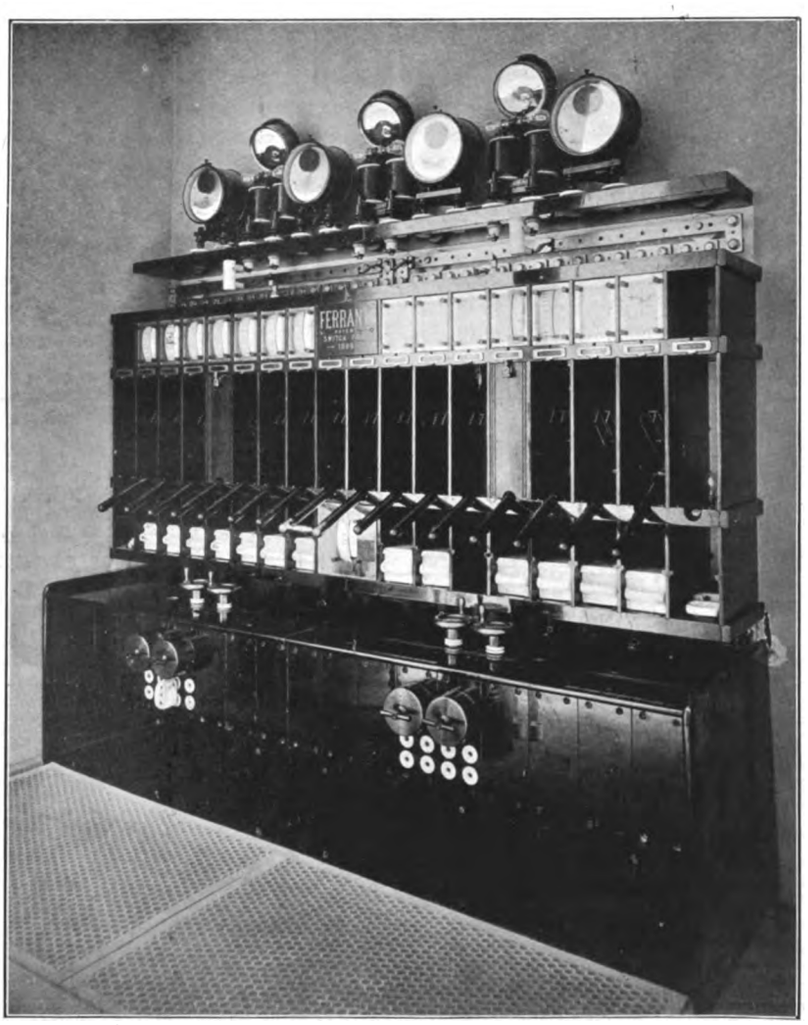
irregularities of drive, the clutch is made double, and each part will work in either direction, so that in the event of one portion of the combination running somewhat out of step one-half of the clutch would be always working right. When using this plant as a motor the usual method is to run the engine up to speed, and when the dynamo is excited the engine can be thrown out of gear. The alternator in this combination plant is of the well-known Ferranti pattern, while the continuous current machine is of the Westinghouse railway generator type. It is of multipolar pattern, and consists of a circular yoke carrying inwardly projecting pole pieces of laminated soft steel. The fields are split horizontally, which permits of ready inspection of armature or field coils. These generators are usually built over-compounded, so that the potential at the terminals increases about 10 per cent. from no load to full load. The shunt and series coils are separately wound and readily removed, the series coils being composed of forged copper conductors of rectangular section. The armature core is made up of punched sheets of steel. This core is built upon an iron spider, which also carries a commutator. The spider is pressed and keyed upon the engine shaft, and may be drawn off at will. Ventilating spaces through the spider and armature cores are so arranged as to allow a constant circulation of air through the commutator and windings when the machine is running. The periphery is slotted and the armature windings are made from bars of drawn copper forged into proper shape on cast-iron formers. After being thus shaped, the bars are thoroughly insulated with mica and prepared and baked to remove moisture. The coils are held in the slots by means of retaining wedges of hard fibre driven into notches near the top of the slots longitudinally with the armature. These fibre wedges are pressed out at will should it be necessary to remove any armature coil. The commutators are of hard-drawn copper, the segments being built up with prepared mica of corresponding hardness. The brush holders are carried on brackets projecting from a ring concentric with and supported by the field. A hand-wheel rocker arrangement gives the necessary adjustment.



Lighting Switchboard.

The other generating plant in the station consists of steam direct-driven alternators. Both the engines and alternators have been constructed by Messrs. Ferranti, and each set is capable of developing 200 KW. The engines are of the compound condensing type, and each set is built on a special foundation bed. The fly-wheel is placed between the cylinders, and carries the revolving part of the alternator. The working parts of the engine are accessible, but when working are enclosed; the lubrication is effected entirely by force pumps which draw oil from reservoirs and deliver it under pressure to the various bearing surfaces. For street lighting there are three Ferranti rectifiers of the latest type. The generating plant is completed by a motor-generator capable of developing 150 amperes at 133 volts, the motor being supplied with current at about 500 volts pressure. There are three switchboards, two of which, the lighting and tramway boards, are arranged in a special gallery, while one, the rectifier board, is placed on the engine room level. The lighting board is of the well-known Ferranti pattern which has been often described in these columns. A few feet away, on the same gallery, is the tramway board which is supplied and equipped by the Westinghouse Company. The principle of this board does not differ materially from those usually employed in tramway works. It is divided into panels for feeders and for the Board of Trade instruments.

The battery consists of 260 cells, supplied by the Tudor Company; the capacity of each cell is 620 amperc-hours at 120 amperes, with a maximum discharge rate of 200 amperes.

The outside work divides itself into two portions, the street lighting and the tramways. Before speaking of this, however, we would point out that the distribution of electricity for private lighting is done by means of transformers placed in chambers built under the footpaths in different parts of the town, access to these being obtained by means of an iron ladder. As a rule four 25-KW. transformers, transforming down from 2,000 to 200 volts, are placed in each chamber. The transformers have been constructed by the Ediswan Company, and of those supplied eight are for 25 KW., each weighing over 1 ton. The terminal fittings of these are mounted on separate porcelain slabs, the secondary connection being arranged for use on a three-wire system, so that 200 or 100 volts can be obtained. The sweating sockets are specially designed and arranged to pass readily through the glands, and are no larger in diameter than the insulated cable. Other types of Ediswan transformer have been furnished, one in particular being for 1,000 volts and 2 amperes. Another has been supplied for meter testing, and is arranged with a secondary sub-divided in such a way that any pressure between 90 and 200 volts can be readily obtained. The whole of the mains have been made by the British Insulated Wire Company, but all the work in connection with the laying has been carried out by the Corporation under the direct supervision of Mr. Rider. The high tension mains are composed of $\frac{7}{14}$ and $\frac{19}{15}$ concentric, which are insulated with paper, lead covered and juted, and compounded over the lead, drawn into Doulton earthenware conduits. The low tension cables are

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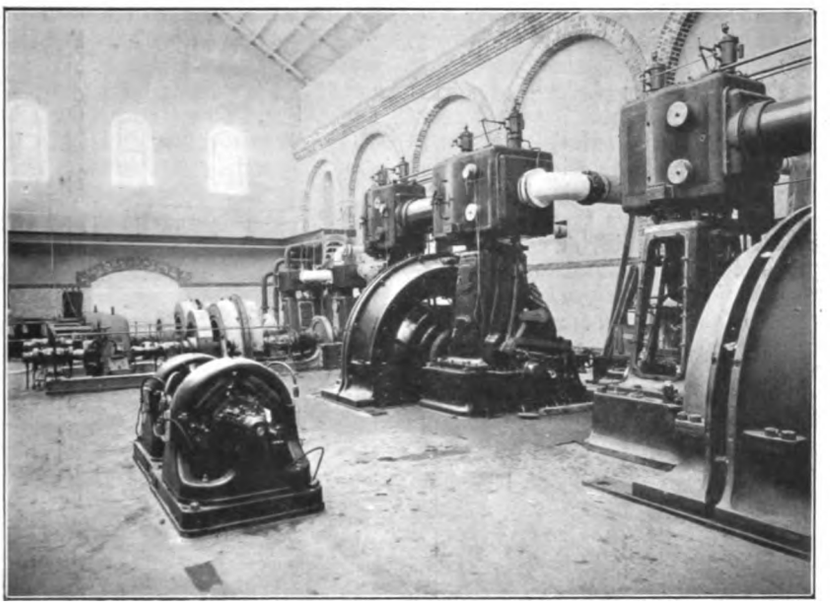
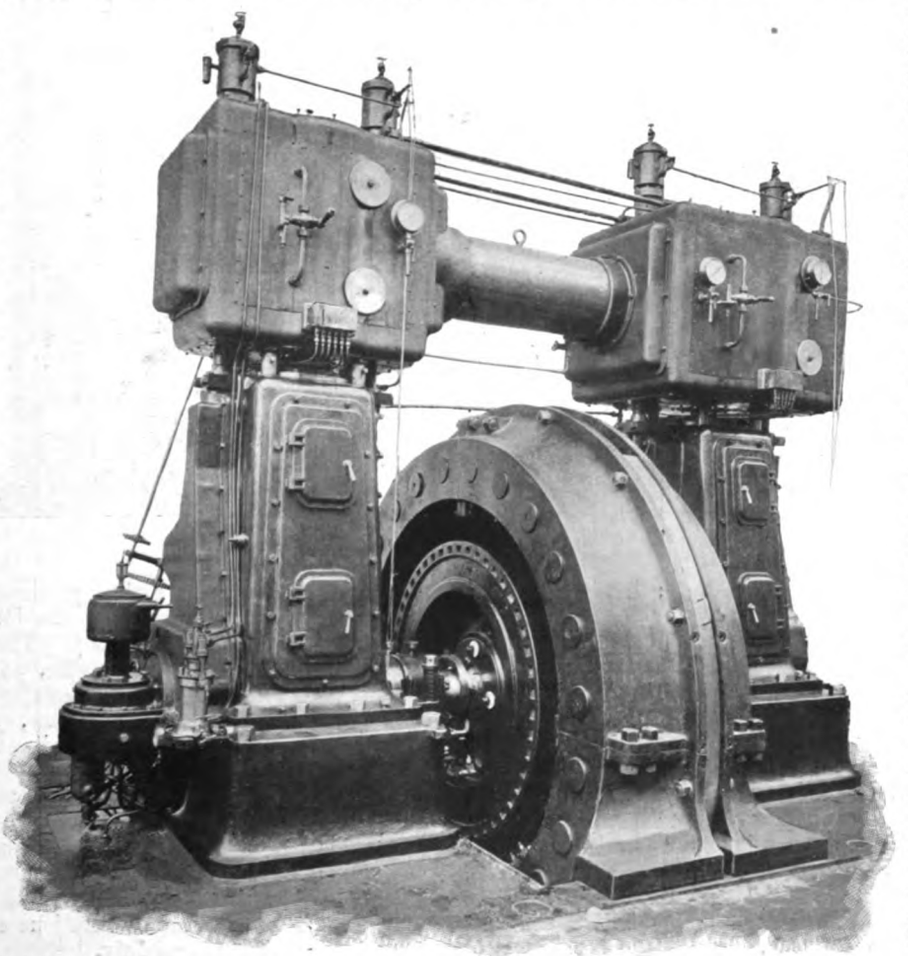
·150-inch, ·20-inch, and ·250-inch triple concentric. These are armoured, and have been laid direct without further protection, as was also the tramway feeder, which is composed of ·150-inch single cable.

The arc lighting cable consists of $\frac{7}{16}$ S.W.G. twin paper insulated lead-covered and armoured, laid direct in the same way as the triple cable, single rubber cables being used between the arc service boxes and the lamps themselves. It is worth mentioning that the service boxes of the arc lamps where they are suspended to the tramway poles, are placed under the foot-path instead of being fixed under the base of the lamp column.



View of Engine Room.

The house service cables are generally composed of $\frac{19}{14}$ and $\frac{19}{16}$. These are concentric and laid direct, the service being connected by means of triple concentric service boxes, with wiped glands, the service terminals being connected by means of fuses to the main terminals. It will be readily understood from what has been said that arc lighting forms a conspicuous feature in the scheme which has been completed. As a matter of fact, there are at the present moment some 74 lamps erected, 13 of which are on the Hoe. As far as possible tramway poles have been utilised, but where the arc lighting is carried out in streets where tramways do not exist, separate poles of a special design are employed. A word of praise ought to be awarded to the designer of the scroll work carried on the top of the poles, and it is gratifying to find that the designs have been originated in the borough electrical engineer's office, Mr. E. G. O'Kell, the chief assistant engineer to Mr. Rider, being responsible for them.



Single Alternating Set.

The pillars are of two kinds—(*a*) cast-iron throughout, and (*b*) tubular steel, with cast-iron mountings. There are 48 cast-iron posts and 30 tubular posts; 28 of the lamps are suspended from wrought and cast-iron brackets, and 50 are fixed in ornamental canopies. The tubular posts are also used for carrying the span wires for the tramway overhead conductors.

The lamps are of the well-known Crompton-Pochin type. They are arranged to burn with a rectified current of 10 amperes. They are double carbon and burn for not less than 32 hours without re-trimming. Each lamp is provided with an internal automatic cut-out to short circuit the lamp in the event of any accident to the mechanism. Each lamp is also provided with an isolating switch, which enables the lamp to be entirely disconnected from the mains and the two cables leading into the post to be connected together. With this arrangement it is possible to re-trim a lamp while the current is on, without any danger to the attendant and without in any way interfering with the remainder of the circuit. In the case of the cast-iron posts, these switches are fixed in the base. In the case of the tubular posts the switches are in water-tight cast-iron boxes under the pavement.

The lamps are run in two circuits off Ferranti rectifiers, each rectifier being capable of supplying current to a circuit of 50 lamps in series.

The whole of the street lighting work, including the erection of the lamps, poles, &c., and the coupling up, has been carried out by Messrs. Crompton & Co., Ltd., of Chelmsford and London.

It is necessary now to refer to the tramway portion of the undertaking, and though the work for the most part is similar in character to the work carried out on other systems, still there are details which might be referred to with advantage. The track which has been specially constructed for electrical operations extends from the Prince Rock to the Royal Theatre in the centre of the town. The line is double throughout and has a gauge of 3 feet 6 inches, the rails being of the girder type, and weighing 92 lbs. per yard.

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They are heavily bonded together, three Chicago bonds being employed in place of the two usually adopted. Messrs. Askham Bros. & Wilson, Limited, supplied a quantity of material in the shape of their patent crucible cast-steel points and crossings, together with their patent joint plates with lock nuts. Mr. Rider is a believer in the swivelling trolley, and it is interesting to observe how he has utilised the undoubted advantages of a revolving trolley head in arranging the overhead wires. Practically every form of overhead suspension is employed, side suspension from single arm brackets, centre poles, suspension from buildings, and suspension from posts and buildings. But a method is employed which we believe has not been previously adopted in this country, it is the suspension of wires on each side of the road. Obviously this is more expensive than employing single arm brackets, it being understood, of course, that central poles are not permissible, but the advantage of a wire being carried on each side of the road is that it needs short arm brackets. It will be seen from the photographs that this method has much to commend it, and is unquestionably an improvement upon the long arm brackets, which are becoming so marked and disagreeable a feature of much of the overhead construction at present in vogue. The wire is of 000 gauge, guard wires being employed practically throughout the system. The tramway poles are of two kinds—they are all of cast-steel; but while some are made in three sections, others have been made in a single section. The engineer, in specifying for the posts, insisted upon an exceedingly rigid test; they were to withstand being dropped three times (butt end foremost) from a height of 6 feet on to a solid substance, and as a bending test they were laid horizontally from a support 5 feet 6 inches from the butt end, and loaded at a distance of 18 inches from the top end with a weight of 700 lbs. The temporary deflection was not to exceed 6 inches. The line is divided into half-mile sections, a junction box being placed at each half mile. Instead, however, of taking the form of a pillar placed at the edge of the kerb, Mr. Rider has adopted a plan which is worth noting; the box, as a matter of fact, is sunk into the wall. The door of the box is flush with the service wall, and looks not unlike a safe. It should be mentioned, however, that both section boxes are on Corporation property, and it is doubtful whether private owners would generally permit of a box being sunk into their property. The rolling stock is not very extensive at present, and consists of only six cars, each of which will carry 42 passengers, 20 inside and 22 outside. The bodies have been constructed by Messrs. Milnes & Co., and are carried on Peckham cantilever trucks. Westinghouse equipment is used on the cars; there are two motors, and the usual controlling devices—emergency switches, electric brakes, &c. The electric braking arrangements are similar to those employed on other lines using Westinghouse equipment. For braking purposes the motors work on a closed circuit, which is varied gradually, the operation, of course, being independent of current from the trolley line. The cars are lighted with electricity in the usual way. Our thanks are due to Mr. J. H. Rider for the courtesy shown to our representative on the occasion of his visit.

Plymouth.—Street Scenes.

2,000-H.P. ENGINES.

The largest factory engines ever made were constructed, we believe, for a Bombay cotton mill by Messrs. Hick Hargreaves and Co., of Bolton. They were of some 4,000 H.P. Marine engines of 30,000 H.P. have been made for Atlantic liners, but, unless the increase has been recent, the maximum power put through any one crank is 5,000, and this figure was reached many years ago in the *Britannic*. In the early days of electricity there was a tendency towards over confidence. This tendency was exhibited by the intention to put down a 10,000-H P. engine at Deptford. The engine, to use an Americanism, did not materialise, at least, not wholly, though a very large shaft was on sale at Deptford. A pair of 1,500-H.P. engines were, for a time, spoken of as the little engines in pleasing anticipation of joys to come in the shape of the large engine which never came. The attempt to do too much at once, to take too big a step, has probably had much to do with the niggling manner in which the steam engineering of central stations has since been carried on. The fact that 10,000-H P. engines failed to be completed, was probably due to a financial, not an engineering, cause, and was no warrant for other stations employing a hundred little engines on the same duty.

Since the days of big things, however, Deptford has gone steadily, and the new engines called for some time ago have been some months at work, and are now described in the *Engineer*, from which we gather a few of the principal dimensions and figures. Made by Messrs. Plenty & Son, Limited, of Newbury, they are of 2,000 H.P., with three

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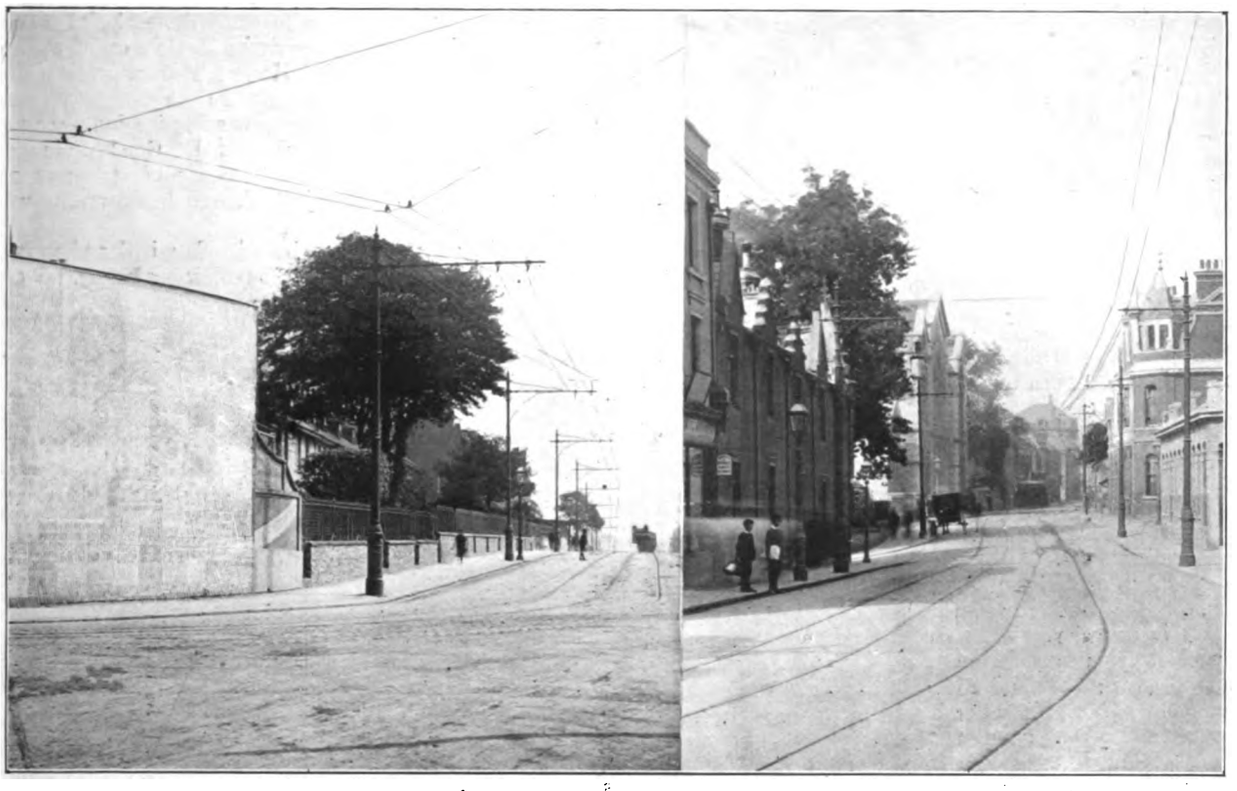
cranks and six cylinders in vertical tandem pairs. The engines are by no means of large size though of a considerable collective power. The high pressure cylinders are 19½ inches diameter, the low pressure cylinders are 43 inches, and the stroke is 26 inches. The speed is 156 revolutions per minute, and the initial pressure 140 lbs. The Siemens-Martin steel shaft is 12 inches diameter in both main bearings and crank pins. The valves of each pair of cylinders are worked by one eccentric, the high pressure valves being of piston type and the low pressure valves of flat or D type. The details are not clearly shown, but seem to indicate too small a valve chest to the low pressure cylinder and somewhat cramped valves. The marine type has generally been followed except that they exhaust to independent condensing plant. The generator driven by these engines is a direct coupled Ferranti alternator, having an output of 150 amperes at 10,000 volts. A test load of 300 amperes has been run and 15,000 volts have been put on the insulation generally, though some of the details were put to more severe tests; for instance, the pole caps of micanite have been tested to 21,000, these magnet pole caps having been the chief offenders years ago in the early failures of 10,000-volt machines.

The *Engineer* states that the latest Deptford machine was finished one day, tested for pressure the next day, for current the third day, and on the fourth day was put on the mains at 10,700 volts at a load of 125 to 140 amperes, and has so been at work half a year. Why, therefore, should other companies go to America for 500-volt plant and costly upstep transformers, when they might manufacture the full pressure at once? At Deptford the "low pressure" plant at 2,500 volts is to be scrapped. The armature, which weighs 38 tons, has 64 bobbins, with cores of laminated brass and asbestos. They are bolted to the wheel with the above-named micanite cap insulation. They are wound with copper corrugated tape, and insulated with silk and vulcanised fibre. Pump lubrication at 15 to 20 lbs. pressure is carried throughout the shaft bearings. The armature shaft is coupled to the engine shaft, and the bedplates are connected into one rigid whole. Current is collected by three brushes from a split ring fixed on the wheel, on the side away from the engines. The field magnets number 128, one on each side of the armature bobbins. Their pitch circle is 20 feet diameter, and the peripheral speed is over 10,000 feet per minute. The field coils are of solid rectangular copper strip. A good deal is made of the three cranks, and five are prophesied. Now three cranks are convenient, but even in a three-crank engine, arranged as at Deptford, all the work has to go through one main bearing, and two of the cranks are too large for their work. In a five-crank engine, probably three of the cranks will be too large, if not four, and an extension in the line indicated is of doubtful value and very problematical economy.

The engines illustrated by our contemporary are open to some criticism. It is extremely bad practice to make the H.P. piston, or, indeed, any piston of a vertical engine with a recessed water-holding upper side. Perhaps we ought to forgive the conical form, though this is avoidable, but if the piston must be conical, it should cone from the cylinder, and not be made water-holding. Then the exposed inner surface of cylinder and cover and piston is enormous. The H.P. piston rod is shown fluted circumferentially, so that it closely resembles a square-threaded screw. Between the two cylinders there is no stuffing box but merely a long sleeve through which works the fluted rod. No explanation of this is afforded though the idea appears good. The cylinders are well drained at their lower ends, but as above stated, are badly provided with drainage above the pistons. The bracket carrying the rocking lever of the high pressure valves is shown as one piece with the top cover of the high pressure valve chest. This is hardly good practice, either for the valve motion pins and bearings, already numerous enough, or for the faced joint of the valve chest cover, which, however, it is only fair to say, covers the exhaust end of the chest.



PLYMOUTH.—STREET SCENES.

ELECTRIC TRAMWAY SYSTEMS AND FREIGHT DISTRIBUTION.

IN a recent issue (see ELECTRICAL REVIEW for June 9th) we referred to the use of the tramway system in Brooklyn for freight purposes, and we discussed the future prospects of this development of electric traction. Since that date we have come across two facts of interest in connection with this subject.

In the issue of an esteemed contemporary for March 18th last, there is a description of a specially designed meat-car for

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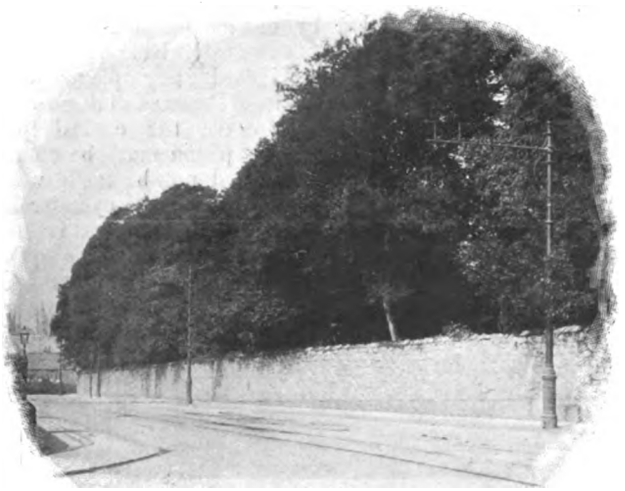
use upon the electric tram system of Buenos Ayres—a city of 850,000 inhabitants.

Owing to the excessive heat, a rapid distribution of the meat killed at the public abattoirs is most desirable. The



Plymouth.—Street Scene.

municipal authorities have therefore taken the matter in hand, and have arranged with the tramway company for a special service of these meat-trolley-cars, to be run between the hours of two and nine in the morning for conveyance of the meat from the abattoirs to the various retail establishments of the city.

The second fact relates to the suggestion, made in our last note on this subject, to the effect that a cart or car which could be run either on the ordinary road, or on the tramlines, was required, before the electric tramway system could be widely utilised for freight distribution during the early morning hours.

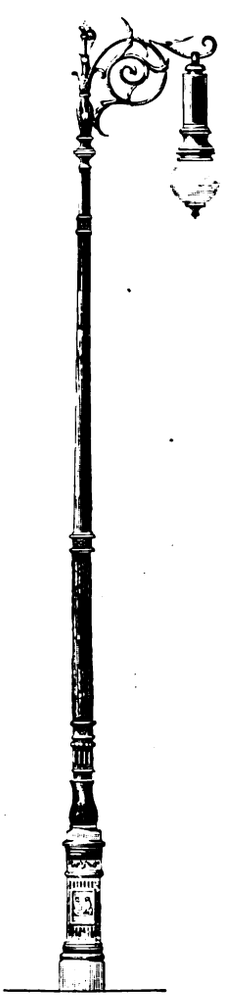
A car has been designed by Messrs. Siemens & Halske, of Berlin, for use on either the ordinary roads or on the tramway lines within that city. When running on the ordinary road, it is worked by an electric motor, and draws its power from a storage battery; when on the tramway lines the motor is driven from the overhead conductor by means of a trolley apparatus, and is kept upon the track by means of two pairs of guide wheels, which can be raised and lowered at will. The storage batteries can be re-charged when the car is running on the tramlines by means of a second trolley pole and apparatus.

This car is intended only for passengers, and it has been successfully run in the streets of Berlin, but it is evident that the utilisation of such cars could be widely extended, and that *if economical in operation* they might be used to distribute every kind of freight and merchandise within the area of the larger towns and cities.

ARRANGEMENTS OF STEAM PIPES.

Mr. Edgcome's paper on steam pipes, read before the Municipal Electrical Association and reprinted on another page in this issue, is written from the point of view of a man who believes in ring mains. To our mind the ring main is a contrivance for providing for breakdowns which would not occur if there were no ring main. As we reproduce the paper in order to let the views of the ring main have fair treatment, it will be seen what a lot of complicated drainage the author thinks necessary to provide. He would have a station full of steam traps and drain pipes. We do not follow the author's reasoning as to the isolating valve and its functions. This valve does not enable a boiler to recover itself in the manner described, but it does prevent a boiler from acting as a condenser, and from swallowing up steam from more active boilers, and it is an admirable safeguard when men are at work inside a laid-off boiler, for it prevents the disastrous effects which follow the accidental opening of the junction valve whereby men may be injured. We rather object to his remarks anent the use of safety keys for blow-out taps. The keys he describes are excellent as a preventive against accidental leaving open of a blow-out tap, for the key cannot be removed until the tap is closed. So far, good. But there is always the chance of there being duplicate keys. Spare keys may be kept under lock and key, but some day a second key will get into the boiler room. Perhaps one key is lost. A second is procured. The first is found again. There are now two keys, and this is sure to be the moment selected for a man to be coming out of an empty boiler. A working boiler is blown off into the common waste pipe, and the man in the empty boiler or half out of the mud-hole is endangered. The lesson is, avoid common waste pipes. Carry each boiler blow-out by its separate waste pipe, so that there cannot be a back flux; but do not trust to special keys except as a safeguard against a collapsed furnace, for which they are admirable. The author points out the danger, but considers locking up of the spare keys is sufficient safeguard. He is mistaken. He is wrong in advising the making of stringent rules against other usages which ought not to be capable of causing the dangers against which the stringent rules are needed. Good design of a boiler plant should avoid the necessity of stringent rules which are always forgotten just when their observance would lead to safety.

If Mr. Edgcome had ever been inside a boiler when it had been blown into from a common blow-out waste, he would



Plymouth.—Lamp-post.

have had less to say of stringent rules, and more to say of the faults which render such rules necessary. The common waste pipe is one of these faults. It may be usual practice. This does not justify it.

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ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page 232.*)

Middleton.—Last week the Council passed a resolution to make application to the Board of Trade for powers to construct tramways from Middleton to the Manchester boundary. Middleton is laying the lines, but the service will be supplied by the Manchester Corporation, with whom an understanding has been arrived at. It was also decided to make application to the Local Government Board for borrowing powers for a further sum of £4,500 for electric lighting purposes.

Newcastle.—At a meeting of the Tramways Committee on August 1st, it was reported that Prof. Kennedy was not prepared to recommend the laying down of a conduit or any intermediate service in the city in connection with the overhead trolleys from outside, but preferred to await developments. There was a suggestion, however, that centre poles be fixed throughout the main streets, as a temporary arrangement, and when practical experience showed a better system these could be removed. It was agreed to recommend the Council to instruct the engineer to advertise for tenders for rails for the permanent way, boilers for the power station, &c., in order that that portion of the work might be proceeded with.

Oldham.—The Surveyor's and Tramways Committee's chairman, Ald. Eckersley, the surveyor (Mr. Pickering), and the electrical engineer (Mr. Newington), recently had an interview with Mr. Alderman Higginbottom, of Manchester, regarding the tramways. Reports respecting the interview were read at a meeting of the committee on Thursday last week. Mr. Pickering said that Alderman Higginbottom did not believe in calling in experts. He did not see why Oldham should not do the same as Manchester, and rely upon its own electrical engineers. He expressed the hope that his Corporation would eventually come to a reciprocity agreement with Oldham for the through service of cars between Manchester and Oldham. Alderman Eckersley's report states that, after the interview, he (Ald. Eckersley) was of opinion that the committee had decided to recommend to the Council the system best adapted to Oldham, and he was more decidedly so when they took into account that they would be more thoroughly able to work their own system in conjunction with Manchester and Rochdale by agreement, as he hoped, to the mutual advantage of all three municipalities. Mr. Higginbottom gave an invitation to visit the Manchester Electricity Works, and he (Alderman Eckersley) thought much good might result to the committee by doing so, and to the Electrical Committee also. He hoped now that the committee would bend its energies to the carrying on and completion of this great scheme.

Peking.—The *Westminster Gazette* learns from the *North China Daily News* that the first electric tramway in China was opened on Saturday, June 24th, between the Peking station at Machiapu and the south gate of the metropolis Yung ting-men. The whole system works excellently. The tramway was projected and constructed by Messrs. Siemens & Halske, of Berlin. It is intended to extend the tramway inside the city, a great difficulty being to break a new gate for the line through the city walls; but after all it will only be a question of time, it being an urgent necessity to have a better communication between the Peking station and the city. "Why should London wait?" asks our green contemporary, forgetting that its own party on the London County Council has been responsible for the delay in London.

Portsmouth.—At a meeting of the Town Council, on August 8th, the Tramways Committee submitted the names of three candidates for the post of superintendent of the reconstruction of the tramways, viz, Messrs. Alan Bannister, of Norwich; E. Rotters, of Seton, Kerr & Co., and F. Smith, of Coventry. The recommendation of the committee that Mr. Bannister be appointed at a salary of £400 per annum, rising to £500, was unanimously adopted. The committee was authorised to invite tenders and to obtain such assistance as might be necessary for carrying out the work.

Rotherham.—The Town Council has appointed a Parliamentary Committee to consider and report on a proposed omnibus bill, dealing with, amongst other matters, a scheme of electric traction.

Stockton.—At a meeting of the Tramways Committee of the Corporation, held last week, Mr. J. Clifton Robinson announced that the Imperial Tramways Company had decided to abandon the extension of the Teeside system to Eaglescliffe for various reasons, the chief being that the requirements of the local authorities were of a too exacting nature.

Stretford.—A meeting of the Electric Lighting and Tramways Committee was held on the 25th ult., at which a letter was read from the United Kingdom Tramway, Light Railway, and Electrical Syndicate, Limited, requesting permission to open negotiations with the Council with a view to the construction of a light railway through the township as part of a scheme comprising the districts of Urmston, Eccles, Farnworth, Radcliffe, and Prestwich. The company asked for a concession of 42 years, and offered to equally divide all profits after they had realised 7½ per cent. The committee resolved that they were unable at present to entertain the proposal. At the same meeting a letter was read from Messrs. Crofton, Craven & Worthington, intimating that the Manchester Ship Canal Company had given notice to the Board of Trade objecting to their granting an extension of time for the construction of the Trafford Road line. The committee resolved that the Manchester Carriage and Tramways Company be requested to at once construct, in a manner suitable for electric traction, that portion of the tramline in Trafford Road authorised by the company's provisional order of 1897. The minutes were adopted. Mr. Robinson stated the position of the Council with regard to the Port Sanitary Authority. In a scheme which it had put forward, the Authority sought to make each district protected liable to pay the expenses properly chargeable to it. The scheme was only tentative, but its reasonableness was admitted. An inquiry was to be held by the Local Government Board, the result of which would be to confirm the arrangements made, and to renew the order for a further period.

West Bromwich.—The Council has decided to promote a Bill in Parliament to purchase, maintain, work or lease that portion of the South Staffordshire tramway which is within the borough. The object of the step is chiefly to strengthen the position of the Council in negotiations with the Tramway Company.

West Hartlepool.—The British Electric Traction Company has given notice of its intention to proceed with the light railway from Church Street to Seaton Carew.

Wolverhampton.—The Lighting Committee has concluded an agreement with Messrs. Chubb & Sons, for the supply of electricity to their factory at 4d. per unit for lighting and 1½d. per unit for motive power for a term of five years.

TELEGRAPH AND TELEPHONE NOTES.

The "All-British" Cables.—A Melbourne telegram, dated the 4th current, says that Mr. Duffy, Postmaster-General of Victoria, has given notice that he will move that it is expedient for Victoria to join Great Britain, Canada, New South Wales, Queensland and New Zealand in the construction and working of a Pacific cable touching British territory only.

An electrical contemporary, in referring to the cables which the Eastern group of companies propose to lay from the Cape to Australia, says: "As the West African route is not a strong one and is more or less at the mercy of the French Colonies, while the East Coast cable goes, of course, to the Mediterranean, like the rest, the proposal will hardly commend itself as a substitute for the Pacific cable."

In the House of Commons, on Monday last, Mr. Hogan asked the Secretary for the Colonies whether he had received any further information in reference to the settlement of the remaining points at issue in connection with the construction of the Pacific cable; and whether the negotiations had now sufficiently advanced to enable him to give a general outline of the amended scheme of joint ownership and mutual responsibility, as agreed upon by the representatives of Her Majesty's Government and the Colonial Governments concerned.—Mr. Chamberlain replied: The terms of the arrangement are not yet completely settled, and I am not in a position to make any statement.

A writer in the *Moniteur Universel*, in reference to the Pacific cable, says that the matter is one of life or death to the French possessions in the Pacific. He calls on France to come to an agreement with the United States for the laying of a cable from San Francisco to New Caledonia, with a view to forestalling the British project, being of opinion that were this done the proposal for a Canadian cable would be abandoned.

The City Police and the Telephone.—After an extraordinary amount of delay, says the *City Press*, the headquarters of the City police force have been connected with the National Telephone Company's system.

Hull Telephones.—At the last Council meeting a motion was considered for giving notice to the National Telephone Company to terminate the agreement as to the wayleaves in the city. A deputation attended, consisting of Sir Albert Rollit, M.P., Alderman Franklin, of Sheffield, and the general manager of the Telephone Company. Alderman Sir J. T. Woodhouse, M.P., said this was a very serious matter, not only for Hull but for the National Telephone Company. The Bill now before the House of Lords was on the point of being passed, and it was essential that they should place themselves in a safe position by giving the Telephone Company notice. Alderman Larard then reviewed the steps taken by the National Telephone Company in connection with the bill now before Parliament. If it passed they would be placed in a very serious position unless they gave the notice which he had placed upon the paper. If the bill passed as it stood, and it was very likely so to pass, then they would lose control to some extent of their streets until 1911. That was a state of things the Council ought to resist, and he therefore gave notice of motion that the agreement as to wayleaves with the National Telephone Company should be terminated in six months. He moved his resolution with the hope that it would be unanimously carried. Mr. Gane, the general manager of the National Telephone Company, stated that the Corporation could, according to the agreement, terminate it on giving six months' notice, and the position of the Council would never be affected unless they determined to become competitors with the National Telephone Company. That company was spending thousands of pounds in Hull, and they had recently entered into a contract to spend more thousands, but if the resolution was passed they as a company would not spend another

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farthing with a risk of confiscation of their property. The question was, was the Council prepared to put an end, as it were, to the telephone service in Hull, or at any rate to very seriously injure that service? As he had said, there was nothing in the agreement to affect the Corporation unless it determined to take over the telephones, and he hoped the Council would not in haste damage the telephone service in the city. The deputation then retired, and Alderman Sir James Woodhouse spoke strongly in favour of the motions, which were carried, with one dissentient.

Melbourne Telephones.—The *British Australasian* says that it is now fairly certain that the Postal Department will decline to comply with the request of the Ballarat sharebrokers for the erection of private telephone lines between Melbourne and Ballarat. It is likely that additional public lines to Ballarat and Geelong will be started shortly, also one to Bendigo.

Norwich and Yarmouth Telephone Service.—In the House of Commons on Friday, the 4th inst., Sir Harry Bullard, one of the Conservative members for Norwich, put the following question to the Secretary to the Treasury, as representing the Postmaster-General, "whether he is aware that serious inconvenience is occasioned in consequence of the insufficient trunk line telephone communication between Norwich and Great Yarmouth, and whether he will take steps to remedy the same." Mr. Hanbury, in reply, said that an additional circuit between those places was opened in March last, and at present more than 50 per cent. of the calls were effected within five minutes. The electrical working of the wires was satisfactory. The traffic, however, was growing, and the Postmaster-General had at present under consideration the provision of additional facilities.

Questions in Parliament Regarding Various Cables.—On Friday, the 4th, on the report of the vote to complete the sum of £71,241 for the subsidies to certain telegraph companies, Sir C. Dilke said it had been strongly rumoured lately that the companies subsidised in this vote were making an alternative route. He would like to know whether the Government could give them similar information to that laid before the Cape Parliament on the subject of the working of the lines subsidised in this vote, of the proposal for an alternative line to the Cape, of the opinions of the home Government as to the strategic importance of the proposed line, and whether, owing to the recent increase of trade in South Africa, these subsidies were necessary. He also wished to know whether the Chancellor of the Exchequer could tell them anything about the recent delays in Government messages from the Cape.

The Chancellor of the Exchequer said there had been proposals under the consideration of the Government from the telegraph companies for a new cable between this country and the Cape, touching St. Helena and Ascension. Negotiations had also been in progress between the companies and the Government of the Cape as to a considerable reduction in rates in return for a grant of land rights. He could not say the matter had approached completion, nor how far papers could be presented. But there were proposals before them which were considered of considerable strategical importance by the Admiralty as to the proposed new communications. With regard to the undue delay of Government messages from the Transvaal, he knew nothing about it, except that there was a breakdown. He knew of no other cause.

The report of the vote was agreed to.

On Monday last, in reference to the proposed cable from South Africa to Australia, Mr. Hogan asked the Secretary for the Colonies what response, if any, had been received from the Colonial Governments concerned to the offer of the Eastern Extension Company to construct a cable from South Africa to Australia.

Mr. Chamberlain said the offer in question was not made through this department. I have no information as to any replies that may have been given to the company by the Colonial Governments concerned.

On Tuesday last the following questions were asked concerning international telegrams:—Sir C. Dilke asked the Secretary of State for India whether it were possible to lay before Parliament any agreements and correspondence between the Government of India on the one side, the Eastern Telegraph Company, the Indo-European Telegraph Company, and the Eastern Extension Australasia and China Telegraph Company, or any of them on the other part, relating to the establishment or subsequent modifications of a joint-purse agreement for dealing with international telegrams and settlement of accounts between the parties to the joint-purse agreement; what was the actual cost at which the Indian Government transmitted telegrams over their lines from Karachi to Bushire and Fao; and what transit rate under the existing joint-purse system the Indian Government would charge over the same portion of their lines for messages to or from England handed to them by any British company not represented in the joint-purse agreement.

Lord C. Hamilton: It would be necessary to obtain the consent of several companies mentioned before the agreements referring to the joint-purse arrangements could be made public, and I am therefore at present unable to undertake to lay papers on the table. The transit rates over the Indian Government cables between Karachi and Bushire or Fao are as follows:—On messages exchanged with India—between Karachi and Bushire, 1·455f.; between Karachi and Fao, 1·905f.; on messages exchanged with countries beyond India—between Karachi and Bushire, 1.09f.; between Karachi and Fao, 1·39f. These rates are laid down in the International Telegraph Convention, and are the same for all classes of messages, whether handed over by any English company belonging to the joint-purse agreement or by any other company or foreign Government Administration. The rates can only be altered with the consent of the States interested who are parties to the International Telegraph Convention.

Sir C. Dilke asked the Chancellor of the Exchequer whether it was possible to lay before Parliament the agreements and correspondence between Her Majesty's Government on the one side, and the Eastern Extension, Australasia, and China Telegraph Company, and the Great Northern Telegraph Company on the other side, relating to the submarine telegraph cables which land at Wu-sung (for Shanghai), Hong-Kong, Labuan, Singapore, and Penang.

Mr. Chamberlain: The latest agreement—that of 1893—can be laid before Parliament if desired, but the earlier correspondence is not only in part of a confidential nature, but is also very voluminous, and extends over many years. I fear, therefore, that it could not be given.

Sir E. Sassoon asked the Under-Secretary for Foreign Affairs whether, in view of the agitation in this country for a reduction of foreign telegraph rates, Her Majesty's Government would request Her Majesty's Ambassador in Constantinople, Lord Cromer, and Her Majesty's Minister in Teheran to procure from the Turkish, Egyptian and Persian Governments respectively copies of all concessions granted to, and all agreements made with, either the Eastern Telegraph Company, the Indo-European, or the Telegraph Construction and Maintenance Company, or the agents of all or any of them, and the Indian Government.

Mr. Brodrick: In reply to the two questions of my hon. friend, I have to say that Her Majesty's Government would not feel justified in publishing or in obtaining for publication, as seems to be suggested, from one of the parties without the consent of the other copies of the arrangements referred to. The arrangements between Her Majesty's Government and Turkey and Persia have already been published.

The Rennes Telegrams.—The number of telegrams sent over the wires from Rennes on Monday night was enormous, says the *Daily Chronicle's* Paris correspondent. At the Central Post Office in the Rue de Grenelle no fewer than 200,000 words were received between 7 A.M. and 4 P.M. Five supplementary wires have been installed between Paris and Rennes, and these, in addition to the five wires in normal use, are busily employed every minute of the day.

The Telegraph Wire Export Trade.—There was rather a more active state of affairs prevailing in the export trade of this country in telegraphic wire and apparatus connected therewith during July last, the shipments during the month attaining a value of £97,635, which compares with only £27,817 in the preceding month and £45,600 in July last year. During the seven months ending with July, the value of the aggregate shipments has amounted to £599,308, an increase of £52,812 as compared with the corresponding period of last year, but a decrease of £7,965 when contrasted with the returns for the first seven months of 1897.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa ...	April 4th, 1898 ...	...
Jamaica-Colon	June 30th, 1899 ...	...
Bonny-Cameroun	May 29th, 1899 ...	...
Latakia-Cyprus	June 20th, 1899 ...	...
Para-Maranham	April 10th, 1899 ...	...
Maranham-Ceara	July 25th, 1899 ...	...
Medan-Olebleh	July 31st, 1899 ...	...
Accra-Grand Bassam... ...	August 1st, 1899 ...	...
Corea-Japan	August 7th, 1899 ...	...
Landlines.		
Communication between Salonika and Monastir ...	March 23rd, 1899 ...	...
Communication between Bolama-Bissao	July 28th, 1899 ...	...

The Telephone Bill.—In the House of Lords on 3rd inst., the Duke of Norfolk moved the second reading of this Bill, the objects of which he explained. Lord Harris said he was a director of the National Telephone Company, but he approached the consideration of this Bill entirely from the point of view of a telephone user. He thought, says the *Times* report, that if the noble duke could appoint a committee of users of the telephone to report on the trunk service, which was under the control of the Post Office, it would report that that service was inefficient and insufficient; and as two millions of money were to be obtained under the Bill for the extension and improvement of the telephone service, he trusted it would be possible for the noble duke to utilise some portion of the money in improving and extending the trunk lines. In France, Germany and America it had been found that a monopoly could work the telephone best, just as a monopoly was found to work the telegraph best. The National Telephone Company had been held up to ridicule as supplying the worst service in the world; but curiously enough the Government in their proposals to improve that state of things had made up their minds it was wiser not to follow the example of other countries. He trusted that the policy recommended in the Bill would be successful, but he was bound to say that those who knew a great deal about the telephone system were by no means confident that the step taken by the Government in the matter was a wise one. The Bill was then read a second time.

The Telephone Service.—The Poplar District Board will not allow the National Telephone Company to lay its main lines underground until it "makes better provision for the public."

Wireless Telegraphy.—According to the daily press, experiments in telegraphy without wires are now being made by Messrs. Siemens & Halske at the entrance to Kiel Harbour. The apparatus is placed on the shore and on board the mail steamer *Prinz*

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Sigismund, which plies between Kiel and Korsör. The net on the land station is 35 metres long, and is suspended from a high mast, while that on the movable station is fixed between the steamer's two masts. So far the results have proved successful and highly interesting. At a distance of 36 kilometres a telegram was successfully sent between the land and the mail steamer as she was d sappearing on the horizon.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—August 21st. The Electric Lighting Committee wants tenders for a 12 months' supply of house service and lead covered distributing cables. See "Official notices" this week.

Barking.—August 12th. The District Council wants offers for the free wiring of premises within the area of supply. See "Official Notices" July 28th.

Battersea.—August 31st. The Vestry wants tenders for an overhead travelling crane (hand or electric), and batteries for the electricity works. See "Official Notices" July 7th.

Battersea.—August 31st. The Vestry wants tenders for steam pipes, pumps, condensers, economiser, tools, &c., also switchboard and booster. Specifications at the office of Prof. Kennedy, 17, Victoria Street, S.W.

Birkdale.—August 19th. The Urban District Council invites tenders for the transfer of its electric lighting powers.

Blackpool.—August 21st. The Corporation wants tenders for 10 double bogie tramcars. See "Official Notices" July 28th.

Carlisle.—August 17th. The Corporation wants tenders for boilers, engines, dynamos, and condensing plant. See "Official Notices" July 28th.

Darwen.—August 22nd. The Corporation wants tenders for rail bonds. See "Official Notices" August 4th.

Devonport.—August 31st. The District Tramways Company invites tenders for the following contracts: Permanent way, road bed, paving and bonding of about 4½ miles of double line, overhead construction for about 4½ miles of route. See "Official Notices" this week.

Dundee.—August 23rd. The Council wants tenders for the overhead line equipment and rail bonding of the Perth Road and Lochee tram routes. See "Official Notices" August 4th.

East Ham.—September 9th. The Urban District Council wants tenders for combined electric light and traction plant, engines, generators, overhead line equipment, cars, switchboard, arc lamps, &c., water-tube boilers, condensers, and other steam plant, electric light cable. Mr. W. C. Ullmann, The Limes, White Post Lane, East Ham, is the Council's electrical engineer. See "Official Notices" August 4th.

Germany.—Tenders are at present being invited by the Frankfort-am-Main Municipal Tramways Committee for the supply of 200 steel tyres and 40 sets of wheels and axles for electric tramcars. Tenders to be sent to the Betriebs Direction der Städtischen Strassenbahn, Frankfort-am-Main (Bockenheim), whence particulars may be obtained.

Glasgow.—August 21st. The Corporation wants tenders for the supply of switchboards, copper bus bars, and electricity meters. See "Official Notices" August 4th.

Hackney.—September 12th. The Vestry wants tenders for four sets of direct current steam dynamos (either high or low speed). See "Official Notices" this week.

Ingleton.—The Ingleton Electric Light and Power Company wants tenders for the supply of dynamos, switchboards, batteries, and wiring. See "Official Notices" August 4th.

Malmo.—September 1st. The Gas Works' directors want tenders for the erection of electricity works for the city. Particulars on application to the clerk of the Gas Works (deposit 12s).

Motherwell, N.B.—August 18th. The Commissioners invite tenders for machinery and works in connection with the proposed electric lighting of their town. See "Official Notices," July 28th.

Perth.—August 28th. The Commissioners want tenders for boilers, condensers, steam dynamos, switchboard, underground mains, and accessories. See "Official Notices" July 28th.

Portugal.—September 6th. Tenders are being invited by the municipal authorities of Cascaes, Portugal, for the concession for the electric lighting of the town.

St. Mary, Battersea.—August 31st. The Vestry wants tenders for steam pumps, pipes, condenser, economiser, &c, switchboard, and boosters. See "Official Notices" July 28th.

Southport.—The Corporation wants tenders for the supply and laying of tram rails, points, crossings, bonding, permanent way; also overhead equipment, including poles, wires, &c. See "Official Notices" this week.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

The War Office.—The Secretary of State for War announces that tenders for various articles, including electrical instruments, will probably be invited from time to time during the next 12 months. Manufacturers who may wish to be applied to when tenders are required, should address Mr. A. Major, Director of Army Contracts, War Office, stating the particular articles they manufacture, and the names of at least two well-known firms or public bodies who have purchased from them, and are in a position to certify as to the quality of their productions.

CLOSED.

Barnsley.—The Council has accepted various tenders for brickwork, iron work, painting, &c., for electric light station buildings; also that of Messrs. Johnson & Phillips for additional plant at £2,236.

Blackpool.—The Town Council has accepted the tenders of the Langdon-Davies Motor Company for the supply of a motor-generator.

Hastings.—The Council on the 4th inst. accepted Messrs. Glover's tender for extension to mains recently advertised. The following is a list of tenders received:—

Glover & Co. (accepted)	£5,848
British Insulated Wire Company	6,424
Siemens & Co.	6,715
Borough Electrical Engineer's estimate	7,225
Callender Cable Company	7,281
The Western Electric Company	10,474

Roumania.—Messrs. R. Johnson, of Manchester, have succeeded in submitting the lowest tender for the supply of 30 tons of steel wire to the Roumanian Post and Telegraph authorities, quoting 540 francs per ton delivered.

Whitechapel.—The Electrical Committee is to have erected apparatus for purifying the feed water for the boilers at the electricity works at a cost of £1,500. The tender of Mr. John Every to supply tanks and apparatus has been accepted.

NOTES

The British Association.—In connection with the forthcoming meeting of the British Association a five days' excursion to Boulogne, Abbeville, Amiens, Arras, Brussels, Antwerp, Ghent, and Ostend, is being arranged. The excursion commences on Thursday, September 21st, and all arrangements are in the hands of Messrs. Thomas Cook and Sons. The French Association for the Advancement of Science meets at Boulogne from September 14th to 21st, and, as already intimated, the French and English Associations will exchange visits. One feature of the French gathering will be the unveiling of a statue of Duchenne, the celebrated French electro-therapeutist, and a new electro-medical section sits for the first time, which the council have formed with a desire to help forward this important branch of applied science. The president of the section is M. J. Bergonié, who has sent us the following note of papers to be contributed:—

1. Traitement par l'Electrolyse des rétrécissements en général et de ceux du canal de l'urèthre en particulier, par le Docteur H. Bordier (de Lyon).
2. Radioscopie et Radiographie Stéréoscopiques par le Professeur Marie (de Toulouse).
3. Récents progrès de la Radiographie, par le Professeur Imbert et le Docteur Bertin-Sans (de Montpellier).
4. De l'Endodiascopie, sa technique et ses résultats, par le Docteur Bouchacourt (de Paris).

The Northern Light.—The daily press says that the object of the expedition which recently left Copenhagen for Iceland under the direction of Herr Adam Paulsen, chief of the Danish Meteorological Institute, is to investigate the nature of the northern lights. In this expedition quite a number of instruments of special construction are being used in connection with photography and the measurement of electrical currents.

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Obituary.—It is with very deep regret that we learn that Mr. Frank King passed away on Thurs lay last week, at the age of 45 years. For nearly 20 years he had been at work upon accumulators, and in collecting notes as to his career we find that it was in 1881 that he first directed his energies to the subject of secondary batteries generally. He then, in connection with Messrs. Beeman & Taylor, invented the "B. T. K." accumulator, which was used in Colchester in the pioneer days of town electric lighting. He joined the Electrical Power Storage Company in 1886, and his ingenuity soon displayed itself in the improvement of the "E.P.S." type of battery, notably by the design of what was known as the "1888" type. This was followed up in 1889 by the introduction of the "K" type, which was intended to meet the demands of electrical engineers of central stations for high rates of charge and discharge. Both these types of cells are being sold in very large quantities even at the present time. He was also responsible for the design and manufacture of the type of battery which worked the cars on the Barking Road Tramways for some years. In conjunction with the late M. Camille Faure he brought out the well-known form of traction battery which is designated the Faure-King, and which has been employed in working the electrical cabs in London and Paris. In 1889 Mr. King became superintending engineer of the Electric Construction Corporation, but in 1891, when the manufacture of the E.P.S. batteries was resumed by the Electrical Power Storage Company, Mr. King became manager, a position which he filled until the early part of 1898, when, owing to failing health, he was compelled to relinquish his active part in the management, but still took a part in the business as a director and consulting engineer, and, as showing the great interest which he still evinced in storage battery manufacture, even at the time of his death he was at work on an improved plate. It was not only, however, in connection with secondary batteries that Mr. King showed his skill and ingenuity. He was the pioneer of what is known as the direct current high tension transforming system, which he originally started in Colchester in the year 1882 or 1883, and on a greatly improved principle in Chelsea in 1889. In 1892 he also took up the position of managing engineer of the Chelsea Electricity Supply Company, and since that time has been responsible for all its improvements and extensions. In the year 1896 he had the misfortune to break a blood vessel in the lungs, which laid him up for some considerable time, and although he sought by change of climate to recuperate his health, he never completely recovered his strength and former vitality. In the spring of the present year he was compelled to have his arm amputated, and this shook again added considerably to his weakness. About three weeks ago he journeyed to Bexhill-on-Sea for a short spell of change of air, and the day being hot he contracted a slight sunstroke. This in his enfeebled state he was unable to shake off, and he finally passed peacefully away at his home on Thursday, August 3rd. He was buried at the Crystal Palace Cemetery on Tuesday last, in the presence of a large gathering of colleagues and friends which had assembled. Of late years on more than one occasion we have been indebted to Mr. King for valuable information and advice, and our readers will recollect that he gave evidence on behalf of the proprietors of the ELECTRICAL REVIEW in a libel action connected with a secondary battery, brought against this journal some two and a half years ago. Mr. King leaves a widow and several children, one of whom, the eldest son, is on the staff of the E.P.S. Company, and to them we offer our respectful sympathy.

It is also our sad duty to chronicle the passing away of another equally well-known secondary battery inventor, for on Friday last Mr. L. Epstein breathed his last, through sudden failure of the heart's action following some two months' illness. It must be nearly 20 years ago since we first saw Mr. Epstein experimenting with accumulators in the old electric light station of the Pilsen-Joel Company in Whetstone Park, Lincoln's Inn Fields. He went back to Germany for some considerable time and was for several years, we believe, connected with the firm of Siemens & Halske, in Berlin. He then returned to England, where he has resided for the past nine years, and during that period he perfected the well-known Epstein accumulator, first put on the market by Messrs. Woodhouse & Rawson, and later by the company bearing the inventor's name. The history of Mr. Epstein's researches during some 18 years or more may be found scattered throughout the reading columns of the ELECTRICAL REVIEW, and in that portion devoted to "Abstracts of Patents." He was an occasional contributor to our pages, and in our Jubilee issue of November, 1897, the special article on "Twenty-five Years' Progress in Secondary Batteries" was from his pen. On this branch of the electro-technical industry he was an unassuming yet great authority, a conscientious and able experimenter, he never claimed impossibilities for his cells, and his demise, at the comparatively early age of about 46 years, immediately following that of Mr. King, makes a terrible gap, which it will be difficult to fill, in the ranks of the few men who really are thoroughly conversant with their work, and to whom we look for that great desideratum of a light and durable battery of much greater capacity than we have hitherto been able to attain. In like manner to Mr. King he gave evidence for us in the same libel suit. Just previous to his illness he had been engaged in litigation with Mr. Harry Lawson over a patent for an electric motor carriage, and this, to our certain knowledge, had very gravely affected his condition. To his widow and only son we offer our heartfelt sympathy in the sudden and unexpected blow which has befallen them.

The saddest event of all in our unusually long list of obituary notices is the death of Mrs. Patchell, wife of the well-known chief engineer of the Charing Cross and Strand Electricity Supply Corporation. Mr. and Mrs. Patchell were holiday making in Cornwall, and the lady, while bathing, observed a boy struggling out of his depth. She went to the lad's assistance, and kept him afloat until a gentleman swam out to the rescue of both. The boy was safely hauled into a boat, but Mrs. Patchell when taken from the water had fainted, and death resulted from syncope. The sympathies of the whole electrical world will be with Mr. Patchell, whose grief and sorrow will, we hope, be hallowed and softened by the thought that his heroic wife came by her untimely end in the saving of another's life, the noblest and most glorious death that man or woman can desire.

Telephonists and Thunderstorms.—"The danger to telephone users in this country," says a writer in the *Outlook*, "is of the slightest. A storm-discharge usually strikes not a single wire, but a cable or whole 'line' of wires at once, thence, if moderate in amount, is promptly diffused over the whole telephonic system and rendered harmless at any individual point. It may, perhaps, have force enough to produce a dozen vibrations of the striker of the call-bell, but usually only one or two. If one wire alone should be struck or the discharge be unusually violent, the current is so much in excess of the capacity of the wire that it will either overleap the small insulators and pass down a post into the ground or overflow on to the 'ground wires,' which pass from near the cable into the ground in readiness for such an emergency. In America this incident is extremely common, and one may sit in his office and hear the lightning playing a gentle but eerie tattoo upon his telephone bell a dozen times during a thunderstorm. The shocks are occasionally severe enough to make one's head ring, and occasionally to stun for a few moments, but no serious or fatal results have, we believe, ever been recorded. And if this is the case with full-grown American or colonial thunderstorms, what is to be feared from the gentle glow-worm flickerings which are dignified by that title in this little island?" The writer is hardly correct in stating that a storm-discharge usually strikes the wires. The discharge, if it took place towards earth, would, in most cases, take the most direct route to earth, viz, the earth wires of the poles. That the lightning does strike the wires occasionally is, however, indicated by the fact that line wires are sometimes cut in two by fusion during a thunderstorm. The discharge which passes through the line wires is more often an induced effect. It is not correct to say that the discharge becomes toned down by being distributed over the whole set of wires, for it is not a fact that single-wire lines are less free from damage by lightning than those with many wires. A bucket of water thrown over a number of wires would not wet any individual wire less as a consequence of the existence of the other wires.

The Institution of Junior Engineers.—The summer meeting of this Institution is to be held from August 12th to 19th, at Portsmouth and Southampton.

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The Atbara Bridge.—It appears from a Parliamentary paper issued this week that Lieut.-Colonel Gordon, who managed the purchase of the superstructure of the Atbara bridge, states that the whole question was one of quick delivery, price being practically not considered. Tenders were called for from four English and two American firms. Only one British firm made any offer, viz., the Patent Shaft and Axle Company. The Pencoyd Company, of Philadelphia, offered delivery of a suitable bridge in six weeks, and this offer was accepted, a director of the English firm acknowledging that they could not compete against such quick delivery. He also doubted whether any firm in the United Kingdom could make as good an offer as they had made, their company being, he believed, the only firm in the United Kingdom that rolled their own material. Colonel Gordon further states that the whole of the material for the bridge was inspected by a representative sent from England, from whose report, adds the colonel, "it will be seen how thoroughly the work has been carried out."

Electric Traction for the Metropolitan Underground—The *Standard* ends an editorial regarding the Metropolitan District Railway meeting with the following:—

> Electric traction, which experts believe will, before very long, be made available for the line, would add greatly to the comfort of the passengers, and might completely alter the conditions of the rivalry with omnibuses, which at present are all in favour of the traffic above ground.

Mr. Forbes's statements on Wednesday regarding the use of electric traction on the Inner Circle naturally agreed with Mr. Bell's remarks to the Metropolitan Company a few days previously. Respecting the electrical experiments, he said:—

> These experiments were being steadily continued, but this was a matter which was not so easy as some persons thought. The problem to be dealt with was not that of constructing a railway under the ground which was best adapted to electrical traction, but of converting a railway already constructed and which had other uses. It would be madness to rush into a blind expenditure without some reasonable prevision and experiment. He had, however, been told by these gentlemen that as far as they had gone, their experience induced them to believe that they would be able shortly to establish beyond question the possibility of dealing with the company's enormous traffic by electrical traction, in a manner consistent with the use of other means of traction as far as might be necessary.

Smoke!—It is astonishing what an amount of rubbish the sensational journalist can bring forth in regard to the smoke nuisance question. A reasonable movement to avoid excessive smoke nuisance we have a certain amount of sympathy with, but when a halfpenny morning paper says that the smoke fiend is eating away London, the Houses of Parliament are crumbling away, Cleopatra's Needle is losing its point, or, as it is put, "decaying," we tremble at the thought of what may come to pass. We are told that no stringent measures have yet been taken to abolish the nuisance. If the prosecutions and heavy fines imposed upon certain electricity works do not represent stringent measures, then we do not know what does. "We have grown wiser since then," says the writer, referring to events which happened 600 years ago. We thought there must be age behind such utterances. "Smoke is as unnecessary as influenza," and the writer might have added, almost as unavoidable.

Personal.—Our correspondent at Wolverhampton says that Mr. T. Parker has relinquished the position of managing director of T. Parker, Limited, but he retains a seat on the board of directors. In addition, the company have appointed him consulting electrical engineer.

We read that Mr. Robert A. Hadfield, chairman and managing director of Hadfield's Steel Foundry Company, Sheffield, is the Master Cutler elect. He is a gentleman with a high reputation for his researches and discoveries in the properties of iron and steel, and his contributions to the Royal Society are familiar to our readers.

Marriage.—Mr. Howard Marryat (of Marryat & Place) was married at Richmond, on Saturday last, to Miss Maude Mortham.

Serious Shock Fatalities at Omaha.—We take the following from yesterday's *Westminster Gazette*:—"A Central News telegram from New York this morning states that a great fire broke out in Omaha last night, and that four firemen coming in contact with a live electric wire were instantly killed, while two others were fatally injured."

Appointment.—Mr. P. T. Macnamara has been appointed Assistant Superintendent of Telegraphs in Ceylon.

NEW COMPANIES REGISTERED.

Queen's Dock Electric Works, Limited (63,113).—This company was registered on July 27th, with a capital of £5,000 in £1 shares (2,000 preference), to acquire, take over as a going concern and carry on the business of electricians, electrical engineers and suppliers of electricity carried on by the Globe Electrical Company at Liverpool and Belfast. The first subscribers (each with one share) are:—P. J. Pakeman, 28, Queen's Avenue, Muswell Hill, N., clerk; H. M. Cordrey, 40, Harders Road, Peckham, S.E., solicitor's clerk; A. W. Read, 11, Ironmonger Lane, E.C., solicitor; J. R. Pakeman, 11, Ironmonger Lane, E.C., solicitor; J. E Simister, 47, New City Road, Plaistow, clerk; R. B. Cannings, 81, Camilla Road, South Bermondsey, clerk; and E Smith, 10, Ironmonger Lane, E.C., secretary. Registered without articles of association. Registered office, 75, Kitchen Street, Queen's Dock, Liverpool.

Southern Electrical Installation and Wiring Company, Limited (63,116).—This company was registered on July 27th, with a capital of £10,000 in £1 shares (2,500 preference), to acquire two businesses carried on at Hastings as "Bruce & Co." and "F. Wordley" respectively, to adopt agreements (1) with F. Bruce, (2) with F. Wordley, and (3) with the mayor, aldermen and burgesses of the borough of Hastings, and to carry on the business of electrical apparatus manufacturers, suppliers of electricity for light, heat, and motive power, telephone and telegraph constructors, &c. The first subscribers (each with one share) are:—W. J. Laite, Pelham Hall, Hastings, journalist; A. L Sayer, Westfield, Sussex, solicitor; H. S. Colt, 33, Havelock Road, Hastings, solicitor; A F. Wood, Gatefield, West Hill, Hastings, clerk; L. F. St. John, 26, Havelock Road, Hastings, auctioneer; H. Kent, 68A, All Saints Street, Hastings, clerk; and Captain A. H. A. Cohill, 16, Pevensey Road, St. Leonards. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification, £100; remuneration, £75 per annum, dividible. Registered office, 33, Havelock Road, Hastings.

Browett, Lindley & Co., Limited (63,128).—This company was registered on July 28th, with a capital of £120,000 in £1 shares, to acquire the business carried on by Browett, Lindley & Co. (incorporated in 1890), at the Sandon Engine Works, Patricroft, near Manchester, and to carry on the business of mechanical, electrical and hydraulic engineers, ironfounders, machinists, tool makers, millwrights, fitters, founders, smiths, builders, hardwaremen, &c. The first subscribers (each with one share) are:—T. Browett, Sandon Works, Patricroft, engineer; H Lindley, Sandon Works, Patricroft, engineer; F. C. Gibbons, Sandon Works, Patricroft, engineer; W. Stead, Sandon Works, Patricroft, engineer; W. R Goulty, Kurnman, Altrincham, engineer; A. Shuttleworth, Ducby Chambers, Clarence Street, Manchester, chartered accountant; and S. B. Beardley, Sandon Works, Patricroft, near Manchester, secretary. The number of directors is not to be less than three nor more than seven; the first are William R. Goulty, Thomas Browett, Herbert Lindley, Frederick C. Gibbons, and William Stead; qualification, £500; remuneration as fixed by the company. Registered office, Sandon Works, Patricroft, near Manchester.

Renewable Electric Lamp Company, Limited (63,144).—This company was registered on July 29th, with a capital of £150,000 in £1 shares (50,000 6 per cent. cumulative preference), to carry on the business of manufacturers, renewers, and repairers of and dealers in lamps, wires, and lines of all kinds; electricians, mechanical engineers, suppliers of electricity for the purposes of light, heat, motive power and otherwise, manufacturers of electrical apparatus and fittings, &c. The first subscribers (each with one ordinary share) are:—H. E. Kershaw, 8, Onslow Gardens, Highgate, N., manufacturer; J. Atherton, Singleton, Huyton, Lancashire, manufacturer; C. Howard, 4, Park Lane, St. James's, S.W., electrical engineer; F. G. W. Leslie, 15, Union Court, Castle Street, Liverpool, solicitor; A. W. W. Miller, Savoy Hotel, Strand, gentleman; M. F. Armstrong, 6, Walbrook, E.C., gentleman; J. Spencer, 3, Firsby Road, Stamford Hill, N., gentleman. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £250; remuneration, £150 each per annum (an extra £50 for the chairman), and a share in the profits.

Electric Light Railways Limited (63,060).—This company was registered on July 24th, with 20 members (the subscribers to the memorandum of association being liable for £5 each and other members for £50 each in the event of winding up), to promote, construct, work and maintain railways, light railways, tramways and auxiliary railways, and to carry on the business of

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electrical and general engineers, telegraph and telephone constructors, &c. The first subscribers are:—W. I. T. Goatley, 93, Chancery Lane, W.C., accountant; J. Battam, 23, Rood Lane, E.C., solicitor; W. A. Davies, Broadway, Ealing, W., solicitor; W. S. Sargeant, Strand-on-the-Green, Chiswick, W., engineer; T. Hutchinson, Ealing, solicitor; A. F. May, 341, Strand, W.C., advertisement agent; A. Blyth, Lancaster Place, Hampstead, engineer; S. H. Doubleday, 27, Burlington Gardens, Chiswick, chartered accountant; N. Caunter, 12, Heathcote Street, Mecklenburgh Square, W.C., accountant; and G. Cuddon, 140, Camden Road, N.W., gentleman. The number of directors is not to be less than two nor more than five; the subscribers are to appoint the first; qualification, membership (guaranteering £50); remuneration, £1,000 per annum, divisible.

Sturtevant Engineering Company, Limited (63,065).—This company was registered on July 24th, with a capital of £60,000 in £1 shares, to acquire and take over as a going concern the business of engineers, merchants and manufacturers, now carried on at 75, Queen Victoria Street, E.C., by George A. Mower, under the style or firm of the "Sturtevant Engineering Company," to adopt an agreement with the said vendor and to carry on the business of mechanical and electrical engineers, merchants and manufacturers of machinery, tool makers, metal workers, brass founders, boiler makers, smiths, &c. The first subscribers (each with one share) are:—W. J. P. Moore, 153, Queen Victoria Street, E.C., engineer; C. A. Knight, 6, Upper Avenue Road, N.W., engineer; G. A. Mower, 75, Queen Victoria Street, E.C., engineer; P. N. Perrin, 75, Queen Victoria Street, E.C., clerk; C. E. Fox, Christ Church Schoolhouse, Camill Road, Brixton, S.W., clerk; W. J. Bassett, Craigleith, King Charles Road, Surbiton, engineer; and W. C. Burrows, 19, Vassall Road, S.W., engineer. The number of directors is not to be less than three nor more than five; the first are George A. Mower, Charles A. Knight, and William J. P. Moore; qualification, £1,000; remuneration, 5 per cent. of the net profits divided amongst them.

South Staffordshire Tramways (Lessee) Company, Limited (63,160).—This company was registered on July 31st, with a capital of £150,000 in £5 shares, to acquire a lease of certain tramways now belonging to the South Staffordshire Tramways Company, and to carry on the business of tramway and light railway proprietors, mechanical and chemical engineers, electricians, suppliers of electricity, manufacturers of electrical apparatus and fittings, carriers of passengers and goods, &c. The first subscribers (each with one share) are:—E. Garcke, Donington House, Norfolk Street, W.C., managing director; J. Raworth, 2, Queen Anne's Gate, S.W., civil engineer; G. Stevens, Donington House, Norfolk Street, W.C., secretary; C. H. Dade, Donington House, Norfolk Street, W.C., assistant secretary; S. Sisson, Donington House, Norfolk Street, W.C., civil engineer; H. M. Sayers, Donington House, Norfolk Street, W.C., electrical engineer; and H. S. Hodgson, Donington House, Norfolk Street, W.C., secretary. The number of directors is to be five, three of whom are to be nominated by the British Electric Traction Company, Limited, and two by the South Staffordshire Tramways Company: no qualification for the first directors; qualification of subsequent directors, £100; remuneration, £500 per annum, divisible. Registered office, Donington House, Norfolk Street, Strand, W.C.

Electrical Transmission Company, Limited (63,173).—This company was registered on August 1st, with a capital of £30,000 in £5 shares, to acquire and take over as a going concern the business carried on at Hammersmith as "The Electrical Power Transmission Company," to adopt an agreement with Powell, Jones & Co., and to carry on the business of electricians, mechanical engineers, suppliers of electricity for the purposes of light, heat and motive power, &c. The first subscribers (each with one share) are:—E. Wahab, Golrings, Loughton, Essex, East India merchant; C. Powell-Jones, 7, East India Avenue, E.C., East India merchant; W. E. D. Simpson, 50, Cannon Street, E.C., paper maker; A. R. Clarke, 8, Southwood Avenue, Highgate, assistant; W. E. Starling, 47, Stapleton Hall Road, Stroud Green, N., accountant; T. J. Young, 83, Kent House Road, Beckenham, wharf manager; and D. C. Lee, 46, Queen Victoria Street, E.C., solicitor. Powell, Jones & Co. are to be the first managing agents. Remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

F. H. Royce & Co., Limited (41,362).—This company's annual return was filed on July 10th, when 6,000 preference, 21,480 ordinary, and 500 deferred shares were taken up out of a nominal capital of £60,500 in 6,000 £5 preference shares, 30,000 £1 ordinary shares, and 500 £1 deferred shares. £1 5s. has been called up on 6,000, and £1 on 9,466, the remaining 12,514 £1 shares being considered as fully paid. £16,966 has been received.

Electric and General Investment Company, Limited (31,506).—This company's annual return was filed on July 12th, when 20,000 ordinary and 100 founders' shares were taken up out of a capital of £200,000 in 39,900 ordinary and 100 founders' shares, all of £5 each. £1 had been called up on the ordinary, and £5 on the founders' shares, resulting in the receipt of £20,500.

CITY NOTES.

The British Westinghouse Electric and Manufacturing Company, Limited.

An extraordinary general meeting of this company was held at the Cannon Street Hotel on Wednesday, 9th inst., for the purpose of complying with the requirement that a general meeting shall be held within four months of the incorporation of the company, and for the purpose of considering and passing resolutions as follows:—

1. Authorising the directors to carry into effect, with or without modification, an agreement dated August 1st, 1899, and made between the Westinghouse Machine Company of the one part and the company of the other part;
2. Increasing the capital of the company to £1,750,000 by the creation of 25,000 ordinary shares of £10 each, such shares to rank in all respects *pari passu* with the existing ordinary shares in the company.
3. Increasing the maximum number of directors from nine to 11, and appointing three additional directors;

And also the following resolution, which, if passed by the required majority, will be submitted hereafter for confirmation as a special resolution:—

4. "That Article 83 of the company's articles of association be altered by the addition thereto at the end of the words 'The directors may also from time to time appoint any qualified person an additional director provided the prescribed maximum number of the board for the time being be not thereby exceeded.'"

The agreement which has been entered into, subject to the approval of the company in general meeting, provides for the acquisition by the company of certain rights, patents, and assistance from the Westinghouse Machine Company of Pittsburg, Pennsylvania, in consideration of the issue to that company or its nominees credited as fully paid up of the 25,000 ordinary shares proposed to be created, the Westinghouse Machine Company covenanting to subscribe or procure subscriptions within a certain period for £250,000 nominal value in preference shares of this company for its general purposes. The company proposes after the expiration of 12 months from the special settlement on the Stock Exchange of the existing preference shares to submit resolutions for the increase of its preference shares by £500,000 nominal value for general purposes in view of the enlargement of the company's sphere of operation. At the conclusion of the general meeting, a meeting of the holders of the existing ordinary shares of the company was to be held for the purpose of giving their separate consent to the resolutions.

Mr. C. W. Benson, who presided, said that so far as the statutory meeting was concerned, there was no particular business to bring before them, as the company's operations had not yet reached that stage when a report could be laid before them. The more important part of the business for consideration was the series of resolutions. Shareholders were perhaps surprised that when the prospectus was issued so recently as July 10th no mention was made of any arrangement with the Westinghouse Machine Company. That was an entirely different company from the Westinghouse Electric and Manufacturing Company, with whom they made their original contract. The business before them was not mentioned in the prospectus, because it was not then in contemplation by the directors; but after the formation of the company third parties made an offer to Mr. Westinghouse to take over the Westinghouse Machine Company's business, in order to manufacture gas engines for Great Britain and its dependencies, and it was then that Mr. Westinghouse gave this company the first offer. The company was formed for making electrical appliances of various descriptions, but electrical appliances all needed some motive power to drive them. It was obvious that it would be convenient to make suitable machines for electric driving from the same works, and that the two classes of machinery could be produced with economy at the same works. Experiments had been in progress for 10 years under Mr. Westinghouse, with the object of producing a really excellent motive power, and the Westinghouse Company was formed to manufacture gas engines. When the formation of the company was determined on, and the details arranged, several months ago, small gas engines up to 250 B.H.P. had been proved to be a success, but the larger sizes, which presented the most profitable commercial field, were still in the experimental stage. In October, 1898, a 650-B.H.P. engine was erected at Pittsburg, and the performance thereof in actual progress had been carefully watched. The engines installed at Chelsea had been examined by some of the highest authorities in this country, and had received very great praise. A 1,500 B.H.P. is now coming through the shops at Pittsburg, and the engineers were confident of its success. Their type of gas engine thus lent itself to sizes much larger than any before possible, and the steadiness of running enabled it to be used for electric lighting, for which purpose gas engines of any considerable sizes had not yet been applied very satisfactorily. Responsible third parties watching the developments of the gas engine, made an offer to Mr. Westinghouse to take over the business. He thought it his duty to come to the board of this company and give them an opportunity of taking over at the same rates. The board consulted Lord Kelvin, and came to the conclusion to acquire the business, patent rights, and assistance of the Westinghouse Machine Company. Lord Kelvin inspected the engines and considered them no longer an experiment but a success, and he referred to the advantages of combining the manufacture of the gas engines in the same works as the electrical apparatus. The board found the area of land they proposed to acquire was sufficiently large to erect a factory to deal with both manufactures. The Westinghouse Machine Company was willing to take the consideration in ordinary shares, which would rank behind the preference shares, but as it was believed that the two manufactures combined would require increased working capital to deal with them effectually, it was believed that after 12 months a

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further issue of preference capital could be made. This should not be an occasion for anxiety to the shareholders, because certain responsible persons engaged in the concern had already decided to find £250,000 additional preference capital when required. They would have found it immediately, but as the Stock Exchange rules did not allow of an issue being made within 12 months of the issue of the prospectus, and, furthermore, as the money would not be required for 12 months, the arrangement had been made to put that subscription off for that period. The money was sure, and it could not be other than an advantage to the company to have the additional £250,000 working capital added to its resources. Mr. Westinghouse was on his way to America, but he had written to say that an inspection of the two separate works at Pittsburg showed that there could be carried on within either of the two works the manufacture of both classes of apparatus, and that in general the same class of large and small tools were employed in both kinds of manufacture. He also emphasised the other economies and conveniences that would result from having one works. There would, of course, have to be two classes of engineers—those familiar with electrical construction and those with engineering and general gas and steam engineering. Such engineers working under a single management would become familiar with both classes of construction. The chairman said that as to Article 83, negotiations were on foot between the board and the persons proposing to find the additional money, for the appointment of additional directors, but the time had not yet arrived for their appointment, nor were all the names definitely settled, but they would be all gentlemen whose services would be of great value to the company. He then formally moved the adoption of the resolutions given above.

Mr. Joseph Lawrence, in seconding the resolution, told what had happened to the English company. The company was constituted with a million and a half nominal capital. Half a million in ordinary shares was allotted to the Westinghouse Company at Pittsburg for patents, assistance, plans, &c.; half a million of the preference capital was allotted to the public, and applications came in for £632,280, the list of subscriptions to that amount embracing some of the most prominent names in the world of finance and banking in London and England. The board were arranging for the purchase of land for building the works at Manchester. They chose a site at Manchester instead of London, &c., because it afforded facilities for obtaining cheaper land, a large and abundant supply of the best skilled labour, and the situation was in the centre of the manufacturing industries. An architect had been engaged, and Mr. Westinghouse had gone to America with him to confer with him at his own works in Pittsburg, with a view to getting the best points from those works. Mr. Westinghouse was of opinion that the building of the works would proceed in a manner unprecedented in England, and put up in a record time. It was possible that the Carnegie Company, of Pittsburg, might supply the ironwork for the works within four months. If they let out contracts in England just now for such works the makers could not deliver within two or three years. That made it possible to proceed with double-quick time. This was not a company on paper, it was a living company buying a living business, increasing by leaps and bounds. The French company formed by Mr. Westinghouse had only been in existence a short time, but had obtained contracts amounting to several millions of francs in connection with the Paris Exhibition and other great works. One day's work recently amounted to 3½ millions of francs. Business promised to be equally prosperous in this country. Regarding the amalgamation question, the chairman said that the proposed amalgamation with the engine company was not contemplated at the time the prospectus was issued. That was strictly true in terms, but the subject was not absent from the minds of Lord Kelvin and Mr. Parsons, their colleague, nor was it absent from his own mind. Whilst the negotiations were in progress it was decided that it was better to carry out the arrangements for the electrical business first and discuss amalgamation with the other afterwards. The advantage of the amalgamation was so apparent as not to need his advocacy. The only question was deciding what was the phychological moment. If they had not settled when they did they might have had to pay higher terms for effecting the amalgamation. Mr. Westinghouse had practically produced an engine of all grades up to 1,500 H.P. In this country, up to quite recently, they thought it a splendid thing if they could do 200 H.P. His engines had been the subject of years of experiment. Not only was his system likely to supplant the present type of gas engine in use in this country, but it would make a trade for itself. It did away with the pulley band, because the shaft was directly connected with the engine. That was one of many valuable features in the Westinghouse engine. They were convinced that there was a field for gas engines over and above the electrical business. This was not the first time Mr. Westinghouse had made his bow to the British public. They all knew of the gigantic success of the Westinghouse brake. His electrical business had begun in a small way, and had developed to such an extent, that it was now represented by a live capital of $13,500,000. Orders were flowing in upon him, so that it became well nigh impossible for him to conduct his European business, and it became necessary that he should seek the assistance of European capitalists in forming a branch of his business here. England was in a deplorably backward state as regards electrical development. It was perfectly painful for anybody who had watched the progress in Germany and America, to see the backward position we are in in England. It was a solid fact, and might be news to some of them that an important railway contract that was let in the first instance to an English firm, could not be carried out by that firm because of the largeness of the contract and the time involved. It was taken up by a German firm, and the length of road was to be constructed in London by German capital and German labour. That was a reproach to British enterprise. This company could congratulate itself upon a happy combination of English and American capital. The list of shareholders included the leading capitalists, from Lord Rothschild downwards. They had a solid business and solid backers. He was going to Pittsburg himself in a fortnight, and the insight and experience he would get at the works would be at the company's service. He was perfectly convinced that this was a sound business, which would be highly remunerative if carefully managed. He seconded the resolutions.

Mr. Ormrod (a shareholder) expressed very strong feeling of dissent at the proposals contained in the circular. His firm acted as the Manchester brokers of the company, and they and a considerable number of friends were shareholders. The prospectus was dated July 10th, and the agreement the board had made with the Westinghouse Machine Company was dated August 1st. It seemed to him a very peculiar thing, in fact a most startling and unique thing, that a circular of that kind should be sent out within so short a period of the issue of the prospectus. There was not a word mentioned in the prospectus as to the existence of a Westinghouse Machine Company, and either the amalgamation should have been known about at that time or it must have been very hastily considered since. He and his friends did not know of the existence of such a company. They had received no information at all as to its profit-making capabilities. The Westinghouse Electric Company—the British Company—they understood to be doing a live business. There were actual results to show, but the Machine Company, so far as they knew, might never have passed the experimental stage. He had had letters from many shareholders in the Manchester district, and they were unanimous in expressing a very strong feeling of dissent at the proposals. No doubt the board were well able to carry their proposals, and he had not come with proxies or anything of that kind. The chairman had made possibly a more or less satisfactory explanation of the circumstances, but to justify such a course as was proposed needed a very satisfactory explanation indeed. He would suggest that a very full and explicit explanation be sent to the shareholders, many of whom were unable to be at the meeting, before formally passing the resolutions. He and his friends applied for shares because it was an electric company. They knew nothing whatever about the machine company. They believed in the possibilities of an electrical company. There might be equally good, if not greater, possibilities in front of the machine company, but they knew nothing about that. He had heard big names mentioned as the parties who were prepared to find that additional £250,000, and he was very much surprised at their countenancing such a proceeding.

The Chairman, in reply, said that what Mr. Ormrod had said was exactly his own feeling, and if he had not felt it his duty absolutely in the interests of the shareholders from the evidence that the directors had, which must be submitted in this way, owing to the circumstances of the case, he would never have voted for it.

Mr. Lawrence said that, having an eye to the value of the preference shares, this was a good bargain, attested by the fact that there was an organisation ready to take the business. He took it that Mr. Ormrod looked at the matter from the position of an ordinary shareholder and underwriter. The preference shares would absolutely benefit by the proposed amalgamation. If Mr. Westinghouse and others chose to give them something of a valuable nature, patents, plans, &c., in return for ordinary shares which had to wait for one, two or three years for a return, that was no concern of his. He was looking only at the preference shareholders who subscribed the cash capital. Several of the leading shareholders were informally consulted, and approved of the scheme. There was absolutely no dissent on the board as to the wisdom of the policy. If it was postponed for 12 months the gentlemen who were finding the additional capital would not hand it over for the same amount of money as to-day. It was absolutely essential to the business that the amalgamation should take place. It would be a retrograde step to postpone the adoption of the resolution.

After a few further remarks had passed between Mr. Ormrod and Mr. Lawrence, the resolutions were carried unanimously, and the usual vote of thanks closed the meeting.

Anglo-American Telegraph Company, Limited.

Mr. F. A. Bevan presided at the half-yearly meeting of this company at Winchester House last Friday. He said the directors were pleased to give such a very satisfactory statement with regard to the receipts for the half-year. Compared with the corresponding half-year of 1898 a falling off might naturally have been expected, as at that time the Spanish-American war was raging, and an immense amount of traffic was sent over their lines, but it was a matter for congratulation that not only had the receipts equalled in amount those of the first half of 1898, but had actually exceeded it by £256. Looking back and taking the figures for the corresponding half-years from 1894 they found that the increase had been gradual and steady from £134,000 to £202,000 in five years. The expenses this year are only larger over those of 1894 by £5,300. The proportion of expenses in 1894 was 41·41, and in 1899 30·19. In addition to ordinary revenue the *Minia* had earned £5,987 more. Since the last meeting they had lost the captain of the *Minia*. To Captain Trott they were greatly indebted for the vast amount of good work that he did, and they hoped that his successor would equal him in his skill. That source of revenue might fairly be called accidental in more senses than one, and therefore could not possibly be relied upon. The accounts are now presented in such a form, that shareholders could at once compare the figures of one half-year with the other. To refer to these briefly, taking into account on one side the increase of the *Minia's* expenses, owing to the amount of employment she had had, and on the other the reduced expenditure on cable, arising from the fact

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that they had had to spend less upon their repairs in the shape of cable, they found that the total increase of receipts had been £6,154. There was a net reduction of expenses of £590, and an increased balance brought forward of £377, so that the total increase of revenue earned and carried forward was £7,121, being £24,701 as against £17,580. That was a most satisfactory statement. During the past year the increase in the renewal fund had been £53,129, so that not only had they had a very satisfactory half-year so far as working was concerned, but they had added to the strength of the company. In the balance-sheet sundry debtors, including the traffic balances, stood at £120,000—£60,000 more than last year. Their debtors were solvent people. They were Governments, and the companies who were in alliance with them. Some of that money had been already paid, and the rest was sure to come. The money owing being so large, the cash in hand was correspondingly small, but that was to some extent righting itself, and shortly would have done so completely. They had begun the new half-year very well, the increase in the gross receipts for the month of July being £2,700, and the *Minia* had already earned during July as much as she did during the whole of the six months in 1898, and there was no doubt that she would earn more. Therefore, barring some extraordinary accident, they would have a very good half-year. As regards the German Cable Company, they had no doubt seen paragraphs in the papers as to what the German Government, or new German Cable Company was going to do, but he could give them no definite information upon the point. The subject had occupied the attention of the directors during the past few months, and it would not be owing to any want of zeal or energy on their part that things turned out not exactly as they hoped and wished. As to what had been called the interminable French law suit, he was glad to tell them it was not altogether interminable. He could say something definite about it, though they had not yet got any cash. In May last, the Court of Appeal, of Rouen, gave judgment in favour of this company for £258,000, less such amount as a committee of experts might determine to repay the value of the assistance rendered by the French Company to the Anglo-American Company by having placed its new cable at the service of the Anglo-Company during the period of performance of the joint-purse agreement, so far as such assistance might not have already been paid for. So far as the board knew, all such assistance *had* been already paid for—every message was paid for as it was sent. Therefore apparently they might look forward to a very nice little addition to their renewal fund, but getting the money was different from a judgment in your favour. As to when they would get the money, or how much they would get, the shareholders knew as much as he did. He thought the decision would justify the directors in the shareholders' eyes in not having dropped the matter, although it might have appeared that they were fighting for a shadow. He would be very pleased when he could announce that they had got the money. He moved the adoption of the report, which appeared in our last issue.

Mr. C. Burt seconded the motion, which was carried unanimously, and the usual vote of thanks closed the meeting.

The City of London Electric Lighting Company, Limited.—Warrants have been posted for the payment of an interim dividend for the half-year ended June 30th, 1899, at the rate of 6 per cent. per annum on this company's 6 per cent. cumulative preference shares (£400,000 in 40,000 shares of £10) Nos. 1 to 40,000.

Yesterday's City Meetings.—On Thursday a meeting of the National Telephone Company was held at Cannon Street Hotel, and of the Waterloo and City Railway at Waterloo. Reports of the proceedings will appear in our next issue.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending August 5th, 1899, were £1,359 13s. 8d.; receipts for week ending August 5th, 1898, £1,125 18s. 4d.; aggregate, July, 1899, to date, £5,818 5s. 7d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending August 4th, 1899, were £8,660 5s. 2d.; corresponding period 1898, £8,981 18s. 5d.; decrease, £321 13s. 3d. (Bank Holiday week).

The City and South London Railway Company.—The receipts for the week ending August 6th, 1899, were £933; week ending August 7th, 1898, £1,105; decrease, £172. Total receipts for half-year, 1899, £5,632; total receipts corresponding period, 1898, £5,861; decrease, £229. Miles open, 8½.

The Dover Corporation Electric Tramways.—The receipts for the week ending August 5th, 1899, were £272 9s. 11d.; week ending August 6th, 1898, £272 12s. 7d.; decrease, 2s. 8d. Total receipts to date, 1899, £5,485 5s. 7d.; corresponding period, 1898, £4,446 18s. 9d.; increase, £1,038 6s. 10d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,553; 1898, 3,906. Number of cars, 1899, 11; 1898, 10.

The Dublin United Tramways Company.—The receipts for the week ending Friday, August 4th, 1899, were as follows:—D. U. T. Co., horse cars, £2,246 18s. 11d.; ditto, electric cars, £1,265 18s. 4d.; D. S. D. Co., electric cars, £1,155 8s. 8d.; total, £4,668 5s. 11d.; corresponding week last year—D. U. T. Co., horse cars, £2 800 8s. 7d.; ditto, electric cars, £787 12s. 6d.; D. S. D. Co., electric cars, £1,312 6s. 0d.; total, £4,880 7s 1d.; decrease, £212 1s. 2d. Aggregate to date, £22,758 19s. 2d.; aggregate to date last year, £22,745 17s.; increase to date, £13 2s. 2d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 12 miles electrically, and 30 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending August 7th, 1899, amounted to £1,654; corresponding week last year £2,007; decrease, £353. 1898 includes Bank Holiday.

The South Staffordshire Tramways Company.—The receipts for week ending August 4th, 1899, were £746 13s. 2d.; aggregate receipts for 31 weeks, £19,967 8s. 5d.; week ending August 5th, 1898, £881 13s. 11d.; aggregate receipts for 31 weeks, £19,272 6s. 11d.

STOCKS AND SHARES.

Wednesday Evening.

The hot weather and the holidays have combined to restrict business in electrical undertakings to the smallest compass, but as the rest of the Stock Exchange is suffering from precisely the same complaint, those who are interested in electrics have no more reason for grumbling than the rest of the house. Indeed, there is a cause of thankfulness to notice how steadily quotations are maintained, because a stagnant market is usually inclined to the down grade. There is hardly a bargain doing in electrical railway descriptions, but the best of prices exhibits no alteration. By the way, the Stock Exchange official list quotes City and South London new Ordinary, with £3 10s. per share paid up, at 2½—3½, while the £10 fully-paid ordinary are only 6¼—6¾. The former is, of course, a mistake. Bordeaux tramway shareholders, who have not yet done so, should immediately avail themselves of their option to purchare shares in the Compagnie Francaise des Tramways Electriques et Omnibus, as there is a premium of £2 per share on them.

Concerning the other varieties of traction shares there is not very much to say. The quiet reading of Light Railway Bills in Parliament goes on month by month, and its fruit will probably be ripening soon, if what we hear about sundry new issues to be made shortly is correct. Anglo-Argentine Trams are hard at 4¼, and Buenos Ayres and Belgrano "A" Preference are well maintained at 4½, the pending call upon the latter having had no effect upon the price. The 4½ per cent. Debentures of the Tramways Union are nominally 101 to 105, but holders are naturally keeping the market very short of stock, as there seems no doubt but that the debentures will be paid off at 110 at once, instead of at par in 1918.

Among the electricity supply companies the noticeable feature of the week has been the fluctuations in City of Londons. After the hurried scamper to get out on the part of those who were so disappointed at the passing of the dividend, it was only to be expected that a reaction would occur. Besides, as we urged when writing last, the company's directors adopted the only safe course, and it was the calm consideration of this view that materially assisted in putting up the price of Citys to the extent of a point, only, however, to relapse again as more sellers came in on the rise. Charing Cross fail to recover the ground they lost last week, and the market is very curious to know how the money will be raised for bringing the company into the City. The share capital of the Charing Cross, *i.e.*, a quarter of a million sterling, is all issued, and its £70,000 worth of 5 per cent. debentures are redeemable at par next year. The company, however, possesses borrowing powers to the tune of £150,000.

Glancing over the remainder of the list, it is observable that prices manage to retain their quotations of last Wednesday, but are unable to make up for the fall which lowered the market all round 10 days back. This is due partly to the fact that some fears are entertained for the companies' prosperity if copper keeps at its present price. It has gone up so rapidly within the last six months, and shows such apparent strength, that it was argued electric supply companies would feel the difference keenly when they came to extend their cables, as they constantly have to do. The same line of reasoning applies, of course, in a much more limited way, to telegraph and telephone companies, but so far this factor has not seriously entered into Stock Exchange consideration. Metropolitan Electric, both old and new, have added to their quotations during the week.

Eastern Telegraph Ordinary stock has been more cheerful, principally because nothing has lately appeared in the papers about the new Pacific cable. The 5 per cent. Debentures rose a point upon their approaching redemption this month. These bonds were issued 20 years ago, in order to acquire £200,000 worth of shares in the Eastern and South African Company, Limited. A large part of the issue has already been converted into the 4 per cent. Debenture stock of the Eastern Company. Of the American companies, the Anglo-American is still the market favourite; but Directs also rose a fraction.

Manufacturing shares are steady. Wireless Telegraph have moved up 10s., but no recordable change is shown by the Telegraph Manufacturing issues. Henley's 7 per cent. Preference have been inquired for, and reflect the demand in their price. Callender's Cable Ordinary are unchanged; the Preference are quoted 5½—6. Telegraph Construction have regained part of the dividend, and this department seems to be worth the investor's attention. National Telephones are being bought, and the anticipated trouble in Glasgow has quite blown over.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, August 2nd.	Closing Quotation, August 9th.	Business done during week ended August 9th, 1899. Highest.	Lowest
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	61 — 64 xd	62 — 65 xd	62½	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	113 —114 xd	114 —115 xd	114⅜	113⅜
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	13¾— 14¼	13¾— 14¼	14⅛	13⅛
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	15⅜	...
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	108 —112	107 —111	108½	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105½	105
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼xd	⅛— ¼xd	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9⅛	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	19½	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½%	3½%	11½— 12	11¾— 12¼	11⅞	11¼
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —108	100 —103	100½	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	150 —155 xd	151 —156 xd	154	152
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	98 —102 xd	98 —102 xd	100	99¼
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104 xd	101 —104	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	115 —120	115 —120	117¾	115¼
250,009	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14½— 15	14½— 15	14⅝	14½
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	114 —119 xd	114 —119 xd	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104 xd	101 —104 xd	102½	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	4 %	...	...	102 —105%	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	5½%	10⅜— 11½	10⅜— 11½	11⅛	10⅞
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15 — 15½	15¼— 15⅝	15⅞	15¼
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	29 — 31	30 — 32	...	...
80,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ⅜	¼— ⅜	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	⅜— 1	⅜— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	5⅜— 5⅝	5⅜— 5⅝	5⅝	5½
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13½	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜— 5⅝	5⅜— 5⅝	...	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	100	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5¼	4¾— 5¼	...	...
151,783£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	100 —103	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¼— 1	¼— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	101 —104	101 —104	...	...
339,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	1 %	2%	...	1⅜— 1⅝	1⅜— 1⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10¾	10½— 10¾	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
30,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	103 —106	103 —106	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	9½— 10⅛	9½— 10⅛	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7⅜— 8⅛	7⅜— 8⅛	...	...
100,000	Do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	112 —114	113 —115	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11 — 12	11¼— 12⅛	12⅛	11⅜
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13½	13⅛	12¾
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	123 —128	123 —128	125½	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 11½	11 — 11½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14 xd	13 — 14 xd	...	...
220,000	Do. 4½ % Deb. Stock, Prov. Certs (£50% to be paid) Rd.	...	...	...	...	51 — 53	51 — 53	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5½— 5¾	5½— 5¾	...	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	7½— 8½	7½— 8½	8	7¾
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	8½— 9½	8½— 9½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7 xd	6½— 7 xd	6⅞	6⅛
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	106 —107	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	14½— 15½	15 — 16	15⅛	15
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14½— 15½	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	15	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	16 — 17 xd	16 — 17 xd	16⅜	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10 xd	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	4 — 4½	4 — 4½	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½—15½ xd	14½— 15½xd	15⅜	14¾

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being vred as capital.

Dividends marked] are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Aug. 2nd.	Closing Quotation Aug. 9th.	Business done during week ended Aug. 9th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3¼— 3⅜	3¼— 3⅜	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	17½— 18½	17½— 18½	...	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	14 — 14½	14 — 14½	14½	...
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	13⅜— 14¼	13⅜— 14¼	14	13¾
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	128½	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅜— 2	1⅜— 2	1 1/16	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2⅛— 2⅜	2⅛— 2⅜	...	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	14½— 15½	14½— 15½	15¼	14 1/16
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10⅜	10¼— 10⅜	10⅜	10 7/16
178,303	Do. do. do. £8 paid	10	...	...	...	8¼— 8⅜	8¼— 8⅜	...	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	2¼— 3¼	2¾— 3¼	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	5¼— 5⅜	5¼— 5⅜	...	...
630,000*l*	City and South London Railway	Stock	1 1/16 %	1 1/8 %	2⅛ %	67 — 69	67 — 69	...	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6¼— 6⅜	6¼— 6⅜	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½ %	6 %	6 %	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½ %	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛— 2⅜xd	2⅛— 2⅜xd	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½xd	3 — 3½xd	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	101 —104	101 —104	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ⅞	⅝— ⅞	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	25 — 26	25 — 26	25½	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	19 — 21	20 — 22	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	111 —114	111	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21 1/16	21⅜
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞ %	3½ %	3½ %	8 — 8½	8 — 8½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	14 — 14½	14 — 14½	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41 xd	38 — 42	38½	38
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9⅜	9¼— 9⅜	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅜— 6¼	5⅜— 6¼	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	102 —105	101 —104	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8½—9½.
British Aluminium, Ordinary, no market; 7 % Pref., no market.
House-to-House, 4½% Debentures of £100, 104—107.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 1—3 nom.
*T. Parker, £10 (fully paid), 19—20.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, August 9th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	32/-	32/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	87/-	87/-	..
a Ammonia, Muriate (crystal) .. per ton	£26	£26	..
a „ „ .. .. per ton	£24	£24	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 °/₀) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 °/₀) .. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25	£26 5	25s. dec.
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a „ White Sugar .. .. per ton	£31	£31	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 °/₀ at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	8½d.	8½d.	..
a „ Caustic (75/80 °/₀) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 °/₀) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£8	£8	..
a „ Bichromate, casks .. per lb.	2¼d.	2¼d.	..
METALS, &c.			
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8½d.	..
c „ Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c „ Wire, basis .. .. per lb.	..	8½d.	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g „ Wire (basis price) .. per lb.	10½d.	10½d.	..
g „ Sheet .. .. .. per ton	£88	£88	..
g „ Rod .. .. .. per ton	£88	£88	..
m German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. .. per lb.	4/3	4/1 to 4/3	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	68/6	71/6	3s. dec.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£12	£11 5	15s. inc
g Lead, English Ingot .. .. per ton	£14 10	£14 10	..
g „ „ Sheet .. .. per ton	£15 7 6	£15 7 6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 7	£8 7	..
d Mica (in original cases), small per lb.	..	1½d. to 6d.	..
d „ „ „ medium per lb.	..	1 9 to 2 6	..
d „ „ „ large per lb.	..	3 6 to 7 -	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd strip & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£146 10	£146 10	..
g „ foil .. .. per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/10	1/10	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7¼d.	7¼d.	..
j „ Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j „ Hemp, 8 ply 10 lbs. .. per lb.	8½d.	8½d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£12 10	£12	10s. inc
j „ Manila, 24 thread .. per ton	£32 10	£32 10	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£28 10	£28 10	..

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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THE MUNICIPAL ELECTRICAL ASSOCIATION.

THE ARRANGEMENT OF STEAM AND OTHER PIPES, AND THEIR FITTINGS.

By J. E. Edgcome, M.I.M.E., M.I.E.E.

Borough Electrical Engineer, Kingston-upon-Thames.

The subject of steam and other piping is one of the greatest importance to engineers of central stations, and, indeed, to all who have to deal with steam plant. It is a subject upon which volumes might be written and still leave much unsaid.

The author does not pretend to advance any especially new or original information, but rather a series of notes based on some little experience, in the hope of eliciting what should prove to be a most interesting discussion, and a discussion from which every member may be able to carry away some useful suggestion, to be put into practice when laying down a new generating station, or when carrying out the inevitable extension of his present works.

The arrangement of piping referred to in this paper is proposed for small or for moderate sized stations, which form the majority, rather than for those very large stations to be found in a few of the big cities, and where, possibly, special arrangements are necessary.

Steam Pipes.

The author is of opinion that in the majority of cases, the best and most favourable arrangement of steam piping is in the form of a steam ring, running from the boiler house through the engine house and returning to the boiler house, as shown in fig. 1.

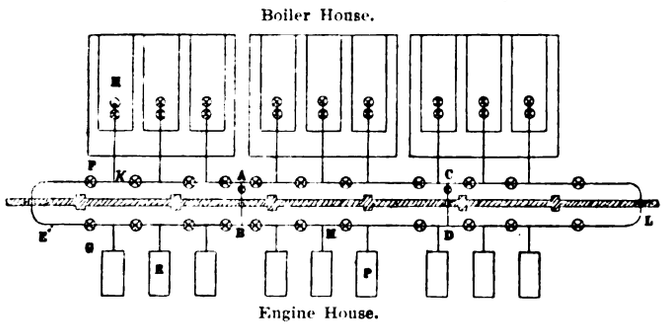

Fig. 1.

It is advisable that the ring should be cross connected at two or more places, as shown at A B and C D, so that in the event of repairs being necessary to any pipe—say at E—the closing of the valves, F G, does not necessitate, in case boiler H is under steam, that the steam should pass to the engines—say P or R—by the long route, K A L M, but by the shorter route, K A B M.

This arrangement will also allow of considerable lengths of steam pipe being cut out when the engines and boilers upon them are not in use, and will be found to give greater flexibility to the ring system.

In most cases, particularly when the engine house and boiler house are approximately on the same level, it is usually more convenient to carry the steam piping overhead, and where a single line of boilers is installed backing towards the dividing wall, and similarly a single line of engines is laid down with the engines abutting towards the same wall, it is extremely simple to carry out the steam ring system.

Where a double row of engines is installed the system becomes a little more complicated, and it is usually advisable to form a second loop of steam piping in parallel with the main ring within the engine house, feeding the engines on either side, the engines in that case facing one another with the machines outward.

Serviceable and reliable steam pipes may be made up of lap-welded mild steel with heavy wrought-iron flanges, the flanges being screwed on hot and the ends brazed. The flanges must, of course, be faced up to enable good joints to be made.

In larger sized steam pipes it will be found that the joints can be kept tighter by having the flanges made with a slight boss, which is faced up for the joint, instead of the whole of the flange being faced up for that purpose, as shown at A in fig. 2; from $\frac{1}{16}$ inch to $\frac{1}{8}$ inch is sufficient for the thickness of the boss.

Steam pipes, where supported on brackets or columns, should be carried on rollers to allow of free contraction and expansion.

Joints.

With the higher steam pressures now in use, care and discrimination are required in making and keeping good sound joints. There are innumerable makes of jointing material on the market. Rubber prepared with plumbago makes a good sound joint, which requires taking up when steam is admitted to the pipe, as the material softens with the heat, although it sets into a hard permanent joint when tightened up.

An admirable and reliable joint is one made with corrugated brass rings, painted with thin red lead.

Drainage.

One of the most prolific causes of trouble with steam piping is that from accumulation of water, and too much care cannot be taken in thorough draining of the pipes.

For this purpose a number of separators should be fitted in the ring on the boiler side to collect the water from the steam where it leaves the boilers, and, in the author's opinion, it is certainly advisable that every engine should be fitted with its own separator, to deal with any water which may be carried over from the main steam pipe.

To deal, however, with the water which will, notwithstanding, collect in the main steam ring in the engine house, it is advisable to connect the ring in several places to steam traps, similar traps being connected to the separators of the engines.

The author has found from experience that, to permanently connect the engine separators to steam traps, deals more effectually with the water trouble than to constantly blow out the water from the

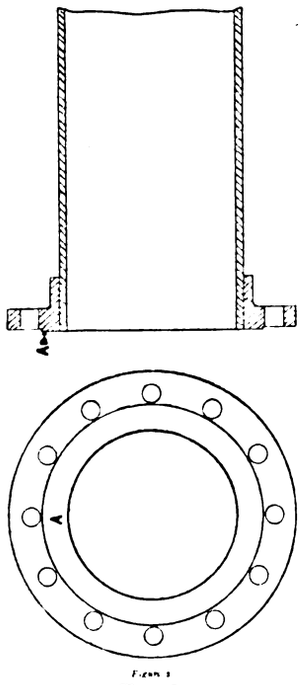

Fig. 2.

separators as it collects there, especially in view of the difficulty experienced in ascertaining the quantity of water in the separators, except by the use of gauge glasses, which are a source of constant trouble owing to the difficulty of getting glasses to withstand the pressure when there is any variation of temperature, or when they are subjected to sudden cold draughts.

The connecting pipes from the boilers to the main steam pipe, and from the main steam pipe to the engines, should be preferably of copper, with full swan neck bends to keep the water back as much as possible, and to allow of expansion.

Steam Traps.

These are most necessary adjuncts to the steam pipes; but although there are some very good steam traps on the market, probably most engineers will agree than an ideal trap has yet to be discovered.

All steam traps require a certain amount of attention, and should be fitted with a reliable class of stop valve to enable them to be shut off from the live steam main for inspection, and for the renewal of the valves and seatings when necessary.

Most of the modern traps will discharge at a considerable height, depending, of course, upon the steam pressure, and it will be found that a quantity of excellent feed water may be collected by this means.

When discharging to a height, each trap should be fitted with a non-return valve to prevent the column of condensed water in the pipe returning to the trap. It will be found convenient to group the discharge pipes from a number of steam traps into a small tank, having an overflow pipe to the hot well. This will enable the discharge of every trap to be inspected, which is a necessary precaution to ensure that each is in proper working order.

Valves.

Valves are a very important part of a steam system, and care should be taken to select a class of valve suitable for the work which it has to perform.

Full way valves possess so many advantages over other types, that in the most modern plants these are almost wholly used for high pressure steam work, and can be obtained from the smallest to the largest size.

The large valves on the main steam ring should each be provided with a small by-pass valve to enable a length of cold steam pipe to be warmed up, and the pressure balanced before the main valve is opened. This will prevent the straining of the joints caused by sudden expansion, and likewise accidents due to water hammer.

When erecting new steam pipes, attention should be given to the thorough cleaning of the pipes, as otherwise fine particles of grit, driven by the steam into the faces of the valves, cut into the seats, causing considerable trouble and expense. The author was informed by one large firm of valve makers that, owing to the trouble they had experienced from this cause, and the expense to which they had been put, due to the necessity of taking down and refacing valves fitted in this manner on new pipes, they intended in future to include in their estimates a certain sum to cover such cost.

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Where, as is almost universally the case, boilers are run in parallel, it is advisable to fit a self-acting valve between the steam ring and the main stop valve on each boiler, the self-acting valve being placed immediately after the stop valve. There are various types of this valve, the usual form being a ball working on an inclined plane. The object in all cases is to provide a valve which shall close automatically when the pressure on the boiler it controls falls below that in the steam ring, as this enables that particular boiler, when thus isolated, to recover itself and to get up a full head of steam, upon which the automatic valve reopens, and again connects the boiler to the steam main.

Blow-Off Valves.

Where the boiler blow-off valves discharge into one common pipe as is usually the case, it is very necessary that the blow-off valve should be of some type in which the handle shall be practically locked when open. This will prevent the blow-off from a live boiler being forced into a boiler which is standing off for the purpose of being cleaned. Want of attention to this precaution has been the cause of many accidents, frequently involving the death of the men working in the boilers.

This locking arrangement is usually carried out by the use of some special form of key, in which the key is held locked in the valve as long as the valve is open, and can only be withdrawn when the valve is shut; and as long as one key only is available, it is, of course, impossible for two valves to be open simultaneously.

As, however, a key is supplied with every valve, the spare keys, which it is advisable to keep in case of breakage, should be locked up, in charge of one of the engineers, and should not be available in the works.

The author remembers seeing on a battery of boilers, which had been carefully fitted with this class of valve, two of the blow-off valves open at one time with, of course, a key to each valve, entirely doing away with the element of safety, and further causing this false feeling of security to become an added danger.

Where the blow-off from the flooding valves of super-heaters are led into the same blow-off pipe, and when, as is usual, a type of two-way valve is used which cannot be fitted with a locked key, possibilities of accident are averted by making a stringent rule that the flooding valves must not be opened unless the key of the boiler blow-off valves is hanging within sight.

Check Valves.

The check valves of boiler feed pipes are more convenient, for the purpose of inspection, when fitted with an arrangement which allows the valve and seating to be inspected while the boiler is under steam, and the author would also suggest the convenience of fitting every feed branch with a plug-cock, having a removable handle, to enable each check valve to be shut off for inspection both from its own boiler and from the feed main.

A plug cock with removable handle is recommended in place of an ordinary wheel valve, as the latter may be accidentally closed, whereas the handle would be fitted to the former only for the specific purpose of examining the check valve or for completely cutting off the water supply from a boiler when standing off.

The feed supply would, of course, in all cases be regulated by means of the check valves themselves.

Perhaps the author may be permitted to say a few words on the subject of feed water supply.

A convenient arrangement is to connect the pump suctions through suitable pipes and valves to the hot well, the cold well, and also to a third supply in case of emergency, and to connect the discharge pipes from the pumps to a double line of piping supplying the feed water either through the filters and one or more economisers, or if required direct to the boilers.

In the accompanying diagram fig. 3, A A A are the feed pumps, B the

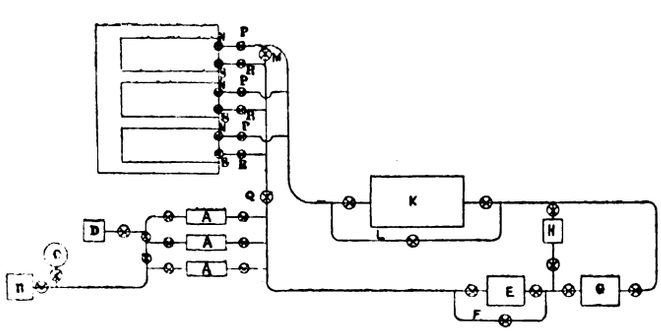

Fig. 3.

hot well, C the cold well, D the tank connected to a third supply, E is a cloth filter with by-pass F; G a sawdust filter fitted in series with E, with a by-pass sawdust filter H, the by-passes being used when the main filters are being cleaned. This arrangement has given excellent results, leaving the boilers clear of all traces of oil, which formerly proved a source of considerable trouble and anxiety.

The condition of the sawdust in G and H is a good indication of the condition of filter E, and proves whether or not it is doing its work properly.

K is the economiser with by-pass L, to enable it to be inspected and cleaned without passing the feed direct to the boilers *viâ* Q, which would entail cutting the filters out of circuit.

The arrangement of the branches from the hot and cold feed, enables the boilers to be fed either with hot or cold water through the stop cocks and check valves P N or R S, and by opening valve M, cold water can be fed through the hot feed check valves, or the reverse, should any of the branch pipes or check valves be out of order.

Pipe Covering.

A few words must be said with reference to the various coverings in use for preventing radiation of heat from steam pipes.

It is most necessary that all pipes carrying steam should be enclosed in a covering of some non-conducting material.

Endless varieties of pipe coverings exist which may be divided into two classes, permanent coverings and removable coverings.

The former, which are generally wrapped with some description of linen or canvas, have a good finished appearance when coloured and varnished, but suffer from the disadvantage that the covering is destroyed when it is necessary to remove it from the pipe at any point, and the appearance of the whole length of pipe is spoilt in consequence.

Removable coverings are, on the other hand, as their name implies, specially made for the purpose of allowing free inspection of the pipe, but in appearance they are usually clumsy, and do not lend themselves to the neat finish of permanent coverings. It is also questionable whether, as a rule, they are such efficient non-conductors of heat as are permanent coverings.

It would take up too much time to attempt to describe the many varieties of coverings on the market. They are all manufactured from some good non-conducting material, such as asbestos, magnesia, slag-wool, or felt, and are put on either wet or dry.

There are also numbers of coverings which depend principally for their non-conducting properties upon an air space being left around the pipe.

Probably every engineer has been induced at some time to try various coverings, and, like the author, has possibly found a few good, many indifferent, and some distinctly bad.

There is no doubt that to obtain an efficient steam supply with a minimum of condensation every portion of steam carrying metal must be covered with a thoroughly good non-conductor, and where practicable all valves and flanges should be treated in the same manner.

This applies equally to the drain pipes, or, at any rate, to that portion connecting to the steam traps. For the sake of keeping down the temperature in the engine house it is generally advisable also to cover the exhaust pipes with some non-conducting material.

Much more might be said on the subject of pipe work, but the author trusts that what he has advanced will fulfil his expectations, namely, to produce a useful and exhaustive discussion on what he ventures to think is a most important portion of central station equipment.

ELECTRIC LIGHTING MACHINERY.

A wail goes up in the *Engineer* from time to time. These wails are recurrent in our revered contemporary, and appear to be coincident with periods of depression to which we are all at times subject. At such moments our contemporary becomes pessimistic but never forgets to write in thoroughly autocratic style. This time electrical machinery and electrical stations come under review. The ignorance of electrical facts is deplored. Engineers have tried to live up to the science of the dynamo by employing scientific many-jointed engines and boilers. They have been like the suburban family living up to the high æsthetic level of the blue teapot. We should prefer to have used the other simile which says something about living up to the blessed doctrine of total depravity, for to our mind this is rather what has been aimed at. Electrical engineers have themselves to thank for most of their troubles. They began wrongly by criticising the wasteful methods of the factory engineers, but this was because so many of them were not men of practice. They emerged from class-rooms and designed stations and plant with no margins. To make matters worse, they undertook the use of untried forms of engines and novel boilers, and taking them all in all they have made a very good job of getting 1,000 H.P. out of a 600 or 700 H.P. plant. There has been too much expected from plant, more from new devices than it was known could be got from old and proved machinery. Everything not absolutely new and fresh in design has been condemned as fossilised. The professor has had full sway. He has worked up from theory to practice, and has taught his pupils to do the same, and in crossing the borderland between theory and practice there is very much rough country, which has never been allowed for. We admit the theory has been false theory in that it has refused to take notice of experimentally determined facts. The theoretical men have been like the lawyer who, at a conference with a client in gaol, said emphatically, "they can't put you in gaol for this." "But," responded the client, "I am in gaol." So with the new school of engineers, they have theorised too much and worked with insufficient margins. They have harped so much on the high cost of land in London and they have crowded plant to such a narrow limit that the dismantled and breakdown stuff occupied more space than would have held other plant. Then, again, in the subversion of the entire design of steam plant, old established firms have been shut out of the market. Being busy on other work, these old firms have preferred to wait until there appeared to be some finality in design. So far, except that there seems to be a tendency to revert to older methods, there is no finality in view. We think that the most successful undertakings of the near future will be those in which the fever heat observable in so many electrical stations is replaced by a more leisurely appearance. We want engineers who have the courage to demand plant of more capacity, and managements which are prepared to give it.

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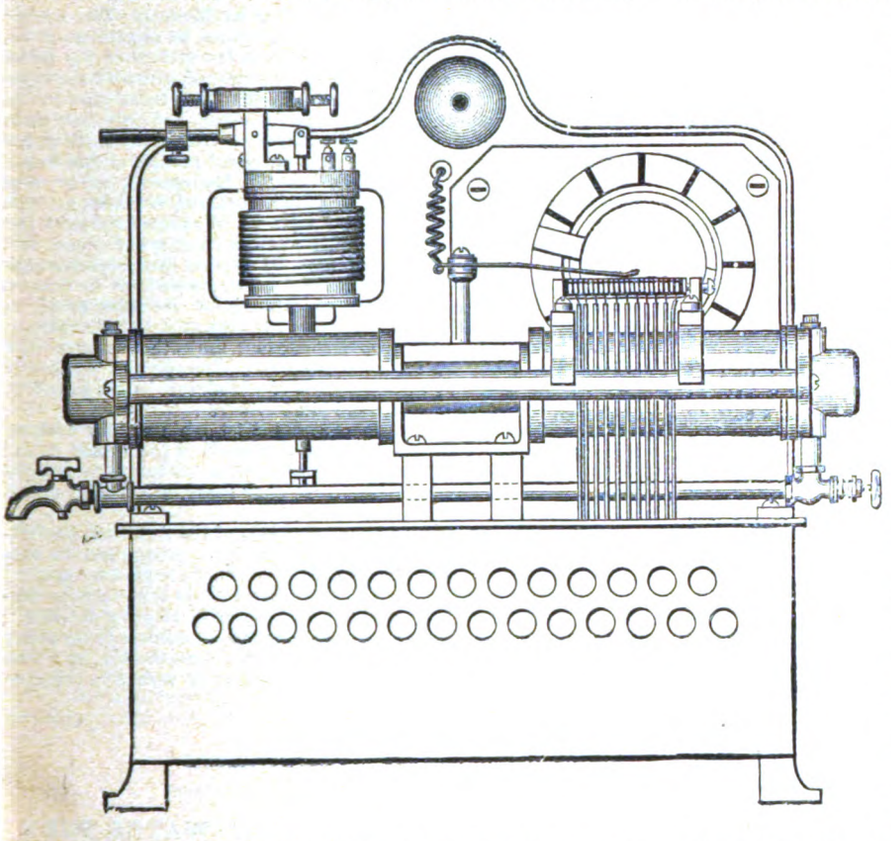
STEADY LIGHT FROM UNSTEADY POWER.

The economical and efficient operation of a plant of incandescent electric lamps involves the nice adjustment of two opposing factors which enter as items of expense. As one item is increased in any given case, the other is decreased, and *vice versâ*. These two factors are, on the one hand, the life of the lamps, and on the other hand, the power consumed in operating the lamps. The life of a lamp is favoured by making it a great watt consumer. A lamp using 4 watts per C P. has a much longer life, other things being equal, than a 2½-watt lamp, but the power used makes it expensive to use. On the other hand, the 2½-watt lamp, when subjected to fluctuations of voltage, becomes expensive in the item of lamp renewals. Close regulation is important for any lamp, but when the low-watt lamp is used it becomes an all-important factor in economy, and it is not infrequent to see in a lighting station one or more attendants constantly engaged in watching the voltmeter and operating a hand regulator as the changes of load or speed demand. The high-watt lamp is necessarily expensive in the item of power, and the low-watt lamp is also expensive in the item of lamp renewals when the regulation is poor; but the low-watt lamp, combined with perfect regulation, is the perfection of economy with incandescent electric lighting. Every electrical engineer fully appreciates this fact, and a good voltage regulator is the urgent demand of the times; this demand is claimed to be fully met in the Chapman voltage regulator, which Messrs. Laing, Wharton & Down, Limited, are now putting on the market. A large number of these are in practical operation, and have proved to be all that could be desired. A dynamo that has 750 4-watt lamps capacity can supply 1,000 3-watt lamps with the same amount of energy. The close regulation which can be obtained by use of the Chapman voltage regulator not only increases the capacity of the machines, but reduces lamp renewals, due to the constantly steady voltage.



The regulator is a magnetic device, and acts very promptly, being only limited in quickness of action by the ability of the generator it may be regulating to respond to change on a field resistance. The device is essentially a field resistance, whose operation is entirely automatic. The moving of the resistance switch is accomplished by the action of a working solenoid, and the actions of the working solenoid are determined by those of an auxiliary solenoid, which operates a set of contacts that control the admission of current to the sections of the working solenoid. The working solenoid is differentially wound, and is composed of four distinct coils, two of which have a small continuous current flowing through them in magnetic opposition to each other; the contacts close the circuit of one or the other of remaining coils, and so neutralise the action of one of the continuously acting coils.

This manner of connecting secures a rise of magnetism in the iron core of the solenoid whenever a break occurs at the contacts, and so avoids any injurious sparking at the contacts that would naturally occur by the magnetic discharge of the core. This arrangement completely neutralises the induction discharge, and no induction spark can occur. All the usual objections to contact points are therefore entirely removed, and they may be set very close to secure the most sensitive adjustment of the apparatus.

The entire work of the auxiliary solenoid is to move a lever arm with contact attached through a short space of, say, $\frac{1}{32}$ inch, and a very slight change of voltage is sufficient to do this. It is often desirable to have the voltage at the generating station rise a little with the load, so that it becomes greater than the voltage at the distributing point or end of feeder, where it remains constant with changes of load. This result is aimed at in the compound winding of generators, but in most cases is far from securing the result desired on account of the changes of speed, which no compounding of the generator can compensate for. The compounding of the auxiliary solenoid, however, secures the desired result under all conditions of speed or load, and a plain shunt wound generator becomes just as effective as a compound wound generator. The use of the Chapman regulator enables the old style alternating current generators having no compound coils to do just as good work as the more modern ones. Many machines that have been discarded as out of date will again become valuable and equal to the best.

The same is also true of direct current generators. There are many old generators of the shunt wound type, that will become just as useful as the more modern built machines, and even more so, by the attachment of the voltage regulator to them.

As to the energy consumed in the regulator, it is so small as to be negligible. The operation of the large working solenoid only requires the use of 60 to 70 watts of energy, and the resistance part of the device is concerned only with the current in the shunt winding of the generator which, as is well known, is only a very small percentage of the output of the machine. For instance, the regulator may be operated on a machine of 150 KW. with an expenditure of energy not exceeding ¼ H P.

The Chapman voltage regulator for varying speed dynamos solves a question of enormous importance to users of electric light. Central station engineers know the importance of unvarying voltage. It is simply out of the question to think of satisfying the general public without an almost absolutely steady light, and there is no way of doing this except by means of some kind of a regulator outside of the generator itself.

The Chapman voltage regulators are applicable to either alternating or direct current, and every plant subject to frequent changes of load and consequent change in voltage, run either by engine or water power, should have them. Their cost is slight compared with advantages gained by their use.

Several direct current machines connected in multiple may be controlled with one regulator, as well as though a regulator were used for each machine, but require special construction and must be so ordered.

Mills and factories can run light plants from their main line shafting without the necessity of special engines, even if there is a variation of 50 per cent. in the speed above the normal, and be assured of a steady light, a fact that could not possibly be accomplished by any other means without enormous loss by burning out lamps many times exceeding the cost of one of these regulators in a very short time.

They are claimed to do automatically what would otherwise require the constant attention of one man.

The size of the No. 1 style is 36 × 17 × 8 inches, and the weight is about 250 lbs. No. 2 is less highly finished, and is not enclosed with a plate glass front.

THE PROPERTIES AND APPLICATIONS OF ALUMINIUM.

MM. Ditte and Moissan have recently contributed to the French Academie des Sciences important papers on the above subject. Owing to the gradual extension of the field of utilization of this metal, we think these papers worthy the attention of our readers, and we therefore present abstracts of them below:—

THE PROPERTIES OF ALUMINIUM.

A. Ditte. *Comptes Rendus.* January 23rd, 1899.

In a previous article the author had proved that aluminium is readily attacked by many re-agents, and that its apparent stability is due to a thin adhesive film of alumina (Al_2O_3), or of gas. When the solvent used is one capable of dissolving alumina, corrosion occurs rapidly, since the protective coating is being continually removed. The presence of oxygen or of carbonic acid is required in order to provide the necessary supply of oxygen. In sea water, the same re-action occurs, the carbonic acid of the air being in this case the oxidizing agent. In the water of the Seine itself, aluminium is slowly corroded, the action being most marked at the point where the air and water meet. In either case, the attacked metal covers itself with a film of alumina, which may retain particles of other salts. If these impurities are allowed to remain in contact with the aluminium, the attack will slowly continue, and the metal will become disintegrated, even after removal from the water. To prevent this, it is necessary to wash the aluminium when taken from the water, with a

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solution capable of removing the last traces of alkaline matter from its surface. The "sickness" of copper investigated by M. Berthelot, is a similar phenomenon to this progressive disintegration of aluminium. In the case of copper, the successive formation and decomposition of a small amount of cuprous oxide is the cause of the evil; in the case of aluminium a similar series of changes of aluminium hydrate brings about disintegration and decay.

THE PROPERTIES AND APPLICATIONS OF ALUMINIUM.

A. Ditte. *Comptes Rendus.* March 27th, 1899.

The author states that two qualities of aluminium were employed in his experiments. The first was sheet metal used for the bodies of bowls, plates, saucers, saucepans, measures, &c., and contained 96 per cent. aluminium, 3 per cent. copper, and 1 per cent. of iron, silicon, carbon. The second grade of metal was used for the rings, links, handles, &c., of the above articles, and contained 93 to 94 per cent. aluminium, 5 to 6 per cent. copper, and 1 per cent. of iron, silicon, and carbon.

These alloys, if maintained for a short time at a red heat, and then plunged into water, change in physical structure. They become granular, and the surface of the metal is found to be covered with fine cracks.

If immersed in a 2 per cent. solution of sulphuric acid, the action of the acid is more intense when pre-heating has occurred, and the surface of the metal covers itself with a black deposit of copper.

A 2 per cent. solution of an alkali carbonate, or a solution of common salt containing 8 grams NaCl per litre, rapidly attacks these alloys of aluminium at the ordinary temperature, and a coating of aluminium hydrate, $Al(OH)_3$, is produced upon the metal. If a polished plate of the metal be immersed in either of these solutions, it quickly loses its polish, and becomes coated with a thin film of crystalline alumina.

The effects of similar action are seen in the aluminium vessels, &c., returned from Madagascar. A piece of aluminium plate, a fragment of a portable water-tank, had its external surface practically uninjured, while its interior surface was found to have undergone physical change and to have become lamellar and fragile. Under the microscope it was seen to be strongly corroded and to be covered with aluminium hydrate.

This inner surface of the plate was more rapidly attacked by sulphuric acid and sodium carbonate solutions than the outer surface, and a metallic crystalline powder was detached. If a thin aluminium sheet be immersed in distilled water, the latter will gradually become alkaline owing to the transfer of small quantities of aluminium hydrate, sodium and chlorine, from the metal to the water; and the combined action of air and of water, containing possibly chlorine salts in solution, had no doubt *started* the disintegration of the inner surface of the metal used for these water tanks. Once begun the action would be self-supporting.

All the other Madagascar articles examined by the author (plates, measures, saucepans), showed signs of similar disintegration. The action of water and air on the cooking vessels was probably intensified by the materials cooked in them. The E.M.F. set up by the different solubilities of copper and aluminium would also assist the attacking agents, and accelerate disintegration. In sea water a copper aluminium couple gives an E.M.F. of between ·486 and ·525 volt.

THE APPLICATIONS OF ALUMINIUM.

H. Moissan. *Comptes Rendus.* April 10th, 1899.

The author states that Ditte regards the results obtained in his experiments as relative to pure aluminium, whereas his analyses show that the metal used by him was not first grade aluminium.

The metal produced to-day at the works of Heroult and of Secretan is almost pure, and contains neither sodium nor carbon. Tests are giving showing that while in 1893 the purest grades of aluminium obtainable contained between ·93 and 1·64 per cent. silicon, and between ·32 and 1·66 per cent. iron, the corresponding percentages of these two impurities in the metal of the present date are ·02 to ·13 per cent. silicon and ·12 to ·32 per cent. iron. This improvement in quality is chiefly due to M. Secretan's modifications of the Hall process.

The water tanks used in Madagascar were mounted on iron, and this fact explains their corrosion. As a set-off to the statements by Ditte that all the aluminium articles used in Madagascar which he has examined are corroded, Moissan states that he has seen numerous articles from that campaign which are practically unattacked, although bent out of shape and blackened with use. (Some of these articles were exhibited at the Academie des Sciences.) The state of the articles examined by Ditte may be due to their having been in contact with sea water in the hold of the vessel in which they were returned. Quotations are given from reports by regimental officers, all in favour of aluminium for camp outfits. The advantages of the metal for military service, as compared with tinned iron, are:—

1. Lightness; each soldier can carry 800 grams weight extra of ammunition.
2. No poisoning occurs from defective tinning.
3. No soldering of the vessels is required, as these are stamped out of sheet metal.

As regards Ditte's tests made by heating the metal and plunging it into cold water, such treatment would destroy any tinned iron utensil. The author has used aluminium in his own household for cooking purposes for three years, and these vessels are still in good condition; nor do they owe their preservation, as suggested by Ditte, to a protective coating of grease and dirt. A large hotel in Paris has a similar experience of one year with aluminium cooking utensils.

The advantages of aluminium may be summed up as (1) lightness; (2) an innocuous oxide; (3) capacity for being stamped.

The author closes by hinting that had M. Ditte lived in another age, he would have been found condemning iron, on account of its readiness to form an oxide and to rust on exposure to the air.

THE APPLICATIONS OF ALUMINIUM.

A. Ditte. *Comptes Rendus.* April 17th, 1899.

A reply to the previous contribution by Moissan. The author states that he has taken note of the impurities in aluminium in his experiments. These impurities remain on the surface of the metal when it is attacked, and by breaking the continuousness of the layer of gases, they render the metal more liable to disintegration. In the course of his investigations he has examined not only the lower grades of aluminium, but also aluminium produced by M. Secretan in 1899, *i.e.*, the purest offered as a commercial product at that date.

With regard to the water-tanks used in Madagascar, copper was purposely used to strengthen the metal employed for these, and the results of his examination of the returned fragments confirmed the results of his laboratory experiments with such alloys of copper and aluminium. The vessels exhibited by him at the Academie des Sciences were not returned in the hold of a vessel, or in contact with sea water; for no traces of chlorine or chlorides could be detected on their surface. M. Moissan has presented to the Academie articles from Madagascar in good condition; the author has presented others that show considerable corrosion. The obvious conclusion that should be drawn is, that vessels of aluminium have a long or a short life, according to usage and circumstances.

The author has not made personal trial of aluminium cooking utensils, but has used forks and spoons made of the metal. These were washed daily with a solution of sodium carbonate to remove the grease, and under this treatment they speedily lost their polish and became pitted and rough.

All the articles exhibited to the members of the Academie (including those exhibited by M. Moissan) have been greasy, and to this layer of grease some of them undoubtedly owe their preservation.

The author agrees with Moissan when he says that "chaque application de ce metal demande une étude speciale, longue et delicate"; and states that he himself has recommended aluminium to the army authorities as the most suitable metal for water-bottles, and has suggested improvements in the design of such vessels, in order to facilitate their mechanical cleaning.

FORCED CIRCULATION IN WATER-TUBE BOILERS.

When that foolish and extravagant experiment was made of putting flatly-inclined water-tube boilers into our big cruisers, the *Engineer* joined in the general acclamation. Recently, however, a leader appeared, which stated practically that it was impossible to expect such tubes to endure. It is pointed out that the tubes next the fire in a water-tube boiler are exposed to fierce heat from end to end, and must often be full of steam in place of water. The very small inducement to circulation which exists in a steam boiler is insisted upon, and the necessity of using larger tubes near the fires and providing free outlets at their upper ends.

We have long insisted on the folly of flatly-inclined tubes. Any tendency of steam bubbles to rise is reduced in a ratio corresponding with the sine of the incline. An inclination of 12° reduces the effect of gravity nearly five-fold. If water-tube boilers are to be a success, the tubes must be of necessity shortened down to a certain limit. Twenty-five diameters is the maximum allowed by the *Engineer* to be possible without bending effects being observed when under fire. Up to this length self-circulation seems to be efficient, or fairly so. It is all a question of water supply, and as we have before pointed out, the provision of a centrifugal circulating pump to draw water from the steam drums and force it to the tubes offers an apparent solution. Such a pump would simply be worked in a closed cycle. It offers no practical difficulties. The system is already at work in many industrial establishments. It is a large boiler which evaporates 600 gallons per hour, but it is a small pump which circulates 600 gallons per minute, and a very small expenditure of power would compel the circulation of water many times the volume of the evaporation.

It would not be difficult to so arrange matters that the lower tubes secured the larger supply. In the Belleville boiler the continuity of the tubes in vertical series demands such a system. Marine engineers accustomed to the use of circulating pumps for their surface condensers, might surely be expected to adopt similar means in the far more important matter of boilers. Until they do so, such boilers as the Belleville with flatly-inclined tubes and tubes in series cannot be considered safe even if made with solid drawn tubes. The serious bending of the tubes in the Belleville boiler is in itself sufficient to call attention to some serious internal trouble being present. Tubes full of water are not likely to bend in the most severe heat. The cooling effect of the water is so far and away beyond the absorbtive action of the external surface of the tubes in the fire that tubes would not become over-heated if they had a rapid current of water flowing inside them. Because such tubes may sometimes give way, and not kill half a dozen stokers, appears nowadays to be a sufficient justification for their use. But the tubes in water-tube boilers do not always produce small effects when they burst.

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The Howard safety boiler killed many men, and so have others. Probably all the accidents of any moment which have happened to water-tube boilers have been due to over-heating due to want of water in the lower tubes. A forced circulation of sufficient amount would prevent such failures. Let us suppose a circulation of ten times the weight of water evaporated. On this basis how much of a tube would be occupied by steam and how much by water? Assume a pressure of 165 lbs. absolute. The relative volume of steam and water at this pressure is approximately 140 : 1. As only one-tenth is assumed to be evaporated, it is obvious that in a length of 14 inches of pipe only 1 inch is solid water. If the evaporation of the lower tubes is assumed to be double the average of the whole tubes—a moderate estimate—then only $\frac{1}{28}$th of the length of a tube is filled with water at the point where the tubes discharge to the headers. Treble the amount of circulation and this will be reduced to about $\frac{1}{10}$th. Now a tube must either be filled with foam of a specific gravity of about 0 10, or with alternations of water plugs and steam. A pipe of 4 inches will perhaps allow water plugs to exist 4 inches in length. Then the steam spaces will be 36 inches long.

If we have not made some error in the above calculations and assumptions, and, as regards the latter, we think we have understated, rather than overstated, unfavourable facts, it would appear that in the lower tubes of a water-tube boiler the bulk of water present is one-tenth that of the steam when the total circulation in the boiler is 30 times the evaporation. This means that all the water in a boiler must make a complete circuit every two minutes. We do not say that this would ensure safety; we do not say that more than this is not already secured by the natural circulation in the boiler. It may be that we underestimate the circulation which actually takes place. But we do not think we err in stating that whatever may be the facts, more circulation is necessary than is so far secured. We have, therefore, made the above simple calculation to fix certain ideas, and to point out how very little water can be present.

We might even go on to show that with a circulation of 1,000 per cent. of the evaporation, only 1 inch in three would contain a plug of water. As steam is not a good cooling agent, the cooling effect on tubes, if any water in them, is reduced in proportion as the amount of water is reduced. The fact that tubes show signs of overheating is, we take it, indisputable evidence that very little water is present. Seeing also that upper tubes do not suffer, it would seem desirable to leave the circulation in these to be accomplished naturally, and employ all the circulatory effort of the proposed pump to compelling circulation in the lower tubes.

THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS.

Several excellent papers were presented at a recent meeting of this Society. One on "Boiler and Furnace Efficiency" may be quoted with advantage. It was presented by Messrs. R. S. Hale and W. B. Russell. They say the furnace should be roomy, and it should be brick-lined so as to secure a high temperature. Especially when the coal is poor should these points be attended to, and air leakage beyond the furnace must be particularly guarded against. These are points to all of which we have repeatedly called attention. The authors go on to say that a combustion of at least 15 lbs. of coal per square foot of grate must be secured when the boiler is doing its normal rating. Here, again, the advice is sound, as also is that to keep the evaporation per square foot of heating surface low.

Certain water-tube boilers suffer from air leakage, but the Thorneycroft boiler is highly spoken of. The Lancashire type of boiler is said to suffer from air leakage also, and it has a poor type of furnace. The furnace is the weak spot of the Lancashire boiler as regards its environment. Hence we say the boiler should be large, and we should expect rings of firebrick to help combustion. Mechanical stokers are not necessarily coal savers, but they may save labour and they may prevent smoke. They may also enable poor coals to be usefully burned. Down-draught grates have shown some good results, but too few tests have been made for final conclusions to be drawn.

A paper by Mr. Henning on "Boiler Explosions" was a plea for testing the materials of a boiler after a long period of work and after it had failed by explosion, from excessive pressure. Overheating produces the typical steel blue rustless scale, brightest at points where the heat has been greatest. Tests of such plates will show up the changes produced by overheating. The yield point will be low, the elongation large, as a rule, and the fracture will be altered in appearance. Overheated plates may be tested against strips of the same plate, cut and polished and overheated to redness at one end in a clear fire, then allowed to cool to a blue heat and quenched. Nicked at points where a change of colour occurs, and compared with the strips cut off plates overheated in the boiler itself, the fracture and colours will be a guide to a correct comparison, and the temperature may be estimated and conclusions drawn as to the behaviour between stay bolts. Generally, by carefully considered comparative tests, much may be learned. Mr. Henning endorses the opinion of English boiler experts that fair working conditions have never been proved to cause any deterioration of the quality of boiler plates. The bad condition of the plates in an exploded boiler has often, however, been used by the maker of the boiler to justify the contrary, probably a slight confusion of cause and effect.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

15,166. "An improved form of electrically actuated railway signal." W. E Langdon. Dated July 24th.

15,169. "Improvements in electric storage battery plates." R. Kennedy. Dated July 24th.

15,178. "Improvements in the brushes of dynamos." F. J. Chaplin. Dated July 24th.

15,189. "Improvements in rail bonds for electric railways." F. H. Daniels Dated July 24th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, April 25th, 1899, being date of application in United States.) (Complete.)

15,194. "Improvements in galvanic cells." W. B. Barry. Dated July 24th.

15,203. "Improved electric elevated railway." L. J. Bruns and H. R. Ottesen. Dated July 24th. (Complete.)

15,210. "Improvements in electric arc lamps." F. G. Chagnaud. Dated July 24th. (Complete.)

15,219. "Improvements in spring motors." E. R. Rogers and J. F. Cushman. Dated July 25th.

15,268. "Improvements in electric lamps." The British Thomson-Houston Company, Limited. (E. W. Rice, jun., United States.) Dated July 25th. (Complete.)

15,309. "Improvements in insulating electrical conductors." W. W. Colley. Dated July 25th.

15,335. "Improvements in tubular conduits for electric wiring" T. Taylor. Dated July 26th.

15,343 "Improvements in electric telegraphs." E. W. Smith. Dated July 26th.

15,359. "An improved primary battery for generating electricity." C. H. Preston. Dated July 26th.

15,365. "Improvements in electromotors." N. Popoff. Dated July 26th.

15,369. "Improved arc lamp having two arcs in series." W. Mathiesen. Dated July 26th. (Complete.)

15,370. "Improvements in secondary or storage battery." T. de Michaelowsky. Dated July 26th. (Complete.)

15,377. "Improvements in the insulation of armature plates in dynamo-electric machines." F. P. V. Leconte. Dated July 26th.

15,404. "Improvements in electrical distributing fuseboards for concentric cables." J. R. Weston. Dated July 27th.

15,407. "Improvements in apparatus for controlling electrically propelled trains." The Lancashire Dynamo and Motor Company, Limited, and A. P. Wood. Dated July 27th.

15,418. "Improvements in insulated electrical conductors or cables." H. Edmunds. Dated July 27th.

15,426. "An improved electric battery and process for constructing the electrodes for the same." A. Tribelhorn. Dated July 27th. (Complete.)

15,438. "A new or improved electrolytic process and apparatus for the production of chemically pure cupric sulphate and copper." E. Frenot. Dated July 27th. (Complete.)

15,440. "Improvements in electrolytic incandescent lamps." M. von Recklinghausen, A. Voor, and Nernst Electric Light, Limited. Dated July 27th.

15,460. "A new or improved tap-switch for electric incandescence lamps." G. Gardner. Dated July 27th. (Complete.)

15,467. "Improvements in switches for breaking electric contact." N. G. Knighton. Dated July 28th.

15,482. "Improvements in and relating to portable direct reading ohmmeters for measuring low electrical resistances." A. Jamieson. Dated July 28th.

15,525. "Improvements in electric switches." R. W. H. Hofstede-Crull. Dated July 28th.

15,541. "Improvements in dynamo electric generators and motors." C. W. Atkinson. Dated July 28th.

15,578. "A new or improved method of, and apparatus for, a combined system of electric light fittings and fire alarms, and for appliances connected therewith." C. C. Metcalfe. Dated July 29th.

15,581. "A combined switch and ceiling rose or other fittings for electric lighting purposes." S. Jevons and W. H. Lloyd. Dated July 29th.

15,583. "Improvements relating to electric cash register tills." W. Snelgrove. Dated July 29th.

15,599. "Improvements in or relating to electric switches and like apparatus for making and breaking electric circuits." G. W. Partridge and G. K. B. Elphinstone. Dated July 29th.

ELECTRICAL PATENTS OF 1885 EXPIRING IN AUGUST, 1899.

We are informed by Messrs. W. P. Thompson & Co. that about 76 applications for electrical patents were filed in the month of August, 1885. Out of these only one has been maintained to run its full length of term, viz., 14 years, and being of considerable interest, we give a short abstract below:—

9,527. "Improvements in Motors for electric railways." T. J. Handford. (F. J. Sprague, United States.) Dated August 10th, 1885. Motors for locomotives. The electro-motors are so arranged that the relative positions of the armature and field magnets will not change, and are so supported that any movement of the car body relatively to the wheels will not disturb the mechanical connection between the armature and the driving axle. The shaft of the armature is carried in bearings fixed to the pole pieces of the field magnets. At the centre of the driving axle are journals connected to extensions from the pole pieces, which maintain the armature at the same distance from the driving axle. The electro-motor is supported by springs from the body of the car, which may be adjusted so as to relieve the driving axle of dead weight to any desired extent. 3 claims.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

17,528. "Improvements in spring jacks for telephone switchboards." J. E. Kingsbury. (The Western Electric Company, United States.) Dated July 26th, 1897. Jacks for telephone switchboards are constructed in rows. A strip of insulating

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material has a row of holes drilled in from the front, and a row of smaller holes from the back, one edge of the holes from front and back being in line. Inclined duct holes are then drilled, and the necessary saw cuts made for holding the springs in position. The metal thimble is fitted in front, and has a shank which is secured in the duct. There is an inner spring thimble or tube having a shouldered shank which lies partly in the duct. There is a central spring for making contact with the tip of the plug, and is secured in saw cuts. The thimbles are riveted to the strip. The plug has two metal sleeves to engage with the thimbles, and a central metal core. 6 claims.

17,540. "Improvements relating to electric light fittings." H. Lea. Dated July 26th, 1897. Several incandescent lamps are carried by holders on arms of a central support which is hung by a twin conductor from a ceiling rose. A translucent china bowl is suspended below the lamps by hooks and cords from the ceiling rose so as to be readily removable for cleaning. The cords pass through eyes on a body, which may be raised or lowered to adjust the height of the bowl relatively to the lamps. 2 claims.

17,546. "An improved electric circuit-closing device." C. A. Holistein. Dated July 26th, 1897. The falling weight of, or operated by, an alarm or other clock or mechanism is arranged to complete the circuit between the contacts at a predetermined time. 1 claim.

17,597. "Improvements in and connected with conductors for electric railways." W. L. Wise. (A. Skrotz, W. P. Allen and O. S. Kelly, United States.) Dated July 27th, 1897. Relates to electric railways and tramways on the third rail system. The conductor is of angular section. In another form is rubbing surface for the collector, or it may be of other sections. It is mounted on insulating posts or insulators on the sleepers or guard rails, and is covered and protected by the covers and side shields supported on the insulators or conductors so as to leave a passage for the collector between the side and the guard rail. The side pieces may be omitted, and the parts may be duplicated for a return circuit. 10 claims.

17,609. "Improvements in or relating to electric furnace." I. L. Roberts. Dated July 27th, 1897. (Date applied for under Patents, &c., Act, 1883, Section 103, December 29th, 1896, being date of application in United States.) A sheet-iron casing provided with a hopper and a flue covers a travelling band which is carried by rollers, and is preferably of cloth woven from wire covered with asbestos. Two electrodes are carried in asbestos packed ball joints in the closed end of the casing, and are bolted adjustably to stationary curved slotted plates. They may otherwise extend downward into the casing, the ball joints being placed in the top of this, between the hopper and flue. Powdered materials are fed in by the hopper, and the electrodes, after being in contact at their ends, are gradually separated until they are parallel, or an arc may be started by placing pieces of carbon between the electrodes. The belt is slowly moved forward, carrying with it unacted on material enclosing a continuous layer of the product of the furnace. This may be delivered in the fused state, if the furnace is short, or otherwise may be broken off in lumps at the end of the furnace. The furnace is applicable for the manufacture of calcium carbide and carborundum, and for other purposes. 11 claims.

17,678. "Improvements in coin-freed electricity meters." W. Emmet. Dated July 28th, 1897. A beam is balanced so as to remain tipped up in the direction shown after a coin has struck the pan at one end, and to tilt in the opposite direction when liquid or sand from a hopper fills the vessel at the other end. In the first position the electric circuit is completed through a pair of upright contacts. According to the strength of the current used a solenoid attracting a lever sets a cam so that the valve of the hopper passes a proportionate quantity of liquid or sand. In the second position the beam completes the circuit with the pair of contacts so that the current passes through an impedance or resistance which reduces the light. 2 claims.

17,694. "Improvements in and connected with electric lamps for cycles and other vehicles, and a device for attaching and adjusting same." J. Moores and H. O. Farrell. Dated July 28th, 1897. A generator for use on a cycle or other vehicle consists of a permanent field-magnet, and preferably a shuttle armature, enclosed in a casing which is supported adjustably by an angular rod and clamps on a fork so that a friction wheel on one end of the armature shaft engages the inside of the rim of a wheel of the vehicle. The casing may support an electric lamp. The friction wheel may be wholly of India-rubber, or may be a metal pulley carrying an India-rubber ring; the India-rubber may be roughened or contain emery to improve its grip. 8 claims.

17,696. "Improvements in and connected with armature cores of permanent magnet dynamo-electric machines." J. Moores and H. O. Farrell. Dated July 28th, 1897. Relates to armatures. An armature core for permanent magnet dynamo-electric machines is built up of two strips of sheet iron, bent over at both ends and fastened together back to back, so that the bent portions together form arc-shaped pole faces. The radial parts may be narrower than the pole faces in which case stiffening plates are added. 1 claim.

17,733. "An improvement in incandescent electric lamps." T. D. Farrell. Dated July 28th, 1897. Relates to incandescent lamps. One or more filaments are arranged with parts conveying opposite currents placed as near together as possible. For this purpose, a filament may be doubled at the middle and wound into a flat spiral, with its ends either at the centre or outside; or it may be formed into a cylindrical or conical helix, and provided with a rod to support the middle of the filament. 4 claims.

17,812. "Improvements in electric railway systems." J. M. L. Murphy. Dated July 29th, 1897. Relates to electric railways and tramways on the sectional conductor system with switches operated electro-magnetically or otherwise. Two grooved sectional rails convey current from a battery on the vehicle to the switch, which connects the main conductor to the exposed sectional conductor. The subsidiary current excites the magnets, which attract the armature, and complete the circuit between the main conductor, and the sectional rail, by the wedge-shaped contact piece and the spring contacts. The magnets are then included in the main circuit to keep the armature attracted until the circuit is broken at the rail, when a spring acting on the rollers on the T end of the pivoted armature restores it and breaks the contacts. The main collector consists of a piece with rollers. It is mounted on a slide, and connected to a pair of fingers which bear in the grooved subsidiary sectional rails. 15 claims.

17,820. "Improvements in the manufacture of electric cables and in apparatus therefor." W. S. Smith. Dated July 29th, 1897. Cables with co-axial helices of wire separated with insulating material are formed by supplying the wires from a twisting machine, having several bobbins mounted on a disc. The main shaft also drives a die-plate by means of bevel gearing. The die-plate and tube are mounted in an ordinary press chamber, and the covered cable passes out of a stationary die. 2 claims.

17,828. "Improvements in electric lanterns." O. C. Prasse. Dated July 29th, 1897. Relates to lanterns for bicycles and other vehicles. An incandescent lamp is screwed into a conical reflector, fixed on a metal battery casing and provided with a glass front. The casing contains two round cells with porous pots and screw covers, which carry hollow cylindrical carbons. Perforations into inclined recesses permit escape of gas from the porous pots, and mercury is placed in these recesses to prevent leakage, if the battery is tilted. Zinc rods are supported by central rubber plugs in the cover. The cells are connected in series through the casing with springs supported in the hinged lid of the casing, when this is closed, and by a disconnecting switch. The porous pots may be charged with dilute sulphuric acid, and the outer cells with a solution of bi-carbonate of potash, sulphuric acid, and bi-sulphate of mercury. 6 claims.

18,029. "An improved process for the manufacture of electrode plates for storage batteries." C. Marschmer. Dated July 31st, 1897. A material for binding the active material to the supporting grid or frame consists of amber dissolved in dichlorhydrin or epichlorhydrin and mixed with alcohol. Reference is made in the provisional specification to Specification No. 12,250, A.D. 1896. 2 claims.

24,833. "Improvements in and relating to electricity meters." J. Routin and C. E. L. Brown. Dated October 26th, 1897. Relates to quantity and energy meters. A current is periodically sent through an electro-magnet which causes a pawl lever to rotate a ratchet wheel to some extent, the lever being returned against a stop by a spring after each such movement. The ratchet wheel drives a counter. For measuring quantity or total energy, the stroke of the lever is limited variably by a cam, attached to the indicating spindle of an ampere or wattmeter. The cam is freed by the lever when this returns; a fixed stop prevents any action of the pawl on the ratchet wheel while the lever is lower than the lowest portion of the cam. For measuring the duration of current, the cam is replaced by a stationary screw. The periodic current is supplied to all the meters on a pair of supply mains, by connecting their coils between one main and an earth plate, a condenser being interposed if the main current is continuous. The main is connected with a source of continuous current, which is periodically connected to earth by a switch operated by a clock. The period may be altered at different times of day, in accordance with the load in the generating station. The source of current may be an exciter for alternators supplying the mains. When the supply of current is from a transformer, the source may be a dynamo driven by a small motor supplied from the mains. 4 claims.

25,307. "Improvements in or connected with drum armatures for dynamo electric generators and motors." V. A. Fynn. Dated November 1st, 1897. Armatures for continuous or alternating current generators or motors. A slotted drum armature, the slots of which certain several superposed conductors or layers of conductors, is wound in such a manner as to avoid all solder joints, except those at the commutator. The conductors are wound on without previously forming the spools or sections, and those portions which are situated outside the slots are symmetrically arranged, and contained between two cylindrical surfaces, one of which passes through the bottom and the other through the top of all the slots. The invention is described as relating to a four-pole machine, each slot being supposed to contain only four conductors arranged in two layers. The inside connections are those at the commutator end, and the outside connections those at the opposite end. Such an armature would have 17 slots numbered 1 to 17, and the step would be from slot 1 to slot 5, from 2 to slot 6, and so on. It will be seen that after the formation of the first section, the conductors forming the bottom layer of slot 1 are in connection with those forming the top layer of slot 5, the end connections being bent upwards from one layer into the other about half way between the two slots. The same applies to all the other sections. 2 claims.

25,396. "Improvements in switching gear for transformers, reactance coils, storage batteries, and the like." The British Thomson-Houston Company, Limited, and H. M. Hobart. Dated November 11th, 1897. Switches for transformers, resistances, storage batteries, &c., for obtaining a fine adjustment. The turns are connected alternately to contacts arranged in rows. Conducting bars are arranged between these rows, and connected by a resistance from the middle point of which a wire leads to the main. Bridge pieces slide along the bars and connect alternately with the contacts in the row. The contacts are carried by, but insulated from, a carrier fitted with a nut which is reciprocated when the screw is turned. 2 claims.

25,332. "Improvements in and relating to the jointing of electrical cables." H. E. Menier. Dated November 11th, 1897. (Date applied for under Patents, &c., Act, 1883, Sec. 108, May 11th, 1897, being date of application in France.) Telegraph and other cables have the insulating material placed over a joint, compressed, while cooling and setting. Two half-moulds are hinged along one edge by a rod, and are locked when closed by a rod on the other edge. Two semi-annular elastic bags fit the hollow of the mould, and leave a central opening for the cable. The bags are provided with tubular extensions into which the tubes are fitted. The extensions through which the tubes pass are closed by caps. Glycerine, water, air, &c., is forced into the bags to produce an even pressure on the insulation over the joint. The bags may be modified, leaving only the outer end portions, the insulating material itself being forced through the pipes. 3 claims.

25,333. "Improvements in and relating to telegraphic receiving apparatus." J. A. L. Dearlove. Dated November 11th, 1897. Receiving apparatus for submarine and other similar cables is arranged with the suspended coil connected to the cable and to a pivoted light lever means of threads. The lever is connected to an influence machine, such as a mouse mill or to the secondary of an induction coil. The longer arm of the lever moves over the contacts, but is not in contact with them. Each of the stops is in connection with a separate coherer circuit, or two separate levers may be employed for receiving dots and dashes. The coherer may be of the filings form, or may be a partially-exhausted vacuum tube containing ball terminals. There is a relay in the local coherer circuit. The armature of the relay is in the local circuit including the recorder or translator. This local circuit also includes the decohering magnet, which may be a single stroke or operate an armature carrying serrated rods passing through the supports of the coherer. 5 claims.

25,389. "Improvements in electrical measuring instruments." G. K. B. Elphinstone and A. C. Heap. Dated November 12th, 1897. Current meters for alternating currents. A pivoted coil carrying a pointer or recording-arm, and controlled by a spring or weight is movable about a stationary soft-iron core between the ends of a laminated soft-iron magnet. This carries two sets of coils, disposed symmetrically to avoid magnetic leakage. One set carries the current to be measured, and may be in series with an inductive or non-inductive resistance if the instrument is used as a voltmeter. The other coils are connected with the movable coil by an adjustable inductive or non-inductive resistance. The coils magnetise the soft-iron circuit; a secondary current is induced in the movable coil circuit. The inducations are stated to be practically independent of the frequency and wave-form of the current. 2 claims.

25,412. "Improvements in electrical transformers." The British Thomson-Houston Company, Limited, and H. M. Hobart. Dated November 12th, 1897. Transformers are wound so as to allow free ventilation and also heavy insulation at the ends of the layers. Corner pieces are arranged at the corners of the core and then a few turns of bare copper strips to serve as the secondary are wound on. A ventilating space is thus left between the core and the coil. A layer of insulating material is then placed in position and the primary coils wound on, there being one or more fewer turns at the ends on each successive layer. The insulating layers project beyond the coils, and the insulation is thickened. Finally one or two layers of secondary may be wound over the primary. 4 claims.

25,441. "Improvements in the preparation of accumulator plates." C. A. Bennert. Dated November 12th. In making plates or electrodes, there is used lead oxide or lead peroxide prepared from white lead or lead hydroxide electrolytically formed such as by the process described in Specification No. 14,801, A.D. 1895. 1 claim.

25,468. "An improved memorandum desk for use with telephones and for other purposes." C. Harryman. Dated November 13th, 1897. Paper rolls are held in bearings in a bar by turn buttons, and are acted on by tension springs. The paper passes through a slot above and below a carbon sheet, between rollers geared together and actuated by a handle and under a cutter. One of the rollers is covered with rubber and is pressed upwards by a spring so that, by turning the handle the paper is drawn tight from the rolls. The cutter serves to sever the used paper. Only one roll may be used. The clips hold the transfer paper. 3 claims.

25,530. "Improvements in apparatus for heating buildings and the like by means of hot fluids or electricity." J. A. Dargue, E. Griffiths, and C. H. Wright. Dated November 13th, 1897. Radiators heated by fluids or by electric currents, are provided below with openings closed by flaps to admit fresh air. The heated air escapes by the grid above. A plate is provided to receive the dust deposited by the air. It is supported on centres or may slide in guides so that the dust can be easily removed by rotating or withdrawing it, or a scraper or the like may be employed to remove the dust from the plate. 2 claims.

25,540. "Improvements in electrical resistance apparatus." F. Hughes. Dated November 15th, 1897. An incandescent lamp is mounted as shown in section for controlling the supply of current to any apparatus, such as the lamp for examining casks, &c., described in Specification No. 8,135, A.D. 1895. The lampholder is carried by the non-conducting top of a perforated cylindrical metal casing which is fixed on a weighted non-conducting base and has a handle and a vertically sliding door. Four terminals, such as are provided in a groove in the edge of the base, two being connected to the lamp terminals, and the other two connected together. 2 claims.

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ELECTRIC TRAMWAYS IN LONDON.

IT is but repeating an oft-told tale to mention that in many matters affecting the welfare, the comfort, and the convenience of the inhabitants, London occupies an inferior position to many, if not most, provincial cities. Not only are the arrangements of intercommunication lamentably old-fashioned, but the lighting of streets and open spaces is neglected to a remarkable degree, and it is not surprising that it should be held up to ridicule by intelligent foreigners. In an American city of moderate importance a swift electric tramway service provides the most popular mode of progression; in London, where walking is impossible, the traveller must use the slow and lumbering omnibus or endure the rapaciousness of a cab driver. There are, however, signs of an improved state of things so far as systems of locomotion are concerned; the districts of West London are likely to receive the benefits of an electric tramway service within a reasonable period, and even the London County Council is prepared to modify the views which it formerly held, and give us a system of electrically operated lines. Some time ago Prof. Kennedy was commissioned to prepare a report on the subject, and in many respects the report which he has presented to the London County Council is of the greatest importance. It is, in the first place, one of the few reports on electric traction prepared by an eminent English consulting engineer for a local governing body, and for that reason alone the conclusions which he has given should be weighed with the greatest care. For the purpose of arriving at a just appreciation of the various systems of electric tramways at present in use, Professor Kennedy has paid visits to the Continent and to America, and doubtless the information which he has obtained is of the greatest value. It is not proposed to make any extended reference or quotation from the report, for we print it full in our other columns. But in order that our comments may be appreciated at their true worth, it will be necessary to make an occasional reference to some of the statements which are put forward. The systems upon which the Professor has reported, comprise the use of gas, compressed air, and electricity. Most of our readers will probably share Prof. Kennedy's convictions that gas and compressed air cars possess unmistakable advantages in being self-contained, and independent of a central source of power. In this, however, they share their advantages with accumulator cars, but just as we should expect the exercise of caution in recommending the latter form of traction, so are we not surprised to learn that Professor Kennedy does not recommend either gas or compressed air, for the reason that there is not sufficient experience of compressed air traction, and gas traction is for the present put out of court by the difficulty in obtaining really suitable engines. Having, therefore, dismissed these systems as not possessing sufficient merit to be entertained by the London County Council, Professor Kennedy comes to consider the use of electricity.

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No one could deny that the four systems of electricity, the overhead, the conduit, the surface contact, and accumulator systems have been carefully gone into. But a most casual perusal of the report soon convinces one that in the Professor's estimation the overhead wire system is practically unsuited to the condition of the central London streets, although for thoroughfares that approach the suburbs Prof. Kennedy is not averse to overhead wires. Coming after the completion of so many important schemes involving the use of overhead wires, the conclusions of Prof. Kennedy are, to say the least, somewhat startling, and it is necessary to carefully consider the whole position of electric tramways in this country, because the proposals of the County Council are watched with the greatest interest by many municipalities, and doubtless the system they adopt will be copied to some considerable extent. It will be admitted that the importance of the County Council's proposals are lessened by the fact that great municipalities, whose work is not one whit less useful than that of the County Council, have already embarked upon overhead wire schemes. In speaking of the overhead wire system, Prof. Kennedy states that when carried out as roughly as it has been carried out in America its cost is very much less than that of any underground system, but carried out as it is necessary to carry out a system in this country the difference of cost is not nearly so great. It will be necessary to refer to this point subsequently, but when it is stated that for this reason the overhead system has naturally commended itself to private tramway companies and also to municipalities in comparatively small towns, one feels constrained to point out that the overhead wire system, where adopted by municipalities, is not in small towns but in the great towns, Liverpool, Manchester, Glasgow, &c. In any one of these cities it can be confidently stated that the tramway systems are equal to, if not in some respects larger than that at present controlled by the County Council. There are probably many engineers who will be inclined to agree with the view that the overhead wires cannot be regarded as likely to prove a permanent and final solution of the traction problem in a great city like London. Admitting that, however, it must not be forgotten that some system may arise which will do away with the necessity of using overhead wires, and that such a system may also render obsolete both the conduit and the present forms of surface contacts. As Prof. Kennedy points out, crossings and street junctions on the trolley system do involve a little complication in overhead wires, but there are many instances in this country where the overhead wire work is of such a description that very little objection can be urged against it. Moreover, much of the complication which at present arises at such places is greatly enhanced by the use of guard wires. Guard wires for the most part, especially in large cities, are necessary to give protection to the telephone system, but the National Telephone Company which owns the whole of the town overhead telephone wires of the country is gradually putting its overhead net-work underground, consequently in a few years' time the necessity for employing guard wires may cease to exist. Moreover, if even telephone and telegraph wires were always to remain in contiguity to the tramway wires, we feel confident that some method would be evolved to obviate the use of somewhat unsightly guard wires. Professor Kennedy makes the statement that "If any private company asked permission from a committee of the London County Council to erect at any one of the 12 junctions, such arrangements of poles, span wires, stays, guys, conductors, &c., the proposal would be met by an absolute and unconditional negative." It is quite probable that Prof. Kennedy is right on this point, and we firmly believe that the County Council would refuse permission. In raising these objections to the overhead trolley system, it is obvious that Prof. Kennedy is paving the way to the suggestion of a conduit system; and it may be said that the chief part of his report is devoted to establishing the claims of an underground conduit or slot system. The Professor states: "I am glad, therefore, to be able to say as the result of my examination of the present state of underground electric tramways, that the laying out and working of lines on the slot system has already been carried out successfully on a very large scale." No one seeks to deny for a moment the conspicuous and well-deserved success that has followed the introduction in some places of an underground conduit. But there ought to be a clear and unmistakable understanding on the part of all persons engaged in considering the problems of electrical traction that the underground system has been only adopted where it has been made compulsory. The authorities that control the roads of our cities have perfect and free right to prevent what may be held as spoliation, but it must not be forgotten that in this country tramways will be for the most part operated and controlled by municipal bodies, and naturally, whether they carry out the system themselves or permit it to be carried out by a company, their concern for the appearance of the public thoroughfares is the same, and admitting that, what do we find? Nothing less than the wholesale adoption of the overhead wire system by the various large towns of the country. And lest there should be any misunderstanding on this point, we want to show that the great scheme of the London County Council is not the only one in the country; it is probable that the tramway system to be converted to electric working will comprise some 200 miles of single track and 500 cars, but the Glasgow Corporation have already decided to adopt a system taking 600 cars as a basis and with a mileage that will be probably greater than that of London. The Corporation of Manchester is at present engaged on a scheme that is of much more importance than that of the London County Council, Liverpool is going ahead with a large scheme, and these municipal authorities have considered that the overhead wire system is the only one to adopt. We have a certain amount of belief in a conduit system, and there is no doubt that from a working point of view it is quite as practicable as an overhead wire system. It may cost a little more to operate on account of the larger maintenance charges, but there is no shadow of doubt that such a system can be really considered on a practical basis. It must not be lost sight of, however, that a conduit system means a very serious increase in capital expenditure. If a local authority is prepared to pay for such a system it must be clearly understood that it will give no better working, and will be, moreover, open to certain drawbacks. Prof. Kennedy lays considerable stress upon the fact that the chief engineer of one of the principal companies using both systems gave as his experience, that where the overhead system has to be provided with underground feeders and with handsome poles and other appurtenances as would meet with the approval of his municipality, the actual difference in cost between the two systems was very inconsiderable. It is necessary that fuller information should accompany such a statement, because it has been fully recognised by engineers who have carefully considered this matter that there is a very considerable difference between the cost of

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constructing an underground conduit and the overhead wire system, even where the overhead work has been of the very best type. One of the most notable instances of the conduit system is that of New York, and there is very little doubt that the commercial success achieved by this line has been due to the splendid way in which the conduit was built, which, moreover, cost as much as £20,000 per mile. It is interesting to quote from our issue of December 2nd, 1898, when we made some reference to the New York conduit system. We said then: "Supposing that the entire Metropolitan system of 210 miles should have been equipped on the best overhead system, instead of the conduit, a saving of 2½ to 3 million pounds sterling in the capital expenditure would have been effected." We further stated that it must not be overlooked that the construction of a conduit, besides at least doubling the total capital expenditure, entails an enormous amount of annoyance to a city during its construction, as the people of Brussels, New York, and Berlin now know to their cost. Before leaving this phase of the subject we would call attention to the views expressed by an expert of undoubted eminence in electric traction, and the opinions put forward by this engineer are especially interesting, because the New York conduit line, about which we have heard so much, was designed and carried out by him. We are referring to Mr. Pearson, who was called in by the Liverpool Corporation to advise on the subject of traction. At that time the municipality of Liverpool were in doubt as to the best system to adopt; but the opinion put forward by Mr. Pearson was clear and emphatic on this subject. He stated in his report to that municipality that "the cost of construction of the slotted conduit is very much greater than that of the overhead trolley, as it is necessary to build the conduit in a very substantial manner, in order to withstand the heavy trucking and the effects of frost, which tend to close the slot and disarrange the conduit."

One advantage possessed by the overhead wire system is, one pole will frequently serve to carry wires for two tracks; but with the conduit each track means a separate conduit, and this affects cost of construction in a most striking manner. Taking Mr. Pearson's estimate for Liverpool, we find that one mile of straight track for overhead trolley would cost £5,822, and one mile of straight track slotted conduit system £9,648. If we were to take these as a basis and apply them to the 200 miles of track in London, a conduit system for track alone would cost the County Council £1,929,600, against £1,164,400 for the overhead. In other words, they would pay £765,200 for the luxury of working tramways without overhead wires. We are quite aware that it is not proposed to apply the conduit throughout, still these figures serve to show how enormously the expenses increase over a large system. Very probably Prof. Kennedy has had in view the permanence of the system, but one may pay too high a price even for permanence. In considering electric tramways, we do not suppose there is a single municipality that has not been at the beginning prejudiced against overhead wires. The report of the Glasgow deputation states that "we started our investigations more or less in sympathy with this objection (to overhead wires), but we are bound to say that what we have seen has quite removed from our minds any objection to the overhead wires. Where the system is carried out in the most approved manner, we found that the wires gave only the very slightest offence." But even if the good citizens of Glasgow had prevented the introduction of the overhead system, they would have been completely debarred from using a conduit system, for on one of the principal routes the surface of the street is within 12½ inches, and at other places the arch of a bridge was only 4½ inches from the street surface; it will be seen that under those conditions concrete below the central conduit to a depth of 2 feet is quite out of the question. Is London in any better position than Glasgow in this respect? There may not be many bridges to cross, but the amazing ramification of pipe work within a few inches of the street surface should give pause to any conduit scheme. Why, the very section on which the County Council proposed to try the conduit system is declared by Prof. Kennedy to be unsuited, because along this route there are "three 30-inch water mains at no very great depth below ground." But if Prof. Kennedy and the Council is convinced that the electric conduit is the right thing, why try experiments? We know that the conduit can be made to work, and surely it is hardly necessary to acquire information as to management. Moreover, an experiment is being already carried out for the benefit of the London County Council, but at the expense of the London United Tramways Company. There is another point on which we should like to lay special emphasis. The Professor says: "While admitting to the fullest extent that for a company whose business is to earn dividends for its shareholders the overhead system will appear the most, advisable, and while admitting also that for small towns where the traffic cannot be anything like as much as, and where the expenditure may be proportionately much larger than in London, it may be desirable, on public grounds, to limit the expenditure to the lowest possible amount, yet in the case of London itself I submit that these considerations have not such weight." Our contention is that it is not the small towns which have adopted electric tramways, but the large ones. It must be admitted that the central portions of Liverpool and Manchester are almost as crowded as London, yet we find that the Liverpool Corporation, after a deputation had inspected the European conduit systems, reject the conduit because it "is unsuitable for Liverpool tramways with their heavy and crowded traffic"; they share with the Sheffield municipality the view that complicated tramway crossings would entail considerable constructive difficulties, the system is expensive to maintain, and liable to interruption; that in case of breakdown the difficulty of access causes serious delays; moreover, the Liverpool Corporation states that from a sanitary point of view an open conduit which cannot be effectively cleansed is objectionable. The Belfast Corporation are possessed of a praiseworthy desire to preserve intact the beauty of their streets, yet a committee declares that "the difficulties that would be encountered in introducing an underground conduit system in the lower portions of Belfast, having regard to the position of sewers, covered river courses, gas and water mains, the relation of street surfaces to high water level, and the necessarily wide groove required in the rails, are so great that the deputation cannot recommend its adoption." The people of London are long-suffering, but it is to be feared that even their patience would be exhausted during the period of constructing an underground conduit. In this respect, the inconvenience of constructing a conduit in Berlin has been so great that though the Berlin police authorities will not permit overhead apparatus in the centre of the city, it was some time ago decided not to allow the construction of any more conduit lines on account of the inconvenience arising during construction. It will be seen that the objections to conduits are very real and very serious. They are not insurmountable, but the removal of the difficulties demands a price.

Prof. Kennedy does little more than mention the surface contact and the accumulator, though he foreshadows the possibility of the former system being brought to a practical state. Whatever system of electric tramways is introduced into London, we shall rejoice to see it. We may, however, point out that the L.C.C. is not likely to err on the side of economy.

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INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(*Continued from page* 214.)

Lighting Couplings.

The chief requisites in lighting couplings are simplicity and reliability. Fig. 63 shows a simple and effective form of plug connection for trailer car lighting designed by Messrs. R. W. Blackwell & Co. The holder is fastened below the floor of the balcony ends of the main car, and consists of a socketed brass projection in which the lighting cables end. The trailer lighting cables terminate in a plug of ebonite tapering into a brass holder. To couple up the two the trailer plug is inserted into the socket of the fixed projection

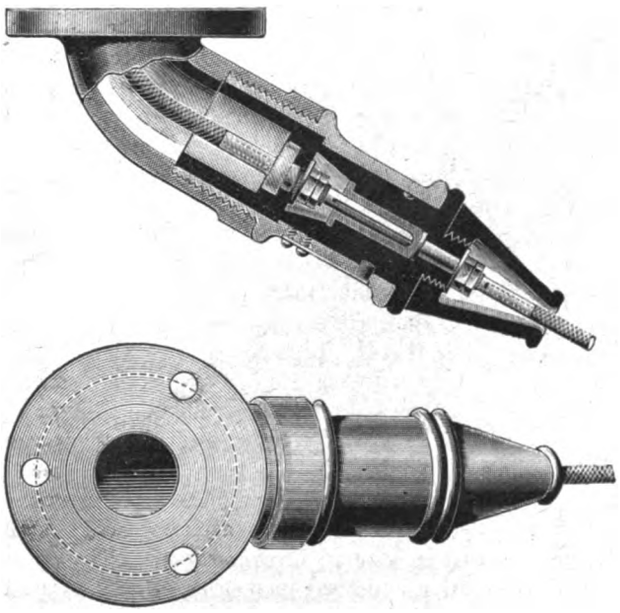

Fig. 63.—Plug Connection for Trailer Car Lighting.

on the main car, the central hollow projection in the socket running into the socket of the plug and receiving the central rod, thus doubly establishing the required connection. This form of coupling is very generally adopted, and fulfils the requisites mentioned above very satisfactorily.

Commutator Segments and Carbon Brushes.

As accessories only are being dealt with in this series of articles, there are only two connected with the motors which will be critically examined; the first are commutator segments, the second commutator brushes. To obtain the standard of thorough efficiency it is most important that commutator segments should be made from metal which is absolutely uniform in texture and fibre throughout, otherwise the flow of the current is interrupted and irregular, heating is generated locally, power is lost, and the segments are more rapidly worn out than they should be. Cast copper even when compressed by stamping is very far from uniform in texture and fibre, and is therefore not satisfactory as a material for commutator segments. These should be forged from drawn rods of wrought copper. The accompanying figs. (64A and 64B) show the operation of breaking down and striking up a forged rod to produce a Westinghouse commutator segment, and figs. 64C and 65 show a T.H.W.P. and an S.C. Westinghouse finished segment, respectively, produced by the drop forging process, which are absolutely free from the imperfections of cast segments, such as porosity, blow-holes, &c. The process consists in forging hot, pickling to remove all oxides, trimming to remove the flash of fin, and finally hitting them a heavy blow when cold, between hardened and accurately gauged dies, to increase the density and impart smooth surface and correct taper and finish.

BILLINGS' PATENT (DROP-FORGED) COMMUTATOR SEGMENTS.

Fig. 64A.—"Breaking Down" Operation.

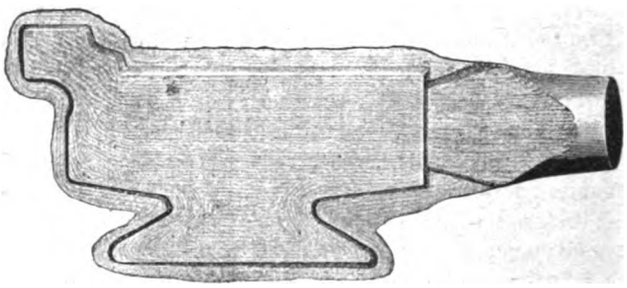

Fig. 64B.—"Striking Up" Operation. S.C. Westinghouse Bar 95 Div.

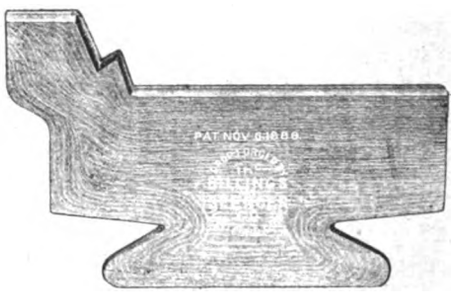

Fig. 64C.—S.C. Westinghouse Bar, 95 Div., Weight 7¾ oz.

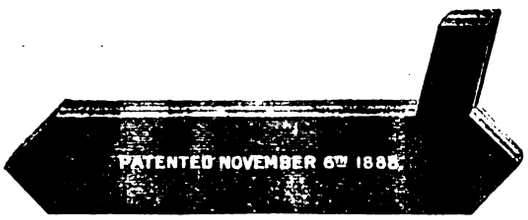

Fig. 65.—T.H.W.P. 30 Bar 64 Div., Weight 6 oz.

Brushes.

In all motors used on electric cars where the motion has to be reversed in direction, the commutator brushes cannot be constructed of copper, the most satisfactory material in

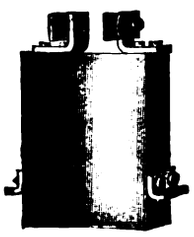

Fig. 66.—Fuse Block.

this case is found to be carbon in certain forms. Carbon in an ordinary way is full of gases and porosities and is therefore wholly unsuitable for the purpose, as it inevitably produces cutting and sparking, both of which materially

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diminish the life of the commutator as well as the brushes themselves. It is, therefore, essential that the carbon of which the brushes are made should, like the metal of the commutator segments, be uniform in texture and fibre throughout. Furthermore, the brushes should be self-lubricating without being greasy and without clogging or gumming at the tips. The ordinary self-lubricating carbon brush is deficient in all these respects, and although cheap in first cost has a very short and troublesome life and is injurious to the commutator in more ways than one. There is, however, a patent process for producing carbon brushes

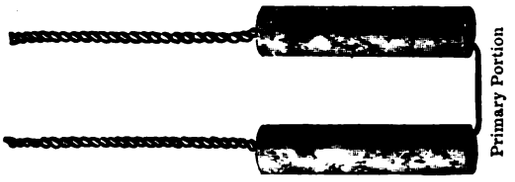

Fig. 67.—Protected Terminal Fuse.

that are free from these drawbacks; by this process the gases contained in the carbon blocks are first extracted, and then the voids are filled by forcing in a special compound, which is a natural lubricant, without being either greasy or oily. This special compound increases the conductivity of the brush and diminishes the specific resistance of the carbon, thus insuring better contact and smaller percentage of loss in the current conveyed, so that the brush is from 7° to 10° cooler than other types of brushes, the life of both commutator and brushes being thus enormously increased. The brushes wear smooth as velvet, and have no tendency to to crumble or break, they require little or no attention, while the commutator is kept constantly lubricated without gumming the segment tips. The compact and uniform texture

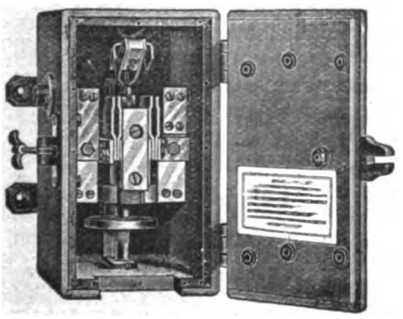

Fig. 68A.—I-T-E Car Circuit Breaker.—Sill Type.

of the surface of these brushes admit of their being plated with either copper or silver, and thus of acquiring the maximum conductivity. The trade name by which they are known is the Le Valley Vitæ Carbon Brush.

Car Circuit Breakers.

The very severe conditions under which the various portions of the equipment of electric tramway cars have to work demand other and more adequate protection than that afforded by fuses. The fuse limits are, in practice, fixed much higher than experience shows is desirable to provide for the jumps in the current which the motors are expected to momentarily sustain. The consequence is, when a short circuit occurs or heavy ground is encountered, the fuse permits dangerously heavy currents to pass without even blowing, and much mischief may ensue unchecked. On the other hand, it often happens that with a heavy load or while ascending a steep gradient, the fuse may blow when it is neither expected nor required to do so; both these drawbacks can be remedied by the substitution of a circuit breaker for an ordinary fuse, and the former to be effective must comply with the following requirements:—

1. They must counteract the careless treatment and abuse of equipment on the part of incompetent or reckless motormen.

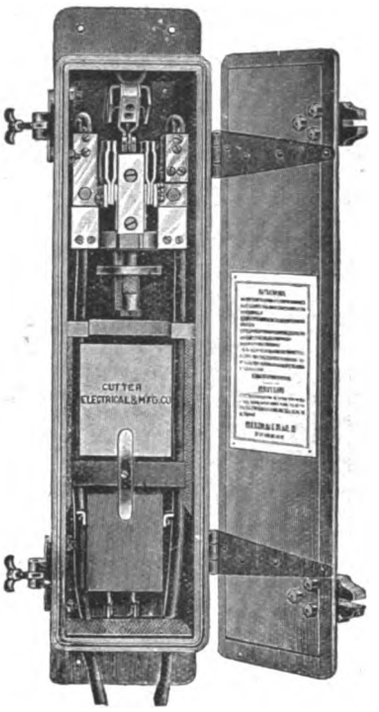

Fig. 68B.—I-T-E Car Circuit Breaker.—Dashboard Type.

2. They must prevent interference with travel and stoppage of service arising from the power station circuit breakers being brought into action through the breaking down of an individual car.

3. They must put a stop to the arcing set up by the sluggishness in blowing of a heavy fuse when ground or short circuit occurs, and the consequent destruction of surrounding material and insulation.

4. They must avoid the development of new faults and flaws in the apparatus during short circuits or ground, contingent on the abnormal carrying capacity of the fuses employed.

5. They must put an end to all burning and blistering of contacts when circuit breakers open.

6. Their adjustment must be independent of friction springs or other fittings liable to alteration, and when adjusted, they must not be able to be altered without the knowledge of the superintendent of equipment.

To ensure the above characteristics, the car circuit breaker must be provided with a fuse block composed of practically indestructible material, connected with a diminutive protected terminal fuse, whose carrying capacity is a small fraction of the lowest adjustment of the instrument. This fuse must be connected in shunt with the circuit breaker contacts so as to blow immediately on the circuit breaker opening, and must be readily replaceable. A record of terminal fuses

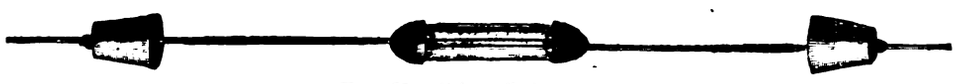

Fig. 69.—"Ajax" Arrester.

expended by each motor man provides a ready check on abuse of equipment, as when a car is properly operated, the necessity for and consequent probability of the contact breaker being opened is reduced to a minimum.

Figs. 66 and 67 show an indestructible fuse block and a convenient form of protected terminal fuse, and figs. 68A and 68B two forms of I.T.E. car circuit breakers, one for fixing on the sill, and the other on the dashboard of a car, which satisfactorily comply with the requirements set forth above.

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Lightning Arresters.

The destructive passage of currents of very high voltage may also be induced through the connections of a motor car, with all the undesirable consequences detailed above, by the action of lightning, and here the circuit breakers would be inoperative, and a special appliance known as a lightning arrester has to be provided. To be efficient a lightning arrester must be extremely sensitive, and must not be liable

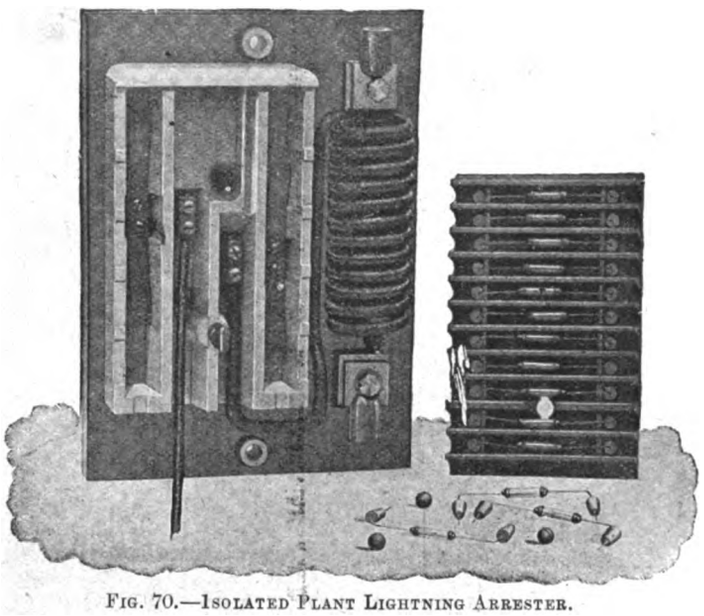

Fig. 70.—Isolated Plant Lightning Arrester.

to getting out of order by contact with dust or damp. Fig. 69 shows a form of fuse (the "Ajax") specially adapted for lightning arrester construction. This consists of two pieces of No. 26 brass wire, each 8 inches in length, having a single silk insulation. These are laid side by side for about 1 inch, as in consecutive armature coils. This lap offers

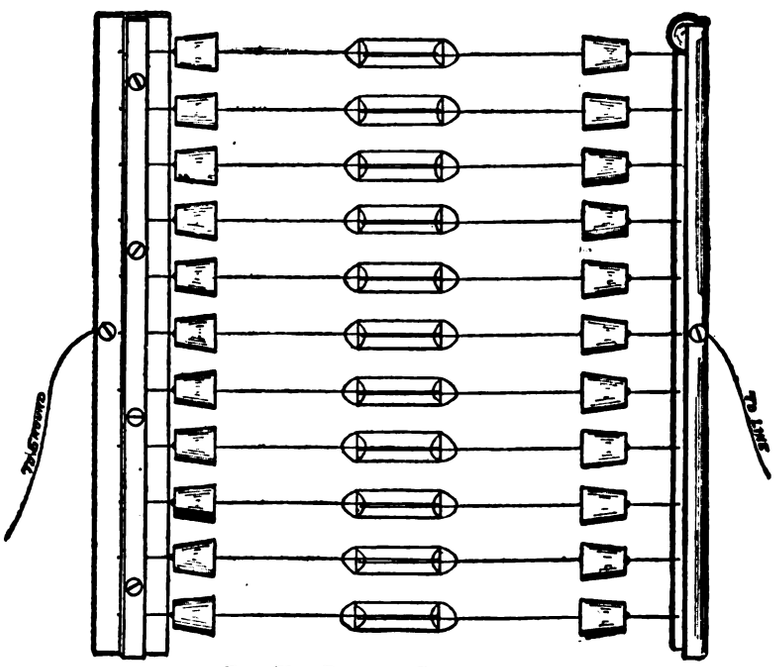

Fig. 71.—Plan of Construction.

abundant surface for the discharge gap which is formed by the two thicknesses of silk amounting to little more than ·002 of an inch. The wires are secured in position by small pellets of highly-insulating wax, and a small glass tube is hermetically sealed over this part of the fuse to keep the dischargers dry and clean till used. Extreme sensitiveness in this part of the fuse is rendered possible by its being called upon to act but once. The ends of the wires are passed through soft rubber plugs, which serve to hold the fuses in the corrugated cover of the arrester (see figs. 69 and 70), and the bare ends projecting through the cover are connected with the line and ground terminals as shown in fig. 71. The fuse frame is fixed on a marble slab, $7\frac{3}{4}$ inches × 11 inches × $\frac{7}{8}$ inch, with an inductance coil in parallel, the latter being connected through the switchboard with the motor and through that to ground.

The adoption of efficient circuit breakers and lightning arresters, such as are above described, reduces the risk of breakdowns due to burned armatures, scorched contacts, and destroyed insulation to infinitesimal proportions, and thus ensures the non-interruption of service so much appreciated by the public.

(*To be continued.*)

THE MACHINE TOOL QUESTION.

In our issue of August 4th we completed a *précis* of an able paper on "Machine Tools," read by Mr. Amos before the Society of Engineers. That the author has bestowed a large share of attention to the subject is clearly shown by the comprehensive and thorough nature of the paper. The machine tool question is assuming dimensions so extended as to render it almost impossible for one mind to possess a detailed grasp of it; much more difficult is it for one firm to do justice to more than a comparatively small section of the industry. The Americans have more fully realised this cardinal truth than the manufacturers on this side, and have as a consequence excelled in their wares, and have thereby provided us food for serious contemplation. Their policy consists of putting into force the well-worn apothegm, "'Tis better to do one thing well than many things badly." This is undoubtedly a great factor in the success of our country cousins. Another factor has been the very high cost of labour prevailing in the States; this has stimulated invention to an enormous extent in reducing hand labour to a minimum and encouraging by convenient arrangements the instant alteration of feed, to deal with changes in the diameter of work. To minimise the time of manipulation the handles controlling the various motions are all brought under the hand of the operator.

An important factor in this tool question, and one which is frequently overlooked, is the miserable want of facilities that English makers have of becoming acquainted with each other's manufactures. A similar difficulty presents itself to the purchasers, whose knowledge of tool makers and types of tools is frequently of the most limited character. This state of affairs is partially due to the jealous manner in which the manufacturers sentinel their workshops against each other, but more largely due, perhaps, to the absence of a journal devoted exclusively to machine tools and manufacture. America has at least two excellent papers of this character, notably *The American Machinist* and *Machinery*. These publications bristle with practical matter by practical men, and it behoves every English manufacturer to include both of them in his literary pabulum.

Added to these elements of advantage must be considered the difference in character of the two nations. We are ponderous and lethargic, while our "cousins" are versatile and energetic. Our brains are probably equal to those of the Americans, but whilst we are considering our ideas the latter go ahead and give effect to theirs. They may make more mistakes, but they "get there" sooner.

The great cry of English makers against the lightness of American tools has now been silenced, with one little exception, which is still adhered to with extraordinary pertinacity. We refer to the tool post, which, in the American design, is a paltry little pillar, with a single screw to secure the tool. The fact of its being so universal in America makes one inclined to think that prejudice has something to do with its disfavour in this country.

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Whilst fully recognising the impossibility of describing every tool in the market, we feel that there are omissions of one or two tools of sufficient importance to justify our mentioning them without apology to the author of the paper. Among these is a type of large and heavy tools known as "portable tools," which are almost indispensable adjuncts in electrical factories where big units are produced. For the employment of these machines a large cast-iron bed is provided and permanently fixed, the surface being cut up by slots in all directions, and upon this is clamped the work to be dealt with. Various self-contained electrically driven tools, such as slotters, millers, or drillers, are carried about by an electric crane to the required site and put to work; in some cases several tools may be employed simultaneously. Newton, of Philadelphia, among others, makes a specialty of this class of machine.

Another excellent portable tool, chiefly used for engine work, is a planing and slotting machine, by Morton, of Muskegur Heights.

Portable tools may be considered an apt illustration of the mountain coming to Mahomet.

In mentioning automatic screw machines, the Cleveland should not be omitted, it being perhaps the most up-to-date of its class, the time of changing from one size of screw to another being reduced to a minimum by the replacement of the cam plates by a simple screw adjustment.

Mr. Brockie (of arc lamp fame) is now putting on to the market a very wonderful machine of the automatic character and of very simple construction.

In connection with the automatic tools, we are surprised that no reference has been made to the semi-automatic lathe of Gisholt. It is rapidly becoming a necessity in this country for repetition turning and boring work. The exact dimensions are obtained very simply without callipering, by means of adjustable screw stops.

The multiple spindle drilling machine for producing holes not all in a line is a most remunerative labour-saving device. The drills can be set in any position within the capacity of the machine and locked immediately, the motion being conveyed to the spindles by "Hook's" joints.

Reference should be made to the "hogging" machine of Ingersoll, the principal feature of which is the cutter, which consists of a cylinder with a number of circular cutters projecting like the bristles of a "hog." It is not clear whether the name is derived from the position of its cutters or from the fact that it "hogs" off the work.

Talking of cutters brings home the importance of tool grinders generally, and there is absolutely none to hold a candle to that of Sellers, which is the prototype of the Gisholt.

The draw shaper is, perhaps, a type of tool known too well to require description.

In the way of "special tools" the 4-spindle boring machine of Newton's is well worth consideration. By its use the four journals are bored simultaneously by four independent boring heads with 6-inch spindles. This arrangement obviates a boring bar and its contingent spring.

With regard to the question of motor attachments one cannot feel very proud of Muir's drill, which does not give one the impression of being more than an afterthought.

In conclusion, the industry is certainly indebted to Mr. Amos for directing its attention in so able a manner to a subject of so much importance; he strongly recommends that all English engineers before purchasing tools to any extent should cross the "herring pond" and see these wonders for themselves.

SOME NOTES ON THE ELECTRICAL MACHINERY AT THE COMO EXHIBITION.

By KENELM EDGCUMBE, Assoc.M.Inst.C.E.

Although the Como Exhibition has been completely destroyed by the disastrous fire of a few weeks ago, some notes on the more important electrical engineering exhibits which it contained, may perhaps be of interest. With the exception of two or three German firms, all the heavy machinery exhibited was of Italian make, and possessing few features of actual novelty, was, perhaps, chiefly of interest as indicating the present tendency of "Continental" design. For although the conditions obtaining in the various European countries obviously differ enormously from one another, yet there is far greater similarity observable between machines built in Italy and Sweden, for example, than between those produced by two such near neighbours as Great Britain and, say, Belgium.

Whatever may be the cause of this state of affairs—and probably the difference in the ratio of cost of material to cost of labour has much to do with it—any such collection of Continental machines possesses a peculiar interest for British engineers.

In a general way, the most noticeable features are (1) the well-nigh universal use of carbon brushes (and the extremely simple and compact brush-holders used therewith). (2) The almost entire absence of the ordinary upright two-pole horse-shoe magnet. The majority of the smaller machines are of the ironclad type, often with a pair of virtual poles, thus forming a four-pole system. (3) The various devices in use to prevent sparking with slotted armatures. In this connection it may be noted that the Allgemeine Elektricitäts-Gesellschaft appears to be abandoning the Dobrowolski cast-iron pole bushing, except for quite small motors, in favour of the Schuckert skew cut horns. The most usual device, however, and one which has probably been adopted from American practice, is merely to cut down the pole tips so as to concentrate the field by lengthening the air gap under the horns. (4) It may be remarked that in nearly all cases marble is used for switchboards instead of slate. This is partly because the former is inexpensive in Italy, and partly owing to the fact that much of the slate contains veins of metal, and is therefore unreliable for this purpose. It is becoming the almost universal practice to employ an iron frame-work for the panels.

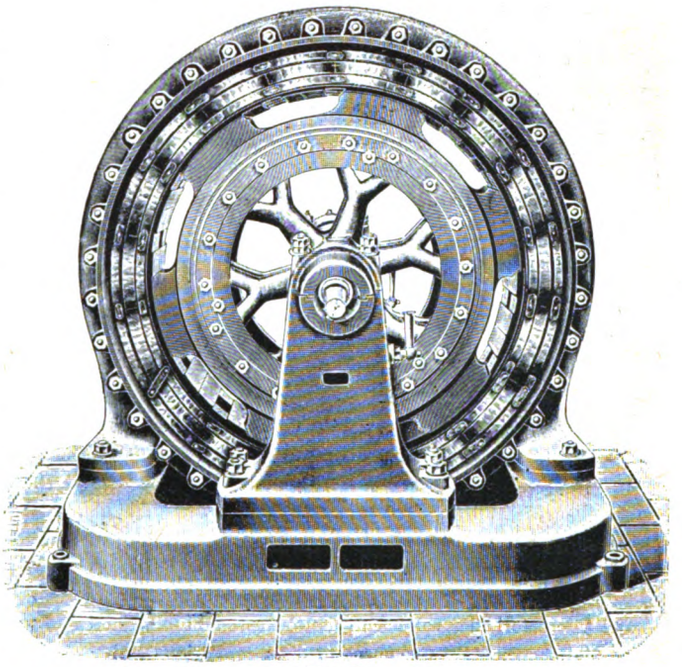

Fig. 1.

Coming now to the actual exhibits. Among those of the Italian firms, perhaps the most interesting display was that of Messrs. Brioschi, Finzi & Co., of Milan. They showed a three-phase inductor alternator of a type which they have constructed for some 12 months with great success, and which presents some interesting features. Fig. 1 shows this machine. The output is 150 kw. at 900 volts. As will be seen from the figure, the field winding is not only fixed, but is wound in slots on the same laminated core as the armature winding. In the particular machine under consideration, the inner and outer sets of coils form the field, while the armature coils, which are of the ordinary type, are "sandwiched" in between them, thus reducing magnetic leakage to a minimum, though of course making efficient insulation more difficult at high voltages. It will be readily seen that as the six laminated poles revolve, the permeance

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changes in such a way as to cause the field to rotate, and in so doing to cut the armature conductors. These machines, which are said to come out slightly more expensive than those with revolving magnet coils, have the great advantage of enabling the armature and field coils to be replaced with the greatest ease, and without its being necessary to remove the magnets.

Fig. 2 shows in longitudinal section a 200 KW. single-phase alternator with magnetic clutch, built by the same firm. As will be gathered from the figure, the exciting coil

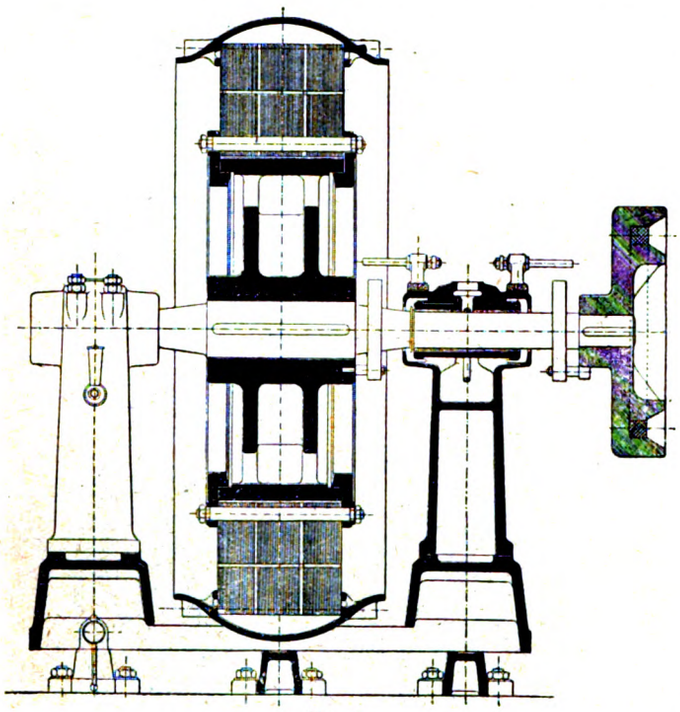

FIG. 2.

of the clutch is in series with the field coils, the current being conveyed to the rotating part by two slip-rings. On test this machine gave the following results:—With a non-inductive load, the full load efficiency was 93 per cent., and the drop in volts, from no load to full load, was 6·5 per cent., the full load voltage being 400. With a load having a power factor of ·8 the efficiency fell to 92 per cent. and the

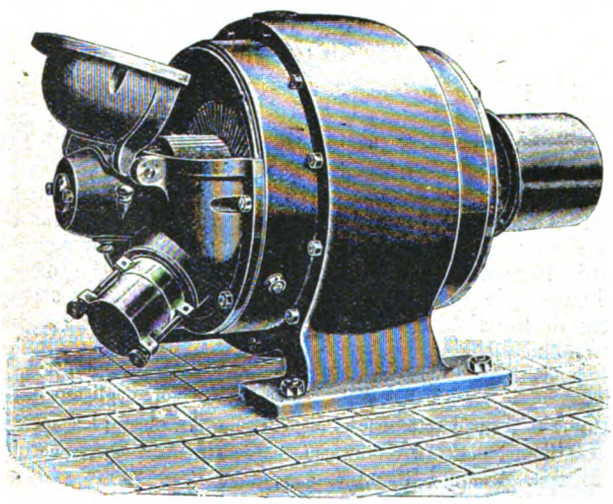

FIG 3.

drop was 25 per cent. The short circuit current proved to be 1,450 amperes, or about three times the normal.

This firm makes a speciality of small motors for driving various classes of machinery, but more especially that used in the silk industry, for which Northern Italy is so famous. For this purpose the motors used are chiefly of the enclosed or semi-enclosed type. Fig. 3 shows a four-pole enclosed continuous current motor of 4 H.P. When the lid is down the motor is hermetically sealed in. The chief peculiarity of this motor is that the entire magnetic circuit consists of laminated iron—not so much to eliminate eddy currents in the poles as to reduce the cross field due to armature reaction. For this purpose the laminations must, of course, be parallel to the armature spindle, thereby offering a greatly increased magnetic resistance to the cross field. The armature, which is slotted, is wound with Eickemeyer coils, held in place by bands. The efficiency of this motor is 85 per cent. at full load. There is also a three-phase 2-H P. motor, arranged for driving a lathe. The speed is reduced to 200 revolutions per minute by gearing fixed to the motor body. This gearing, which consists of a raw-hide pinion driving a cast-iron spur-wheel, has an efficiency of 95 per cent. That of the motor is 79 per cent., so that

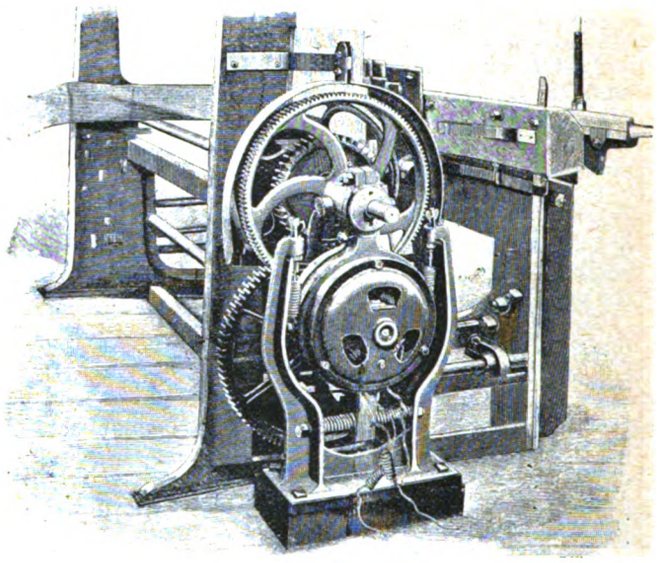

FIG. 4.

the combined efficiency reaches 75 per cent. at full load. The motor is so pivoted that its weight is partially supported by the driving belt, thus securing an even tension on the latter.

In the case of motors driving textile machinery through intermediate gearing, it is usual to support the motor on springs, so as to avoid all shocks. Fig. 4 shows such an arrangement applied to a three-phase motor. The motor body is so suspended as to be capable of swinging about the

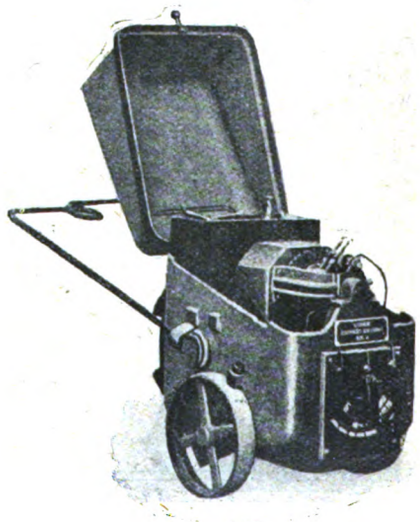

FIG. 5.

axle of the driven machine, its weight being carried by the two vertical spiral springs. In order to keep the motor in position two horizontal springs are applied, one on each side, to an extension of the under side of the case, as will be seen from the figure. By the simple expedient of hanging the motor slightly eccentrically, the distance from centre to centre of driver and driven can be easily adjusted.

The most noticeable feature about the enclosed motors built by this firm is that the outer surface of the case is pro-

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vided with a series of ribs, which serve the double purpose of strengthening the construction, and of increasing very greatly the cooling surface. In the 1 H.P. motor the surface is nearly 40 per cent. greater than that of the

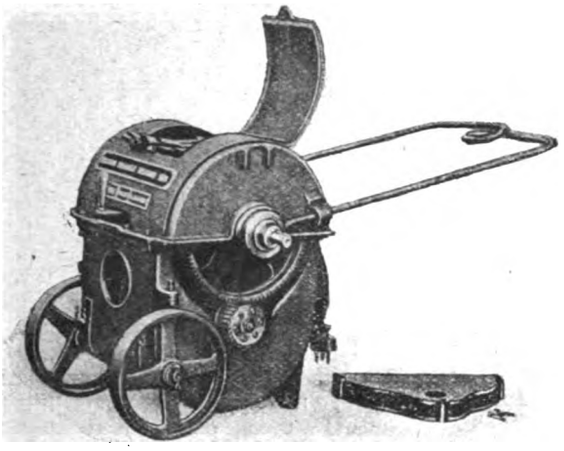


Fig. 6.

corresponding size without ribs. This device is now adopted in nearly all enclosed motors, for with such machines the provision of sufficient radiating surface is always a matter of some difficulty. As an example of the great increase of surface thereby obtained, it may be mentioned that in the case of a 15 H.P. three-phase motor there is a gain of 85 per cent. due to the ribs.

The Allgemeine Elektricitäts-Gesellschaft showed a large number of small machines, of which, perhaps, the most interesting are their portable drilling motors. Fig. 5 shows one of these with the case open. It consists of a continuous current motor of 1 H.P. in a cast-iron box, provided with a

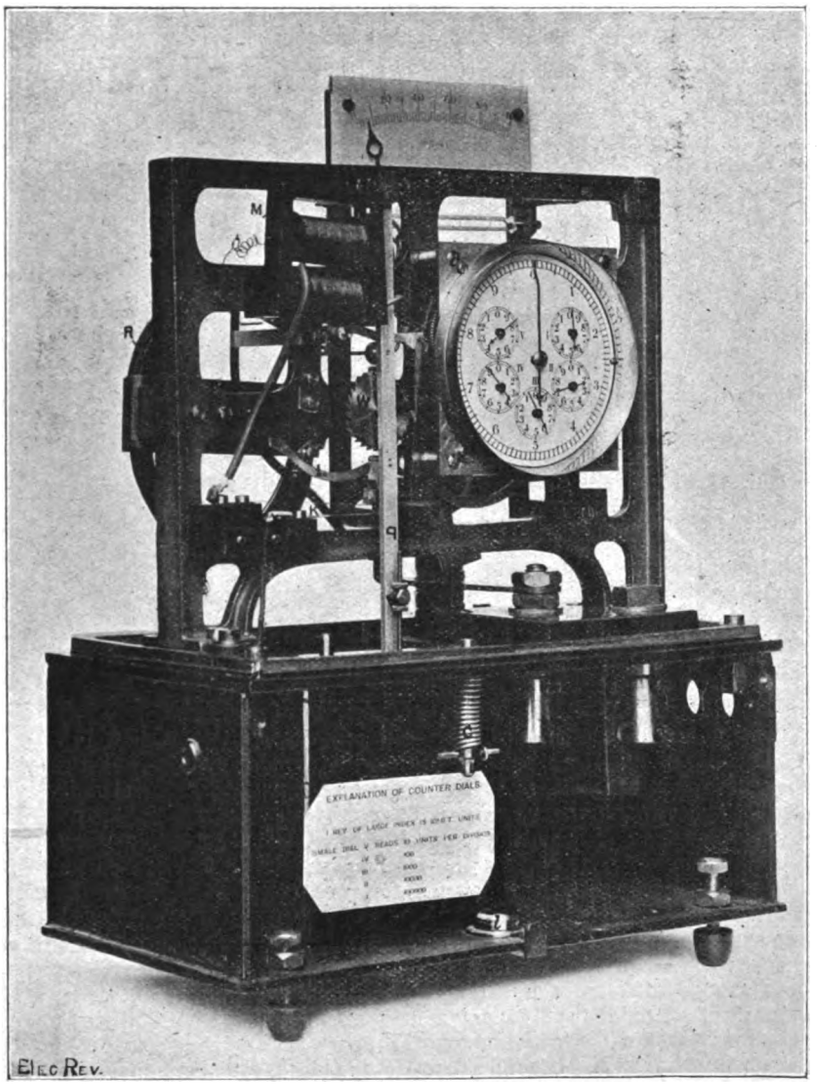
Fig. 7.

movable handle, by means of which the whole can, if required, be slung from a crane, either for transport or to enable the motor to be brought close up to its work, as, for example, in drilling girders in position. The speed is reduced by means of three spur-wheels to 210 or 450 revolutions per minute respectively. By means of a lever either of these speeds can be applied to the drill, or it can be stopped altogether without switching off the current. In the case of three-phase drilling motors, one of which is shown in fig. 6, provision is also made for driving direct off the motor spindle, if required, so that besides the two speeds above mentioned, a speed of 1,440 revolutions per minute can be obtained. The weight of the continuous current 1-H.P. motor is 5 cwt. complete, and that of the corresponding three-phase machine, slightly less. Besides the necessary starting gear, each motor carries a small tool box and several yards of twin cable wound on a drum. As will be seen from the figures, each of the wheels, of which there are but two, can be locked by means of a set-screw, so as to prevent the motor moving, owing to its vibration. Power is transmitted to the drill either by flexible shafting or by a telescopic shaft having a universal joint at each end. The former, which ranges from 5 feet 3 inches to 8 feet 6 inches in length, is constructed to transmit ·2, ·75 and 1·5 H.P. respectively, at 200 revolutions per minute, while the latter transmits 1·5 H.P. at the same speed, and can be extended from 4 feet to 6 feet 7 inches in length. The flexible shafts require supporting in the middle when running. In order to enable several drills (up to four) to be driven by one motor the machine shown in fig. 7 has been devised. The four upper spindles which communicate through flexible shafts with the various drills are driven by the lower spindle, which in its turn is connected by means of either a flexible or telescopic shaft, with the motor. This machine is designed to transmit 1·5 H.P. at 200 revolutions per minute, and weighs about 1 cwt.

(To be continued.)

THE "J. & P." ELECTRICITY SUPPLY METER

This meter, to which we briefly referred in a Note not long ago, we have now had the pleasure of examining. We give below a description of its mechanism, with photographs.



"J. and P." Meter: Front View.

It is a true integrating ammeter for direct or alternating currents, the integration being intermittent—that is, the current is measured at equal intervals of time (usually 30

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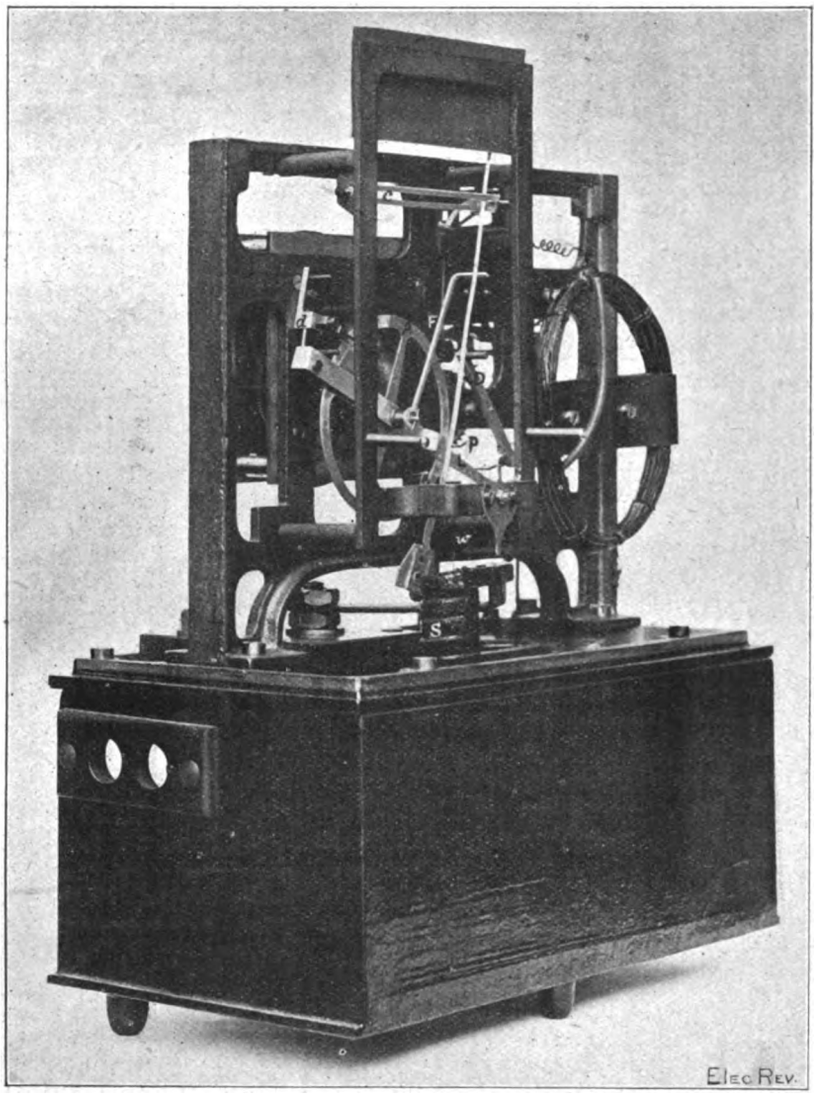
seconds), and a corresponding record is made, which represents the product of the current strength and the time for each such interval. By substituting a wattmeter for the ammeter the instrument becomes an integrating wattmeter, which records the energy supplied to a circuit in Board of Trade units.

In passing, we take this opportunity of protesting against the misuse of the phrase "recording wattmeter." We assert that 99 per cent. of the engineers who use this term have never set eyes on a recording wattmeter, which is an instrument for recording power used at any instant by means of a line traced on a revolving paper cylinder, just as a recording voltmeter registers the pressure which exists at any instant in a similar manner. The proper expression for a meter which records Board of Trade units is *integrating wattmeter*, or *energy-meter*, or *watt-hour meter*; similarly, a meter



"J. and P." Meter: Back View.

which records ampere-hours is an *integrating ammeter*, or *quantity-meter*, or *ampere-hour meter*.

The meter itself presents many novel features. The controlling pendulum, which drives the mechanism, consists of an aluminium rod, P, pivoted at the top, and carrying a leaden bob; the latter swings in a separate chamber, and its beat is regulated by means of the lock nuts seen on the front of the rod. There is a small electro-magnet, M, connected in series with a resistance, R, and a key, K, across the service mains; the pendulum rod carries a loose steel pawl, which trails freely over a block of fibre on the upper side of the key when in full swing, but fails to clear the block, catches in a notch, and depresses the spring contact when the beat falls to a certain minimum extent. The key is thus momentarily closed, and the electro-magnet energised; this happens at intervals depending upon the supply pressure, on the "hit-and-miss" principle, but the effect on the isochronism of the beats is inappreciable, while the average consumption of power is said to be less than 1 watt—a very important feature. The key is always closed when the pendulum is at rest, so that the moment the main circuit is closed the pendulum starts swinging automatically, and by making the key of two springs of unequal length, a rubbing action is obtained, which ensures good contact. The motion of the pendulum is communicated to the mechanism by means of a roller carried on the pendulum rod, which tilts an aluminium lever once in each vibration, and thereby rotates the ratchet wheel, W, through one tooth. The arbor of the ratchet wheel carries a double-ended crank, D, which revolves, with the wheel, once in 30 seconds. The ammeter consists of a solenoid of heavy copper strip, S, in the main circuit, and a fine iron wire, *w*, which is 0·013 inch in diameter and 2 inches long; the latter is suspended in the upper end of the solenoid (which is about 4 inches long) from a pivoted arm, which is controlled by two hair springs, and which also carries the pointer, *p*. The pointer is normally held fast by the clamp, *c*, but during a certain part of each revolution the crank, D, raises a wire which tilts the clamp and sets the pointer, *p*, at liberty to take up a position corresponding with the current strength; during this operation the other end of the crank travels over the curved part of the aluminium lever, L, holding it at rest. The clamp is then applied, and the lever, L, by the continued motion of the crank is allowed to drop slowly, until the feeler, F, rests against the pointer; the end of the lever is provided with a light steel V-shaped pawl, which rests against the edge of the thin aluminium wheel, A, and as the crank comes into contact with the other end of the lever, the pawl engages the rim of the wheel and carries it round through a distance exactly proportional to the displacement of the ammeter pointer. The pawl is a specially noteworthy detail; it will be seen that the combination is exactly similar to that of a pawl and a ratchet wheel with an *infinite number of teeth*, so that there is no backlash or "lost motion." A similar pawl or detent, *d*, is fixed to the frame, and prevents the wheel, A, from being carried backwards by the slight friction of the pawl attached to the lever. The wheel, A, is connected by the usual gearing with a train of dials, the largest of which can be read, in the 10-KW. size, to 0·1 B.T.U. with ease. It is under consideration to replace the dials by numbered drums, as in revolution counters, &c., to further simplify the readings. A novel addition is that of a scale, visible from the outside, by means of which the consumer can tell at a glance what current he is using—if he wants to do so. The scale divisions are perfectly uniform right across the scale. To overcome the slight inaccuracy at very low currents, owing to the iron wire not being saturated, a very clever device is adopted:—One of the controlling hair-springs is firmly attached both to the frame and to the ammeter movement; the other, which is much weaker, is fixed to the latter only, while its outer end is free to rotate with the movement through a small angle before meeting a stop. In this way the controlling force is diminished for currents below the saturation value.

To convert the instrument into an energy-meter, the ammeter is replaced by an ingeniously contrived wattmeter, which, however, is the subject of patents not yet completed, and cannot be here described. The instrument is otherwise unchanged.

The loss in the main coil is very small, not exceeding 8 watts in the 100-ampere size at full load, and frictional errors are entirely absent. The framework and the base are of cast-iron. Levelling screws and a spirit level are provided in the lower chamber, which contains also main terminals of an improved form, and a catch, C, by means of which the

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pendulum can be clamped for transport and freed when the meter is fixed in place.

The whole of the mechanism is enclosed in a case, which is sealed by the makers. The lower chamber, which contains all requirements for setting up and starting the meter, is provided with a door which can be sealed by the supply undertakers. High insulation is maintained throughout.

The meter, which appears to us to attain a high level of excellence and simplicity, is being manufactured under the supervision of the inventor at Messrs. Johnson & Phillips' works, Old Charlton.

The makers guarantee to keep the meter in good going order, free, for two years, provided that the works are not tampered with, and certify that the error at no part of the range exceeds 1 per cent.

THE REPORT OF THE PACIFIC CABLE COMMITTEE.

(*Continued from page* 224.)

We thus find that after reducing the paying words to four per minute by "a process which interested the Committee very much," and deducting from that limited output still another eight-letter word per minute, to ease the pressure of work, the relays of clerks, although tired of sending these three words per minute, could still continue transmitting the messages for a longer period than 10 hours out of the 24, if such work presented itself! It certainly must be admitted that it is more fatiguing to send three words per minute than, say, 18; and from that point of view it is really a cruelty to the clerk to deprive him of the extra word per minute under the plea of over-pressure, even although he has still the 3½ words of non-paying traffic to relieve him of this strain.

We have gone into this portion of the subject at considerable length, as being probably that which would be of most general interest to readers of the REVIEW, and having examined the various opinions expressed as to the carrying capacity of various cores, and the relative proportions of paying and non-paying traffic, we will now refer briefly to the probable revenue which the Pacific cable might be expected to earn under the conditions which we have detailed. We have shown that on the part of the Eastern Extension Company, who are not unnaturally opposed to the laying of a competing cable, the estimated traffic, as allowed by them, is unduly small, being only 672,000 paying words out of the 1,948,000, which formed the total transmitted in 1895; although, even with this division of the traffic, the Eastern Extension Telegraph Company anticipate a reduction in their receipts of £118,000, should the present rates be maintained (which cannot be expected), or an annual reduction of £197,000 in their revenue, should the rate be reduced to 3s. per word. This estimate appears to be made on the assumption of a non-elastic traffic, and the large increase in the volume of the traffic which experience leads us to expect, consequent upon any considerable reduction in the rate, has, apparently, not entered into this calculation. This is strange, as not long after the Eastern Extension Company reduced the Australian rate from 9s. 4d. per word to 4s. 9d. per word, the traffic increased so rapidly that the total revenue at the reduced rate soon exceeded that of any previous year. The representatives of the Eastern Extension Company, ignoring this experience, anticipate that they would be unable to pay dividends from the Australian traffic, and that "it would be unfair to make the telegraphing public of China, Java, &c., pay higher rates than necessary for the benefit of Australia." And yet, with this sensitive regard for the purse of the public, this company does not seem to realise the unfairness of subjecting the telegraphing public of India to higher rates than they should be charged, so that the Eastern Extension Company, who do not carry messages to Europe, should derive a benefit from the joint purse agreement which they have with the Eastern and other lines which do carry these messages. The Marquis of Tweeddale assumes that, taking a rate of 3s. per word between Australia and England, this amount would be divided up as follows:—2d. to Australia, 4d. for the transit of America, and 1s. for the Atlantic cable which carried the message, leaving 1s. 6d. as the share of the Pacific cable. Mr. J. C. Lamb pointed out that the Government officers in England could do nothing to collect traffic for the Pacific route, except in as far as they would be bound by an old agreement with the Anglo-American Telegraph Company, which was made between the Duke of Montrose, as Postmaster-General, and the Atlantic Telegraph Company and the Anglo-American Telegraph Company in 1868 (31 years ago). This agreement was scheduled to the Telegraph Act, 31 and 32 Vict, c. 110, and the seventh clause is as follows:—"The Postmaster-General to hand to the companies in London all messages which can be sent by the companies' cables, and the companies to hand to the Postmaster-General in London all messages received through the cables, unless otherwise expressly required by the sender in either case." No limit of time is mentioned in this agreement, but it appears that a memorandum was passed between the Postmaster-General and the companies relative to the above Act of Parliament, by which the agreement is limited to 30 years, with clauses providing for a revision of its terms at various specified periods. As the 30 years mentioned in the memorandum have expired, it would be of interest to know what revision has been made, as the Act must have the effect of placing the majority of the Atlantic traffic originating in the United Kingdom at the disposition of the Anglo-American Telegraph Company, who are thus, to a great extent, supported by the English Government against competition.

Mr. Lamb criticises the possible action of the Commercial Cable Company in regard to the collection of traffic for the Pacific route, by saying that it would "give rise to a certain amount of adverse comment that a competitive foreign company was practically acting as agent for a Government line," which presumably means that it would be indelicate on the part of the Commercial Cable Company to attract traffic over their cable, if to reach its destination such traffic had ultimately to pass over the Pacific cable.

Mr. Lamb also said that the Post Office could do nothing towards procuring traffic for the Pacific cable, but does not say by which *viâ*, "Pacific" or "Eastern," the unrouted messages handed in at English telegraph offices would be sent. In virtue, however, of the Act above cited it appears that the English Post Office would be compelled to hand all unrouted traffic for Australia over to the Anglo-American Company, which is, of course, equivalent to routing this traffic *viâ* Pacific. This witness agrees pretty nearly with the Eastern Extension Company's representatives in estimating that one-third of the traffic from Australia would be all that would fall to the share of the Pacific route, and that with a 3s. rate the Pacific cable would retain about 1s. 6d. At this rate Mr. Lamb estimates that for the first year the revenue of the Pacific cable would be £46,500, and that, with a traffic increasing at the rate of 7 per cent. annually, in the tenth year the revenue would be £85,480. In general reference to the laying of the Pacific cable, after referring to the probabilities of cables being laid across the Pacific by foreign Governments, the chairman put the following question to this witness:—

2,395. You would rather see a cable across the Pacific going to Japan and China and to Australia respectively entirely in foreign hands than you would see a British cable in British hands if it was subsidised by the British Government?—Well, I would rather put my answer in this way: that I doubt whether the British Government would be justified in subsidising the cable across the Pacific in order to prevent a foreigner from laying a cable, but of course I would prefer that the whole enterprise, if it is carried out, should be in the hands of the British.

Mr. R. K. Gray pointed out that New South Wales, Victoria, Queensland, and New Zealand being interested in the Pacific cable and controlling the collecting stations, would probably give all their messages to this cable, while in England all the trans-Atlantic cable companies would be anxious to have an increase of traffic, and would therefore become collectors for the Pacific route in Great Britain. The Eastern and the Indo-European Telegraph Companies being the only collectors in Britain for the existing cables have 16 collecting offices in the United Kingdom, while the trans-Atlantic companies have amongst them 58 collecting centres.

Mr. Reeves in his evidence laid stress on the steady growth of telegraph business in New Zealand during years in which

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this colony was "not specially prosperous." Mr. N. Cork expressed the opinion that the volume of telegraph business with Australia is constantly increasing, his own experience being that between 1891 and 1896 the increase in the number of messages was 63 per cent. The witness also gave an interesting account, showing how the use of the telegraph is gradually but steadily growing in banking business as the rates are decreased. The evidence given by Messrs. T. E. Doxat and C. U. Kingston fully corroborated the opinion expressed by Mr. Cork.

Sir Sandford Fleming, on a basis of a 3s. rate between England and Australia, assumes that the Pacific cable will take 2s. of this amount, and that 50 per cent. of Australian traffic, including the traffic which will arise in Canada, will accrue to the Pacific line. He also pointed out that during the last 20 years the average increase in traffic had been 36·4 per cent., and that in his estimates he had taken less than half of this increase on which to base his calculations.

IPSWICH AS AN ENGINEERING CENTRE.

By E. K. SCOTT.

It is rather surprising that of the London firms who from various reasons have found it advisable to remove their works into the country, none should have hit upon Ipswich. This town seems to be eminently suited for the establishment of engineering works, especially those laying themselves out for colonial and foreign trade. Situated as it is on the Orwell, which is practically an arm of the sea, fairly large steamers can come right up to the Ipswich quays, and in any case it is an easy matter to barge down to Harwich and load direct on to ocean-going boats.

The steady expansion of such well-known firms as Messrs. Ransome, Sims & Jeffries and Messrs. E. R. & F. Turner shows that Ipswich is a good centre for engineering work, and also indicates that suitable workmen and mechanics are to be found in the neighbourhood. With the value of land increasing so rapidly, London will become more and more the city of the middleman, the merchant, and the banker. It is certainly no place for the working mechanic, who likes a bit of ground where he may grow his own vegetables and fruit. As Mr. Orcutt has so eloquently pointed out in the *Engineering Magazine*, the prosperity of an engineering works is intimately bound up with the well being of the workmen, and this is one of the principal reasons why up-to-date engineering establishments in provincial towns go ahead so much more rapidly than old established works and firms which continue to carry on in London.

As with Newcastle-on-Tyne, Ipswich is only served by one railway, but the Great Eastern Company treats the town exceedingly well. The London service consists of over 24 trains each way daily, the time occupied by a single journey being only 1½ hours. Day excursions are run to Manchester for 6s. return as a regular thing, and the boat service from Harwich to Antwerp and the Hook of Holland is one of the most remarkable instances of railway company's enterprise which this country can show.

Messrs. Reavell & Co. have recently set up works in Ipswich for the manufacture of high-speed engines, and Messrs. Maudslay, Sons & Field are moving down there from Westminster Bridge Road. It is also rumoured that a large works for the manufacture of torpedoes is about to be started.

CORRESPONDENCE.

Bankruptcy Proceedings.

In your report of my public examination, you have omitted a very important fact which is sure to do me a great deal of harm in the electrical world. Out of the liabilities which were returned at £4,514, the London and District Bank has a claim of £3,464, which I stated in my examination I knew nothing about. They kept the books, received all takings, and found all monies to carry on the business. How then could I owe them this money when I received from them only my salary?

I took sole control of the business November 24th, 1898, at which time the liabilities to creditors was £1,300. On June 8th, when the petition was presented, the liabilities had been proved to be only about £800. Add to this £150 which I agreed to pay the bank for the £120 they paid the official receiver for the estate of Inrig & Chester, gives us a total of £950. This sum includes £250 claimed for goods on order but not delivered, so that my total indebtedness is only about £700.

At the time the bank took this drastic action I had on my books orders for about £2,000 worth of work, on which about £600 had been spent. The value of my machinery, stock, and plant at invoice prices was £1,864.

I took the business over from the bank with a debt of £1,300, and in seven months I had paid off £600 of this, and could have cleared it all in another four months.

The bank is clearly liable for all these trade debts as there was double the amount when I took control, but had they left me alone I could and would have paid them all.

Alec Gavan Inrig.

Correspondence.—Pressure upon our space compels us to hold over until next week a letter by Mr. Arthur Shippey on "Converting old electric lamps into new," also another communication from a correspondent on the "Renewable lamp."—Eds. Elec. Rev.

THE TELEPHONE BILL.

The Telegraph Act, 1899, is not a very voluminous document, so that we are enabled to print it in full for our readers' information. By this Act, the Government afford facilities for competition in a service in which there should be no competition, and defer indefinitely, if they do not altogether prevent, the acquisition of a complete service by the State. We do not think this Act can be regarded otherwise than as a temporary measure, but we hope, nevertheless, that the popularisation of the telephone, which is desirable—indeed, necessary—may be one of its results.

An Act to make further Provision for the Improvement of Telephonic Communication, and otherwise with respect to Telegraphs.

[August 9th, 1899.]

Be it enacted by the Queen's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

1. The Treasury may, without prejudice to the exercise of any powers previously given for the like purpose, issue out of the Consolidated Fund or the growing produce thereof such sums not exceeding in the whole the sum of two million pounds, as may be required by the Postmaster-General for the purpose of the Telegraph Acts, 1863 to 1897, according to estimates approved by the Treasury, and sub-sections two and three of section one of the Telegraph Act, 1892 (which relate to the mode in which money may be raised) shall apply with respect to the sum so authorised to be issued.

2.—(1.) Where the council of a borough or an urban district are licensed by the Postmaster-General to provide a system of public telephonic communication, they may defray the expenses of exercising the powers conferred by the license in the case of a borough out of the borough fund or borough rate, and in the case of an urban district not a borough out of the rate out of which the general expenses of the council in the execution of the Public Health Acts are defrayed, and may borrow money for the purpose in accordance with the Public Health Acts, but in the case of a borough any money so borrowed shall be borrowed on the security of the borough fund or borough rate; and the council may, subject to the provisions of the Telegraph Acts, 1863 to 1897, and of the license, exercise their powers under the license throughout the area for which it is granted, although part of that area may be outside the borough or urban district.

(2.) In the application of this Act to Scotland, a Royal or Parliamentary burgh shall be substituted for a borough, and a police burgh for an urban district, and the town council or commissioners thereof, as the case may be, for the council of a borough or urban district, and for the borough fund or borough rate, or rate out of which the general expenses of an urban district council in the execution of the Public Health Acts are defrayed, there shall be substituted the police or the burgh general assessment, or, where there is no assessment so named, an assessment under any head of the burgh assessments or city

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rate under any local Act payable by occupiers only; and the town council or commissioners, as the case may be, may with the consent of the Secretary for Scotland, borrow for the purposes of this Act on the security of that assessment or rate, but subject to the conditions for the repayment of loans prescribed by the Public Health (Scotland) Act, 1897.

(3) In Ireland expenses incurred for the purpose of this section may be defrayed as expenses incurred in the execution of the Public Health (Ireland) Acts, 1878 to 1896, for sanitary purposes, and money may be borrowed accordingly.

3.—(1.) Where an existing company have before the passing of this Act, under a license from the Postmaster-General, provided a system of public telephonic communication in any exchange area, and it is proposed to grant a new license to a local authority or to another company to provide public telephonic communication in the same exchange area, or any part thereof, then, if the existing company consent to it being made a condition of their license—

(*a*) that they will not give favour or preference to any person whomsoever within the area specified in the new license, and will not, within that area, as a condition of giving a service, require from any person the grant of any facility except for the purpose of supplying telephonic communication to that person; and

(*b*) that their charges shall not, within the area specified in the new license, exceed the maximum rates or fall below the minimum rates authorised in that behalf by the Postmaster-General within that area,

it shall be a condition of the grant of the new license, that where it is proved to the satisfaction of the Postmaster-General that the existing company have incurred or contracted to incur, in the area specified in the new license, material expenditure in laying down underground wires, and have by agreement with any local authority within that area acquired powers for that purpose, those powers shall continue for the period specified in the new license for the duration thereof, but, subject as aforesaid, on the terms and conditions specified in the agreement (including any provisions thereof for determination on breach of covenant), except so far as they may be varied by any subsequent agreement with the local authority.

(2) Where an existing company is at the passing of this Act under a license from the Postmaster-General supplying public telephonic communication in any exchange area, a license to provide a system of public telephonic communication within the same area, or any part thereof, shall not be granted by the Postmaster-General to any person or body other than the council of a borough or urban district, unless it is shown to the satisfaction of the Postmaster-General that the application for the license is approved by the council of each borough or urban district within which it is proposed by the application to establish a telephonic exchange.

(3.) An existing company shall not, without the consent of the Postmaster-General given after the passing of this Act in each case, open an exchange in any exchange area in which they had not, before the passing of this Act, established an effective exchange.

(4.) Where a local authority or a new company, under a license from the Postmaster-General, provides a system of public telephonic communication in the whole or any part of an exchange area in competition with an existing company licensed by the Postmaster-General before the passing of this Act, then, if the existing company consent to it being made a condition of their license:—

(*a*) That they will not give favour or preference to any person whomsoever within the whole of the exchange area in question, and will not, within that exchange area as a condition of giving a service, require from any person the grant of any facility except for the purpose of supplying telephonic communication to that person; and

(*b*) that their charges shall not within the whole of the exchange area in question exceed the maximum rates and (where the company are empowered by agreement with the local authority to lay underground wires) shall not fall below the minimum rates authorised in that behalf by the Postmaster-General within the area specified in the new license,

the license of the existing company shall within the whole of the exchange area in question be extended and continue for the period specified in the new license of the local authority or new company for the duration of such new license, but, except as varied by this Act, the provisions of the license of the existing company (including any provisions thereof for determination on breach of covenant) shall remain in force.

(5.) If the license of an existing company is, under the provisions of this section, extended in respect of any exchange area for a period of not less than eight years beyond the term existing at the passing of this Act, the company shall, at the request of any other licensee of the Postmaster-General providing public telephonic communication in the whole or any part of that exchange area, and under such circumstances and on such terms and conditions as may within six months from the passing of this Act, be prescribed by an order of the Postmaster-General, made with the approval of the Treasury, afford all proper facilities for the transmission of telephonic messages between persons using the system of the company (either in the whole or in part of the exchange area, as the Postmaster-General may prescribe) and persons using the system of such other licensee, provided that the licensee so requiring inter-communication shall in any such case afford similar facilities.

(6.) For the purposes of this section, the expression "exchange area" means an exchange area as defined by any agreement made by an existing company with the Postmaster-General before the passing of this Act.

4. This Act may be cited as the Telegraph Act, 1899, and may be cited with the Telegraph Acts, 1863 to 1897.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending Aug 16th, 1898.		Week ending Aug. 15th, 1899.	
Adelaide	Value £25	Adelaide. Teleg. mat.	Value £1,675
Alexandria	27	Amsterdam	30
Antwerp	45	Bombay	52
Bombay	28	Brisbane	27
Bordeaux	25	Buenos Ayres	845
Bolougne	225	,, Teleg. mat. ..	279
Buenos Ayres	9	Calcutta	214
Calcutta	691	,, Elec. cable	288
Cape Town	144	,, Elec. machinery ..	2,770
Colombo	287	,, Teleg. wire	71
Demerara	9	Cape Town	434
,, Teleg. mat. ..	640	Christiania. Teleg. mat. ..	988
Dunkirk	300	Colombo	40
Durban	155	Durban	164
Halifax	350	East London	273
Hamburg	280	Fremantle. Teleg. mat. ..	242
Hobart	468	Genoa	460
Melbourne	139	Hobart	330
Paris	18	Korsor. Teleg. cable	3,189
Penang	81	Madras	27
St. Petersburg	30	Melbourne	95
Shanghai	68	Ostend	46
Sydney	157	Port Elizabeth	1,646
Wellington	25	,, Teleg. wire ..	105
		Port Said	16
		Rosario	87
		Rotterdam. Teleg. mat. ..	85
		Singapore	104
		St. Petersburg. Elec. motors ..	67
		Stockholm. Teleg. mat. ..	1,205
		Sydney	24
		Trinidad	15
		Wellington	204
		,, Teleg. mat.	80
		Yokohama	53
		,, Teleg. mat. ..	671
		,, Teleg. wire ..	671
Total ..	£4,286	Total ..	£17,522

Foreign Goods Transhipped.

Durban. Telephones ..	Value £29
Paris. Elec. machinery ..	80
Trinidad. Teleph. apparatus ..	39
Total ..	£148

American Electrical Apparatus for China.—Our New York namesake says that the Westinghouse Electric and Manufacturing Company, of Pittsburg, with its kindred interests, has been awarded the entire contract for the equipment of the numerous electrical plants which will be installed on the Chinese Eastern Railroad. The contract at present calls for the immediate delivery of three temporary electric lighting plants, each comprising 15 H.P., 20 H.P., and 60 H.P. Westinghouse dynamos. The shipments about to be made are estimated to be worth some $40,000, but, as the apparatus now ordered is only for temporary work, it is assumed that $200,000 will ultimately be involved in the contract.

Arc Lamp Masts.—Messrs. John Spencer, Limited, of Wednesbury, have just completed two electric light masts for the front of the pier and the new square, for the Corporation of Bournemouth. The masts are of wrought steel to designs by Mr. F. W. Lacy, and are 62 feet high by 21 inches diameter, and ½ inch thick.

Bankruptcy Proceedings.—A receiving order has been made in the case of L. Lawrence (Lawrence & Butcher, 5, Stafford Street, Old Bond Street, W.), electrical engineer, on a creditor's petition.

Notice is filed in the *London Gazette* of release of trustee (Mr. H. Brougham) in the case of E. A. Ingold, electrical merchant, Wandsworth Bridge Road.

At Bradford, last week, Arthur B. Blackburn and J. Walker (Blackburn, Walker & Co., electrical and mechanical engineers, Cleckheaton) came up for public examination. The debtors started in Batley Carr in 1893 as electrical engineers, with £10 of their own capital and £30 borrowed. In every year since 1895 they lost money over contracts, and £50 had been lost experimenting. They had not drawn more than an average of 10s. per week. The examination was closed.

At the Liverpool Bankruptcy Court last week, the case of Messrs. Wild, Rothwell & Co., electrical and general engineers, Southport, was up for consideration. An adjournment to October 5th was granted, so that the accounts which had been ordered might be completed.

The first meeting and public examination has been arranged for August 4th and September 19th respectively, in the failure of L. J. Lawrence, electrical engineer, Stafford Street, Old Bond Street, W.

Liquidations, Dissolutions, &c.—The Woking Sanitary Electric Laundry Company meeting at Palace Chambers, Westminster, has resolved to reconstruct. Mr. E. Mann was appointed liquidator to wind up the company. The new company is to be known as the Woking Laundry Company.

The Hiram S. Maxim Electric Lighting and Engineering (Pioneer) Syndicate is winding up voluntarily. Mr H. C. Emery, 15, George Street, Mansion House, E.C., is liquidator.

Messrs. J., J. W., and A. E Palmer (John Palmer & Sons, ironmongers and electricians, of Clifton, Redland and Bristol) have dissolved partnership.

A meeting of New & Mayne, Limited, is to be held at 33, St. Swithin's Lane, E.C., on September 20th, to hear an account of the winding up from the liquidator, Mr. D. F. Basden.

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Bills which have received the Royal Assent.—The Royal assent has been given to the following Acts:—

Electric Lighting (clauses) Act, 1899.
Telegraph Act, 1899.
Tramways Orders Confirmation (No. 2) Act, 1899.
" " " (No. 3) "
Electric Lighting Order Confirmation (No. 20) Act, 1899.
Moss Side Tramways Act, 1899.
Stretford Tramways Act, 1899.
Withington Tramways Act, 1899.
Weston, Clevedon, and Portishead Light Railways Act, 1899.
South Staffordshire Tramways Act, 1899.
Wolverhampton Tramways Act, 1899.
City and Brixton Railway Act, 1899.
Gateshead and District Tramways Act, 1899.
Manchester Corporation Tramways Act, 1899.
Southport District Tramroad Act, 1899.
North-West London Railway Act, 1899.
Brompton and Piccadilly Circus Railway (Extensions) Act, 1899.
Charing Cross, Euston, and Hampstead Railway Act, 1899.
Newcastle-upon-Tyne Tramways and Improvement Act, 1899.
Bradford Tramways and Improvement Act, 1899.

Catalogues and Lists.—From the "Cotsworth" Arc Lamp and Electric Lighting Syndicate we have received a trade price list of the Cotsworth arc lamps and accessories. Descriptive notes and illustrations are given of the lamps of standard, plain, factory, and inverted types.

Mr. T. M. F. Tamblyn-Watts, of Goldielands, Settle, Yorks, has brought out an electrical catalogue which is intended to serve as a guide in the selection of electrical apparatus for laboratory or for students' use. Various materials have been included in the list, such as wires, bells, telephones, switches, &c., in addition to experimental apparatus, and prices and a few illustrations are given.

Mr. S Schreiber, of Victoria Avenue, Bishopsgate Street Without, sends us a descriptive circular and price list relating to rawhide pinions for noiseless gearing which have been used with good results in the United States and elsewhere for some years past, and also by leading English engineering firms. The rawhide material employed has been made for 25 years past by the Chicago Rawhide Manufacturing Company, Chicago, by a special process. It is claimed to possess great hardness, strength, toughness, general strain resisting qualities, to be impervious to atmospheric changes and to be eminently suitable for electric motor work, motor cars, printing machinery, &c.

We have received from the Cutter Company, Philadelphia, a list of the Q. C. rheostats, in which types B., C., and D. motor starting rheostats, are illustrated, general particulars, code words and prices being also given. The Q. C. field rheostats for different voltages (75 to 500) volts are also included.

Messrs. Polland & Co., of Newcastle-on-Tyne, send us an illustrated circular of the domestic telephone system based on the "P. H. C." micro-telephone, which enables one to use the wiring of any existing electric bell system for telephoning by changing the old pushes for new ones with the metal tubes for pin connectors.

The Edison & Swan Co. has issued a leaflet (No. 130) describing the "Monarch" adjustable ball fitting, which permits the light to be swung from one side of a room to the other without having the flexible cord in any way encumbered, and will sustain any size of enamelled iron or opal glass shade, from 6 inches to 12 inches diameter. The construction is very simple, there being no springs to break, or other mechanism to get out of order, thus rendering it suitable for almost every purpose where a movable light is required. The fitting consists of two balls, the upper ball having a recess on one side of centre in which is a pulley of hard vulcanised fibre. On the opposite side of the centre a hole passes through the ball in a slanting direction from a point in the centre of the upper surface to a point one side of the centre of the lower surface. The lower ball is weighted, and is fitted with a grooved pulley of hard fibre. The flexible cord passes down through the hole in the upper ball, round the pulley in the lower ball, up round the pulley in upper ball and down to the lampholder. The cord not does pass through the lower ball in going to the lampholder, but is left to swing free, thus allowing the light to be carried to any point of angle without being encumbered by the counterweight. The flexible cord between the upper ball and ceiling rose serves as a swivel, allowing one to walk around the room with the light. The fitting is also supplied with a special attachment consisting of a simple revolving shuttle, to which is attached an insulating hook to catch the flexible cord, the shuttle being wound with about 10 feet of line to the free end of which is fastened a five-pointed hook, which permits of its being fastened to a window casing, picture moulding, pigeon-hole of a desk, &c. It is considered well adapted for use in offices, reading rooms, libraries, machine shops, &c.

Charge Dismissed.—The Hon. Charles Rolls and Mr. Ernest Hutton, J.P. were summoned at West London by the police for unlawfully driving motor cars at a speed greater than is reasonable or proper, having regard to the traffic in the highway. Constable Beck said the defendants on the 26th ult. each drove a motor car along Palace Gate, Kensington, and witness estimated the speed they were travelling at as between 14 and 16 miles an hour. Prof. C. V. Boys, F.R.S., said the car ridden by Mr. Rolls was an electrical one, and could not be driven at a high speed. The magistrate was satisfied on the evidence that the constable had been mistaken, and dismissed the summons.

Conditions of Engineer Employment in Germany.—The report for this month of the Amalgamated Society of Engineers, which is abstracted in the *Birmingham Daily Post* for Wednesday, contains some interesting statements by Mr. G. N. Barnes, the secretary, on the conditions of labour in a number of the German engineering works, as shown during a recent "mission" authorised by the society. Workshops were visited in Düsseldorf, Augsburg, Chemnitz, and Berlin. It is stated that "the fencing of machinery, the general protection of workmen, and provision for their comfort are much more complete than in this country, and the shops are more spacious and cleanly. This may be, to some extent, due to stringent Government inspection, brought about contemporaneously with, if not as the result of, accident and other insurance laws; but I am inclined to think that much of it is due to voluntary initiative on the part of employers. Another common feature is the modern appearance of most workshops and the use of first-class appliances. Everywhere new factories are building; machinery is being put down, and a great deal of that at work is dated this year or last. A no less marked feature common to German workshop life is the leisurely manner in which the men go about their work. Although piecework is common, I saw no bustle. With one exception, in all the shops visited men smoked during working hours, and in most of them there were canteens or other provision for getting refreshments while at work." The report states that: "In regard to hours of labour and wages they, of course, compare unfavourably with those current in this country, although there is certainly not the marked difference which is here generally supposed. And when due allowance is made for the stopping time for refreshments, it is doubtful if the actual working time much exceeds that in the area covered in this country by the Employers' Federation. At Düsseldorf the outside or inclusive hours are 60 per week, with one main break in the day—namely, from 12 to 1 30. In Augsburg the hours are the same as at Düsseldorf. But there are two recognised breaks for refreshments in the forenoon and afternoon of a quarter-of-an-hour each, which takes three hours per week from the inclusive time. At Chemnitz the hours are about the same, but vary a little from shop to shop. At Berlin the working day is shorter than elsewhere, but, curiously enough, it varies considerably, in some cases being different in length in different departments of the same firm. The maximum inclusive time is, however, 59 hours per week and the minimum 54. The shortest working day obtains in the largest, best-equipped, most scientifically organised, and best-paying concerns, those of the Allgemeine Electricitäts Gesellschaft, which employ some 14,000 people, and Messrs. Siemens & Halske's, employing nearly as many." Detailed accounts are given as to wages. At Düsseldorf the wages of some 1,200 workpeople averaged over 4s. per day. This included boys and labourers. Most of the fitters and turners were on piecework. There was no sub-contracting, each man being paid through the office, and skilled men earning about 6s. per day as a rule; young men less. The smiths, however, earn more, the earnings of the leading heavy workman averaging 12s. to 13s. per day. The apprentices, who all work together, get 9d. per day for the first year and serve three years. Baths for the workpeople were found at some works, besides refreshment houses and dining-rooms, and on the whole the appointments for the care of those employed would seem to be excellent. Most of the machine tools used were found to be of German make, but there were a few from America and from this country. Altogether the report affords ample evidence of the progressive character of engineering work in Germany.

Crystal Palace School of Practical Engineering.—On Friday last, August 11th, the list of certificates awarded by the examiners in the lecture theatre of the school was presented, Mr. Francis Fox, M.I.C.E., joint engineer of the Great Central Railway, presiding. The report of the examiners showed among other things that in the electrical section the dynamo work of the second term was declared to be particularly satisfactory. Mr. Fox, in his address, referred to a visit he had recently made to America, which showed him that this country is behindhand in engineering, electric light and traction matters. He remarked that men would have to become more highly technical and specialised, or Englishmen would be superseded by Americans in foreign posts and work. Mr. Fox seems to think that there is a great necessity for us to wake up or we shall lose our supremacy, and England may no longer be the workshop of the world.

Electric Launches at Colombo.—Trial trips were successfully made recently with the two new electric launches, the *Water Nymph* and *Venus*. We understand that the electrical apparatus has been made by the Thames Valley Launch Co., Limited, Weybridge, England. The motor is placed at the bottom of the boat—at the stern, while under the seats, which are placed all round the boat, the batteries are put. The electricity is generated by means of a dynamo near the Pettah station, but enough can be stored on the boat to work it for 16 hours, so that a fresh supply will be taken in each day, before starting, the working hours being from six in the morning till nine at night. The power is four-horse, and the boat draws two feet of water. The seats are placed in the larger part of the boat and there is room for 50, for which number the boat is licensed.

For Sale.—The Borough Engineer of St. Helens, Lancashire, is offering for sale a vertical boiler and two Bumstead and Chandler engines, direct coupled to two Castle dynamos. See "Official Notices" this week.

Hull Trucks.—Mr. Maskell E. Curwen, of Victoria Street, S.W., selling agent on this side for the J. G. Brill Company, of Philadelphia, writes as follows:—

We beg to call your attention, which we neglected to do at an earlier date, to your issue of July 21st, page 110. You refer to the truck under the Hull cars as being supplied by the Peckham Company. We desire to call your attention to the fact that all of the trucks so far supplied to Hull are made by the Brill Company, and on page 108 of your above number you show a picture of one of the Hull cars mounted on its truck, said truck showing very plainly that it is a Brill truck. We shall be glad if you will take steps to have this properly corrected at your first possible opportunity.

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Finsbury Technical College.—The following is a list of the students who have regularly attended a complete course of instruction for day students (extending over a period of two years for mechanical and electrical engineering students and three years for chemical students) at the Finsbury Technical College, and have now satisfactorily passed the several class examinations:—

Name.	Course.
Bartlett, Arnold W., London C.C. Inter. Scholar	Mechanical Engineering.
Brown, Dugald A., London C.C. Inter. Scholar	Electrical Engineering.
Cazeaux, Sebastian	Mechanical Engineering.
Conradi, Emile S.	Mechanical Engineering.
Cooke, Stanley W.	Mechanical Engineering.
Crush, Hugo P.	Mechanical Engineering.
Endacott, Arthur P., Devon C.C. Scholar	Mechanical Engineering.
Eynon, Lewis	Technical Chemistry.
Fiddian, Kenneth W.	Electrical Engineering.
Fisher, Percy A., London C.C. Inter. Scholar	Electrical Engineering.
Holliday, James W., London C.C. Inter. Scholar	Electrical Engineering.
Howgrave-Graham, Robert P.	Electrical Engineering.
Jeffery, Walter J., Middlesex C.C. Scholar	Mechanical Engineering.
Jollyman, Walter H.	Technical Chemistry.
Jones, Thomas M.	Mechanical Engineering.
Levy, Arthur G.	Technical Chemistry.
Lillywhite, George H.	Mechanical Engineering.
Linford, Walter J., Somerset C.C. Scholar	Electrical Engineering.
Lonnon, William U.	Mechanical Engineering.
Lyddon, Hugh E., London C.C. Inter. Scholar	Mechanical Engineering.
Monk, Reuben G., London C.C. Inter. Scholar	Mechanical Engineering.
Morshead, Leslie R.	Electrical Engineering.
Murphy, Leonard, London C.C. Inter. Scholar	Mechanical Engineering.
Paxton, George S.	Technical Chemistry.
Rolph, William M.	Electrical Engineering.
Seeley Charles G.	Electrical Engineering.
Slaney, George H. T.	Mechanical Engineering.
Smallpage, Rupert S.	Mechanical Engineering.
Stacey, Francis	Electrical Engineering.
Theobalds, Vincent W.	Technical Chemistry.
Trimen, Stephen H.	Technical Chemistry.
Trussler, William T.	Electrical Engineering.
Vigor, Theophilus H., London C.C. Inter. Scholar	Mechanical Engineering.
Walsh, Thomas C.	Technical Chemistry.
Wechsler, Elkan	Technical Chemistry.
Woodward, Percy J.	Electrical Engineering.
Yates, Charles F.	Technical Chemistry.
Young, Ernest V.	Electrical Engineering.

Madras Electric Tramways Company, Limited.—On 19th inst. in the Companies Winding-up Court, Mr. Justice Wright, sitting as an additional judge of the Chancery Division of the High Court of Justice, had before him a petition for the compulsory winding-up of the above company, presented by the Electric Construction Company, Limited. We briefly mentioned the case last week.

Mr. Eve, Q.C., said he appeared for creditors for £32,000 odd, and for other creditors for a like amount.

Mr. Herbert Reed, Q.C., who appeared for the Madras Company, asked his Lordship not to make the order applied for, as no useful purpose would be served by winding up the company, on all the property of which the applicants held a first mortgage; they had debentures covering everything, and there was nothing else whatever. They had been in that position for a long time. His (counsel's) affidavit showed that the company was formed to construct tramways in Madras, the period of construction occupying a long time, and there had been considerable delay, but it was believed that if they were got into working order and a reasonable time allowed them, there would be enough to pay all the debenture holders. It was also proposed to have another form of electrical construction, and recently the petitioners were offered £65,000 to pay them off, their (the petitioning creditors') debt being £72,000 on their own statement, allowing for all the interest which was due to them; and they being the mortgagees in possession. His Lordship would see that the margin was exceedingly small, and if petitioners had been willing to take the £65,000 they would have been paid off. The affidavit also stated that a strong committee was now being formed in Madras. The position of affairs was very serious, as the shareholders were in many instances natives of Madras and people in poor circumstances, who had invested all they had in the company, and the whole of whose interest would be destroyed through winding-up. Trustees of the debenture holders had been appointed in Madras, and they hoped to be in a position to work the tramways. All the troubles of the company had been caused by the petitioning creditorr. Great damage was caused by delay, and the company was obliged to submit to have work done by those creditors, which gave the latter the right under which they now petitioned. The directors strongly believed in the future of the company, and as a proof of that he (Mr. Reed) might say that for five years they had given up their fees, and the chairman had also given up his fees, which alone amounted to £650 a year.

Mr. Eve, in reply, said that in March, 1898, an agreement was come to between the company and the British Electrical Company with a view to seeing whether the latter would take it over and get rid of the creditors. They gave them from March, 1898, to June this year to make some arrangement of that kind, and they had held their hands for 15 months. In order to raise a sum of £8,000 a second series of debentures was issued, and out of that £3,000 was paid to the British Electrical Company. What they complained of was that an office was being kept open in Madras, for which the petitioners had to find the money. There was not a penny coming in for the shareholders to enable that office to be kept open, and it was only piling on liabilities, which would go on increasing, if they allowed the matter to stand over. That would be to the prejudice of the petitioners.

After some further argument, his Lordship ordered the case to stand over until the first petition day in November. If by that time nothing had been done the order for winding-up would be made.

Phillips' Monthly Register.—Mr. C. D. Phillips (*Phillips' Machinery Register*), of Newport, Mon., announces that he has just opened an electrical department. He has decided to publish a supplement of new and second-hand electrical plant for purchase and sale along with his monthly register.

Plymouth Electric Tramways.—In our article on Plymouth electric light and tram undertaking last week, we omitted to say that the Peckham trucks, and all overhead line material were supplied and successfully erected by Messrs. R. W. Blackwell & Co., of London, who were sub-contractors to Messrs. The Westinghouse Electric Company of London.

Phosphor Bronze Company.—A petition presented to the High Court of Justice for confirming a resolution reducing the capital of the Phosphor Bronze Company from £90 000 to £45,000, will be heard by Mr. Justice Kekewich, on October 28th.

Suicide.—On Saturday last, A. R. Marshall, formerly employed by the National Free Wiring Company, of Egremont, committed suicide at Seacombe, by shooting himself. A warrant had been issued on the previous day for his arrest on a charge of embezzling money belonging to the company.

The Castner-Kellner Litigation.—A financial paper understands that the Castner-Kellner Co.'s recent application to the House of Lords desiring that the Commercial Development Corporation, Limited, should, in the event of the former succeeding in their appeal to the House of Lords, give an undertaking to repay any costs they have been ordered by the Court of Appeal now to pay, failed, as a similar application to the Court of Appeal had previously failed.

Theft.—At Southwark, on Monday, George Smith, 37, was sentenced to six months' hard labour for stealing a coil of electric wire, value £6, from Mr. V. G. Middleton, electrician, who had been carrying out some work at Messrs. Clowes, printers, Duke Street. As considerable quantities of wire had been missed, a galvanometer was made to play the part of a thief detector. Two wires connected the coil with the warehouse so that immediately the coil was touched the needle of the galvancmeter would move and thus indicate what was taking place. Prisoner was caught handing the wire over to a woman.

The Glasgow 1901 Exhibition.—We read in the *Engineer* that the Machinery and Electric Lighting Committee of the Glasgow International Exhibition, 1901, have agreed to accept as exhibits for producing steam for electric lighting and motive power, the following:—Lancashire boilers from Messrs. Penman & Co., Glasgow; water-tube boilers from Messrs. Babcock & Wilcox, Limited, Glasgow; Messrs. Stirling & Co., Limited, Edinburgh; Messrs. Weir, Limited, Cathcart, Glasgow; Mr. W. E. Berry, Manchester; and Messrs. Penman & Co., Glasgow. It is estimated that the total power required will be about 5,000 H.P.

Trade Announcements.—The Imperial Electrical Engineering and Stamping Company have taken over the business of Harrison & Co., 133, High Street, Aston, and will devote themselves to the manufacture of special types of switches at their newly-fitted works, 63, Lionel Street, Birmingham.

Messrs. H. M. Salmony & Co., Limited, of Charing Cross Road, having disposed of their accessories and fittings department, announce that they have considerably increased their engineering department, and are prepared to undertake the erection of complete lighting and power plants. They will also trade in the Upton Midget enclosed arc lamps, dynamos and motors, Hart switches, Stirling railway supplies, ironclad rheostats and measuring instruments. The Sun Electrical Company, formerly trading as the Salmony Electrical Company, has purchased the fittings and accessories business referred to.

We are asked to state that the trade announcement sent to us by the Jandus Company, and published in the ELECTRICAL REVIEW for July 28th, requesting that communications should be addressed to the Hartham Road works, related only to the supply of manufacturing requirements to the company. All communications relating to the sale or working of the Jandus lamps, as also all matters relating to licenses to manufacture under royalty, should be addressed as hitherto to the company's sole agents, Messrs. Drake & Gorham, 66, Victoria Street, Westminster, S.W.

Messrs. Frederick Bamford and H. Duckworth Halstead inform us that they have entered into partnership as Bamford & Halstead, consulting, mechanical and electrical engineers, at 49, Deansgate, Manchester.

The Phœnix Dynamo Company has removed from Hubert Street, Leeds Road, Bradford, to Joseph Street Works, Bradford. The new works, which are three times larger than the old place, are more centrally situated and better adapted to the company's purposes.

Trolley Poles.—We have before us a circular of the steel trolley poles for electric car equipment as supplied by the Pittsburg Trolley Pole Company, of Pittsburg, Pa. This company manufacture poles from steel pipe of a superior quality, made especially for their purposes. They have had new machinery erected at the works recently, by which they are able under a special process to produce at one heating of the steel pipe a trolley pole complete, before leaving the machine, of uniform taper, smoothness and strength. The process is covered by letters patent, and the Pittsburg Company has the exclusive right of manufacture.

ELECTRIC LIGHTING NOTES.

Bolton.—A dispute has occurred between the Corporation and the electrical fitters in their employ. The men refused to work overtime except at special rates, and apprentices were told off to do an emergency job, but declined, and subsequently the whole of the

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workmen took their tools out. As several important works are in progress, men have been introduced from other towns, principally Liverpool.

Bradford.—Mr. W. A. Ducat, Local Government Board inspector, held an inquiry last week into an application by the Town Council for sanction to borrow £37,500 for extensions of the electricity works and mains.

Brechin.—The Police Commission has agreed to transfer its provisional order to the Angus Electric Light and Power Company, Limited, Messrs. Edmundson, Limited, being guarantors, and to appoint Mr. Lackie, Glasgow, to see to the proper carrying out of the work on behalf of the town.

Bury St. Edmunds.—The Town Council is applying for sanction to a loan of £600 for lighting certain roads with electricity.

Calcutta.—We are informed by the Calcutta Electric Supply Corporation, Limited, that Mr. B. N. Sen is not chief engineer, but engineer-in-charge of the electricity works, under Mr. K. A. Scott-Moncrieff, who has been chief engineer of the company in Calcutta from the commencement.

Camberley.—The District Council is considering the advisability of applying for a provisional order, and has decided to obtain a report on the subject from an expert.

Cardiff.—The Town Council has increased the salary of Mr. Appelbee, the electrical engineer, from £300 to £350.

Cleethorpes.—The District Council is endeavouring to arrange with the Grimsby Tramway Company for a joint electricity works to supply both lighting and traction.

Cork.—The City Council has caused a large number of arc lamps of different types to be erected in the principal streets, in order to decide which kind should be adopted for the public lighting.

Dartmouth.—The Town Council has agreed to offer no opposition to the Urban Electric Lighting Supply Company in obtaining a provisional order. The Council will have the option of purchase at the end of 14 years, or any subsequent period of five years.

Devonport.—The Corporation has obtained a satisfactory site for the electricity works in East Stonehouse, and has come to an agreement with the Urban Council of that district to treat the borough and the district as one area for electric lighting purposes. The District Council agrees to oppose any application for lighting powers, save that of the Devonport authorities, so long as the latter carry out their obligations; Plymouth is therefore barred from Stonehouse, which lies midway between the two.

Dolgelly.—The question of lighting the town by electricity is under the consideration of the District Council.

Frinley.—The District Council has resolved to employ an expert to report on a scheme for lighting the district with electricity.

Glasgow.—The annual report and balance-sheet of the electricity undertaking for the year ended May 31st, 1899, shows that the gross revenue amounts to £44,141 4s. 7d., and the gross (or working) expenditure to £24,013 4s. 3d., to which is added depreciation written off capital, £7,520 18s., making together £31,534 2s. 3d., the balance carried to profit and loss account being £12,607 2s. 4d., out of which the Committee had to meet the following requirements:—(1) Interest on loans, £7,445 17s. 3d.; (2) sinking fund, £3,220—£10,665 17s. 3d.; leaving a balance of £1,941 5s. 1d., which has been placed to credit of reserve fund account. With reference to the prices to be charged for energy supplied, either for lighting or for motive power purposes during the year which commenced on June 1st last, the Committee recommend that the same should remain as they were last year, except that to all consumers supplied at 250 volts the second or rebate rate be 1½d. per unit instead of 2d. as heretofore. The quantity of electricity sold to private consumers during the past year was 2,566,016 units, as compared with 1,885,902 units during the previous year, being an increase of 36·06 per cent. The number of private consumers on May 31st, 1899, was 1,858, as compared with 1,437 at May 31st, 1898, being an increase of 421 or 29·29 per cent. during the year. There were 52 consumers who consumed the equivalent of five hours or over per day of their maximum demand throughout the year. The number of motors in use and supplied off the Corporation mains at May 31st, 1899, was 78. The total number of arc lamps erected and in regular use in the streets as at May 31st, 1899, was 227, as compared with 119 at the same date last year; and the quantity of electricity consumed for street lighting was 258,334 units, as compared with 228,134 during the preceding year. This increase would have been much greater but for the fact that the lighting of the Springburn route only came into operation in February last. The number of 8 C.P. lamps applied for, or the equivalent in other devices, as recorded on May 31st, 1899, was 191,062, as compared with 150,000 in the corresponding date in the preceding year, being an increase of 27·37 per cent. The number of units consumed, per lamp fixed, by private consumers, averaged out month by month according to date of connecting up, was 14·8, as compared with 15·17 during the previous year, the falling off being due to the curtailment of supply during last winter. The maximum load or demand made upon the generating stations during the year occurred on December 22nd, 1898, and was 3,095·9 kilowatts, which was beyond the capacity of the plant available last winter.

Glossop.—The Town Council is negotiating with private companies with a view to selling its electric lighting order.

Gosport.—The Electrical Power Distribution Company has notified the District Council of its intention to apply for a provisional order; the Council, however, has resolved to apply on its own account.

Halifax.—The Town Council has decided upon an extension of the electricity works, practically doubling the present accommodation. When completed, the new building will afford capacity for machinery of the total value of over £60,000. The extension is to be commenced at once, as the tramway developments and the increasing demand for the electric light permit of no delay.

Harrogate.—The Council decided on August 14th to extend the electric lighting station and the mains, and to purchase new plant, at a cost of £28,000. Application will be made to the Local Government Board for sanction to a loan of that amount.

Hertford.—The Corporation has resolved to dispose of its provisional order to the Municipal Electric Supply Company.

Kesteven County Asylum.—The Local Government Board has held an inquiry into the application of the Kesteven County Council for sanction to a loan of £14,000 for the erection of a new asylum near Sleaford, including £5,000 for electric lighting.

Lowestoft.—The Local Government Board has sanctioned the borrowing by the Council of £30,000 for electric lighting.

Lytham.—The District Council has accepted Mr. Tiddeman's scheme for electric lighting, as amended by Mr. Tonge, and has instructed him to prepare the necessary plans and specifications, and to invite tenders for carrying out the work. The Council has also decided to make application to the Local Government Board for the necessary borrowing powers.

Maidstone.—The District Council has decided upon the erection of a dust destructor at an estimated cost of £4,270, to be worked in conjunction with the electric lighting scheme.

Marylebone.—Messrs. Whamond, Williams & Co., accountants, have valued for the Marylebone Vestry the Marylebone electricity plant of the Metropolitan Electric Supply Company, which the Vestry is desirous of acquiring. They allow £319,735 in respect of capital expenditure, £305,283 for goodwill and other items, making a total of £643,580. On the other hand, Messrs. Deloitte, Dever, Griffiths & Co., the accountants to the company, agreeing as to £319,735 representing capital expenditure on the Marylebone section, estimate the goodwill value of the undertaking at £613,476, their total estimate thus being £933,211, hence a difference of £289,631. The Vestry will consider the report after the vacation.

Penarth.—The District Council is negotiating with the Electrical Power Distribution Company respecting the electric lighting order. The company desires an extension of the time for compulsory purchase.

Penzance.—The Town Council is considering the question of applying for a provisional order for electric lighting.

Perth (W.A.).—Electric train lighting has been introduced for the first time in the colony, on the goldfields railway.

Rhyl.—The Urban District Council on Monday passed the Electric Lighting Committee's recommendation that Messrs. Trentham & Peers prepare a scheme, report, and plans for an electric lighting installation and refuse destructor.

Scarborough.—A Corporation Committee has been appointed to consider and report upon the question of acquiring the undertaking of the Scarborough Electric Supply Company, Limited.

Stirling.—It is expected that the electricity supply will be available for the coming winter. The scale of charges will be:—For lighting, for the first 500 units per annum, 6d. per unit; for the next 500 units, 5½d.; for the next 1,000 units, 5d.; for the third 1,000, 4½d.; and for every additional unit above 3,000, 4¼d. per unit. For motive power, not exceeding 50,000 units per annum, 3d. per unit; exceeding 50,000, on terms to be arranged.

Sudbury.—The town is suffering under a gas supply at 4s. 6d. per 1,000 feet, and the Town Council is considering the question of electric lighting. As a new sewerage scheme is in hand, the engineer, Mr. Eayres, suggested that the pumps for the latter should be driven electrically, so as to dispense with a separate power station. Mr. Eayres's suggestion, we would point out, is of very great importance to the success of this and similar undertakings. It is possible to so design the pumping installation that the latter may be shut down during the hours of heavy lighting load and regulated at other times, so as to maintain a practically constant load on the generating plant. Under these conditions electricity could be supplied at a profit for 1d. or 2d. per unit.

Sydney.—The City Council is taking steps towards lighting the city with electricity, and has communicated with the Agent-General with a view to obtaining the services of an expert technical adviser.

Wimbledon.—The District Council has received a report from Mr. Preece to the effect that the original estimate of £37,000 for electric lighting had already been exceeded by £10,000, and that a further sum of £10,000 was required for immediate extensions, the plant being fully loaded.

Yarmouth.—The income for the past quarter was £1,209 15s., sufficient to pay all works' costs and capital charges, and to leave a small profit. The Council is making inquiries as to the cost of an additional 150 K.W. alternating set.

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ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Blackrock.—A collision occurred on the 13th inst., between an electric car and a hackney car; the latter was upset, and one of the three occupants was seriously injured.

Bradford.—On August 14th a little girl, four years old, was knocked down by an electric tramcar. The child was caught on the guard, and received slight injuries.

Cheltenham.—The Town Council has approved of a new route for the tramways through the town, joining the section already sanctioned to Cleeve Hill.

Dover.—The municipal electric trams are doing excellently. The season has been very satisfactory so far as they are concerned, a record of 20,000 passengers in one day having been made.

Germany.—Messrs. Siemens & Halske, of Berlin, are preparing plans for a projected electric railway in the town of Coburg.

Glasgow.—The Tramways Committee on August 15th, on Mr. Parshall's recommendation, accepted the tender of Messrs. E. P. Allis & Co., U.S.A., for steam engines, the price being £114,554.

Ilford.—A committee, which visited Glasgow and other places, has reported to the District Council in favour of the trolley system. Mr. Hawtayne is to be asked to prepare an estimate for the construction of the tramways.

Ipswich.—The Town Council has had under consideration the question of purchasing the tramways from the Ipswich Tramways Company, at a price to be decided by arbitration. Mr. J. E. Waller, of Messrs. Kincaid, Waller & Manville, has prepared a report for the Parliamentary Committee, in which he states that the lines would require entire reconstruction for electrical working, and recommends extensions amounting to about 4½ miles. The total outlay Mr. Waller estimates at £83,000, exclusive of generating plant and feeders, which would be provided by the Electric Lighting Committee, and he recommends the combination of the lighting and traction works in one station. The Council will take immediate action in the matter.

Leamington.—The Leamington and Warwick Tramways Company is desirous of introducing electric traction, and will probably obtain assistance from the British Electric Traction Company.

Leeds.—The Corporation is about to invite tenders for 50 additional electric cars.

Liverpool.—The City Council has resolved to apply to the Local Government Board for sanction to a loan of £300,000 for electrical purposes.

A serious accident occurred on August 13th, at 9.30 p.m.; a bus which was turning the corner of Crown Street into Upper Parliament Street was run into and overturned by an electric tram proceeding in the direction of Smithdown Road. The collision, which occurred without warning, caused great consternation among the passengers, who were scattered in all directions, and several of them sustained serious injuries.

London.—In a communication to the *Daily Graphic* last week, Mr. Holroyd Smith suggests that while the County Council is laying conduits for the electric tramways south of the Thames, it may as well go further, and construct a large subway under the track to accommodate the various gas, water, and electric mains. For this purpose, he would place the slots in the two rails nearest the centre of the roadway instead of in the middle of each track as is usual, so as to bring them over the subway. The idea is attractive, but would involve an immense expenditure, and we do not expect that it will go any further.

Plymouth.—Sanction has been received by the Plymouth Corporation to their proposal to borrow £18,000 for the reconstruction of the Compton section of their tramways and the equipment of them for electrical traction. The Tramways Committee have decided to invite tenders for the supply of rails and bonds with a view to the early commencement of the work, which, however, will not be completed until a scheme for widening part of the roadway, which is now in progress, has been carried out. A further extension of the eastern section of electrical tramways is to form the subject of an application for a provisional order next session.

Portsmouth.—On the 10th inst. Mr. F. J. S. Hopwood, C.B., from the Board of Trade, sat at Portsmouth to hear an objection of the Portsmouth Corporation in respect to a light electric railway from Cosham to Horndean, to cross Portsdown Hill. It was stated that the War Department was in favour of its construction for military purposes, there being forts on the hill, where it is intended hereafter to erect a military hospital. The scheme was passed by the Light Railway Commissioners, after an inquiry which was presided over by the Earl of Jersey. The Portsmouth Corporation has obtained powers to take over the Portsmouth tramways, and it objected to the terminus of the light railway being made at a narrow part of the road leading out of Portsmouth, on the ground that it would be dangerous to passengers, as there was a good deal of road traffic there. After hearing statements on either side Mr. Hopwood suggested that the parties might agree upon a temporary arrangement, with a view of making a junction between the tramways and the light railway. The War Office and another public department were anxious to see the light railway constructed at an early date, as it would be useful for military purposes. He should advise the Board of Trade on the matter and communicate the result to the parties, who he thought might easily arrange their differences.

Sunderland.—The Corporation Tramways Bill has received the Royal assent, and the Council has agreed to purchase the undertaking from the Sunderland Tramways Company at a cost of £35,000. The whole of the old and new routes are to be electrically equipped by August 31st, 1900, the total expenditure being estimated at £126,618. The estimate of the electrical engineer, Mr. Snell, was £120,600—a very good approximation. The contract has been placed in the hands of Messrs. Dick, Kerr & Co.

The New York Elevated.—According to the *American Electrician*, the Manhattan Railway Company, in July, decided to place a contract with the E. P. Allis Company, Milwaukee, for 8 8,000-H.P. engines, capable on overloads of developing 100,000 H.P. The company had already selected a location for a power house and placed a heavy order for third rails. These engines will be by far the largest ever used for driving electrical generators, having just double the capacity of the 11 4,000-H.P. sets now under erection for the Metropolitan Street Railway Company, New York City. The power station of the elevated will have exactly the same capacity as that planned for the Third Avenue Railroad of New York City, for which 16 4,000-H.P. units were proposed.

Westbury.—The Bristol Tramways Company, Limited, in response to a petition from residents, has promised to obtain powers for extensions to Westbury at the next opportunity.

York.—The Tramways Company applied to the City Council some time ago for leave to adopt electric traction; the Council has now decided to open negotiations with the company with a view to purchase.

TELEGRAPH AND TELEPHONE NOTES.

African Trans-Continental Telegraphs.—The report of the Commissioners of the British Central Africa Protectorate for the year ended March 31st, of which a lengthy summary appears in the *Times* for Tuesday last says with regard to the Trans-African telegraph:—

> The African Trans-Continental Telegraph Company have proceeded steadily with the construction of their line to the north, which is now completed to a point close to the south end of Lake Tanganyika. By the time this report reaches England the line will have been formally opened up to Tanganyika. A branch line is now in course of construction from Domira Bay, on the west shore of Lake Nyasa, to Fort Jameson, the headquarters of the British South Africa Chartered Company in Mpeseni's country. With regard to the extension northward of the African Trans-Continental Telegraph Company's line from the south end of Lake Tanganyika towards Uganda, I am informed by the company's representative that a steamer of considerable size has already been ordered in England for Lake Tanganyika, to be used both for the transport of telegraph material from the south end of that lake to various points on its eastern shore, and also for telegraph purposes after the construction of the line is completed. The telegraph company have now a large number of native operators, and they find that the educated African, as turned out by the various missions in the country, takes readily to telegraph work. Dr. Laws, the head of the Free Church of Scotland Mission in the Nyasa districts, has established a short line of telegraph at the Kondowe Mission, and has a special class of natives who are trained for this work. By thus using native telegraph operators it will probably be possible in future to carry on the work of the African Trans-Continental Telegraph Company's lines with only a very moderate number of European employés. From April 1st, 1898, to March 31st, 1899, 176½ miles of line were constructed and strained—*i.e.*, from Kota Kota to 44 miles beyond Karonga. Blantyre is now in direct communication with London *viâ* Cape Town on the one hand, and with the most northerly part of Lake Nyasa on the other. A Belgian expedition, under the command of Mr. Mohun, passed through the protectorate in the commencement of 1899 for Tanganyika, its object being to erect a telegraph line from a point on the west shore of Lake Tanganyika to the Congo river. A German expedition also passed through with material, &c., to place a new steamer on Lake Tanganyika.

Bradford Telephones.—The Bradford Corporation last week held a special meeting to consider the question of giving notice to the National Telephone Company to determine the agreement as to wayleaves between the Corporation and the company, dated August 20th, 1896. A resolution to that effect was passed, and the town clerk was instructed to carry out the necessary steps.

Congratulations.—We are glad to observe that Don Primitivo Vigil y Lopez Losada, who has on several occasions represented Spanish Government interests during the laying of submarine cables by English companies, has recently been promoted to the position of "Director de Seccion" of the first class.

Glasgow Telephones.—The Corporation Telephone Committee, on 15th inst., agreed to recommend that application should be made for a license to establish a Corporation telephone system in the city.

Gutta-Percha and India-Rubber from Nigeria.—In the course of a series of interesting articles on Nigeria the *Pall Mall Gazette* gives us the following information:—"After ivory, rubber must lay claim to our attention as an important article of Nigerian trade. The white, sweet-smelling flowers of the rubber vine are one of the commonest sights in the forest of Nigeria. Unlike ivory, of which the output is on the decline, the trade in rubber will assuredly grow to large proportions as soon as the advent of competitive commercial enterprise into the Niger and the consequent increased demand for European merchandise on the part of the natives has provided the necessary stimulus for its development. At present the transactions in this product are, comparatively speaking, small. But both trees and vines (*Kickxia africana*, *Landolphia owariensis*, &c.) exist in plenty throughout a large proportion of the Niger territories,

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and only require intelligent working—in which the attractions of immediate gain must not be permitted to spoil future prospects, as has been the case elsewhere—to yield good results. Bearing in mind the gigantic growth of the rubber industry in Lagos, the Gold Coast, French Guinea, and the Congo during recent years, there is every reason to hope and believe that, with stringent regulations against wholesale tapping, the Nigerian rubber trade will ere long become very considerable. Gutta-percha is as valuable an article of commerce, and as greatly in demand for European manufactures, as rubber itself. In Nigeria gutta-percha is collected immediately the rainy season is over, the sap at that time of year flowing more freely from the tree. In coagulating, the milk assumes a reddish tinge."

Imperial Telegraphs.—A *Times* special despatch from Simla "by Indo-European Telegraph," dated August 13th, says:—"Referring to Mr. Henniker Heaton's article in the *Times* of July 18th, and his assertion that the Indian telegraph lines may be carried across Afghanistan to Merv or Teheran, the Ameer having already sanctioned the erection of lines to Kabul and Herat, I have the best authority for stating that the Government of India are unaware of any such sanction having been given; also that Sir Edward Sassoon's belief that 'Lord Curzon had gone the length of recommending the alternative route known as the Russo-Chinese route,' for an Asiatic international telegraph is totally mistaken. The Viceroy never countenanced or authorised the expression of any such opinion. Finally, regarding the linking up of the Mergui telegraph with Singapore *viâ* the Malay States, which Mr. Henniker Heaton and Sir E. Sassoon apparently regard as a simple matter, it is necessary to point out that the Indian telegraphic authorities hold a very different opinion. They believe that the construction of such a line would be very difficult and costly, and the expense of maintenance may be judged by the fact that while the cost per mile in India is Rs.11 or Rs 12, the Tavoy-Mergui line costs about Rs.25 per line of wire. It is estimated that a line from Mergui to the Malay States and Singapore would cost from Rs.30 to Rs.35 per mile.

Telegraph Engineers in Conference.—The fourth annual conference of the Amalgamated Association of the Postal Telegraphs Engineering Department was held in the Grand Hotel, Cardiff, on Monday. Delegates were present from London, Manchester, Liverpool, Birmingham, Northwich, York, Selby, Nottingham, Newcastle-on-Tyne, Sunderland, and Cardiff.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa ...	April 4th, 1898 ...	...
Bonny-Cameroon	May 29th, 1899 ...	...
Latakia-Cyprus	June 20th, 1899 ...	...
Para-Maranham	April 10th, 1899 ...	...
Maranham-Ceara	July 25th, 1899 ...	August 15th, 1899
Medan-Olehleh	July 31st, 1899 ...	August 4th, 1899
Acora-Grand Bassam... ...	August 1st, 1899 ...	...
Corea-Japan	August 7th, 1899 ...	...
Iquique-Valparaiso	August 15th, 1899...	...
Florida-Bahama	August 14th, 1899...	August 16th, 1899
Jamaica-Colon	June 30th, 1899 ...	...
Jamaica-Porto Rico (Ponce)	August 15th, 1899...	...
Jamaica-Porto Rico (San Juan)	August 15th, 1899...	...
Landlines.		
Communication between Salonika and Monastir ...	March 23rd, 1899 ...	...
Communication between Bolama-Bissao	July 28th, 1899 ...	...
Dominica Landlines	... August 10th, 1899 ...	August 14th, 1899

The Telephone Service.—In the House of Commons last week, Mr. Channing, for Sir James Woodhouse, asked the Secretary to the Treasury, as representing the Postmaster-General, whether any terms had been agreed upon with the National Telephone Company as to inter-communication between the subscribers of that company and the subscribers of any competitive telephonic systems which might be set up under the provisions of the Bill now before Parliament when they should come into force; and, if so, whether he would state what those terms were.—Mr. Hanbury said if the subscribers of any competitive telephone system equalled one-half the numbers of subscribers to the National Telephone Company, then inter-communication would be free over and in the restricted area of the new licensee, or, if they numbered one-half of the whole area they would also be free. If they were equal to one-quarter and less than one-half, a charge of one penny would be made.—Mr. Provand asked what the terms would be if the number were less than one-quarter.—Mr. Hanbury replied that where the subscribers were less than one-fourth there would be a rate of three-halfpence charged for inter-communication. These cases would be extremely rare, because he certainly would not advise the Post Office to grant a license except there was a *bonâ fide* competition, which would not be the case where the subscribers were less than one-fourth.

The "All-British" Cables.—On the 10th current the Legislative Assembly of Victoria adopted a motion brought forward by Mr. Duffy, the Postmaster-General, to the effect that Victoria should join the Pacific cable scheme. One of the members urged the superior advantages of the Cape cable offered by the Eastern Extension Company, but Mr. Duffy stated that Victoria was committed to the support of the Pacific cable and it was impossible to withdraw. Mr. Gillies strongly supported Mr. Duffy, whose motion was carried by acclamation.

In Ottawa, in the speech from the Throne on the occasion of the prorogation of Parliament on the 11th, the Governor General of Canada, said: "I am glad to observe that the action of Canada in deciding to unite with the mother country and the Australian colonies in the construction of a Pacific cable has met with general approval. I congratulate you on the evidence of continued prosperity that prevails in all parts of the Dominion, and which has stimulated the formation of so many companies having for their object the development of enterprises that must tend to increase the wealth of the country." The speech concluded with the expression of a hope that Canada would long continue to enjoy the prosperity that at present prevails.

Cable Rates to South Africa.—A Reuter despatch from Cape Town says that on September 1st next the cable tariff between England and all stations in South Africa, including places in the Free State and the Transvaal, will be reduced to 4s. per word.

The West Indies Hurricane.—The Halifax and Bermudas and the Direct West India Cable Company have placed their cables at the disposal of the Lord Mayor, free of charge, for any messages relating to the Mansion House Fund. Both cables between Jamaica and Porto Rico, belonging to the West India and Panama Telegraph Company, are interrupted. This, without doubt, is due to the effects of the hurricane. It is understood that repairs will be effected before the end of this week. After having passed over Turk's Island, where no damage was done, the hurricane made itself felt in the Bahamas, the cable to those islands being also interrupted.

The West Indian Cables.—A Washington telegram to the *Standard* says:—"It will be recollected that Mr. Alger, when War Secretary, and other authorities, sustained the Western Union Telegraph Company's concession, which gives that company, with the British connections, a monopoly of West Indian telegraph business, *viâ* Cuba. But Mr. Root, his successor, will reopen the question, and will submit it to the President. He will take this action upon the opinion of Senator Edmunds, supporting the Commercial Company's claim to a right to land a cable upon its private premises in Cuba—a course now prevented by the military authorities alone.

Wireless Telegraphy.—The *Standard* says that the Admiralty have called for a report from the commanding officers of the battleship *Alexandria* and the cruisers *Europa* and *Juno* on the advantages and general results of the use of wireless telegraphy on board those vessels during the naval manœuvres. The Admiralty are so satisfied with the experiments made with the Marconi system during the naval manœuvres, that they have ordered a complete set of the apparatus to be supplied to the Torpedo Schoolship *Defiance* at Devonport, where further experiments will be tried under the direction of Commander W. C. M. Nicholson, who has made a special study of the system.

CONTRACTS OPEN AND CLOSED.

OPEN.

Aberdeen.—August 21st. The Electric Lighting Committee wants tenders for a 12 months' supply of house service and lead covered distributing cables. See "Official notices" August 11th.

Barnsley.—September 16th. Tenders are wanted for electric light wiring and fittings at the Harvey Institute, Eldon Street, for about 700 lights. See "Official Notices" this week.

Battersea.—August 31st. The Vestry wants tenders for an overhead travelling crane (hand or electric), and batteries for the electricity works. See "Official Notices" July 7th.

Battersea.—August 31st. The Vestry wants tenders for steam pipes, pumps, condensers, economiser, tools, &c., also switchboard and booster. Specifications at the office of Prof. Kennedy, 17, Victoria Street, S.W.

Birkdale.—August 19th. The Urban District Council invites tenders for the transfer of its electric lighting powers.

Blackpool.—August 21st. The Corporation wants tenders for 10 double bogie tramcars. See "Official Notices" July 28th.

Carlisle.—September 11th. The Corporation wants tenders for extension to steam, drain, and feed pipes, feed pump, and extension of economiser at the electricity works. See "Official Notices" this week.

Darwen.—August 22nd. The Corporation wants tenders for rail bonds. See "Official Notices" August 4th.

Devonport.—August 31st. The District Tramways Company invites tenders for the following contracts: Permanent way, road bed, paving and bonding of about 4½ miles of double line, overhead construction for about 4½ miles of route. See "Official Notices" August 11th.

Dundee.—August 23rd. The Council wants tenders for the overhead line equipment and rail bonding of the Perth Road and Lochee tram routes. See "Official Notices" August 4th.

East Ham.—September 9th. The Urban District Council wants tenders for combined electric light and traction plant, engines, generators, overhead line equipment, cars, switchboard, arc lamps, &c., water-tube boilers, condensers, and other steam plant, electric light cable. Mr. W. C. Ullmann, The Limes, White Post Lane, East Ham, is the Council's electrical engineer. See "Official Notices" August 4th.

(*Continued on page* 279.)

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A "FIN-DE-SIECLE" MACHINE SHOP.

By FRED. BATHURST, A.M.I.E.E.

To English readers the above title would, under present conditions, suggest that this article deals with a recently installed American factory, or else an English workshop re-modelled on American lines and equipped with the latest types of American tools, since for up-to-date machine shop lay-out with scientific and economic production, it is only too seriously true that at the present moment we have to look to U.S. practice for the best examples.

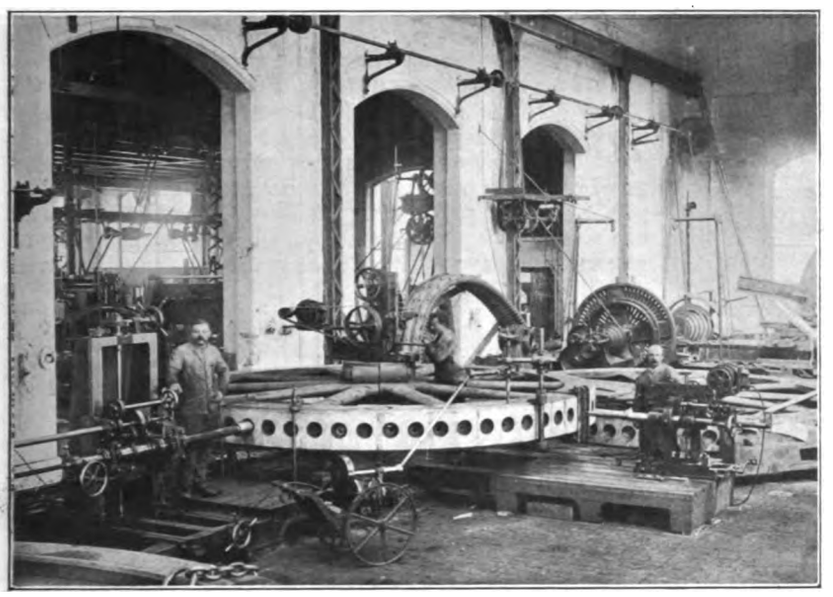

Fig. 1.

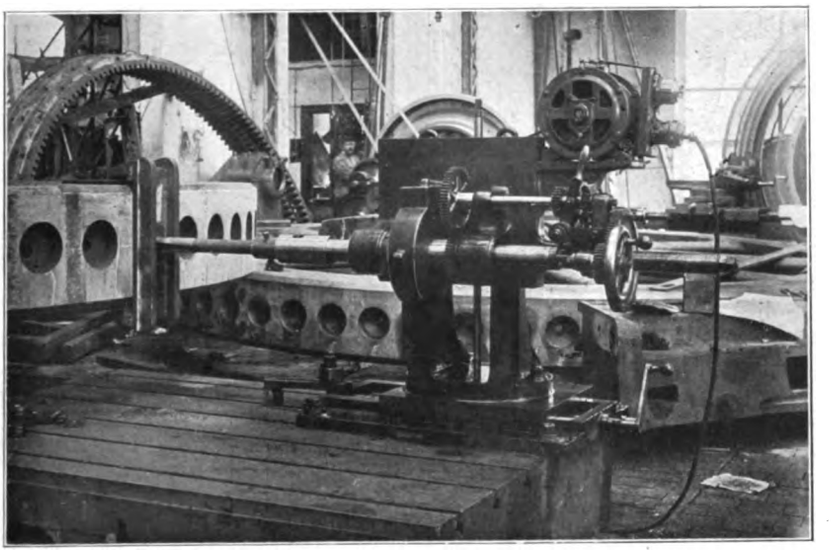

Fig. 2.

It is with pleasure, therefore, that one finds in the centre of Europe, at Prag-Vysocan, in Austria (midway between Vienna and Berlin), the dynamo machinery factory of Kolben & Co., or, to give it its full Bohemian title, the "Elektrotechnická Akcrová Spolecnost drise Kolben a Spol." It is thought the following description and illustrations of machines found in this shop will prove that there is near at hand at least one instance of as perfect a combination of European and American workshop practice as can be desired.

In describing a modern machine shop, designed for the purpose of manufacturing all sizes and types of dynamo-electric apparatus, it is only to be expected that we should find the advantages of electric power transmission fully appreciated, although rarely so fully and completely utilised as in this particular instance. An up-to-date factory manager having to consider the question of alterations or extensions to an existing plant, must by this time thoroughly recognise the advantage and economy arising from the use of electrical transmission of energy by means of small flexible and easily installed copper wires, instead of following the old-time practice of power transmission with its shafting and belting from the main engine, necessitating fixed and heavy runs of steel shafting with a consequent limitation as to the design of the shop and the position of the machine tools.

With electric transmission the shops can be arranged:—

1. Just as required in the natural process of production and without regard to the lay-out of the building.

2. Extension can be effected and additional machines laid down in any direction without any regard to driving power and the shafting runs.

3. Great saving in the wear and tear of the driving shafting (oftentimes from 30 to 60 per cent. of the total power required in the factory) can be effected by applying electric power direct to the larger or special portable tools, whilst smaller machines are separately driven in groups from short lengths of countershafting.

Thanks to the high state of development and mechanical perfection that has been reached in respect to continuous current motors and generators, many factories can now be found in which the above advantages have been seized upon, and descriptions of such plants are no longer new.

The plant of Kolben & Co., although comparatively small by reason of its exceptional design in respect to the horse-power required, is a unique and up-to-date exemplar of three-phase current electric power distribution, a type of practice which has been comparatively neglected in England until recently. The writer's opinion is that examples of three phase work in England have been few, and our electricians have not acquainted themselves sufficiently with foreign and Continental practice, so

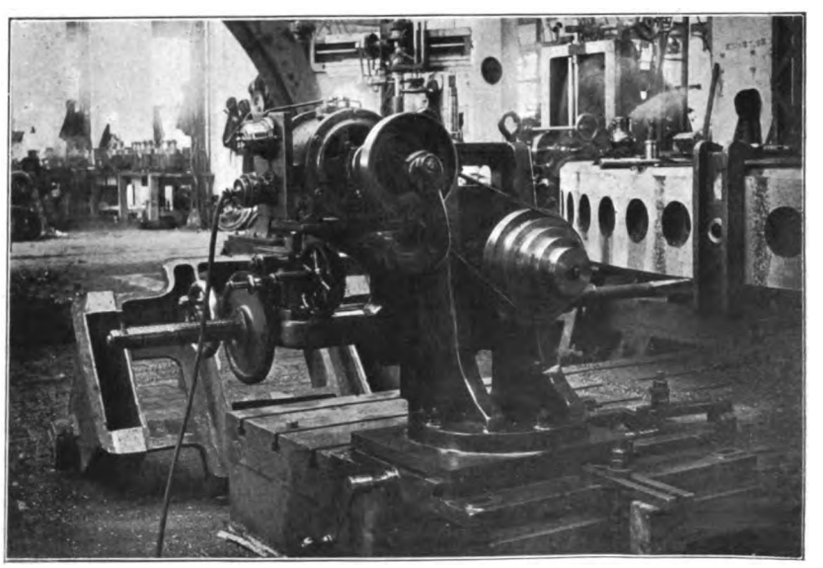

Fig. 3.

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that they have failed to appreciate the advantages and possibilities of this system of electric supply.

The approaching visit of the I.E.E. to Switzerland may, it is anticipated, offer an opportunity of seeing the successful and practical use of three-phase plants, and will doubtless lead to their more general development in England.

It may, however, be taken for granted at once that, for any power installation requiring a number of motors for varied applications, and where the total capacity required amounts to 100 H.P., under most conditions a three-phase plant will be found more economical both in first cost

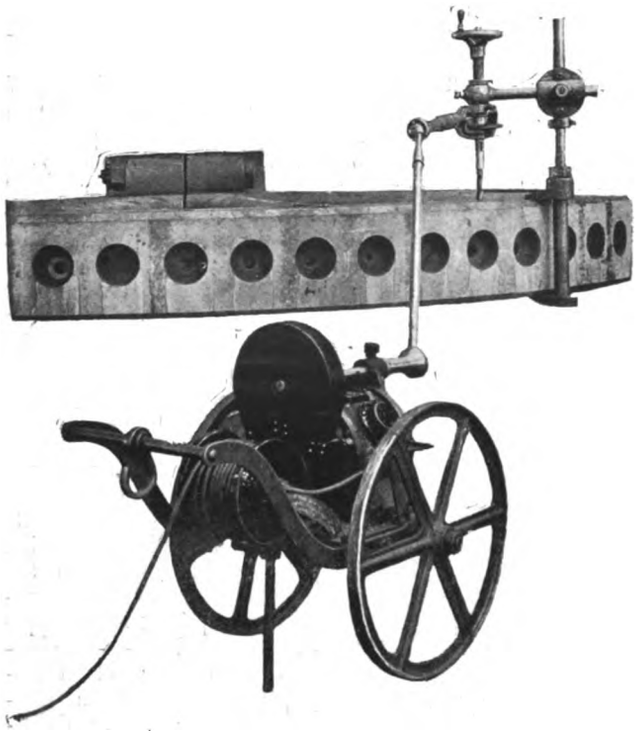

Fig. 4.

and in maintenance than a continuous current installation. The comparative absence and unimportance of the motor starting and regulating boxes, and the greater impunity with which the three-phase motors can be handled by unskilled and non-technical workmen alone counts greatly in favour of this system, but this point is best brought home by actually seeing a few plants in operation rather than by discussion.

Having determined the prime source of power, and chosen the method of distribution by which the power is to be advantageously applied, the factory manager, in order to reach an ideal lay-out, has to provide high-class tools which will give

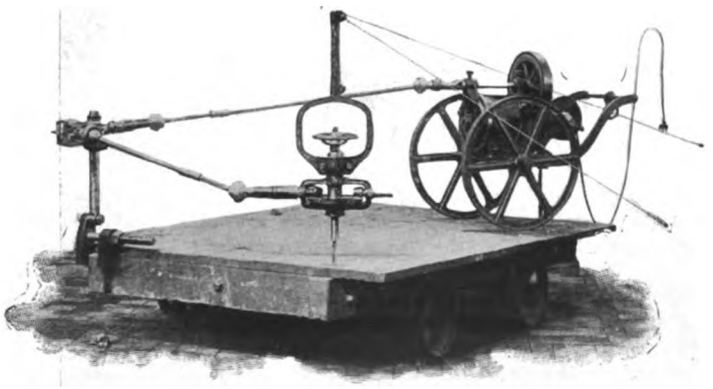

Fig. 5.

a large output at low cost production and within a minimum of time. The work provided must employ each tool upon its standard work for as many hours as possible during the working day so that the tool may fully earn the interest on its first cost. Floor space must be occupied as economically as possible.

It is problems such as these that Herr Emil Kolben set himself to work out in connection with this factory. Probably very similar conditions present themselves in almost every factory, but certainly in a rapidly-growing and developing industry like that of dynamo machine manufacture, although the utmost care and discretion may have been exercised in the selection and arrangement of the tools, a time comes when the castings and parts to be operated upon grow too large for the existing appliances, and the management has to face the solution of newer and more difficult problems. It is in meeting this condition that the works of Kolben & Co. appear to have attained most complete success, so that to-day this factory must be counted amongst the few that can readily undertake and execute any and all classes of electrical work that can be called for or that progressive development may dictate. The unexpectedly rapid increase in kilowatt capacity of the generators required for electric light and traction work brought into the shop heavier and still heavier

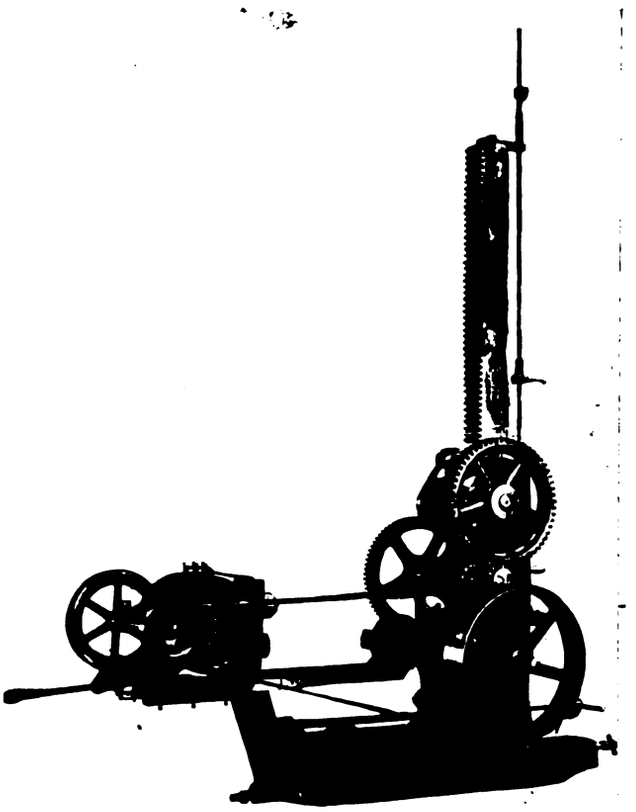

Fig. 6.

castings, whilst the adoption of the fly-wheel type of multipolar generating machines so increased the size and shape of the castings handled as to necessitate an almost complete reversal of the practice the shop had been laid out to meet.

The castings grew larger and larger until they reached the practical limit for satisfactory handling. When castings of fly-wheel shape grew from 2 and 3 feet to 12 and 20 feet diameter, and increased in weight from 4,000 lbs. to 80,000 lbs., it was found easier to bring the tools to the work, instead of taking the work to fixed tools.

The main object of this article is to bring the illustrations and descriptions of these specially designed portable tools before the readers of the Electrical Review, so as to show the comparative ease with which a machine shop can be re-equipped, to enable it to undertake the production of machines of the largest size with a comparatively small fresh outlay of capital. Incidentally, also, it will be noticed how completely and efficiently three-phase motors of any size can be applied to meet the requirements of machine tools.

Fig. 1 shows four processes, *a*, *b*, *c*, *d*, being carried on at one and the same time upon a 16-foot diameter magnet wheel (weight 46,000 lbs.), designed for use in a 1,000 H.P three-phase alternating current generator.

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The illustration sufficiently indicates the difficulty that would be entailed in handling such a large-sized piece of work, if it had to be taken from tool to tool for each process, and by comparison shows how conveniently the small portable self-contained motor tools can be arranged around it, so that horizontal drillings in two sizes, side drillings, and key seating operations can proceed together.

Instead of choosing a position with respect to the countershafting available for tool driving, the casting is dropped down anywhere in the shop, and a flexible electric cable brought to the motor of the portable tool from the nearest wall plug. In this particular case, the work has been placed so that it can be operated upon (process *a*) by a fixed horizontal boring tool (shop-driven by a 6 H.P. three-phase motor) which has to make the 64 12-inch diameter holes for the magnet cores. By arranging three other portable tools around the casting, economy of floor space, as well as of labour, naturally follows, and although three workmen can be seen in the picture, only two are needed to tend the four tools at work.

Figs. 2 and 3 show in detail the tool by which (process *b*) the side boring of a hole 2½ inches in diameter inside the 12-inch hole in the cast-steel frame is carried out. This portable horizontal boring machine weighs, complete with motor, only about 900 lbs., its approximate overall dimensions being: height, 3 feet; width, 2 feet 6 inches; length, 4 feet 6 inches without boring tool.

The machine is arranged on a base plate, which can be clamped or bolted to the shop floor or a convenient tool bed. The body of the machine is mounted on a sliding bed in such a manner that it can swivel completely around or move along it, so that the boring mandrel can be readily faced up toward or adjusted to the work. A three-phase 1-H.P. motor bolted to the frame casting provides sufficient driving power, a cone pulley on the motor shaft driving by belt a counter cone, which is connected through screw gearing to the boring shaft. The gearing can be thrown in or out by the workman as he desires, whilst the boring shaft has a self-governing screw feed. With this machine holes of any size up to 3 inches diameter can be readily bored out. The approximate cost of the complete tool is about £70.

Fig. 4 shows the detail of the Universal portable truck drill which is seen at work in fig. 1 (process *c*), making a side hole for a 1-inch bolt. This tool weighs, complete, about 650 lbs., and, including the waggon, has overall dimension as follows: Height, 2 feet; width, 2 feet; length, 3 feet 6 inches. When fitted complete with flexible shaft, drill holder outfit, connecting cable and winding drum, its cost is £80.

It consists of a two-wheel carriage supporting a 1-H.P. (three-phase or other type) motor driving by single reduction a geared countershaft which operates the flexible shaft. The whole machine is balanced in such a manner that when it is necessary to do drilling at a height more than 5 feet from the ground (the limit of the flexible shaft), as may be required for the inside of large generators (or in another condition, as for roof or bridge work), the whole tool is swung into the air by means of a crane, and the drilling shaft remaining horizontal, drilling can be proceeded with in this position. Holes up to 1½ inches diameter can be made by this machine.

Experience proves that the possibility of operating this machine whilst it is suspended in mid-air is very useful in the case of large generators, the necessary hole being made whilst the work is *in situ*; without such apparatus the work would have to be laid over on its side upon the floor of the shop, and brought with difficulty under the ordinary drilling press. It is obvious that this truck drill when fitted with a special head-piece can be most usefully employed inside boilers or similar hollow work, as well as finding an invaluable application in respect to flat tablets and marble slabs used in electric switchboard work. The latter application is shown in fig. 5.

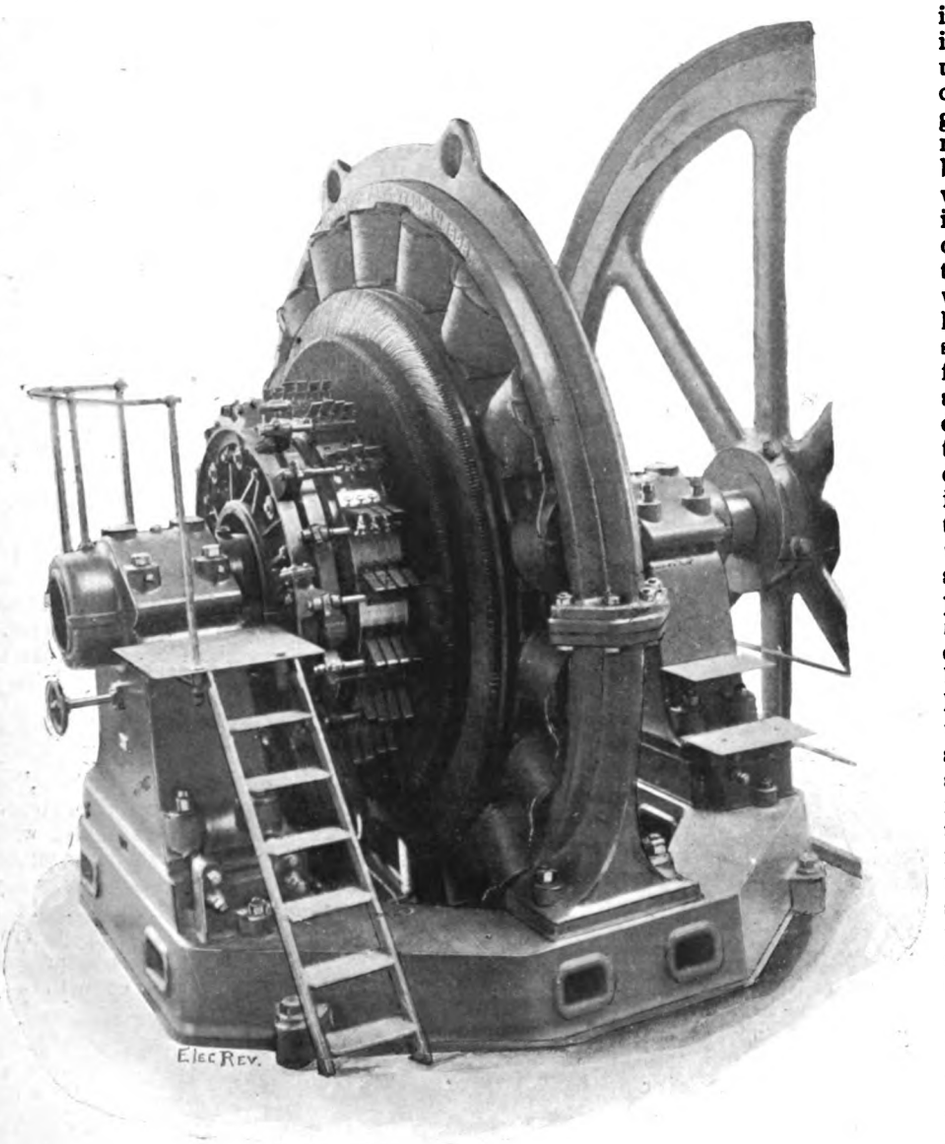

Fig. 7.

Fig. 6 shows in detail the American type of key-seating machine, driven by its self-contained ½ H.P. three-phase motor, which is carrying out process *d* in fig. 1. This portable combination tool, weighing about 1,800 lbs., is one of the most useful machines to be found in Kolben & Co.'s shops. Whilst dynamo manufacturers in England are mostly employed upon two, four, and six-pole generators, having comparatively high-speed small diameter armatures, Continental practice in respect to generators for outputs above 200 KW. has developed through "many poles," until to-day the most favoured type is a direct-connected slow speed bar-wound armature of large diameter, enclosed by a field magnet often containing 20 or more poles (see fig. 7, showing the design of a 400-KW. continuous current generator running at 90 revolutions and having 18 poles). This constant increase in the diameter of the armature required a continual increase in size of the swinging arm of the slotting machines necessary for cutting

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the key-way for the engine or driving shaft, until the limit of a practical tool was reached.

The race between the size of the work and the tool required for it, having been decided in favour of the work, we now find this comparatively small tool, having overall dimensions, height 8 feet, width 3 feet, length 6 feet, uniformly employed upon all the larger size pulley or wheel-shaped castings required for armature spiders. The portable

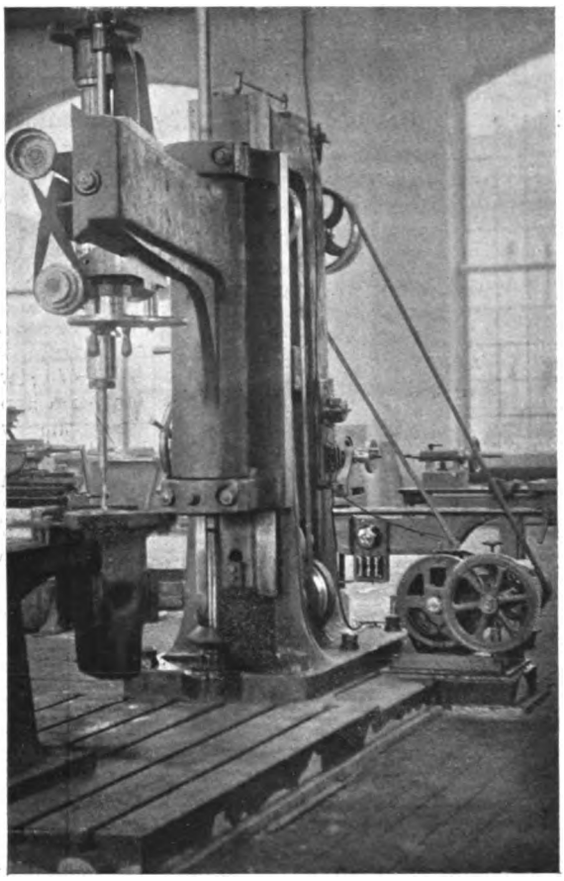

Fig. 8.

tool has the advantage that the shop crane readily transports it to the particular casting to be operated upon, and being fixed in position thereon, the key-seating process can proceed at the same moment as, and without hindrance to, other essential operations, making a great saving and convenience in the handling of the castings, as well as permitting a saving in the time required for finishing them.

Instead of the practice usually followed in slotting machines, by which the tool head in making the cut is forced downwards into the work with the tendency to compress or bend the tool holder out of position (necessitating considerable stiffness and strength of tool arm and body), advantage has in this case been taken of the general lightness of the design (required for portability) to reverse the action of the tool, and employ the tool head as a *draw bar* under tensile or pulling stress instead of under compression. A special clutch gearing is also used, so that the tool returns from its work four times as fast as its normal cutting speed, this movement, as well as the feed, being provided for automatically.

The ½ H.P. motor is provided with single reduction gear and belt drives on to the tool mechanism, so that the slip of the belt partially compensates the strain on the tool mechanism, as the tool enters or leaves its work. The motor being mounted on a sliding baseplate, a belt tightening attachment provides any desired adjustment. This tool cuts a key-way in shaft bores of any size from 4 inches to 20 inches diameter, as deep as necessary, from ¾ inch to 4 inches wide. The approximate cost of such a tool complete is £200. It is obvious that such a convenient tool has a wide range of application in other machine and metal working shops.

Fig. 8, showing a radial drill driven direct from its independent shop motor can be advantageously referred to at this point, as showing the difficulty that the ordinary drilling as well as keyseating tools present by reason of their clumsy overhanging swinging arms. After seeing in operation the drilling and boring tools shown in fig. 1, no one will want to arrange a large casting of awkward shape underneath tools of the swinging arm type. The tool shown has a 7-foot swinging area, and is belt-driven through single reduction gearing by a 3-H.P. motor secured to the same bedplate. This tool is now relegated to its proper use, that of drilling holes up to 3½ inches diameter in large base plates or other flat castings of large area. At the back of the drill part of the tool head and bed of a small lathe may be seen, together with the simple starting and regulating switch, by which its self-contained three-phase motor is controlled.

Fig. 9 gives a good idea, by comparison with the relative size of the men at work within it, of the diameter of the pieces of work that are being dealt with in the Kolben factory. It illustrates the assembling of the stationary armature for a three-phase 1,000 H.P. generator. This armature frame is 19 feet inside diameter, and has a finished outside diameter of 25 feet. Its approximate weight (finished) is 60,000 lbs., whilst the generator, assembled complete, weighs 140,000 lbs. These figures may be considered sufficiently eloquent in themselves to save allusion to the fact that it is better to let such pieces remain on the shop floor as much as possible in one position, and bring portable tools to them, rather than endeavour to take them around the shop to large fixed tools. The four men seen within the ring have their hands fairly full of hard work, for they have to assemble 26,000 lbs. of thin sheet iron, consisting of 11,500 segments (seen as sectional stampings), and the winders, who occupy their position later, have to handle a considerable weight of copper in arranging in the 384 peripheral (slotted) holes, 192 carefully insulated coils. Always having a thought towards the saving of floor space, it is no uncommon sight in this shop to see two, or even three, of these armature frames being assembled one within the other, and yet find that the nine or ten men employed have plenty of working room.

A further note in connection with the assembly of this armature may be of interest to English manufacturers who are still mainly in the "japan pasting," or perhaps in the "paper punching" stage. In ordinary practice, the 11,500 iron segments would have to be assembled with an equal number of separate and similar tissue paper punchings, the work of assembling these frail sheets being really more trying and fatiguing than the iron segments. In fact, the difficulty and annoyance arising from the paper sheets has convinced many designers that equally good mechanical and magnetic "insulation" can be obtained with a japanned disc, in

Fig. 9.

spite of the incidental difficulty of effective painting and drying. Careful and complete tests have convinced the engineers of the Kolben Works that "paper" separation is to be preferred, provided always that wood-pulp tissue paper, which will bear subjection to great heat and pressure without charring, is chosen. The difficulty and extra time required for stamping and assembling the paper has been overcome by designing a machine which pastes every sheet

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of iron with a complete facing of paper, so that the one punching operation for making the sections cuts out the stamping ready papered for assembling. With this machine, a modified form of printing press, two men can in a 10 hours' day cover 6,000 feet of iron sheeting 4 feet 6 inches wide without any difficulty. The immense saving of labour which this machine effects is further supplemented by advantages which follow in assembling, for with pasted sheet armatures the holes or slots in the disc or segment, line up quite truly without the necessity of "gouging out," and leave a larger and truer space for the winding, permitting a considerable percentage increase either in copper cross-section or for the insulation of the wire or bars.

(*To be continued.*)

CONTRACTS OPEN AND CLOSED.

OPEN.

(*Continued from page 274.*)

Germany.—Tenders are at present being invited by the Frankfort-am-Main Municipal Tramways Committee for the supply of 200 steel tyres and 40 sets of wheels and axles for electric tramcars. Tenders to be sent to the Betriebs Direction der Städtischen Strassenbahn, Frankfort-am-Main (Bockenheim), whence particulars may be obtained.

Glasgow.—August 21st. The Corporation wants tenders for the supply of switchboards, copper bus bars, and electricity meters. See "Official Notices" August 4th.

Hackney.—September 12th. The Vestry wants tenders for four sets of direct current steam dynamos (either high or low speed). See "Official Notices" August 11th.

Hampstead.—The Vestry invites tenders for the extension of its electric lighting station, and is spending £30,000 on new machinery there.

Ilfracombe.—September 25th. The District Council wants tenders for boiler plant, engine plant, dynamos, condensers, switchboard, mains, lamp-posts, accumulators, meters, crane, buildings, &c. See "Official Notices" this week.

Ingleton. — The Ingleton Electric Light and Power Company wants tenders for the supply of dynamos, switchboards, batteries, and wiring. See "Official Notices" August 4th.

Leeds.—August 30th. The Tramways Committee wants tenders for the electric lighting of the car sheds, Kirkstall Road. See "Official Notices" this week.

Malmo.—September 1st. The Gas Works' directors want tenders for the erection of electricity works for the city. Particulars on application to the clerk of the Gas Works (deposit 12s).

Manchester.—August 23rd. The Baths, &c., Committee is inviting tenders of an electric light installation for the new Islington Baths and Public Halls. Specifications from the general superintendent, Osborne Street Baths.

Motherwell, N.B.—August 18th. The Commissioners invite tenders for machinery and works in connection with the proposed electric lighting of their town. See "Official Notices," July 28th.

Perth.—August 28th. The Commissioners want tenders for boilers, condensers, steam dynamos, switchboard, underground mains, and accessories. See "Official Notices" July 28th.

Poplar.—September 6th. The Guardians wants tenders for high speed engine and dynamo, electric motors, Lancashire boilers, economiser, and other plant, as briefly particularised in our "Official Notices" this week.

Portugal.—September 6th. Tenders are being invited by the municipal authorities of Cascaes, Portugal, for the concession for the electric lighting of the town.

St. Annes-on-the-Sea.—September 11th. The Council wants tenders for high speed engines, continuous current dynamos, and balancing booster, for electric lighting. See "Official Notices" this week.

St. Mary, Battersea.—August 31st. The Vestry wants tenders for steam pumps, pipes, condenser, economiser, &c., switchboard, and boosters. See "Official Notices" July 28th.

Southport.—The Corporation wants tenders for the supply and laying of tram rails, points, crossings, bonding, permanent way; also overhead equipment, including poles, wires, &c. See "Official Notices" August 11th.

Sunderland.—The Corporation wants tenders for four 270-kw. three-crank direct current steam dynamos, and two surface condensers and cooling tower. See "Official Notices this week.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

CLOSED.

Bootle.—The Town Council has placed a contract with Messrs. T. Parker, Limited, for the necessary station plant for the purposes of electric traction, according to Mr. Miller's specifications, at £2,353; also with Messrs. R. W. Blackwell & Co. for poles, bracket arms, span, trolley, guard, and other wires, street boxes, &c., necessary for the complete equipment of the overhead trolley line along Stanley Road from the south to the north boundary of the borough, with a branch line along Strand Road to Derby Road; also with Messrs. Callender's Cable Company for the supply and laying of traction feeders at £1,228.

Bridgwater House.—Sixteen tenders were received for the wiring of Bridgwater House state rooms, and that of Messrs. W. J. Fryer & Co., Limited, of Sloane Square, has been accepted.

Glasgow.—We understand that the Corporation Tramway Committee on Tuesday considered tenders for supplying engines for the Glasgow electric tramways. Mr. Parshall, the electrical engineer, strongly recommended acceptance of the tender of Messrs. E. P. Allis & Co., of America, who offered engines for £114,554, and by seven votes to six this tender was accepted. Messrs. Harvey and Williamson, of America, tendered at £160,000 while Messrs. D. Stewart & Co. tendered at £54,800, but offered a lighter engine.

Hapton.—The Parish Council recently invited estimates for lighting the township electrically from September this year to April next year, and the tender of Messrs. Simpson Bros., a local firm, at £118 15s. has been accepted.

Islington.—The Guardians have accepted the tender, £192, from Messrs. Kirk & Randall for telephonic communication at Highgate Hill.

Pembroke (Ireland).—The following is a list of the tenders submitted to the Commissioners for electrical plant, &c.:—

Section K.—For Condenser, Air Pump and Feed Heater.

Name of firm.	Amount of tender.
Worthington Pumping Engine Company	£535 0 0
Wheeler Condenser Company (accepted)	556 0 0
Worthington Pumping Engine Company (alternative)	589 0 0
R. W. Blackwell & Co.	758 9 6
Frederick Nell	854 0 0
John Spencer, Limited	981 6 0
Mirrlees, Watson & Yaryan	1,052 0 0
Klein Engineering Company	1,365 0 0
W. H. Allen, Son & Co.	1,393 0 0
George Wailes & Co.	1,810 0 0
G. S. Derriter	2,192 12 0

Section L.—For Water Cooling Plant.

Korting Bros.	£442 10 0
Wheeler Condenser Company	631 15 0
Klein Engineering Company (accepted)	707 0 0
Worthington Pumping Engine Company	718 0 0
Isaac Storey & Sons	806 0 0
John Spencer, Limited	850 0 0
Klein Engineering Company (alternative)	877 0 0

Rathmines and Rathgar (Ireland). — The list of tenders for electrical equipment submitted to the Commissioners is as follows:—

Section K.—For Public Arc Lamps and Posts.

Name of firm.	Amount of tender.
Veritys, Limited (accepted)	£3,042 8 6
The Electrical Company, Limited	3,124 3 6
Calvert & Co.	3,291 16 0
Oliver & Co.	3,376 2 0
Johnson & Phillips	3,462 2 0
W. Lucy & Co., Limited	3,463 10 0
The Gilbert Arc Lamp Company, Limited	3,491 10 0
The British Insulated Wire Company, Limited	3,524 6 0
The Gilbert Arc Lamp Company, Limited (alternative)	3,740 0 0
Crompton & Co., Limited	3,747 17 0
Cotsworth Arc Lamp and Electric Lighting Synd'e, Ltd.	3 761 16 0
Brockie-Pell Arc Lamp, Limited	3,889 19 6
The Walsall Electrical Company, Limited	4,441 18 0

Section L.—For Generating Station, Pipe Work, Feed Tank, Feed Heater, &c.

R. W. Blackwell	£1,789 9 0
John Spencer, Limited (accepted)	1,997 18 8
George Wailes & Co.	2,134 0 0

Section M.—For Condenser and Air Pump.

The Wheeler Condenser & Engineering Co. (accepted)	£413 0 0
The Worthington Pumping Engine Company	415 0 0
Frederick Nell	439 0 0
John Spencer, Limited	493 10 0
Mirrlees, Watson & Yaryan Co., Limited	815 0 0
Klein Engineering Company, Limited	895 0 0
W. H. Allen, Son & Co.	1,067 0 0
Bow, McLachlan & Co.	1,250 0 0
George Wailes & Co.	1,250 0 0
G. S. Derriter	1,901 12 0

Section N.—For Water Cooling Plant.

Korting Bros.	£417 10 0
Calvert & Co. (exclusive of pipes)	550 0 0
Wheeler Condenser and Engineering Company	656 15 0
Worthington Pumping Engine Company	725 0 0
Isaac Storey & Sons	781 0 0
John Spencer, Limited	825 0 0
Klein Engineering Company, Limited (accepted)	847 0 0
Bow, McLachlan & Co.	925 0 0

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Sunderland.—The Council last week sealed the contract with Messrs. Dick, Kerr & Co. for permanent way, overhead equipment, and electric cars for the new tramway system at about £126,618. The chairman of the Tramway Committee said that the preparation of the Chester Road route was to be commenced at once, and the permanent way finished by December 31st next, and it would be available for horse trams during the reconstruction of the Hylton Road section. The existing routes were to be commenced as soon after January 1st next as was practicable, and the contractors agreed to complete the Roker, Christ Church, Hylton, and Chester Road sections by June 30th next—ready for electric traction. The remainder, if possible, would be finished by that date, but at the latest by August 31st, 1900, or the contractors would have to pay a penalty of £10 per day. There was also a penalty for the non-delivery of cars. Under the Act the Corporation had five years in which to do the whole of the work, but the committee was anxious to make a smart change from the old to the new systems.

The Town Council has accepted the tender of Messrs. G. and J. Weir, Limited, for two boiler feed pumps, and that of Messrs. Galloway, Limited, for four boilers and economisers. New feeder cables are to be laid for Hendon Road district at £1,550. Three automatic cut-outs for the new steam dynamos are to be obtained at £60, and indicators, meters and house fuses at £300 for stock. An extension of mains is also to be carried out to Roker Avenue and Dock Street Chapel at £587.

NOTES.

Personal.—Mr. Hugh Erat Harrison, B.Sc., principal of the Electrical Standardising, Testing, and Training Institution, has been appointed by the Board of Trade electric inspector to the Corporation of Tunbridge Wells.

A Glasgow evening paper says that ex-Prof. Jamieson has been called out to Cape Town to give expert evidence in a big case between the Cable Company and the Corporation running electric cars, the latter being alleged to affect adversely the working of the delicate telegraphic instruments connected with the cable.

We notice in the *Journal Officiel* of the 11th inst. that the French Government has granted the grade of Chevalier de la Legion d'Honneur to M. Paul Wallerstein, the administrator of the Société Industrielle du Téléphones, under whose personal direction was laid the Brest, Cape Cod, and other cables of the Compagnie Française du Cables Télégraphiques. The distinction conferred on M. Wallerstein will give pleasure to his many English friends.

Mr. O. M. C. Heyl informs us that he has resigned his position as district manager and engineer to the Newcastle-on-Tyne branch of Messrs. English Industrials, Limited, and has joined the engineering staff of the Allgemeine Electricitats Gesellschaft, of Berlin.

Mr. A. H. Roe has been appointed departmental electrical engineer to the Bradford Corporation, in succession to Mr. C. A. L. Prussmann, whom he formerly assisted, and who has gone to Doncaster as Corporation electrical engineer.

Mr. C. A. Midgley has resigned the post of chief assistant electrical engineer at Wakefield, to take up the post of city electrical engineer at York. Mr. H. T. Lee takes Mr. Midgley's place at Wakefield.

Appointments.—Fifty-five applications were received for the post of assistant engineer to the Bournemouth and District Electric Supply Company, and Mr. F. E. Benest, at present with Messrs. Siemens Bros., has been appointed.

Train Lighting—Gas v. Electricity.—In a recent article on "Lighting Railway Carriages by Electricity," the *Engineer* said that the total weight of the electric plant is less than would be required for a gas lighting system affording the equivalent amount of light. This has drawn from Pintsch's Patent Lighting Company a correction, stating that the weight of the electric light apparatus is rather more than double the weight of the gas lighting apparatus, the latter giving a superior light. The editor of our contemporary has wisely asked the writer and also Messrs. Stone & Co., of Deptford, the owners of the Gill train electric lighting system, to give actual weights of their respective systems. This information, if forthcoming, should be interesting.

The Opposition to the Pacific Cable Scheme.—At the present moment, when all who have the best interests of Great Britain and her dependencies at heart, and who are not inspired by motives of self-interest, are very anxious that the Pacific cable scheme should enter the sphere of active operations, it is worth while noting the tactics of the opposition group of cable companies. The only reply they received to their protest was a snub, if we may put it curtly, from the lips of Government Ministers. Perhaps this was responsible for raising their ire, for no stone has been allowed to gather moss which by rolling would postpone still further the great scheme. Now that there seems to be some prospect of a settlement, the tactician has been secretly at work upon further details in the opposition programme. To fill certain works with orders to occupy them for a long time ahead so that they would be unable to carry out the Pacific contract, to purchase gutta-percha in large quantities, thereby restricting the market and stiffening the price, these have been some of the the methods adopted to serve the desired end. The mere knowledge of these facts should be sufficient to place the Government officials upon their guard. We will not devote too much space to discussing the legitimacy of the procedure, but we would add that others also have had a watchful eye upon submarine cable material, and there are other works, who, we believe, are well able to fulfil the Pacific contract with satisfaction and expedition. The activity in submarine cable work just now is noteworthy. We believe it is a fact that about 14,000 miles of such cable are either on order or contracts are ready to be let, and the greater part of it may, as hinted above, be gathered into one net. Our representative called on one of the manufacturers for confirmation of the above rumour, which had reached us through other channels, and was informed that although the rumour is correct, generally speaking, some of the particulars are erroneous. The manufacturer hazarded the opinion that a well-known Company would probably use its undoubted influence in the cable ring, and would fan the forest fire which is apparently causing a stampede among the managers of the Globe Telegraph and Trust Company and its satellites. As a journal representing trade interests, we approve of reserve funds, hitherto invested in Government stocks and railway debentures, being realised and employed to promote fresh work, but such action should be taken deliberately and after mature consideration, and should not convey the impression that the copper dam has burst on the appearance of the Pacific cable banshee.

A Fair Hearing Wanted for the Trolley.—The current issue of the *Railway World* contains a timely note regarding the objection frequently raised of late by opponents of the overhead trolley system that it is not giving satisfaction in America. We reproduce the following on the point, which may be of interest both to Prof. Kennedy and the London County Council :—

Rumours of dissatisfaction with the trolley system in America are very greatly exaggerated. Complaints are occasionally made, but these are generally due to particularly unsightly street work, such as no one would propose to repeat in this country. Take the United States as a whole, and leaving out of the account the cities of New York, Chicago, and Washington, it may be said that the trolley system is universally approved by both the public and the tramway companies. Of the 16,000 miles of electric railways, all but a very small proportion are trolley lines. Visitors to America who have not penetrated further than New York, may return and write to the newspapers that the trolley lines are being replaced by the conduit system, but the fact is that no trolley lines in America have as yet been removed, nor are there any projects for conversion. In New York and Washington, and in some streets in Chicago, the overhead wire has never been admitted, largely because older forms of mechanical traction rendered less necessary the immediate adoption of the trolley. Elsewhere the trolley has met with approval, and it has done excellent service. History will repeat itself here as fast as new lines are opened, and corporations that have decided to instal the trolley system have no occasion to reconsider the question. The Manchester Council, which has been urged to send a delegation to America to investigate with a view to reconsideration of the determination to adopt the overhead wire, has made no mistake in declining to accept the suggestion. Its advisers perfectly understand the situation abroad, and at the present stage they recognise that, all things considered, the trolley system will most completely meet the requirements of the city for cheap and comfortable transport.

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Obituary.—It is with great regret that we record the death of Sir Edward Frankland, who was celebrated for his great work in the field of organic chemistry. He was also an eminent authority on water analysis, particularly in connection with the London water supply. He was the Government water analyst. For many years he held the post of Professor at the Royal College of Chemistry (School of Mines), retiring therefrom in 1885. He had previously acted as Professor of Chemistry at the Royal Institution, at St. Bartholomew's Hospital, and at Owens College, Manchester. In 1865 the Royal Society awarded him the Royal Medal for his researches into the new series of organic bodies containing metals. His "System of Notation," published in the *Journal of the Chemical Society*, is said to have cleared up a great many points in organic chemistry. His "Lecture Notes for Chemical Students," published in 1876, have had a large circulation, while he also published "Experimental Researches in Pure, Applied, and Physical Chemistry," and several hand-books. He has occupied the presidential chair of the Chemical Society and the Institute of Chemistry, and he was also a member of numerous English and foreign scientific societies. Sir Edward was born in 1825, so was 74 years of age. He will be well remembered in electrical circles as a member of the Committee of the Electro-Harmonic Society, at whose concerts he was frequently present in the capacity of chairman.

It also falls to our lot this week to chronicle the death of another very eminent worker in the school of chemistry. Prof. R. W. Bunsen, F.R.S., died at Heidelberg, on Wednesday morning, in his eighty-ninth year. So far back as 1836 the deceased professor succeeded Wöhler as professor of chemistry in the Cassel Polytechnic School, and some 16 years later, in 1852, he was appointed to the chair of experimental chemistry at Heidelberg. This appointment he held until 1889, when he resigned. Meanwhile honours were conferred upon him from all directions for his remarkable investigations and discoveries, but it seems from what we read in the *Times* that beyond all the orders and decorations of monarchs he valued the foreign fellowship of the Royal Society, to which he was elected in the year 1858, and the recognition of his work by numerous other scientific societies. The Royal Society in 1860 awarded him the Copley medal, and in 1877 he and Kirchhoff were jointly made the first recipients of the Davy medal. The Bunsen gas burner has made his name familiar in every household, while the Bunsen voltaic battery is known to every electrical student. From the list of his very numerous investigations we may select for brief mention the chemistry of blast furnace gases, actinometry, and the chemical action of light, but his greatest work is considered to be that undertaken with his colleague Kirchhoff on spectrum analysis. The work of these two professors placed analysis by spectrum observation on a sound and firm experimental basis. At the time of his death Bunsen was spending his last days in well-earned retirement at Heidelberg.

Standard Electric Wiring Rules.—Mr. W. G. McMillan, the secretary of the Institution of Electrical Engineers, is sending out the following circular on this very important subject. The recent papers and discussions at the Institution on the desirability for securing uniformity, or something approaching thereto, will be well within the minds of our readers:—

> You are no doubt aware that members of our profession who wire premises for the supply of electrical energy have for some time past been complaining that they are harassed by the multiplicity of existing rules. It is generally admitted that the rules, framed by a committee of experts representative of the special interests involved, and published by this Institution, have been accepted by a large number of central station, municipal, and consulting engineers, inspectors for fire insurance offices, and others.
>
> The council of this Institution has appointed a committee to inquire into the reasons, if there be any, which prevent the Institution rules being accepted by everyone as the standard. The committee feel that it is very probable that most of the authorities who are using other rules might be induced to accept those of the Institution if these latter were modified in some particulars. As a first step, therefore, towards the standardising of rules, the committee are anxious to receive any reasonable suggestions that may be offered with the above object. I should be glad if you would kindly let me know whether you would, if called upon, be willing to assist the committee with your advice and criticisms on the existing rules, and, if so, I am directed to inform you that the committee will prepare and forward to you a paper of questions, to which they will ask you to be good enough to reply."

Contracts for Steel Work.—Following the explanation of the Atbara bridge contract comes the announcement in the daily press of a large Japanese steel contract placed with an American house, in fact with the contractors for the Atbara work, viz, The Pencoyd Iron Works of Philadelphia. The contract is for the supply of from 8,000 to 10,000 tons of steel for bridges within a year for the Japanese government. The value of the order is $750,000. We should think it is pretty certain that here again the time element influenced the placing of the contract, and it is interesting in this connection to draw attention to a statement made last week at the meeting of the British Westinghouse Company. The contract for the iron and steel work for the new works to be erected at Manchester is to be executed by the Carnegie Company, of Pittsburg, within four months. It seems that the present state of English iron and steel works would not allow them even to look at such urgent business.

Record Trip.—*The American Electrician* says that the longest trip of storage battery automobiles ever reported is that of Comte de Chasseloup Loubet, who drove, July 2nd, from Paris to Rouen without recharging, the distance being some 85 miles, and the time 7 hours and 15 minutes. After recharging, the return trip was made the same night in practically the same time. The vehicle was of the Jeantaud make.

Appointments Vacant.—The D. P. Battery Company wants a works' manager at the Lumford Mills, Derbyshire. See "Official Notices" this week.

The Edinburgh Corporation wants two assistant engineers for its electricity supply stations at £100 a year. See "Official Notices" this week.

A telegraph foreman is required for the Telegraph Department, Gold Coast. See "Official Notices" for particulars.

The Government of Jamaica requires an experienced electrician to act as inspecting engineer for all matters connected with electricity, at £500 per annum. See "Official Notices" this week.

Electric Motor Carriages, ad lib.—They are talking of very big things in the automobile way across the Atlantic. We read that President Rice, of the Electric Storage Battery Company, says that orders have recently been placed for 4,200 vehicles at an aggregate selling price of some $8,000,000. They consist of about 2,000 pleasure vehicles, 2,000 hansoms and broughams, and 200 delivery waggons. It is anticipated that they will not all be sold, but the greater part will be operated by the local sub-companies of the Columbia and Electric Vehicle Company. By the way, we presume that in keeping with our namesake's ruling, this company should reconstitute itself as the Columbia and Automobile Company.

The British Association.—Canterbury has appointed an influential executive committee to carry through arrangements for giving the members of the British Association and the French Academy of Sciences a fitting reception on September 21st. The visitors are expected to number about 1,500.

Apparent Dark Lightning Flashes.—Lord Kelvin writes from Aix-les-Bains, August 7th, to *Nature*:—

> Last night, during a thunderstorm of rare severity, in which brilliant flashes—single, double, triple, or quadruple—followed one another at intervals often of not more than a few seconds of time, I was surprised to see, with great vividness, on a suddenly illuminated sky, two nearly vertical lines of darkness, each of the ordinary jagged appearance of a bright flash of lightning. I remembered to have seen two real flashes of just the same shapes and relative positions, and I concluded that the black flashes were due to their residual influence on the retina. I turned my eyes quickly from the dark sky outside to an illuminated wall inside the house, and I again saw the same double dark "flash," which verified my conclusion in an interesting manner. The fatigued part of the eye failed to perceive the sudden brightness of the sky in the one case and of the wall in the other.

Swiss Visit of the Institution.—The secretary asks us to remind those who, being eligible, wish to participate in this visit, and who have not already applied for tickets, that applications should be submitted to him before *Thursday*, the 24*th inst.*

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Speed Tests on High Speed Electric Railway.—The *Street Railway Journal* publishes some speed tests made upon the Cleveland-Lorain Railway, which are of interest as being made upon a high speed road that has practically no grades and few curves. The cars tested have four G.E. 57 motors geared 1 : 5·7, with 33-inch wheels and Brill trucks. The cars weigh 24 tons (apparently 2,000 lb. tons). On a grade of 1—500, the speed per hour taken at the end of six periods of 10 seconds each is given, west bound, 9·7, 26 6, 34·8, 39·6, 40·8, 47·2. By the end of 60 seconds the car had run 2,913 feet, at an average of a little over 33 miles per hour. East bound and probably up grade the speed attained was 43·1 miles per hour in a distance of 2,520 feet, but the average speed between the fortieth and fiftieth second was 47·4 miles per hour. Similar differences appear with other cars, but practically the tests show that between 40 and 50 seconds after starting, a speed of 40 miles can be easily exceeded against a wind of 10 to 15 miles' velocity. On a run of 60 seconds of a 23-ton car in which a distance of 2,802 feet was covered, the following readings will be of interest for each period of 10 seconds on a down grade of 1 in 500:—

Seconds.	Amperes.	Volts.	Feet run.	Total distance.
10	485	500	149	149
20	350	520	144	493
30	275	550	483	976
40	225	570	559	1,535
50	195	575	630	2,165
60	180	580	637	2,802

On a nearly level and straight track, with moderate wind of 6 miles per hour, the traction in both directions was 31·75 and 32·53 lbs. per ton at speeds of 40 to 49 miles per hour, and 39 to 51 miles. These are the average readings at two points on the track under favourable conditions. Other tests show tractive forces of 30·8, 34·1, and 32·6 lbs per ton, at similar speeds up to 51 miles.

Boilermakers Busy.—"Remarkable activity" is the account of the boilermaking industry during the past quarter. Mr. Knight, the general secretary of the United Society of Boilermakers and Iron and Steel Shipbuilders, reports that the demand for men has been greater than the supply. The demand fluctuates very considerably. This is practically unavoidable, but Mr. Knight adds, if it were possible to regulate the demand so as to ensure a steady and continuous employment, it would be an unqualified blessing both to employers and to workmen.

The Progress of the Manchester Electricity Works.—For the purpose of the Iron and Steel Institute visit to the Corporation electricity works this week, Mr. C. H. Wordingham, the city electrical engineer, drew up a pamphlet giving particulars of the generating and distributing plant at the central station, Dickinson Street, and the various sub-stations. The works were started in 1893 with a capacity of 1,320 KW., with plenty of floor space and chimney accommodation to allow for large extensions. Vertical compound condensing engines, 100 H.P. and 400 H.P., driving by means of link belts shunt wound continuous current bipolar dynamo machines, were installed, and the employment of jockey pulleys riding on the top slack side of the belts for greatly shortening the length of the drive is said to have been amply justified by experience, the loss of power with this method of driving compared with an ordinary belt being inappreciable. Lancashire boilers with Galloway tubes were installed, and coking mechanical stokers. The first extension was carried out in 1894-5, and consisted of two more 400-H.P. engines of the same design, with corresponding dynamos. The second extension took place in 1895-6, when the buildings had to be enlarged, and at this stage Mr. Wordingham was appointed consulting as well as resident engineer. The definite plan laid down when the original works were designed for extending plant has been strictly conformed to in subsequent developments and the same type of plant retained. Experience has shown that this course was well advised, but the uniformity has been broken by the erection of two horizontal engines of the same power as the vertical engines, driving similar dynamo machines by means of ropes instead of belts, this being done for purposes of comparison with the vertical sets, but the original design has been fully proved to be the better. The 1895-6 extension added six vertical sets, 400 H.P., and two horizontal, an extension to the boiler house, and five more Lancashire boilers. In 1897-9 the third extension was taken in hand. The large increase in size of the works had rendered the small units of plant originally put down practically useless, and the six small sets were removed for replacement by two large engines of 2,500 H.P. each for direct driving. On the space formerly occupied by generators developing 600 H.P., there are now fixed generators developing 5,000 H.P. The whole of the balancing on the five-wire system is now done by means of motor generators instead of dynamo machines. Six more Lancashire and four Babcock boilers were installed. It should be added that this last extension is not yet quite complete, the second large generator being still in course of erection. Mr. Wordingham follows with a description of the station as it now exists, also the sub-stations, mains, &c. The electric street lighting at Manchester is not a large item, there being only 28 open type arc lamps and one enclosed in use. All the lamps are fed from the ordinary distributing mains. The unenclosed arcs take 10 amperes and the enclosed 5 amperes. There were at June, 1899, 2,703 consumers with 261,988 8-C.P. lamps (or equivalent) connected (this comprising 379 motors aggregating 1,320 H.P.). The total demand, if all consuming devices were working at once, would be 8,430 KW. For the year ended March 31st, 1899, 4,773,247 units were sold, the total maximum supply demanded being 4,246 KW. The total costs per unit sold were 1·53d., the works' cost being 1·11d. Large extensions are now in progress for supplying outside districts, a scheme which has been often referred to in our columns, and for traction purposes. At a station to be erected in Bloom Street, there will be four direct coupled sets of 1,800 KW. each, to give current either for lighting at 400 to 440 volts, or for traction at 500 volts. These generators are already on order. This plant will deal with an area having a radius of about half a mile from the station. The rest of the area of supply will be dealt with by means of an entirely new generating station at Stuart Street, $2\frac{3}{4}$ miles from Dickinson Street. Here there will be fixed generators producing three-phase current at a pressure of 6,500 volts, which will be transmitted to a number of sub-stations situated at various points in the district of supply. At these sub-stations the high pressure three-phase current will be converted into low pressure continuous for all purposes, viz., lighting and traction on a three-wire network with 200 volts on lamps, 400 for motors, and traction at 500 volts.

A Method for Determining the Resistance of Electrolytes.—This new method has recently been worked out by Parker C. McIlhiney (*vide Journal of the American Chemical Society*, Vol. 20, pages 206—209), and whilst not so accurate as that of Kohlrausch, is of advantage for making many readings in a short space of time. It consists in determining by a galvanometer, preferably a D'Arsonval, the potential difference between the ends of a known resistance placed in series with the resistance to be determined. The current is supplied by a gravity battery, and before passing through the electrolyte, it is transformed into an alternating current by means of a rotary pole changer, but the current passing through the known resistance is direct. When a current passes through two resistances in series, the fall of potential in each of them is proportional to its resistance.

Chemical Effects of X Rays.—When photographic plates that have been exposed to the action of X rays are afterwards exposed to light, the image undergoes reversal in the same way as if both exposures had been made to light, and the precise character of the phenomena depends on the relative magnitudes of the exposures. Plates exposed for some time to X rays show increased sensitiveness to the less refrangible rays. An interesting communication on this subject was recently made by P. Villard in the *Comptes Rendus Hebdomadaires des Séances de l'Académie des Sciences*, Paris, Vol. 128, pages 237—239.

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The Solution of Platinum and Gold in Electrolytes.—This subject was studied by Max Margueles last year, and a paper appeared by him in *Poggendorff's Annalen der Physik und Chemie*, (II.), Vol. 65, pages 629—634, in which the results of his researches were given. In his earlier experiments, it may be remembered, an electro-magnet with armature served as contact breaker to the current from two Daniell cells, and between the terminals of the coil of the magnet an electrolytic cell with gold or platinum electrodes was introduced. With this arrangement the metal can be dissolved in hydrochloric, nitric, or sulphuric acid, or in potassium or sodium hydroxide. The metals always dissolve from the electrode, which is the anode to the battery current. The solution is, however, in some way assisted by the current from the magnet, as neither a constant nor intermittent current from the battery alone is capable of effecting solution. In the same journal Margueles makes some additions to his former statements with reference to the dissolving of platinum and gold in electrolytes. The dissolution of platinum takes place only at the anode when the cation of the electrolyte is hydrogen; in salt solutions the platinum is attacked simultaneously at both anode and cathode. Platinum not only dissolves in the electrolytes previously named, but also in phosphoric, formic, and acetic acids; oxalic acid is, however, without effect.

Determination of Polarization.—In an electrolytic cell of resistance, R, with insoluble anode, through which current, C, is passing with E.M.F. = E, we have $E = p + CR$, where p is the polarization. If a thin sheet of metal be interposed between the electrodes so as to divide the cell completely, without sensibly affecting its resistance, and the current be maintained unchanged, we have $E' = 2p + CR$, or $p = E' - E$. In putting the method into practice, the main difficulty is encountered in arranging the cell so that the third electrode may be put in or taken out easily, and in such a way that the current shall pass through it, and not round it. A rectangular ebonite cell is provided with platinum electrodes fitting into grooves in the walls 60 mm. apart. Between these a third groove, 8 mm. deep and 0·25 mm. wide, receives the third electrode. This depth is sufficient to prevent undue leakage round the electrode with moderate conductivities and current densities. A greater depth would be better. About half an hour elapses before the polarization becomes constant. The following are some of the results obtained:—

Copper Sulphate, 16 per cent., at 14·7—14·95°.

Current density	0·03	0·06	0·12	0·2	0·3 amp. sq. dcm.
Polarization ...	1·591	1·628	1·668	1·695	1·717 volts.

Silver Nitrate, about Normal, at 15—15·5°

Current density	0·015	0·03	0·06	0·12	0·2	0·4 amp. sq. dcm.
Polarization ...	0·888	0·897	0·903	0·908	0·926	0·935 volt.

The above is an abstract of a paper by Karl Heim in the *Zeitschrift für Elektrochemie*, Vol. IV., page 527.

NEW COMPANIES REGISTERED.

Electric Battery Case and Fittings Syndicate, Limited (63,268).—This company registered on August 10th, with a capital of £12,000 in £1 shares, to carry on the business of manufacturers of and dealers in electric battery cases, cells and fittings of every description, and to adopt an agreement with J. H. W. Stringfellow. The first subscribers (each with one share), are:—William Morgan, 6, Great Winchester Street, E.C., accountant; John W. Savage, 10, Hafer Road, New Wandsorth, S.W., chemist; Thomas Black, 103 Grosvenor Road, Highbury, N., gentleman; William Burley, 99, Shardeloes Road, New Cross S.E., engineer; William Pickering, 6, Garway Road, Bayswater, secretary; Edmund White, 2, Denby Road, Ealing, W., chemist; and Mrs. Jane H. Braithwaite, 390, Uxbridge Road, W. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification £250; remuneration as fixed by the company.

Brazilian Street Railway Company, Limited (63,241).—This company was registered on August 5th, with a capital of £120,000 in £1 shares, to acquire the business hitherto carried on by the Brazilian Street Railway Company, Limited (incorporated in 1868) to adopt an agreement with the said old company and its liquidators, and to acquire, construct, equip, and work railways, tramways, buildings, electric traction and lighting works, &c., in Brazil. The first subscribers (each with one share) are:—J. S. B. Hawkins, Hagenhoe Park, Welwyn, banker; A. G. Kendall, 148, Leadenhall Street, E.C., merchant; W. Martineau, 3, Beaumont Villas, Hornsey Rise, N., civil engineer; F. R. Bluett, Egerton House, Beckenham, accountant; J. Wilkinson, 38, Nicholas Lane, E.C., solicitor; H. Bluett, Egerton House, Beckenham, Kent, accountant; and J. W. Walker, 2, Abercorn Terrace, Upper Holloway, N., accountant. The number of directors is not to be less than three, nor more than seven; the first are William B. Hawkins, Arthur S. Kendall, William Martineau, Samuel J. Wilde, and T. Comber; qualification, 500 shares; remuneration, £400 per annum, divisible.

Kalgoorlie Electric Power and Lighting Corporation, Limited (63,248).—This company was registered on August 8th, with a capital of £225,000 in £1 shares (200,000 preference and 25,000 deferred), to enter into an agreement, dated August 3rd, with the Kalgoorlie Power Syndicate, Limited, to acquire, own, and work any land, water rights, electrical and other works, &c., and to establish and maintain a system of generating and supplying electricity for mining purposes, and otherwise. The first subscribers (each with one share) are:—J. T. Thompson, 116, Nevill Road, Stoke Newington, N., gentleman; C. E. Mozley, 257, Winchester House, E.C., secretary; S. F. Wall, Rock Villa, Wallington, Surrey, clerk; C. N. L. Shaw, 1, Elm Villas, Derby Road, South Woodford, clerk; W. Owston, 134, Dornton Road, Balham, S.W., clerk; H. D. Kerr, 5, Buaburgh Terrace, N.W., secretary; and M. E. Williams, Winchester House, E.C., solicitor. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £250; remuneration, £250 each per annum (an extra £100 for the chairman), and a share in the profits.

Sun Electrical Company, Limited.—This company was registered on August 9th, with a capital of £50,000 in £1 shares (20,000 preference) to acquire and take over as going concerns any electrical businesses, and to carry on the business of manufacturers of and dealers in electrical accessories and instruments, wires, cable and lines of all kinds; electricians, electrical and mechanical engineers, suppliers of electricity for the purposes of light, heat, motive power and otherwise; bicycle, tricycle, velocipedes and motor car manufacturers; cycle accessory and appliance manufacturers, &c. The first subscribers (each with one share) are:—F. H. Minn, 77, Grange Park Road, Leyton, electrician; F. J. Collis, 61, New Kings Road, S.W., electrician; G. Payne, 53, Goldhurst Terrace, South Hampstead, N.W., gentleman; R. T. Smith, 61, Carey Street, W.C., solicitor; N. H. Boyne, 61, Carey Street, W.C., solicitor; J. W. Beacher, 4, Queen Victoria Street, E.C., stockbroker; F. O. Smith, Hilldene, Harrow, solicitor. The number of directors is not to be less than three nor more than five; the first are F. H. Minn (managing director), R. T. Smith (chairman), and G. Payne; qualification, £200; remuneration as fixed by the company.

Woking Laundry Company, Limited.—This company was registered on August 2nd, with a capital of £2,500 in £1 shares, to acquire and carry on the business of the Woking Sanitary Electric Laundry Company, Limited. The first subscribers (each with one share) are:—C. A. Rollason, 6, Fairlight Avenue, Harlesden, N.W., engineer; G. R. Rollason, 26, Greenhill Road, Harlesden, N.W., engineer; W. G. Parker, Windlesham Road, Harlesden, N.W., gardener; E. T. Pimms, 34, High Street, Harlesden, licensed victualler; E. Mann, Palace Chambers, Westminster, S.W., engineer; W. H. Fletcher, 123, Abbey Road, N.W.; and W. F. Fearn, 3, Delahay Street, Westminster, solicitor. The number of directors is not to be less than three nor more than seven; the first are E. Mann, W. H. Fletcher, and C. A. Rollason; qualification, £50; remuneration as fixed by the company.

River Plate Construction Company, Limited (63,271).—This company was registered on August 10th, with a capital of £120,060 in 1,200 £100 ordinary shares, and 1,200 1s. deferred shares, to carry on the business of electrical engineers and suppliers of electricity for the purposes of light and power, and to establish and maintain electric lighting works, signalling, telegraphic, telephonic, and other systems, tramways, railways, &c. The first subscribers (each with 10 deferred shares) are:—C. Bright, 14, Copthall Avenue, E.C., engineer; A. F. Farish, 57½, Old Broad Street, E.C., solicitor; A. G. Lewis, 47, Park Road, Forest Hill, clerk; E. E. Ford, 12, Kylemore Road, N.W., gentleman; T. F. Stevens, 37, Sandown Road, Woodside, S.E., gentleman; G. A. Eggleton, 10, Cheriton Square, Upper Tooting, S.W., secretary; W. A. Hunter, 27, Trossacks Road, Dulwich, S.E., clerk; J. W. Ward, 14, Marney Road, S.W., gentleman; T. C. Richards, 57½, Old Broad Street, E.C., clerk; and W. S. Wild, 33, London Road, Clapton, N.E., gentleman. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £10; remuneration, £100 each per annum.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Thomas Parker, Limited (40,973).—This company's annual return was filed on July 20th, the entire capital of £75,000 in £10 shares being taken up; 1,750 shares are considered as fully paid and £10 has been called up on each of the remaining 5,750, resulting in the receipt of £57,500.

Oldham, Ashton and Hyde Electric Tramway Company, Limited (55,318).—This company's annual return was filed on July 28th, when the entire capital of £30,000 in 4,000 ordinary and 4,000 preference shares of £10 each was taken up and paid in full.

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CITY NOTES.

Liverpool Overhead Railway Company.

The half-yearly meeting was held on Tuesday, at the Law Association Rooms, Cook Street, Liverpool, Sir Wm. Forwood, chairman of company, presiding.

The Chairman, in moving the adoption of the report, said it had been the good fortune of the directors to meet the shareholders each half-year with an account showing expanding traffics and increased passenger receipts. He therefore regretted they could not on this occasion render to them a similar gratifying statement. It was true that they showed a small increase of 2,338 in the number of passengers carried as compared with the corresponding half of last year, but this was due to the late service of trains, which, by permission of the Dock Board, they now ran to Seaforth, which had given them a traffic of over 100,000, and also to an increase of 286,486 in the number of workmen carried, owing to the extension of time they had given to working men's return tickets; but their loss of revenue on the southern section of the line, between the Pierhead and the Dingle, had been very little less than £2,000 in the half-year. This loss was due entirely to the competition of the Corporation electrical tramways, which were now carrying passengers to the Dingle, a distance of 2½ miles, for 1d. Glasgow, which had a model system of tramways, for an equal distance charged 2d. and 2½d. It was admitted by the chairman of the Tramways Committee that they made a loss last half-year of £7,000 on the entire service, and, so far as he had been able to analyse their accounts, the loss on the Dingle line had exceeded this amount. The public had an undoubted right to enjoy the lowest possible fare at which the tramways could be worked, but the City Council had no right to run their tramways at a loss, to the injury of private enterprise. It was not merely making the general community pay for the benefit of the few, but introducing a principle most disastrous to the prosperity of the country. A continuation of the present tramway policy would mean the levying of a tramway rate to pay the annual deficit, and the Overhead Railway Company, as one of the largest ratepayers in the City, would have to contribute to this rate. He knew that they would agree with him that this was scarcely a fair state of things. It was not ordinary business competition, and, if it occurred in other walks of life, Parliament would step in to stop it. Certainly the Overhead Railway was entitled to the special consideration of the City Council. It was constructed solely to facilitate and cheapen the service of their docks, and to enable Liverpool to maintain her commercial position, and it had, undoubtedly, largely contributed to this result. Liverpool owed its very existence to its commerce, and one would have thought the first care of the City Council would be to conserve the interests of an undertaking admittedly doing a great public service for the commerce of the port. On the contrary, they saw not only public money being used to their injury, but, to compete with them, a speed was maintained through the public streets frequently much in excess of the Board of Trade regulations, which would not be possible unless the police were employed to safeguard the traffic. Their railway was further threatened by a proposal of the City Council to obtain running powers over their Waterloo and Crosby tramways and by the construction of an electric tramway along the line of docks, running parallel with the overhead railway. He could not think that either of these proposals were likely to be seriously considered. To construct a line of electrical tramways along the line of docks would simply be to duplicate so much capital. It was admitted that the Overhead Railway gives an excellent service, both in speed and in the frequency and regularity of the trains, and it did that without any interference with the street traffic. He had thought it well to bring these circumstances before the shareholders, but he was sure they need not feel any alarm. He thought they were now encountering the worst of the tramway competition. Matters had been very much rushed, but he saw indications that wiser counsels would now prevail on the Tramways Committee, and that they would try to get back to a sound business basis. He could assure them that the directors of the company had pursued a watching and waiting policy. They had not attempted to meet the competition by reducing their fares. They had anticipated the difficulties of the Tramways Committee, and felt sure that when they had some experience of working with electricity, they would find out—as the Overhead Railway Company had found out—that the cost of working during the first year was not a basis upon which they could calculate in future, and that it was not possible to permanently have a penny stage of 2½ miles, except at a serious loss. Referring to the accounts, he said the gross receipts for the half-year had been £36,492, against £37,220 in the same half of last year, or a decrease of £728. The expenditure had been £24,924, as against £23,326, showing an increase of £1,548. This increase had been accounted for in a larger payment for coal of £691, owing to the flooding of the mine with which they held their contract. The expenditure in materials had increased by £257, principally due to the renewal of their commutators, and the increased price of copper. Then during the past two years they had spent £2,300 in the removal of their storage batteries. They had also during the half-year to re-wind a great many of their motors; but the result of all this extra outlay, he hoped, would enable them to work more economically during the present half-year. It had always been their policy to maintain the line in a thoroughly efficient condition, and in the speed, comfort, and punctuality of their service to maintain the good opinion they had earned. Their earnings per passenger had fallen from 1·98 to 1·95, owing to the decrease of first-class traffic from the Dingle and the increase of workmen's return tickets. Of the future he would not prophesy, but he thought they had seen the worst of the tramway competition. Municipal trading was a dangerous and uncertain factor, and had not been a success in this country. The directors would carefully watch developments, and the shareholders might depend that their interests would be carefully safeguarded in every way. He was pleased to add that the line had lost none of its attractiveness to the holiday people, as the traffic last Bank Holiday was the largest on record.

Mr. R. Hobson seconded, and the motion was carried.

It was further resolved that a dividend at the rate of 5 per cent. per annum be paid on the preference shares for the half-year, and a dividend at the rate of 2½ per cent. per annum be paid on the ordinary shares, leaving a balance of £4,320 to be carried forward.

The Chairman, in acknowledging a vote of thanks to the directors, said it was very gratifying to receive such a vote, seeing the shareholders had got a reduced dividend. This showed that their efforts were appreciated. He still looked forward with confidence to the future prosperity of the Overhead Railway Company.

Waterloo and City Railway Company.

Mr. Wyndham S. Portal (chairman) presided on Thursday last week over the half-yearly meeting of the above company, and in moving the adoption of the report said the figures had been fully explained in previous half-years, and did not require on this occasion any detailed examination. On the last occasion he congratulated them on the completion and opening of the line, and now he had to congratulate them on the first complete half-year. Capital account showed total expenditure to the present time of £566,134, of which £16,678 had been expended during the past half-year. It was estimated that a farther sum of £56,000 would be required, which was amply provided for by the company's available powers amounting to £145,531. The authorised capital is £720,000, and of that, £540,000 had been raised by the issue of ordinary stock, and £26,000 by debenture stock, making a total amount raised of £566,000, or an increase of £5,000 since the preceding half-year ending December, 1898. As regarded the revenue account, during the past half-year the gross receipts, after deducting Government duty, had amounted to £13,114. £13,093 was received in fares and £300 in rents. Government duty was £278, leaving the sum of £13,114, from which the South-Western Railway Company had retained for working expenses, £4,690, or, £1,950 less than the actual working expenses. The balance was £8,424, which was payable by the South-Western Railway Company, under the agreement of March, 1894, to enable the Waterloo and City Company to pay a dividend at the rate of 3 per cent. per annum on the ordinary and borrowed capital. To this £8,424 they had to add £10 10s. for transfer fees, which made £8,434 odd, and they had to deduct £406 for general charges, and £5 18s. for law and Parliamentary expenses, which left £8,021 to be carried to the next account. The net revenue account commenced with £290 balance brought forward from last half-year, then they had the figure of £8,021 just mentioned, to which they added £190 for bankers and general interest and an item of £625 10s. described as "rent charge," and this made a total on the credit side of that account of £9,155. Out of that they had had to provide £324 as interest on debenture stock, and £458 rent charge payable to the South-Western Railway Company, in respect of the easement at Waterloo Station and that left them with £8,372 available for dividend, and they proposed to pay a dividend at the rate of 3 per cent. per annum on the ordinary capital, and carry over £272 to the next half-year. They would notice the auditor had added at the end, the words, "There is a contingent liability to repay to the South-Western Railway Company, the deficiency in respect of net revenue." This referred to £1,950 which he had mentioned, and to a sum of £1,869 which was similarly provided by the South-Western Company in respect to the working of the preceding half-year. These two amounts together made £3,819, and the agreement of March, 1894, provided that if in any subsequent half-years the difference between receipts and working expenses was sufficient to pay a dividend of more than 3 per cent. the South-Western Company should be at liberty to recoup themselves the amounts which they had provided in previous half-years. This was the contingent liability to which the auditors referred. The number of passengers carried during the past half-year was 1,715,825, or a daily average of 11,142, and the number of season ticket holders at June 30th last was 747, which was estimated to be equal to 194,220 single journeys, or a daily average of 1,261. This made the total daily average number of journeys 12,403. As the railway was only in its infancy they were unable to make a comparison with any previous period, and they would, of course, remember that the City station was still unfinished, inasmuch as the subways and approaches to be constructed by the Central London Railway Company had not yet been completed. Two days ago he received a report of the engineers, Mr. Galbraith and Prof. Kennedy, which he thought they would like him to read, as follows:—"The works of the railway have now been tested with 12 months' continuous running and are all in good order and repair. A little trouble was at one time experienced from leakage of water in the short brick tunnel at Waterloo, but it has much diminished, and the pumps which were provided to meet this contingency were found to be amply sufficient. The iron tunnels within which the railway and City station were constructed are quite watertight and are perfectly sound. The Central London Company's subways at the Mansion House are fast approaching completion, and it is hoped that three additional communications between the streets and the subways will be ready for use in October, namely, (*a*) in Mansion House Place, (*b*) at the Union Bank, Princes Street, and (*c*) at the junction of Lombard Street with the Poultry. At the same time the two staircases at the City station will be shortened and improved. Since the opening of the railway the line has been continually worked with the electrical plant provided in the generating station at Waterloo. The electrical difficulties which occurred in the

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earlier working of the line have, as was to be expected, yielded to time and experience, and all the electrical apparatus appears now to work regularly, steadily, and without difficulty. The trains have for months past been running to a time table at six minutes interval during the busiest part of the day. Further rolling stock has been ordered by the London and South-Western Company, and when this arrives it is intended that the trains shall be still more frequent than they are at present."

Lieut.-Col. the Hon. H. W. Campbell seconded the motion and it was carried.

National Telephone Company.

Mr. J. S. Forbes (chairman) presided on Thursday last week over the twenty-fourth ordinary general meeting of the shareholders of the National Telephone Company held at the Cannon Street Hotel, and in moving the adoption of the report said the accounts were very similar to those of previous years, the only essential alteration being in the figures. Under all the circumstances, the directors considered the figures eminently satisfactory. There had been an increase in the income for the half-year of £63,000, which had been attended with an increase in the working expenses, but still they were left with an increased profit of £24,844, which was no inconsiderable sum. Comparing the figures with the corresponding half of 1898, they would see that the Post Office royalties had increased by a very large sum, and amounted to £58,859—an increase of £9,186. The net income had increased by £54,000, and the working expenses by £29,000. The working expenses had been reduced from 61·94 per cent. to 61·15 per cent., which was a tangible gain. The debenture and other interest had increased by £7,623, but the preference and ordinary dividends were practically the same. They proposed to carry to reserve £60,000 as against £50,000, and to carry forward £5,213 against £548. A most interesting and satisfactory feature was the large sum for rentals carried forward for unexpired terms. They had already received the enormous sum of £651,000 in respect of services to be rendered by the company after the expiration of the term they were dealing with, and that was an increase of £56,000. In fact, so far as the year had gone, it had been a record one, and they had had the largest accession of subscribers they had ever had in any year of the company's existence. Out of the available balance of £178,963, a dividend of 6 per cent. on the ordinary share capital was recommended. With respect to the capital expenditure that must always go on, for they could not expand the business without money, and if they were to go on in the same ratio as they had last half-year—an addition of 17,000 subscribers—they must have more money to meet the large expenditure involved. In the half-year under review, £372,000 had been expended on capital account in the erection of 10,479 additional exchange and private lines, and in the construction of underground lines. Their system was undergoing a gradual change; the vital feature being that they were getting under the earth, and a very large sum of money had been spent in the last few years in placing the wires underground in Liverpool, Manchester, Birmingham, Bradford and many other places. They estimated that at the present moment they had about £750,000 lying in the earth, but, of course, in laying out a new system they allowed for an expanding business. There it was, however, lying ready to be utilised as the wants of the community increased. Of course, interest had to be paid on that money, but still the shareholders had a fair dividend, and were in possession of a latent power which would enable them, at a comparatively small cost, to greatly increase the number of subscribers, so that the cost, which was harped upon by critics as having been extravagant and watered, in due course of time would come down very nearly to the moderate figure which the enthusiastic promoters of new schemes believed to be the approximate one. That, however, could only be in a great undertaking, and not in a small one.

Lord Harris seconded the motion, and it was carried unanimously without discussion.

The meeting was then made special, and the Chairman moved a resolution giving power to increase the capital of the company by £2,000,000 by the creation of 400,000 new ordinary shares of £5 each. He said that might be considered to be a tall order, but still, they had to look things in the face, and that great corporation could only be made efficient by expansion, and expansion meant money. If they went on spending at the rate of £600,000 or £700,000 a year they could not go far without getting into debt, and they must either have behind them the power to meet the debt or stop. He thought their company was likely to go on, and it was time that they had to face a new Government policy, but if they could not get all they wanted they must get all they could. They were, after all, only the licencees of the State and they had now come to an agreement with the Government because they thought it was politic in the interests of the shareholders. They had got to face the competition of the Post Office, but yet they had been so fairly treated in the course of recent discussions with the Government that they were bound to act loyally in assisting them in the object they had in view. How far it would succeed time only would show, but the company must not be behindhand in securing their own position and also in expanding, and honestly and in good faith see what they could do to make the position of the Government that which they wanted. The Government wanted to popularise the telephone, and the company would do its best to help that policy forward. In moving the resolution, he would warn nervous people that it did not mean they were coming forward at once for £2,000,000, but they believed that it would be wise to be armed with the power to raise the money.

The resolution was seconded by Lord Harris and carried.

British Electric Transformer Manufacturing Company, Limited.

The *Times* contains a report of the first ordinary meeting of this company held at Faraday House, Charing Cross Road, Mr. R. Stewart Bain presiding.

In moving the adoption of the report, the Chairman stated that prior to the completion of the company's works in October last, the manufacture of their transformers had to be carried on in a temporary workshop, which was found to be both inconvenient and expensive. The shareholders might take it that the first three months of the period under review were not profit-earning, although the time was usefully employed in bringing the transformers prominently under the notice of future customers and in organizing the staff On the whole, he thought that they had every reason to be satisfied with the results achieved during the nine months that they had been working in their own factory. Turning to the profit and loss account, he pointed out that the total sales, after deducting returns, amounted to £10,991. Of this sum, £5,633, or over 50 per cent, represented the sales of the three months ended June 30th last, thus showing that as their organization became perfected their capacity of output increased more than three-fold. He regarded this as a very encouraging feature in relation to the future of the company. The item of £1,623 represented the value of the work in progress at the close of the financial year. It was only taken at cost, and would, of course, show its due proportion of profit when completed. The remaining items brought up the total amount on the credit side of the profit and loss account to £12,835. On the debit side they had the aggregate manufacturing costs figuring at £10,230. This was more than it would have been but for their having to occupy temporary workshops from June, 1898, to the following October. Against this, however, must be placed the fact that the prices of copper, iron, and other materials had increased during the past six months. The general charges, £942, could not, he thought, be considered extravagant. His own feeling was that if it were desired to make a business pay they must commence by studying the strictest economy during its early years. As proof that the directors practised what they preached, he might state that, of the fees due to them, £669, they had relinquished £369. The amount drawn about recouped them for their out-of-pocket expenses in attending to the company's affairs. Out of the balance available for distribution the board recommended the payment of a dividend of 6 per cent. on the subscribed capital, leaving £237 to be carried forward. To the sum of £25,000 the cost of patents as per agreements of March and May, 1898, there had to be added £250, being the expenditure during the year in obtaining additional foreign patents. The company's transformers were covered by letters patent in France, Belgium, Italy, Austria, Switzerland, the United States, New South Wales, South Australia, West Australia, Queensland and Tasmania, and an application had been made, and was now under consideration, in regard to Germany. The question of how these foreign patents should be dealt with was a matter which was occupying the attention of the board. The directors attached considerable value to them, but whether they would be sold or worked by this company was a subject for future decision. Already the board had been approached with a view to the sale of some of them. Referring to the company's prospects, he said that, at the date of the report, they had orders on hand amounting to £9,260, which was nearly equal to the sales of the period under review, and additional orders had come in since. Their working capital was very small, and they had to deal with the fact that one of the conditions of municipal contracts was, that from 10 to 20 per cent. of the amounts represented by such contracts was retained for a year. The board had, therefore, resolved to issue a further 5,000 shares, which would be offered at par, to the subscribers for the original capital. He could not afford the shareholders better proof of the directors' confidence in the business than by stating that it was their intention, as well as that of the officials, to put more of their own money into the company.

Mr. Reginald J. Wallis-Jones having seconded the motion, it was unanimously agreed to.

W. T. Henley's Telegraph Works Company.

On Tuesday at Cannon Street Hotel, Mr. Sydney Gedge, M.P., presiding, the resolutions passed at the extraordinary meeting held on July 31st were unanimously confirmed. At a subsequent meeting of preference shareholders a resolution was passed ratifying the agreement of July 19th between George Sutton on behalf of the holders of the preference shares of the company of the first part, Arthur Edward Salmon on behalf of the holders of the ordinary shares of the company of the second part, and the company of the third part, and declaring the same to be binding on all the holders of the preference shares of the company. And at a third meeting of the ordinary shareholders the agreement was also ratified.

The Hampstead Electric Supply Company.

A meeting of this company was held last Friday at Winchester House, the Chevalier Soares presiding. The object of the meeting was to pass certain resolutions altering the articles of association, as the company had applied to the Stock Exchange Committee for a settlement, and they, in compliance with their regulations, wanted the various alterations made. The chairman moved the adoption of the resolutions, Mr. Watling seconding, and they were carried. A confirmatory meeting will be held in due course.

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British Electric Works Company, Limited.

The first general or statutory meeting of the shareholders in this company, of Birmingham, was held, on 14th inst., at the Law Association Rooms, Cook Street, Liverpool.

Mr. W. M. Brigg, in addressing the shareholders, said that the meeting was a formal one. He thought they might congratulate themselves on the fact that the whole of the capital had been subscribed, and that they had come into possession of exceptionally good works—works that were designed and intended for the cycle trade, but which lent themselves very well indeed to the business the company had in view in taking them over, which was largely the manufacture of electrical fittings. The articles they produced were meeting with a very ready and very acceptable sale. They had been introduced to and were being taken up by the Government, the Post Office, and the Naval Department, and the company's name was on their list. Since the middle of May, when the company actually came into possession of the property, they had had a good deal of machinery to alter and to adapt to the particular purposes required, and they were now really beginning to reap a benefit. They had a good many orders on hand and a good many more in prospect. He hoped that the business would go on as it had begun, and increase and develop, and that at the end of the financial year they would have a dividend to declare.

Hong Kong Electric Company, Limited.

The tenth ordinary yearly meeting was held at the offices at Queen's Buildings.

Mr. H. L. Dalrymple (the chairman) congratulated the shareholders on the further increase in the company's business, the gross earnings showing an increase of upwards of $21,000. The increase had spread almost equally over all branches of the company's business, with the exception of arc lighting, which has remained stationary. During the 12 months under review they carried out a large number of installations, and at the present moment have a considerable amount of installation and other work in hand, all of which will increase the demand for lighting. The board still continue the policy of installing the light at as near cost as possible. The chairman proposed that the report and accounts as presented be adopted, that a dividend of 6 per cent. (60 cents per share), absorbing $18,000, be declared, and that $17,354.23 be written off plant account for depreciation.

Mr. Veitch seconded, and the motion was carried.

Blackpool and Fleetwood Tramroad.—At the half-yearly meeting of this company, held on 15th inst., Mr. G. Richardson, the chairman, said that they had conveyed 620,000 passengers during the past six months. The total receipts during that period amounted to £9,991. From July 1st to August 12th the receipts were £7,981, and they had carried only one-third less passengers during that time than during the whole preceding half-year. An interim dividend of 6 per cent. was declared, and £390 carried forward.

Stock Exchange Notices.—Applications have been made to the Stock Exchange Committee (1) to appoint a special settling day in and to grant a quotation to Giffre Electro-Chemical and Power Company, Limited—110,000 £1 shares, fully paid, and to allow the following securities to be quoted in the Official List:—Imperial Tramways Company, Limited—10,000 6 per cent. cumulative preference shares of £10 each, fully paid, Nos. 1 to 10,000, 20,000 ordinary shares of £10 each, fully paid, Nos. 1 to 20,000, and £200,000 4½ per cent. first mortgage debenture stock.

The Hove Electric Lighting Company, Limited.—The directors have declared an interim dividend at the rate of 6 per cent. per annum for the half-year ended June 30th last; the dividend will be paid on October 15th next.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending August 12th, 1899, were £2,167 18s. 5d.; receipts for week ending August 12th, 1898, £1,923 8s. 4d.; aggregate for half-year to date, £7,981 4s. 0d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending August 11th, 1899, were £4,489 1s. 5d.; corresponding period 1898, £2,869 19s. 7d.; increase, £1,619 1s. 10d.

The City and South London Railway Company.—The receipts for the week ending August 13th, 1899, were £1,038; week ending August 14th, 1898, £928; increase, £110. Total receipts for half-year, 1899, £6,666; total receipts corresponding period, 1898, £6,784, decrease, £118. Miles open, 8½.

The Dover Corporation Electric Tramways.—The receipts for the week ending August 12th, 1899, were £334 5s. 3d.; week ending August 13th, 1898, £259 13s. 7d.; increase, £74 2s. 8d. Total receipts to date, 1899, £5,819 10s. 10d.; corresponding period, 1898, £4,706 12s. 4d.; increase, £1,112 18s. 6d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,667; 1898, 3,845. Number of cars, 1899, 12; 1898, 10.

The Dublin United Tramways Company.—The receipts for the week ending Friday, August 11th, 1899, were as follows:—D. U. T. Co., horse cars, £2,274 8s. 7d.; ditto, electric cars, £1,353 9s. 5d.; D. S. D. Co., electric cars, £1 284 5s. 8d.; total, £4,911 18s. 8d.; corresponding week last year—D. U. T. Co., horse cars, £2 608 3s. 0d.; ditto, electric cars, £529 11s. 11d.; D. S. D. Co., electric cars, £1,036 17s. 6d. total, £4,174 12s 5d.; increase, £737 6s. 8d. Aggregate to date, £27,670 17s. 10d.; aggregate to date last year, £26,920 9s. 5d.; increase to date, £750 8s. 5d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 12 miles electrically, and 30 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending August 13th, 1899, amounted to £2,704; corresponding week last year £1,743; increase, £331.

The South Staffordshire Tramways Company.—The receipts for week ending August 11th, 1899, were £987 2s. 6d.; aggregate receipts for 32 weeks, £30,954 10s. 11d.; week ending August 12th, 1898, £580 16s. 3d.; aggregate receipts for 32 weeks, £19,858 8s. 2d.

STOCKS AND SHARES.

Wednesday Evening.

A pleasant little rise has at length come to infuse some cheerfulness into the electric lighting market, and, although prices in the list do not show much appreciable change, the quotations are nearly all "harder." There are now to be found buyers at the middle prices instead of sellers, and with the brighter tone prevailing, the buying element came to the front with boldness. City of Londons present almost the only dull feature in the coterie, and the hopes of shareholders appear to be fast vanishing the nearer the quotation approaches its par value. A time of great stress seems to lie before the company in the immediate future, and although it will probably weather this storm as gallantly as it has passed through others, it is certainly a difficult position for the company at present.

On the other hand, Charing Cross have risen, and it is thought that the directors will have very little difficulty in raising the new capital that will be required before the company can supply current in the City. It is believed that at least 1½ million sterling will be required before effective competition can be commenced.

London Electric Supply Preference have been bought, and there has been some demand for the Preference shares of the House-to-House Electric Supply. South London Electricity have shed a small fraction, sellers predominating in the market.

The electric railway market has also been firm, the feature being a rise in Waterloo and City Ordinary. This was due chiefly to the optimistic tone of Mr. Portal at the meeting last week, whose speech was very favourably received in the Stock Exchange. Considering that the company is only in its infancy, as the chairman remarked, its progress appears to be distinctly encouraging to the stockholders. We adhere to our opinion, however, that the latter are not likely to get more than their guaranteed 3 per cent. for some few years to come. Of course, the company has the inestimable advantage of being backed by the London and South-Western Railway, without whose aid a different story would probably have been told, and the price of the Ordinary stock might have stood nearer that of the pioneer electric railway, the City and South London. The "City" Company would, in all likelihood, do much better business did it adopt a more generous scale of fares, that in force at present tending rather to foster irritation among passengers than to attract them. Central London shares present an unchanged front; the partly-paid capital is to be called up in a day or two.

Tramways Union shares are 8½—⅝, but very few change hands, as shareholders are looking forward to obtaining a better price should the company be able to go into voluntary liquidation after the sale of the last, *i.e.*, the electrical part of its lines.

Telegraph issues have fallen into a state of holiday quiescence, and scarcely a rise or fall marks the calm stillness of the share list. It has been finally decided that the Telegraph Construction and Maintenance Company should have the manufacture and laying of the new German trans-Atlantic cable to New York. It is a remarkable fact that there should be no German company able to undertake such a contract, but the foundation stone of competition has already been laid in Germany, and the provincial markets are shy of raising the price of Telegraph Construction shares, which already stand at a very substantial premium. Electric Construction 4 per cent. First Debenture were inquired for by a small buyer, with the result that the price has been raised a point.

Aluminium "A" shares continue dull, and the excellent report lately issued has had no effect in stimulating an upward move. The Hampstead Electric Supply Company has at last awakened to the necessity for obtaining a quotation of some sort in the Official List, and is taking the necessary steps in that direction. The price at present is purely nominal.

National Telephones are steady, but the observations of Mr. J. S. Forbes at the meeting produced no effect upon the price. The company is undoubtedly doing a splendid business, and there seems some justification for the opinion in the Stock Exchange that the price of the shares will touch 6 again before long. There is nothing doing in other telephonic ventures.

A prospectus has reached us, marked "Strictly Private and Confidential" of the United Kingdom Tramway Light Railway and Electrical Syndicate, Limited. The Syndicate starts with a modest capital of £20,000, and its scope lies in acting as a parental company to new electrical railway undertakings, and the like. Various concessions have already been obtained in different parts of England, the most important being in North-east Durham. The Syndicate appears to possess some chance of success, but its shares are at present, we understand, all held privately

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, August 9th.	Closing Quotation, August 16th.	Business done during week ended August 16th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	62 — 65 xd	62 — 65	63⅛	62½
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	114 —115 xd	114 —115	115	114½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	13¾— 14½	13¾— 14½	14½	14⅛
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	15½	15
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3 xd	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105½	...
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼xd	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9⅜	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
80,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	103½	...
60,710£	Direct United States Cable	20	3 %	3¼%	3¼%	11⅜— 12¼	11⅜— 12¼	11⅞	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	151 —156 xd	151 —156	154	152
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	98 —102 xd	98 —102	100	99½
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104	101 —104 xd	..	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	115 —120	115 —120	117½	115
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14½— 15	14½— 15	14⅝	14½
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,040, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	114 —119 xd	114 —119	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104 xd	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	5½%	10⅜— 11¼	10½— 11	11⅛	10⅞
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15¼— 15⅜	15 — 15½	15⅜	15¼
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	...	...
93,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½%	6 %	6 %	5⅝— 5⅝	5½— 5½xd	5½	5¼
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	14	13½
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅜— 5⅝	5¼— 5½	...	...
1,339,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	100	99
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	7⅝	...
3,881	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	4⅜— 5¼	5	...
151,733£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	100 —103	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	101 —104	101 —104	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	103½	...
88,321	West India and Panama Telegraph	10	1 %	⅝%	...	1⅜— 1⅝	1⅜— 1⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10⅝	10½— 10⅝	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	103 —106	103 —106	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	9½— 10½	10 — 11 xd	10½	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
24,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8½	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	113 —115	113 —115	113	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11½— 12½	11 — 12	12	11⅞
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13½xd	13	12 13/16
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	123 —128	123 —128	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 11½	11 — 11½	11⅛	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14 xd	13½— 14½	14	...
220,000	Do. 4½% Deb. Stock, Prov. Certs (£60% to be paid) Rd.	...	...	...	...	51 — 53	51 — 53	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5¼— 5⅝	5½— 5¾	...	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	7½— 8½	7½— 8½xd	8¼	8
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	8½— 9½	9 — 10 xd	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7 xd	6½— 7	6⅞	...
100,000	Do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	106 —107	105 —107	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	15 — 16 xd	15½	...
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14½— 15½	14½— 15½xd	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	118¼	117½
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	16 — 17 xd	16 — 17	16⅝	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	4 — 4¼	3⅞— 4⅛	4 1/16	4
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½— 15½xd	14½—15½	15⅝	14¾

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being *vred* as capital.
Divid ds marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Aug. 9th.	Closing Quotation Aug. 16th.	Business done during week ended Aug. 16th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3½— 3⅝	3 — 3½xd	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	17½— 18½	17½— 18½	18¼	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	14 — 14½	14 — 14½	14½	...
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	13⅝— 14¼	13⅝— 14¼	14	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	129½	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅜— 2	1⅜— 2	1 7/16	1 1/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2⅛— 2⅜	2⅛— 2⅜	2 9/16	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	14½— 15½	13 — 14	14⅞	13⅝
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10⅜	10¼— 10⅜	10⅜	...
178,308	Do. do. do. £8 paid	10	...	...	...	8¼— 8⅜	8¼— 8⅜	...	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	2⅜— 3½	2⅜— 3½	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	5½— 5⅝	5½— 5⅝	5½	...
680,000*l*	City and South London Railway	Stock	1 2/16 %	1⅞ %	2⅛ %	67 — 69	65 — 67 xd	...	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6½— 6⅝	6½— 6⅝	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	3⅝	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½ %	6 %	6 %	2 — 2½	1⅞— 2⅛xd	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½ %	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛— 2⅜xd	2⅛— 2⅜	2⅜	2⅛
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3⅛xd	3 — 3⅛	3½	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	101 —104	102 —105	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000 ...	2	...	...	...	⅝— ¾	⅝— ¾	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	25 — 26	25 — 26	25⅞	25¼
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	20 — 22	20 — 22	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	...	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞ %	3¼ %	3½ %	8 — 8¼	7⅝ — 7⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	14 — 14½	13½ — 14	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	38 — 42	38 — 42	...	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	104	...
18,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9⅜	9¼— 9⅜	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅜— 6¼	5⅜— 6¼	6	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	102 —105	103⅜	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8½—9½.
British Aluminium, Ordinary, 10—11; 7 % Pref., 11—12.
House-to-House, 4½ % Debentures of £100, 103—106.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8½. Debentures, 103—106. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 3—4.
*T. Parker, £10 (fully paid), 19.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, August 16th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	32/-	32/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	87/-	87/-	..
a Ammonia, Muriate (crystal) .. per ton	£26	£26	..
a „ „ .. .. per ton	£24	£24	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25	£25	..
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a „ White Sugar .. .. per ton	£31	£31	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	8½d.	8½d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
b Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8½d.	..
c „ Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c „ Wire, basis .. .. per lb.	8½d.	..	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g „ Wire (basis price) .. per lb.	10½d.	10½d.	..
g „ Sheet .. .. .. per ton	£88	£88	..
g „ Rod .. .. .. per ton	£88	£88	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/1 to 4/3	4/3	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	63/6	68/6	5s. dec.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£13 15	£12	35s. inc
g Lead, English Ingot .. .. per ton	£14 10	£14 10	..
g „ „ Sheet .. .. per ton	£15 7 6	£15 7 6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 7	£8 7	..
d Mica (in original cases), small per lb.	1½d. to 6d.	1½d. to 6d.	..
d „ „ „ medium per lb.	1/9 to 2/6	1/9 to 2/6	..
d „ „ „ large per lb.	3/6 to 7/-	3/6 to 7/-	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd strip & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£146 10	£146 10	..
g „ foil .. .. per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/10	1/10	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	..
j „ Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j „ Hemp, 3 ply 10 lbs. .. per lb.	8½d.	8½d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£12 10	£12 10	..
j „ Manila, 24 thread .. per ton	£85	£82 10	£2 10s. inc
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£28 10	£28 10	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
Messrs. Johnson, Matthey & Co., Ltd.
The Phosphor Bronze Company, Ltd.

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THE MUNICIPAL ELECTRICAL ASSOCIATION.

Discussion on Mr. Edgcome's Paper* on "The Arrangement of Steam and other Pipes, and Their Fittings."

Mr. Ferranti pointed out that there was a great similarity in electricity stations between the system of steam pipes and the switchboard system of communication. With the switchboard, most engineers wished to be able to do everything, and very many complications resulted from its having to fulfil so many requirements. Very much the same thing applied to the system of steam pipes and valves. It was desired to feed every engine from every boiler in every conceivable way. For his part, he would reduce the pipes down to the lowest possible limit. He would give up many conveniences, and would do away with a great deal, provided he could bring the pipes down to an irreducible minimum. They cost a great deal to instal, and a great deal more to maintain. The stand-by losses were, to a great extent, due to pipes, and what was not attributable to pipes was, in a great measure, attributable to valves. In his opinion, the only things worse than steam pipes were valves. For his part, he would rather follow the system of putting the plant into sections than have any complicated system of steam pipes. He would rather see engines with a certain number of boilers sufficient to run and to spare attached to each engine, so that each set formed a complete unit. All that would be necessary in that case would be to have small inter-connecting pipes between the various systems available in case of a breakdown.

Mr. Gibbings (Bradford) said that with reference to the author's description on page 5 of his paper, he had found since his station was first started—practically two years—he had not had to make more than one joint. When the joint had to be made they had the advantage of being able to take out a complete packing ring instead of having to cut a special ring of asbestos or other packing. Instead of connecting the drainage pipes direct from the steam pipes, they had interposed another—a small casting. There was an overflow arrangement in the inside of this circular casting. If the steam trap was not acting properly, it was always easy for the engineer, as he went round, to see that the water was standing at a higher level than it should, that was to say, than the overflow of the water itself.

Mr. Steinitz (West Ham) agreed with Mr. Ferranti as to the complications. He should prefer one single main with a certain factor of safety. The ring main was the invention of the electrical engineer. They did not hear of it in waterworks or such like establishments. They ran more risk by the addition of the ring main than the advantages justified. Where they were using large valves they could make them act as separators by turning them upside down. It was necessary the steam traps should be regularly examined.

Mr. Boot (Tunbridge Wells) said Mr. Ferranti had referred to complicated systems of pipes. They had a steam ring, and they found it of very little use, except to give employment to fitters. They had tried almost every kind of joint mentioned by Mr. Edgcome, and had had trouble with them all. With regard to the question of covering, when they started it was not the practice to cover their valves and their fittings beyond just the ordinary piping, but they found there was a considerable loss occasioned by their not being covered, and about a year and a half ago they decided to cover every valve. The result in economy had certainly been remarkable. It seemed only a small matter, but it was extraordinary to notice the difference in temperature that it had caused in both the engine room and boiler house, so that the losses must have been considerable from these causes alone. The latest form of covering they had tried was blue asbestos, and he thought that would be satisfactory. Mr. Gibbings had mentioned the question of the reservoir. They some time ago had traps in all their drains, but they gave it up, and did away with traps altogether, bringing all the drain pipes to one large steam reservoir with the arrangement mentioned by Mr. Gibbings. They put in one blow-down pipe and the result had been satisfactory.

Mr. Chamen (Glasgow) said he was glad attention had been called to the question of steam rings, and he reminded the meeting of the terrible affair which happened at Kensington Court in the early days. He agreed entirely in this matter with Mr. Ferranti, who, he thought, had put the whole case most clearly, and the arrangement he had described was practically what he had decided to introduce in Glasgow. He had a 15-inch steam main which he had put at the highest point inside the boiler house, the connection from the boiler running up to that. That main was broken at intervals, and he had an arrangement to connect the various parts by small pipes. The only place where he thought it desirable to have a steam trap was the engine separator. Reference had been made to the question of recessed pipes. While of service in keeping the joints in sound condition, it had presented difficulties in case of repair, and he preferred the arrangement suggested by Mr. Edgcome. With regard to explosion valves mentioned on page 8 of the paper, Mr. Edgcome did not mention the double-acting valve which was in use on the Babcock boiler. As to blow-off valves, he did not think they ought in future to have the boilers' blow-off valves discharging into a common pipe, particularly in large stations. There might be a leakage to be dealt with, and there would be difficulty in finding out exactly where it was. His idea was that each blow-off valve should discharge into a separate culvert, and that in each case there should be ample facility for inspection. The engineer would, of course, take care that there were periodical examinations. In his remarks he had let the valve makers alone. Their consciences would tell them what to suggest.

Mr. Mountain (Huddersfield) thanked Mr. Ferranti for trying to standardise their steam pipes in the way he had done, although it was an expensive item. There could be no doubt they were forced to have some system of duplicate pipes. Describing the system he had adopted for draining the pipes, he said he did not have any steam traps at all; he simply drained his water to a cast-iron cylindrical vessel, whence it was taken up to a condensing tube in the roof and then conveyed directly back to the boiler. Really it was nothing more than the American system of returning condensed water, but it worked well, and they could be absolutely sure the pipes contained no water. As to the covering of the exhaust pipes, he had trouble with the heat in his engine room, and he put a casing round the pipe and let his feed water go through it. That accomplished the double process of cooling his engine room and heating his feed water. He thought if that plan were adopted it would help to economise.

Mr. Hopkinson said he was afraid the poor valve makers had a lot to answer for. It was not, however, altogether the construction of the valves, but the way in which they were used. In order to ensure their being fairly tight, valves should be closed regularly, say, two or three times a week. They were often spoilt in the first two or three days of working. If the gentlemen present could arrange some means of having their pipes cleaned before erection the trouble from valves would be largely reduced. Mr. Chamen had referred to an explosion valve, but that was not exactly the valve referred to by Mr. Edgcome. His was an isolating valve, which automatically cut off the boiler, not in the event of a large escape of steam, but immediately the pressure fell.

Mr. Ruthven Murray remarked that this was a subject of very great interest to them all, because they all had steam pipes—they even found them in water-power stations. He thought insufficient attention was, as a rule, given to providing for the expansion of pipes. They had also to provide for draining the pipes, though he dared say, by the use of superheated steam, the necessity for drainage was less than it formerly was. As regarded the means of providing for expansion, there were practically two; one was by the elasticity of the pipes, in which case they must use bends, and it was advisable to keep the pipes comparatively small in size. He thought on large steam mains Mr. Wordingham had done this by putting a series of small pipes parallel, which ought to get over the difficulty very nicely. The second way was by mechanical expansion joints, which some of them had not found satisfactory. There was a great deal of danger in the use of copper. In the matter of the blow-off valves, his practice had always been to fit on the blow-offs a valve, then a cock in series. He thought the danger Mr. Edgcome had referred to of getting steam back into a boiler might be easily and satisfactorily overcome by putting a back pressure valve on the blow-off.

Mr. Fletcher (Ashton-under-Lyne) confessed that he had listened with very great interest to the paper given by Mr. Edgcome, but he would like to point out that the valve makers were not always at fault; the blame often rested with the electrical engineers. References had already been made to foreign matter coming into the valves. He had frequently experienced that, and sometimes he had found a great part of the building inside. The by-pass was an important matter in all these things. Standardising would, he thought, save a good deal of trouble.

Mr. Wordingham (Manchester) thought the question of steam pipes was, perhaps, one of the most difficult in a central station, and it certainly was one of the most fruitful sources of worry. Mr. Ferranti's remarks referred chiefly, he thought, to large stations. He thought, however, that whether the station was large or small, it was wrong to let it depend upon a single joint in a steam pipe. They must have some means of getting around that joint, either by a ring main or a complete set of duplicate mains, and, to his mind, the latter plan offered special advantages. Seeing that they had two connections from each boiler and engine, one to each steam pipe, it followed that if they had leaky valves they were sometimes difficult to trace. It was important that there should be facilities for easily testing where the leakage was. Now in a large station the difficulties of steam pipes were enormously accentuated, because although they were growing larger units every day in their generating stations, it was very difficult to get a larger unit in boiler power. In the last station he was designing they would probably have 11 units for the generators and something like 120 units for the boilers. He did not think they wanted to carry the duplication of the steam pipes right away to every boiler. He had adopted a unit of seven or eight boilers, and there would be a duplication in the engine room, but in a sense it would not be a complete duplicate. He thought something on those lines was what was really wanted. He agreed with Mr. Ferranti that they did not want a lot of complication, but he did not agree with him if he meant that they ought only to have a single pipe on which to depend. He understood Mr. Ferranti to suggest that there should be a reserve of sections, and if so he thought there was a good deal to be said for it.

Mr. Ferranti: That is right.

Mr. Wordingham quite agreed that they only needed small interconnections. He was glad to have heard a little bit about Mr. Mountain's gravity return system, and would like to hear more. In Mr. Edgcome's paper he showed some cross-connections in his steam ring. He (Mr. Wordingham) thought that if carried out in the way suggested there would be a great amount of trouble with the expansion of the two legs of rings. One of the most important things was the question of expansion joints. He did not think there was any joint so called that was of any use, and he had had to fall back upon bent steam pipes. Mr. Edgcome apparently advocated automatic valves. To his mind, the fewer automatic things they could have about an engine house the better. As to the high steam and low water valve that they found on the Lancashire boiler, he thought it absolutely useless. As to pipe covering, he did not think accessibility to the pipes themselves was necessary, but they must have access to the joints, and therefore to that extent it must be a removable covering. If they desired a nice little engine room, it was necessary to cover the cold water pipes, otherwise the condensation of water on those pipes would cause a deal of rust.

Mr. Snell believed the best type of steam joint was the corrugated

* Electrical Review, August 11th, 1899, page 251.

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ring. With regard to drainage, he did not like the idea of turning his valves upside down.

Mr. Ram suggested that if possible many boiler coverings actually helped to keep the pipes cool rather than warm.

Mr. Andrews (Hastings) wished to say a word in support of the steam ring. About six years ago they put in a steam ring at Hastings, and for four years they never had occasion to use it, and he began to look upon it as an unnecessary complication. They then had occasion to extend the ring to couple up a new boiler, and during that time a joint blew, and they had their lights out in the town for about half an hour. They must have duplicate feeders. It was absolutely necessary to provide against a fault in any part of their system cutting off the whole supply.

The Chairman, Mr. J. H. Rider, said he would like to add a few words before Mr. Edgcome replied. In the first place, he totally disagreed with the author in his advocacy of the steam ring. He thought it was time the steam ring was killed, and he thought the ring Mr. Edgcome had designed in his drawing was bad, even for a steam ring, because instead of taking his steam branches from the same side of the ring to which the boilers were connected, he took them from the opposite side. He thought he should take them from the same side, and use his ring entirely in the boiler house with the lower half having no branches at all, so that the lower part could be used as a drain. He agreed with what Mr. Ferranti had said. Supposing they had half a dozen boilers in a station, they could get all possible necessary combinations by coupling these boilers directly to their engines and by putting in a small connecting pipe. The extra advantages they were supposed to get from the steam ring and the inter-connecting devices were more than upset by the trouble of condensation and the trouble of getting water into the pipes if they were kept off except in cases of emergency. He hoped the meeting would condemn the steam ring, and let it go forth that it did not like it. He was sorry that the gentlemen who claimed to have discovered such good steam traps would not tell them where they came from, because they were things which they all desired. He thought one of the advantages of the Association should be to give information of that kind. He quite agreed with the jointing arrangement suggested, viz., corrugated brass rings. As to valves turned upside down and the liability to leakage through the glands, he knew a station where the valves were turned upside down, and he did not think a cupful of water had come out of those valves during the last two years. As to pipe covering, he certainly thought that covering for the flanges was quite as necessary as the covering for the pipes. In most stations there was a large area of joints open to the atmosphere which ought to be covered, but it was, of course, necessary that the covering should be removable in order that they might get at the joints when necessary. They were indebted to Mr. Edgcome for the able manner in which he had brought the subject forward, and he was sure they would give him their hearty thanks.

Mr. Edgcome, in his reply, said that when he got back he should start pulling down his present steam ring and arrange a station on the Gay-Rider system. With reference to the remarks of Mr. Steinitz, he thought they were answered by the fact that until the electrical engineers took the question in hand no other engineers took the trouble to give a duplicate supply of steam pipe—due to the fact that until the electric supply stations were running there was no necessity for absolute continuity of running. With gas and water works there was always a large amount of storage. With other works it caused inconvenience, but it did not advertise itself in the same way as with electric light plant. When something went wrong at other works no one knew anything about it. Various hints had been given in the course of the discussion as to special information which some of the members possessed, and he hoped at the close of the session when the reporters were not present they would tell their colleagues these good things.

PROF. KENNEDY'S REPORT TO THE LONDON COUNTY COUNCIL ON MECHANICAL TRACTION ON TRAMWAYS.

Report by Alex. B. W. Kennedy, F.R.S., &c., to the Highways Committee of the London County Council.

17, Victoria Street,
Westminster, S.W.,
June 5th, 1899.

To the Clerk of the London County Council,
Spring Gardens, S.W.

Mechanical Traction on Tramways.

Sir,

In your letter of March 3rd last you communicated to me the following resolution of the Highways Committee of the London County Council:—

"That, taking into account all of the varying circumstances, present and prospective, of tramways in London, Mr. A. B. W. Kennedy, F.R.S., do report to the Highways Committee his opinion (*a*) as to the best system or systems of mechanical traction, other than steam or cable, for adoption, on the tramways, (*b*) where, or under what conditions, an experimental line could best be introduced to initiate such system or systems, and (*c*) generally on the whole subject."

I have now pleasure in making my report to your committee, in accordance with this resolution, upon the matters referred to me.

I should like to say, in commencing, that in view of the enormous importance of this matter to London and the very great complexity of the problem as applied to London, and in view also of the very rapid extension in the use of mechanical traction which has taken place during the last few years on the Continent and in America, I have thought it desirable, before reporting to you, to make special visits to those cities both in Europe and in America in which there now exist traction systems having special interest, or containing features which seemed possibly or probably to be of value, in connection with the special problem of mechanical traction in London. I have very great pleasure in acknowledging that during these visits made on your behalf I have received most valuable information and courteous help on all hands from engineers, tramway officials and manufacturers, for which I am greatly indebted.

I do not propose to describe in detail any of the visits which I have mentioned, but will confine myself solely to dealing with the matter as it affects London and as it has been referred to me. If your committee wish to have before them detailed descriptions of systems used elsewhere I shall be very glad to add them to this report at any time, but these are probably the less wanted as very excellent descriptions of some of the most important works have recently been placed before your council in the illustrated report drawn up by one of their members, Mr. J. Allen Baker.

(*a*) As the use of steam and cable for the trams is specifically excluded from the reference to me, there remain only, as systems of mechanical traction, the use of gas or compressed air, or of electricity.

As to the two first, if they could be successfully carried out on a large scale, they would certainly have the advantage that the cars would be self-contained and independent of each other or of any overhead or underground work. Any breakdown would therefore be that of one car only and would not affect the general system. I consider that this is a real and great advantage, and an advantage quite sufficient to outweigh smaller drawbacks if the systems in question were in other respects sufficient and satisfactory. Unfortunately, however, neither of them has yet attained sufficient success to warrant me in recommending their use on London tramways in the present state of the engineering problems connected with them. The cars to be used in London must be so large and heavy, and the power required in each so considerable, that the use of reciprocating engines (whether gas or compressed air) of sufficient power as motors is accompanied by many difficulties; in fact, I do not think that really suitable engines for this particular purpose have yet been designed. On a small scale, gas trams are running with considerable economy in the north of England, where I have examined them, and compressed air tramcars are going to be tried for a portion of the cross-town traffic in New York. I had the advantage of seeing these last cars during my visit to America, but they were not at the time in actual work.

Further, as to the use of gas or compressed air, I think I need only point out that if during the time occupied by the construction and running of your experimental line such advances should be made in the matter of gas or air engines as to render it advisable to consider this matter further, tramcars so propelled could quite easily be worked along with others on your lines in case circumstances arose which rendered such trials in any respect desirable.

As to the use of electricity, there are, as you know, various systems possible and in use. These are—

1. The ordinary overhead system, in which the current is carried from an overhead wire to the motor, and returned by the rails themselves to the station.

2. The underground conduit or slot system, in which (with the exception of one type) both conductors are insulated and are carried in a conduit underground, from which the current is transferred to the motor in the car by means of a plough working in a slot in the roadway.

3. Various underground surface contact systems in which no slot is used.

4. Systems using batteries as a sole means of propulsion, or batteries in combination with overhead conductors.

Taking the above possibilities in electric traction in the order in which I have mentioned them, the overhead system is, of course, by far the most used. Its great advantage is that it does not require any special interference with the roadway beyond that necessary for laying the lines of the tramways in any case;* and, further, that more experience has been obtained in connection with this than in connection with any other system. When carried out as roughly as it has frequently been carried out in America, its cost is very much less than that of any underground system. Carried out, as it is necessary to carry out such a system in this country, the difference of cost is not nearly so great. This difference will always, however, be considerable in cases where there are a great many pipes below the road near the surface which have to be shifted or otherwise dealt with. For this reason the overhead system has naturally commended itself to private tramway companies, and also to municipalities in comparatively small towns where the traffic could not be expected to be sufficiently large to pay on an increased capital. The overhead system is capable of giving any reasonable amount of power and any required speed of cars.

In straight roads or streets its disadvantages are at a minimum, the most obvious being the line or lines of poles (in London streets there would generally have to be a line on each side of the road), with the span wires connecting them, the trolley wires, &c., these being at a height of something like 20 feet from the road. Apart altogether from the much vexed question of appearance—as to which there is so great a difference of opinion—I cannot help doubting whether any system of overhead wires can really be regarded as likely to prove a permanent and final solution of the traction problem in a great city like London. But leaving aside this general question, I have to

* In this country the feeders would, of course, be laid underground, but these do not require any such depth of excavation as to be seriously inconvenient.

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point out that at crossings and street junctions (of which there are an enormous number in the tramway systems of London) the trolley system is inevitably accompanied by such a metallic network overhead as in my opinion to put it altogether out of the question in busy London streets. If any private company asked permission from a committee of the London County Council to erect at any one of a dozen junctions which are shown on the tramways map, such arrangement of poles, span wires, stays, guys, conductors, &c., as are necessary with an overhead system, and as are to be seen in certain cities, I feel certain that the proposal would be met by an absolute and unconditional negative. So far as my own opinion is concerned I do not think that it would be advisable or even permissible to use such a system in such places as I have mentioned. This difficulty affects nearly all the tramways north of the Thames, and it affects the South London tramways over an area roughly about two miles wide, and parallel to the course of the Thames, between Deptford Reach and Chelsea Reach.

South of the Thames and of the limits which I have just mentioned, long lines of trams radiate into suburban or semi-rural districts, these lines being mostly straight, along broad roads and free from junctions. In such cases the disadvantages of the overhead system are at a minimum, and its comparative advantages are greatest. As I shall have occasion to point out later on there is no engineering difficulty whatever in using a mixed tramway system, *i.e.*, partly underground and partly overhead. Whether this is worth while in the case of London is no doubt a matter for very serious consideration, and one which must be, to a considerable extent, decided by the nature of the roads along which the trams are to run and the details of the systems proposed.

I should point out that in any case the overhead system must practically use the rails as return conductor, and must therefore be an earthed system.

2. The underground conduit or slot system is the only one now used in New York, and is partly used also in Washington, in Buda-Pest, in Berlin, in Paris, &c. It is now 12 years since it was first tried in Buda-Pest. The system adopted there was in certain respects tentative, and is in certain important points quite unsuitable for London. Nevertheless, this original system, which is one of the earliest constructed of electric lines anywhere, has worked well and economically ever since its construction, and quite lately it has been much extended, both by the original company, and by a second company following the example of the first one, but with such improvements as later experience has suggested. The American experience in the slot system is more recent, and the results there have also been thoroughly satisfactory. I am glad, therefore, to be able to say, as the result of my examination of the present state of underground electric trams, that the laying out and working of lines on a slot system has already been carried out successfully on a very large scale. Moreover, it must be said that this success has been obtained in spite of a most singularly persistent and not very easily understood opposition. As a matter of fact the cost of power on the two systems (and, what is of equal importance, the cost of maintenance) is practically the same. The drawback of the underground or conduit system is that it certainly costs more per mile of line than the overhead systems. The chief engineer of one of the principal companies using both systems gave me as his experience that where the overhead system had to be provided with underground feeders and with such handsome poles and other appurtenances as would meet the approval of his municipality, the actual difference in cost between the two systems was very inconsiderable. And I have no doubt that the difference has been in the past, for various reasons, very greatly exaggerated. At the same time, however, in addition to the actual increase of capital expenditure due to the system itself, there must be in a place like London very considerable additional expenditure in many places due to difficulties caused by gas and water pipes, &c., which will have to be lowered or shifted or replaced. I have no doubt, therefore, that it is right at this stage to anticipate that any underground system will cost considerably more per mile of line than even a first-class overhead line. I will deal further with this question later on, but here need only point out that the actual amount of the difference in cost will depend on the amount of care given to the details of the design and construction of the underground conduit, in special reference to the particular circumstances and conditions of the London streets.

As to the conduit system itself there are two chief types in use. In one, one of the running-rails is made double, and the slot for the plough is carried down between its two halves, so that the running-rail itself lies directly above the conduit carrying the conductors. In another system the conduit lies in the middle between the rails, and the slot rail is therefore in the middle between the running rails, and is entirely separate from them. In the original Buda-Pest system the slot was about 1¼ inches wide, and even now in Brussels the slot is about 1¼ inches wide, and of still greater width at the points. Such an arrangement would no doubt be quite inadmissible in this country, and I must say that it appeared to me in some cases dangerous. In New York, Washington, Paris, and other places where the centre slot is used it is only about ⅞ inch wide—a breadth which is not the slightest hindrance or danger to any traffic.*

The conduit system has insulated conductors throughout—that is to say, it does not use the rails or earth as a return. I think this is undoubtedly an advantage so far as it goes, as it obviates as completely as in the case of electric light companies, the possibility of electrolysis due to leakage currents and the disturbance of telegraphs or telephones. The concrete below the central conduit is generally from 2 feet to 2 feet 3 inches below the road surface. Unless large pipes occur within this depth there will not be much trouble; it is only with large pipes occurring nearer to the surface than this that serious trouble is found. I think, however, that it is possible by careful design somewhat to reduce the depth of the conduit, and so reduce the trouble and expense due to this cause.

3. In surface contact systems there is no surface slot rail, but a series of studs, or buttons, or a continuous solid centre rail (divided electrically into sections), whose upper level is somewhat above that of the roadway between the running rails. These studs or rail sections become alive only when the car is actually passing over them and when they are rubbed by a skate or brush carried by and underneath the car itself. In these systems the return current is carried back by the rails exactly as in the ordinary overhead system, so that they have not the advantage of an insulated return. I have examined the working of a number of surface contact systems, some running on a commercial scale, some only experimentally. As compared with overhead lines they have, of course, the advantage of doing away with all poles, wires, &c., above ground. As compared with the conduit system, they are in general cheaper,* certainly in cases where the conduit system requires the removal of pipes under the roadway, for the surface contact system necessitates comparatively little excavation. The studs, or buttons, do not at all seem to be in the way of ordinary traffic, although I think that the raised centre rail which has been proposed in several cases might probably be found inconvenient. In most of the contact systems, however, a serious disadvantage, a disadvantage especially in our moist climate, is the fact that the working of the system depends upon the permanence of a very large number (from 300 to 1,500 per mile of single line) of coils of fine wire placed in switch boxes or in separate chambers underground, along or beside the line. I have been most anxious not to attach an exaggerated importance to this point, but after full consideration I must say that until it is experimentally demonstrated that these coils will remain permanently in good order and well insulated under the conditions of ordinary road traffic in our own country, they appear to me to constitute a serious drawback to the systems in question.

I must add, however, that there is a class of contact systems differing from those I have just mentioned in having electro-magnetic coils only upon the cars and not underground at all. Such coils are very few in number, and the failure of any of them would cause the failure of a car only, and not of a section of line, while they are much more accessible and readily tested and examined than coils placed permanently underground. No large experience has yet been gained in connection with such a contact system as I have just mentioned, but the experience, so far as it has gone, has been favourable, and it appears probable that a system based on this principle may be carried out successfully even under English climatic conditions. A good deal, however, has still to be done in order to work any such system into a form suitable for use under the conditions of London traffic. Equally with the other contact systems, there would in this case be a return by the rails.

4. Batteries of accumulators are used sometimes as the sole means of propulsion (in which case the battery is removable and is taken out of the car after a certain length of journey and replaced by another), or as part of a combined system, where the batteries are charged from the overhead portions of the line as the car is running upon them. In the latter case the batteries are never taken out of the car except for the purpose of overhauling. A battery car has the advantage that it may be made self-contained, so that a breakdown would be that of the car itself and nothing more. The batteries add, however, very greatly to the weight of the car (from 2½ to 4½ tons), their maintenance is very considerable in most cases, and at the best they are practically only suitable for use on level lines as in Hanover or in Ghent, in which latter place especially their use appears to have been attended with great economy, although of course it is only on a small scale. As with gas and compressed air, it will be possible for you at any later time to give a trial to a battery car or cars on your experimental lines if it seems desirable to do so, but I do not advise you at present to enter into any experiments yourselves in connection with this system of traction.

In concluding this section of my report I have to say, after examining very many overhead and underground lines in large cities, and especially after seeing the two systems frequently side by side in the same city, that the general convenience of having the roadway absolutely clear of all overhead obstructions, especially at important street junctions, seems to me so great that even if the extra cost were much more than it is actually likely to be, I think that the London County Council ought to adopt over all the central parts of their lines, an underground system—that is to say, a system in which overhead wires are entirely dispensed with. As to the much vexed æsthetic part of the question, I do not wish to say anything. But I feel certain that in such a large and wealthy city as London, a city where the tramway traffic will be enormous, and especially a city where the tramways are actually in the hands of the municipality, any such overhead arrangements as are inevitable at such places as I have indicated would never be tolerated as more than a makeshift. I believe that if for the sake of saving in the first cost they were to be adopted in London at present, there would before many years be a peremptory demand that they should be pulled down altogether and replaced by something free from these obvious drawbacks.

As to section (*b*) of the reference, I am very glad to understand that the Highways Committee propose to apply mechanical traction in the first instance to an experimental line. That is, as I understand, that they propose in the first instance to apply mechanical traction to only a certain detached section of their whole network, in order to gain such experience in the special conditions of London

* As to this I may mention that in Edinburgh, where a cable line is being laid, and where there is therefore a centre slot rail along the track with a slot ⅞ inch wide, the surface of this slot rail is the favourite line for bicycle riders to follow, as being the smoothest and best part of the street.

* But this would certainly not be the case in several of the systems I have actually examined, unless the conduit were made disproportionately expensive on account of the removal of the pipes.

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traffic as may guide them in completing their scheme later on. Such a section or experimental line should be of sufficient length to be in itself a paying concern, and therefore it should be on a well-frequented route. It ought also to be on a route containing good examples of any such surface difficulties (I do not refer to underground pipes) as may be expected to occur in other parts of London. A total length of five or six miles would be sufficient—a much smaller length would hardly be desirable. I find from the drawings kindly sent me by Mr. Gunyon that the line originally proposed for this purpose is already the site of three 30-inch water mains at no very great depth below ground, otherwise the line proposed was in every way suitable. I think, however, that it would be a pity at this stage of the work to deal with a portion of road offering such special extraneous difficulties as this particular road appears to offer. If, therefore, Mr. Baker can, from the point of view of traffic generally, suggest some other line, I believe it would be advisable to adopt it, supposing always that it is not found as difficult to deal with as the first one.

In view of the fact that the County Council have already sanctioned the proposal of a private company to bring a portion of their overhead lines within the county of London, and that this overhead line appears to be in the hands of excellent contractors, and will be subject to the approval of the Council's engineeer, and always accessible for examination by members of your committee, I do not think it will be worth while to fit up any portion of whatever line is chosen for experiment with overhead conductors. I have therefore to recommend to you that a scheme be worked out for fitting up such a line as I have just mentioned with a conduit system, having both conductors insulated. The details of this system will, of course, require very careful working out before tenders are obtained. On such a length of line as that proposed it will be found quite possible—if, on going into details, it is also found desirable—to try more than one arrangement, so as to determine the best for final use. On the same line there could also be tried—if in the progress of the work it seemed desirable—a contact system based on the principle which I have mentioned above.

I have already pointed out that on any experimental line constructed by the Council self-contained cars of any type (gas, compressed air, or battery) could be tested if it seemed desirable to the Council to allow such experiments to be made.

The total power required to work the cars upon such a section of line as I have suggested depends, of course, upon the number and weight of the cars. Assuming, however, that the line is six miles in length, and that there is a two-minutes' service of heavy cars during the busiest parts of the day, running with a maximum speed not exceeding 10 or 12 miles an hour, you would require to provide something like 2,000 H.P. for the work. I fear that it is hardly possible for you to buy continuous current to this amount from any of the private companies supplying electrical energy on the south of the Thames, or at all events, to buy it at any cost approaching that at which you could supply yourselves from a station of your own. This is especially the case, as, while any such arrangement could only be of a temporary character, it would entail upon the company supplying the energy the purchase of a large amount of special machinery. I think, therefore, that it would be most advisable and economical for you to have the plant designed and specified especially in such a way as to form part of the complete scheme which you will be carrying out later on. And if possible, it should be put down on a site which should be the site of one of your permanent power stations, so that it might not have to be removed later on. I quite recognise, however, that it may not be possible to make sure of obtaining this last condition, in which case it must be made certain that the whole of the plant can without more than reasonable inconvenience be shifted into its permanent position later on.

I think I need not point out to you that the questions of the type and weight of the cars, and especially of the speed of running, must be dealt with and settled as soon as possible, as upon these points depend so very much the whole electric equipment of the line.

(*c*) In conclusion, as to the whole matter of mechanical traction in London, I have to say that it is necessary to remember that the conditions of working in London are and will always be very different from those which exist either on the Continent or in America. In some respects the differences will make our working easier, in others more difficult. In particular I should think that it was improbable that the County Council or the police authorities would permit any such speeds to be reached as are quite common elsewhere. I am afraid that it must be admitted that the high speeds which I have found common in very many cities, and which are certainly popular with the people, have been and continue to be the cause of very numerous accidents of a kind which would be considered in this country most serious, and which would, in fact, be sufficient if they occurred here to result in the immediate prohibition of the fast running to which they are apparently due. The rough arrangements of wooden posts and overhead feeders, which are still visible in the streets in many places, would be also impossible here. The breadth of slot also which is used on the Continent would rightly be considered here as inadmissible, if not dangerous to traffic.

In respect also to the amount of the tramway traffic, I wish I could anticipate that it should be as large in proportion as the traffic obtained elsewhere. I have examined, for example, the traffic on 37 of the largest American lines for which statistics are published, and I find that on the average the tramways of these 37 towns carry their whole population in less than six days, and in the cases of large cities, such as Boston, New York, Minneapolis, Troy, &c., a number of passengers equal to the whole population is actually carried by the tramways in less than three days. This is the more surprising when one remembers that the travelling in an American tramcar is one of the most uncomfortable experiences possible, the car being at all busy hours of the day crammed with people standing up as well as those seated in what we consider a legitimate manner. But although it can hardly be expected that the trams of the London County Council shall, for a long time to come, carry two million passengers per diem, it is yet a matter of, I believe, universal experience in this country, so far, that a change from horse cars to the greater speed and comfort of mechanically worked cars is always accompanied by a very large increase in traffic.

I understand that at present, even with your horse tramcars, the difference between receipts and expenses amounts to something like 3½d. per car mile. With mechanical traction your expenses will certainly be diminished and your receipts will be largely increased, unless you balance the greater number of passengers by a very large reduction in average fares, as I presume before long you would wish to do.

It has not been possible, in the time at my disposal, to make accurate estimates of cost, but I may put before you a few approximate figures as some indication to your Committee of what the whole matter means. The present length of tramline in London may be taken roughly as equivalent to 200 miles of single track. On this 200 miles, when working electrically, you might probably have something like 500 cars running, and these cars might make not very far from 20,000,000 car miles per annum. Taking the cost of the lines, cars, and power stations, merely for the sake of assuming some figure, at £15,000 per mile of single track, the total value of the whole tramway system would be £3,000,000 sterling, on which, therefore, £150,000, roughly, would be necessary to provide interest and sinking fund. This, you will see, amounts to 1·8d. per car mile, or just about one-half the present difference between your working expenses and receipts. I hope therefore that the committee will find themselves able to believe that the enterprise in which they are about to embark is one which will not only be for the benefit of Londoners generally, but one also which will pay its way, and on which therefore there would seem to be no reason for grudging such expenditure as to make the whole scheme one of a kind suitable for and worthy of the greatest city in the world. I think it is worth while to emphasise this point because of what I conceive to have been undue emphasis which has been sometimes laid during the last few years on the additional capital expenditure necessary for a conduit line as compared with an overhead system. While admitting to the fullest extent that for a company, whose first business is to earn dividends for its shareholders, the overhead system will appear the most advisable, and whilst admitting also that for small towns where the traffic cannot be anything like as much as, and where the expenditure may be proportionately much larger than in London, it may be desirable on public grounds to limit the expenditure to the lowest possible amount, yet, in the case of London itself, I submit that these considerations have not such weight. Each £1,000 per mile of additional capital cost would (on the basis of the traffic which I have just mentioned) carry with it capital charges amounting to about $\frac{1}{8}$th of a penny per car mile, from which figure the additional charges corresponding to any probable increase of capital cost per mile can be at once estimated. I do not think they should be such as to prevent you from carrying out an underground system, which would, I believe, be permanently satisfactory to Londoners and worthy of the city and its governing body.

I should add finally that if it should be decided to carry out the long extensions to the south of London on an overhead system, there is no difficulty in arranging the cars so that they can run from underground to overhead and *vice versâ*, either with no stoppage at all at the point of change, or with a stoppage of only a few seconds.

I remain, your obedient servant,

ALEX. B. W. KENNEDY.

A NEW WHEATSTONE BRIDGE.

THE form of Wheatstone bridge shown by fig. 1 is a pattern which is being manufactured by the Scientific Instrument Company, Limited, of Cambridge, and patented by Prof. H. L. Callendar, F.R.S., and Mr. E. H. Griffiths, F.R.S. It is specially adapted for the measurement of low resistances, and was designed to get rid of some of the sources of error met with in the ordinary form of bridge.

The arrangement consists of a wooden base on which are mounted seven porcelain plug holders, also bridge and galvanometer wires of platinum silver, and the necessary terminals for battery and galvanometer connections, &c. One end of the bridge wire is held by a brass spring, the tension of which can be adjusted in order to take up any looseness in the stretched wire due to shrinkage of the wooden base or to the lengthening of the wires due to change of temperature. This brass spring is adjusted by means of a screw set midway between the fixed end of the spring and the end to which the bridge wire is connected.

Connection is made between the galvanometer and bridge wire by means of a simple but effective contact maker. This consists of a small felt-padded ebonite button placed on a steel spring. This is pressed on to the bridge and galvanometer wires, which are in their turn depressed on to a small piece of platinum silver wire set at right angles to them, and fixed on to the sliding piece which carries the vernier, thus completing the galvanometer circuit. It has been found in practice that this form of contact maker does not damage the bridge wire to the same extent as the old form of contact, in which the contact piece was pressed direct on to the wires. Moreover, any shake or uncertainty which may occur when the contact piece is movable is avoided. Again, tension in the wires also tends to break the contact as soon as the spring is released. The carrier runs between guides in which it is held by means of a weak spring. The galvanometer circuit can be kept closed by means of a small clamp screw mounted on the contact maker.

Stout rods are used for connecting the bridge wire to the coils and

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to the leads, so that this resistance is small compared to that of the coils. These coils, which are made of platinum silver, are wound loosely in small hanks, and are suspended in air from the end of their connecting rods, set in a box at the back of the base board. The coils are seven in number, and are each put in circuit by removing a plug. Every plug contact is made in a porcelain pot, in which is cast a special fusible metal into which the plug is fitted, the contact surface of the latter being 3 centimetres in length, and so made that when in position the top part of its taper is below the upper surface of the fusible metal, thus avoiding a shoulder being worn on the cone of the plug, and ensuring a perfect contact. It will also be seen that each contact being independent of its neighbour, the withdrawal or inser-

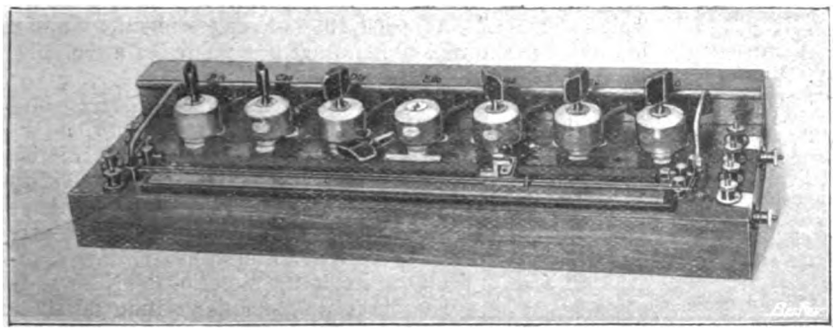

FIG. 1.

tion of a plug does not disturb the contact of either of its fellows, even if the plugs are pressed in with great force. The copper leads which join the coils to the plug blocks are specially designed to avoid any alteration in the length of copper being made when one or all the coils are in or out of circuit. This is effected by an ingenious device due to Mr. Horace Darwin. The copper connections are made in the form of the letter X, being fixed together where the lines intersect, thus leaving four equal arms. The front two are cast directly into the fusible metal sides of two consecutive plug pieces, one arm being attached to the right hand portion of the left hand plug hole and the other to the left hand half of the right plug contact. The back arms are connected to the ends of two consecutive coils. Fig. 2 fully explains this:—

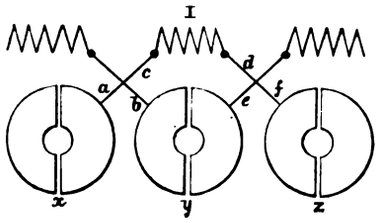

FIG. 2.

x, y, and z are three plug blocks, connected by the copper rod a, b, c, d, e, f, which form equal quarters of the X connections. Supposing the plug is removed from y in order to put the coil I in circuit, then the length of copper connection in circuit is equal to f, d, c, a, but should this plug be in, then we have an equal length of copper in circuit in the sections f, e, and b, a.

The coils are arranged in the form of a binary scale with 10 units as the lowest coil, and taken to the sixth double of this coil, viz., 10, 20, 40, 80, 160, 320, and 640. Each coil has a corresponding letter, B, C, D, E, F, G, and H, it having been found that this lettering frequently prevents errors in the entering of observations. Moreover, as any one low resistance can only be made up by the combina-

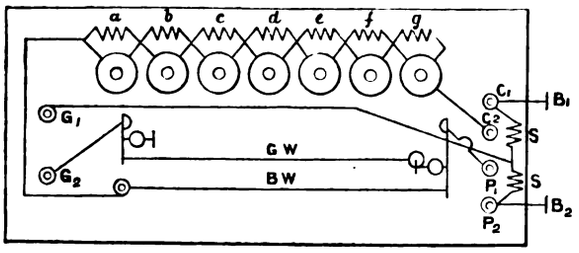

FIG. 3.

tion of certain definite resistances, it is possible to re-check the corrections to the coils with a degree of accuracy unobtainable in a box in which the coils are numbered 5, 10, 15, 20, &c., as a resistance in the latter box may be made up by two or three combinations of resistances. As the box is essentially one for low resistance work the unit is taken as one hundredth part of one ohm, so that coil H (640 units), is in reality 6·4 true ohms. The bridge arms are adjusted to exactly the same resistance, viz., 10 ohms (1,000 units), and being wound together and embedded in paraffin wax, any change in temperature affects both arms equally.

The arrangement of equal arms greatly facilitates the measurement of any resistance, as when G is balanced and the scale reading taken, then in order to obtain the true resistance at x, it is only necessary to subtract or add the bridge wire reading to that of the plugs (according as the reading is to the left or right of the zero point on the scale). The box is so arranged that the reading on the scale is subtracted from the plug resistance when the balance point is to the left of zero, and added when to the right. The scale is divided into millimetres, a centimetre on the bridge wire being approximately equal to one box unit.

The method of compensating for the external leads is, perhaps, the most important improvement in this box, and deserves special notice. These leads are not made up in a pair, as is generally the case, but consist of a stranded conductor composed of four stout flexible leads carefully interwoven with one another. Two of these leads are connected to the resistance to be measured, and the other two, which are short circuited near the resistance, are placed in the opposite arms of the bridge. Thus any changes in the resistance of the leads, owing to differences in temperature, are compensated for, and no corrections have to be made on the score of leads. The leads have copper lugs soldered at each end after they have been adjusted for equality. Thus with the most ordinary care there is no danger of this equality altering. The true zero point on the bridge wire can readily be determined by short circuiting these two pairs of leads.

Fig. 3 is a general diagram of the bridge.

Everything being compensated for in the way described, a high degree of accuracy may be attained, and though the bridge, fig. 1, is styled a "student's bridge," yet it is, when carefully calibrated, capable of doing really excellent general work. It can be tested and calibrated on itself, as the value of the coils can be found in terms of one another by a method, details of which are supplied with each instrument. It is thus only necessary to know the value of one coil in true ohms to be able to obtain the absolute calibration of the whole apparatus.

The above is only one pattern of this special bridge. More elaborate designs have been completed, with which some of the finest possible resistance work ever attempted has been accomplished. Among other improvements the coils consist of bare platinum-silver wire wound on mica frames and immersed in a high insulating oil. The oil bath is fitted with stirrers, and it is possible to determine the temperature of the coils with a much higher degree of accuracy than if they were embedded in solid paraffin.

An excellent type of this box may be seen in the physical section of the South Kensington Museum.

LIGHT ELECTRIC RAILWAYS IN MIDDLESEX.

Proposals to Gradually Link up the County by Means of a Network of Lines.

The Middlesex County Council is jealous, and justly so, of the independence of its own county, and when the London County Council recently suggested the appointment of a joint committee of the two bodies "to consider and deal with all matters relative to the promotion and carrying into effect of light railway schemes affecting both Councils," the astute members of the former body thought there was an insidious movement behind the proposal. There was no doubt on the matter. The London Council thought, or at least the Highways Committee were under the impression, that it was the desire of the Middlesex Council that the two bodies should act in unison in settling and promoting schemes for light railways to be constructed in Middlesex in connection with the tramways in London, with a view to ultimately coming to some arrangement as to the method under which such light railways should be administered after their construction.

This impression, which was founded on an erroneous basis, was dispelled by Sir Richard Nicholson, clerk of the Middlesex Council, who informed the London Council that it was impossible to understand how it could be imagined that Middlesex would act in any way in conjunction with London, except upon the distinct understanding that each county council should be the light railway authority in its own county. Sir Richard added that the County Council would not reverse its avowed policy from the commencement "of admitting no interference from any outside authority in its county." This statement places the whole matter in a nutshell. London wanted to unwarrantably interfere in Middlesex, but London was not sufficiently conscientious as to ask Middlesex in return to interfere in the metropolitan area. It would at once have cried, "Hands off!" if the suggestion had been made. The Middlesex County Council is, however, ready to enter into negotiations for an interchange of traffic between the two counties. What more does the L.C.C. want? In a moment of pique at this rebuff the L.C.C. resolved to support one of the District Councils in opposing a light railway scheme projected by the Middlesex County Council. It will be interesting to learn what the Light Railway Commissioners will have to say on the unseemly attitude of the L.C.C. in this respect when the local inquiry takes place.

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In the meantime it should be mentioned in connection with the 21 light electric railway schemes proposed by the Middlesex County Council, that Mr. James Bigwood, M.P., the chairman of the Parliamentary Committee, has been authorised to obtain the advice of an electrical engineer, in addition to that of Mr. Wakelam, the county engineer and surveyor, in the elaboration of the schemes. The latter gentleman has also been directed to prepare the necessary plans and sections and books of reference for deposit with the Light Railway Commissioners.

Of the 21 light electric railways proposed for Middlesex, the County Council has decided to apply to the Light Railway Commissioners, in conjunction with the Metropolitan Tramways and Omnibus Company, for a provisional order to construct 10 of these lines, these being included in the Middlesex Light Railways Order, of which public notice has already been given. One scheme relates to a line in Friern Barnet and Finchley, which the former District Council suggests should be substituted for a section included in the Middlesex order; four others refer to a line from Harlesden, through Wembley, Harrow-on-the-Hill, and Wealdstone to the foot of Stanmore Hill; whilst the remaining six proposals affect Isleworth, Twickenham, Teddington, Hampton, and Hampton Wick. It may be remembered that the London United Tramways Company promoted lines in the latter parishes, but the Light Railway Commissioners declined to grant the desired order.

In conclusion, it should be mentioned that the object aimed at by the Middlesex County Council is the gradual construction of a network of light electric railways throughout the county, so as to link up the most important districts and at the same time afford a connection with the London tramway system. The only serious difficulties likely to be encountered are those put forth by some of the district councils, who not unnaturally desire to be considered in regard to the proposed routes, terms of lease, and other matters. These points are receiving the attention of the Middlesex County Council, and it is hoped that all obstacles will shortly be overcome. The hostile attitude of the L.C.C. can hardly be expected to in any way affect the ultimate result; it cannot possibly have any *locus standi* in Middlesex, which intends to preserve its independence, whilst at the same time being prepared to discuss ways and means for an interchange of traffic at the boundary lines of the two counties.

REVIEWS.

The Value of Electrical Treatment. By Julius Althaus, M.D., M.R.C.P. Lond., M.R.I. Third edition. Longmans, Green & Co., London, New York, and Bombay.

In 1873 Dr. Althaus published "Medical Electricity," a work which, from the medical standpoint at least, seems to have been more than abreast of its time. In 1895 there appeared the first edition of the volume now under notice, and it was a matter of comment at the time that it contained no adequate recognition of the great progress in electro-therapeutics that had been made in the long interval since 1873. For example, sinusoidal currents, high frequency currents, and the methods of Apostoli were noticeable only by their absence, although these procedures were at the time very generally known. "Metallic electrolysis" was not mentioned, and the short notice of cataphoresis that did appear, by no means atoned for the opinion expressed in the volume of 1873 (p. 708) that the view that "electricity may serve to introduce drugs into the system is likewise untenable." We are glad to see that in the present edition the above-named gaps are to some extent filled in, and that the writer, profiting perhaps by criticism on his first edition, now notices a certain portion, at least, of what he condescends to call "the quiet and useful work" that has been done since 1873. There is even a chapter on current from the main, a title which might almost have been put in inverted commas, as it is now many years ago (1891) that a writer in the *Lancet* first drew attention to this subject under this title, and has continued to do so at intervals ever since.

In this connection it may be incidentally mentioned that it was not until after the publication of one of these articles that the instrument maker referred to by Dr. Althaus introduced the shunt principle into his rheostats.

Of all the forms of electricity for medical purposes, Dr. Althaus still maintains, and doubtless with excellent reason, his unswerving allegiance to "the battery." Indeed, in describing electrical energy in its more modern forms, although he deals with these at some length, his descriptions fall far short of impressing the reader with the idea that he has actually handled these currents himself, or that even he quite apprehends what is known of their phenomena. Speaking of currents of great frequency and high potential, by means of which intensities may be passed through the body, which at a lower frequency might be fatal, he recognises an analagous fact in the spheroidal condition of bodies; for example, in molten metal at white heat not injuring the hand plunged into it, whereas only at a red heat serious injuries would follow. Those of his readers who understand the physics of the phenomena in question, may perhaps be excused if they fail to see the force of such an analogy.

It is not our province to criticise the medical part of this book; we can only regard its curative achievements with feelings of wonder and praise, and also with a consolation akin to that which the devout believer finds in the "blessed" word "Mesopotamia." At page 49 we learn that in the human brain there is a region known as the "anterior association centre." It is this centre "which directs our actions, enables us to judge our own conduct, and tells us what is right and what is wrong. It therefore constitutes the δαιμονίον (the divine warning voice), of which Socrates speaks in Plato's Euthyphron. Disease of this centre changes the perception of the Ego as an active being, and diminishes or annihilates personal initiative." A disordered condition of this centre appears in "deficient self-control, diminished initiative, indecision, and difficulty in fixing the attention." Now it is not without misgiving that we recognise certain of these symptoms in ourselves, and even in our friends. Our wandering thoughts on these summer days point to a "difficulty in fixing the attention," and certain unsatisfactory transactions with city friends can only be explained by an unfortunate disability (on their part) to "distinguish between what is right and what is wrong." It is only too evident that things are not quite as they ought to be with our respective "anterior association centres," and it is no small relief to find that all this, serious as it is, may be set right by a trifling expenditure of $\frac{2}{10}$ths of a milliampere of continuous current from the head to the hand, applied according to the author's methods.

A little further on (p. 60) we find that "our mean lifetime is at present about 50 years, but the complete cycle of physiological life to which we ought all to aspire is 100," and it is with feelings of gratitude we note that we can be helped on towards attaining our "century" by a cautious use of continuous current to the brain—according to the author's methods. "A week or two after the commencement of such a treatment the energy of the system is habitually found to have been considerably enhanced. The old man takes fresh interest in the affairs of daily life . . . . his peevish and querulous temper is no longer a source of trouble to his friends. . . . . Quite recently a veteran actor who delighted the last generation by his magnificent Shakespearian performances, told me after a few applications, 'I no longer crawl but walk;' and a composer of music, of advanced age and bowed down by many infirmities, volunteered the remark, 'I no longer walk but fly.'" The "Value of Electrical Treatment" is surely no adequate name for such a book as this. "The miracles of medical electricity" would in our opinion be a title none too strong. At least one thing seems clear. Could a certain eminent "electrician," who so long adorned a conspicuous corner in Oxford Street, once more return to the scene of his labours and success, it would only be to find that in comparison with the achievements of the legitimate practitioner, he is no longer "in it."

Pocket Book of Useful Formulæ and Memoranda. By Sir Guildford L. Molesworth and Henry Bridges Molesworth. 24th edition. London: E. and F. N. Spon, Limited, 125, Strand.

In the preface to this issue we are informed that neither has labour been stinted nor counsel disregarded in order to render the 24th edition worthy of its predecessors.

The electrical portion of previous editions was struck out of the 23rd edition, as it was the intention of the authors to have published a separate electrical pocket-book. For reasons which it is unnecessary to state, that intention has been abandoned, and an entirely new electrical section has been now added to the 24th edition.

It is somewhat to be regretted that the authors' intention of publishing a separate electrical edition was not carried out, not, however, from the view of the possibility of such an electrical edition proving a valuable compilation, but from the fact that it would have relieved the present issue from

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what can only be characterised as a very unsatisfactory production. Not only is a large amount of the matter included of an unpractical nature, and almost useless to the practical engineer, but we come across such an astonishing display of errors as one could hardly credit. Turn, for example, to page 787; we should have thought that every schoolboy knew what a submarine cable was like, yet here we have the most remarkable "Typical Submarine Cable" that was ever devised, and we are constrained to ask, Was it inserted as a joke or in sober earnest? First we have the "conductor" which the author calls the "core," then the gutta-percha insulation, next a "composition," then a "lead sheath"!!!; next hemp, then the armouring, such as was never seen yet on a submarine cable, and finally the hemp serving. The figures illustrating insulators must have been devised from the author's inner consciousness, as such patterns are never seen in practical use. Also the "Telegraph Poles" illustrated are a curious combination of wood and iron. Then we have "Lightning Arresters," "a pile of metallic discs separated by laminæ of mica . . . . the top disc connected with the line, and the bottom disc to the earth." It is a pity that an illustration is not given of this "pile of metallic discs." Next we have "Duplex Telegraphy," in which we are told that "the *current* from line is neutralised by that from the condenser." The description of the differential duplex is also a marvellous display, either of want of knowledge or lack of descriptive power. On page 740 we have a brief table showing "Best Resistance and Deflection for Telegraph Cells," a table which, in the absence of constants, is just as valuable as the dimensional "lump of chalk" of tradition, let alone the fact that the figures given could only be for special cases, and are of no general value whatever. On page 783 we are told, with reference to "Test in Laying Cables," "Leakage is indicated by a *fall* in the deflection of the ship's galvanometer." The "Electrostatic Capacity" test (De Sauty's) which follows, and which is the only one given, is the most unreliable one that could have been selected.

The pages are plentifully bestrewn with matter by H. E. Harrison, which matter, although doubtless perfectly correct, is not generally of a description suitable for practical engineers. Page 752 contains the well-known illustrations of types of winding the field magnets of dynamos. The repetition of these illustrations in every class of engineers' pocket or handbooks is often sneered at by critics, but we maintain that they are very much in place, and should by no means be omitted. Such matter as this, and that on the following two or three pages, is distinctly useful, and if the whole electrical section had been compiled on such lines it would have been of considerable value. In the pages following where Messrs. Harrison and Russell appear, the want of discretion in the selection of matter becomes apparent. We venture to say that the omission of such matter would be a gain rather than a loss. On page 756, a frequency of 16½ is given as the best for utilising continuous current dynamos for synchronizing motors!—and an absurd diagram of a projector arc occurs on page 786. Such diagrams as that given on page 765, showing the "increase per cent. in the resistance of hard copper with increase of temperature," are much better dispensed with, and a short table of numerical values and a formula given instead. Graphic representation is all very well, but it has been, in our opinion, very much overdone. It often seems to be forgotten also that a series of curves which, drawn on a large scale, are of value, become practically useless when reduced to pocket-book size.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

15,644. "Electrical ignition apparatus." F. Kupper. Dated July 31st.

15,663. "Improvements in governing devices in connection with fluid pressure engines in combination with dynamo-electric machines and other machinery which requires accurate governing." R. P. Isaacson. Dated July 31st.

15,677. "Improvements in supports for galvanometers and other delicate instruments." J. H. May. Dated August 1st.

15,699. "Electric fuse outfit." H. E. Davis. Dated August 1st.

15,705. "Improvements in or relating to electric meters." J. H. Barker and J. A. Ewing. Dated August 1st.

15,717. "Improvements in fusible cut-outs." The British Thomson-Houston Company, Limited, and E. B. Wedmore. Dated August 1st.

15,720. "Improvements in electric arc lamps." Crompton & Co., Limited, A. J. Hodgson, and C. F. Tubbs. Dated August 1st.

15,744. "Improvements in or connected with electric regulating switches." O. D. Lucas. Dated August 1st.

15,807. "Improvements relating to the terminals of electric batteries and the like." A. C. Wright. Dated August 2nd.

15,816. "Improvements in electro-magnetic rail brakes." A. Wilde. Dated August 2nd.

15,882. "Improvements in apparatus for operating two or more electrical regulating switches or resistance devices together or separately." O. D. Lucas. Dated August 3rd.

15,904. "Improvements in and connected with transformer boxes." A. J. Lawson, J. D. Dallas, and E. T. Goslin. Dated August 3rd.

15,911. "Improvements in or relating to electro-magnetic apparatus." W. F. Jones. Dated August 3rd.

15,967. "Improvements in electric arc projecting lanterns." L. Kamm. Dated August 4th.

15,973. "Improvements in and relating to the direct coupling or connection of rotary fans or pumps with electric or other motors or engines driving same." S. C. Davidson. Dated August 4th.

16,005. "Improvements in the method of and apparatus for manufacturing incandescent electric lamps." A. Swan. Dated August 5th. (Complete.)

16,040. "Improvements in electric fuses and electric detonator fuses." G. Smith and D. Corrie. Dated August 5th.

16,055. "Improvements in electric switches." W. F. Jones. Dated August 5th.

16,062. "Improvements in or connected with electric light fittings." H. H. Cooper. Dated August 5th.

16,083. "Improvements in controlling devices for electric currents." H. Cuenod. Dated August 5th.

16,091. "Improvements in electrical apparatus suitable for lighting, cauterizing and other purposes." J. Richardson and H. Ramsbottom. Dated August 5th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

12,638. "Improvements in means for regulating the voltage of dynamos." La Societe Generale des Industries Economiques. Dated May 21st, 1897. (Date applied for under Patents, &c., Act, 1883, Section 103, March 20th, 1897, being date of application in United States.) In order to regulate the voltage of dynamos driven by explosion engines and other motors, the speed of which varies in different portions of the cycle, a series of resistances is placed in the field circuit, and these are increased or decreased automatically as the speed of the motor varies. A suitable form of apparatus comprises a collector, having a series of contacts connected through resistances to a contact ring, and a brush holder carrying brushes, bearing on the circle of contacts and the contact ring respectively. Either the brush holder or the collector may be fixed to the motor shaft so as to rotate it. The contacts are so spaced and the resistances so graduated as to exactly compensate for the fluctuations of speed of the motor; the arrangement shown is that employed for a four-stroke cycle explosion motor. 2 claims.

12,642. "Improvements in contact fingers for electric controllers." E. C. Parham. Dated May 21st, 1897. (Date applied for under Patents, &c., Act, 1883, Sec. 103, November 18th, 1896, being date of application in United States.) The contact fingers of controllers are formed of magnetisable metal, and are so arranged as to produce an electro-magnet which will blow out an arc, if formed, on breaking contact. The contacts engaging with the contacts on the drum are carried by forks secured to the springs connected to the base. The forks thus form electromagnets and tend to blow out any arc which may be formed when contact is broken. In a modified form, a single arm is employed in place of the fork, and the magnetic circuit is completed through suitably arranged bars. 15 claims.

12,643. "An improved system of conductors for electric railways." E. Lachmann. Dated May 21st, 1897. Electric railways and tramways on a three-wire system. The exposed conductors on which the collectors run, here shown on the overhead system, are alternately positive and negative, and the non-exposed portions are placed alongside. The current is picked up by a number of collectors and between them and the motors on the vehicle an automatic reversing switch is placed to maintain a uniform direction for the current to the motors. This consists of a rocking arm for each collector working over two pairs of contacts and operated by a magnet acting on the coils, which are included in the circuit from the collectors so as to be attracted alternately according to the current. In case of alternating currents this switch is unnecessary. 2 claims.

12,665. "The combined generation and application of electricity supply and the manufacture of salt." H. Tee. Dated May 22nd, 1897. Brine is concentrated in a closed vessel from which salt is removed by rotary scrapers, while steam is generated under pressure to drive condensing engines connected to dynamo electric generators; the current from these may be employed for making calcium in electric furnaces, or other purposes. The concentrating apparatus may be heated by the exhaust steam of high pressure engines, which also operate electric generators, or by gaseous or other fuel. Specifications No. 6,565 and 6,565A, A.D. 1895, are referred to. The brine is contained in vessels having conical roofs and bottoms connected by central openings, and supported by walls which form heating flues under the bottoms. A vertical central shaft carries scrapers. The apparatus is closed at the top by a steam dome, and at the bottom communicates by a valve with a receptacle for the salt; this can be removed by another valve when the valve is closed. Similar apparatus, but with flat floors and roofs separated by steam spaces, is used for concentrating by exhaust steam. In a modified arrangement a single vessel only is used, or two such vessels are placed side by side with one continuous heating flue. The floor in such apparatus may be flat or rise to the centre, and salt receptacles may be provided at the side; a flat door may be stayed to bottom plates, enclosing space for the heating gas, the stays being protected by cast-iron tubes. The scraper shaft may be tubular, to enclose a central vertical stay. 10 claims.

12,810. "Improvements in telephone receiver supports." L. Duque and F. McClelland Cosgrove. Dated May 25th, 1897. Consists of a support for a telephone receiver for holding it in a convenient position near the head of the user. The receiver rests in a cage or basket with two screw sockets, either of which may be screwed to the end of a rod, which slides in a tube, fixed by a hinge-point in the horizontal arm of a bracket attached to the wall, &c. A clamping screw holds the tube in any angular position, and the rod is fixed by a screw. A weight may be hung from the receiver hook when it is desired to keep the receiver in the basket while calling. 1 claim.

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12,874. "Improvements in electrical telegraph systems and apparatus therefor." H. H. Lake. (C. G. Burke, United States.) Dated May 26th, 1897. In receiving instruments used on submarine or other long lines for recording Morse or similar signals, the magnet is caused by suitable electric impulses to make a continuous mark in the absence of line current, so that the code signals are indicated by breaks in the line recorded. The signals are sent by a hand-key, or preferably automatically by tape prepared in a special instrument. In order to indicate the spaces between letters and words, long breaks are made in the record, or the last signal of the code for any latter is lengthened or duplicated at a very short distance. A pole changer consisting of a pivoted forked lever working on a tapering or wedge-shaped contact, and operated from the armature of a relay magnet, is used for "clearing" the line; by this special form of contact the duration of the clearing current can be regulated as desired. Similarly the perforations in the tape are made triangular in shape, so that, by shifting the tape transversely in the transmitter, the length of contact for dots and dashes may also be regulated. The apparatus for preparing the tape is fitted with two keys for the dot and dash respectively, and with suitable spacing keys. When a key is depressed, a contact is made which closes the circuit through the punching magnet; a contact on the armature lever of this magnet closes a relay circuit when a key has been depressed, and by means of pawl and ratchet mechanism causes a feed of the paper strip. The separate keys are arranged to give differential spacing. When the instrument is to be worked by persons ignorant of the code, the keys are depressed by magnets in circuits controlled by contacts operated from alphabetical keys. 8 claims.

26,656. "Improvements in and relating to electric accumulator plates." P. F. Ribbe. Dated November 15th, 1897. The plates or electrodes consist of a flat plate of lead with a thickened rim, and vertical rows of perforations covered on each side with celluloid strips, which are united to each other by celluloid solutions through the perforations. The strips have undercut edges which hold the active material in place. The whole is covered by thin plates of celluloid in which are many apertures. 1 claim.

26,657. "An improved device for guiding the carbons in electric arc lamps." R. W. L. Holsten and the Electrische Bogenlampenfabrik Naeck and Holsten Gesellschaft mit beschrankter Haftung. Dated November 15th, 1897. Relates to arc lamps.—The carbons in a focussing lamp are carried by movable holders and are guided near the arc by a thin cross bar and a mica plate secured on an enamelled reflecting disc, these parts being carried by clips adjustable on the side rods of the lamp. The arrangement permits thin carbons to be used. 1 claim.

26,659. "An improved automatic cut-out or short-circuiting device for electric arc lamps." R. W. L. Holsten and the Elektrische Bogenlampenfabrik Naeck and Holsten Gesellschaft mit beschrankter Haftung. Dated November 15th, 1897. Relates to means for short-circuiting a lamp should the arc in the lamp fail. The electro-magnet which regulates the arc acts on an armature fitted with a platinum contact and connected to one of the terminals. An electro-magnet and resistance are connected to the other terminal. In normal working, the contact does not touch the contact of the electro-magnet, but, should the arc fail, the armature is more strongly attracted and makes contact, so completing a circuit through the resistance. When the carbons once more approach, the current through the magnet is short-circuited and the armature falls away. 1 claim.

26,671. "Improvements in or relating to electrical indicating apparatus for use in hotels, restaurants, workshops, and for analogous purposes." A. J. Boult. (H. Montardier and L. Boudet, France.) Dated November 15th, 1897. Relates to an electric indicating apparatus or order telegraph for use in hotels, restaurants, workshops, &c. The transmitter is provided with two dials, one having interchangeable plates marked with the names of the articles, &c., which may be asked for, and the second being adapted to show the number of each article required. Two hands, fixed on the spindle and sleeve respectively, are capable of being moved over the dials, and the spindle and sleeve are each provided with a toothed wheel adapted to rotate the contact-making ratchet wheels through the pinions. The ratchet wheels each consist of a metal half and an insulating half, which are arranged so that the contact springs of the leads to the receiver alternately bear on a conducting part and an insulating part. The receiver is provided with two dials and hands corresponding to those of the transmitter, the hands being each operated by a clockwork mechanism, the escapement of which is controlled by an electro-magnet energised by the current from the transmitter. Only two connecting wires are employed, each transmitter and receiver having a local battery, the negative pole of which is connected, conveniently through a gas pipe or water pipe, to earth. In operation, the operator at the transmitter presses a call-knob, which completes the circuit of a drop-down annunciator at the receiver, indicating the number of the room from which the call is made, &c. The annunciator shutter, when it falls, completes the call-bell circuit. On receiving the call, the attendant at the receiver inserts a contact plug or jack in a socket corresponding to the number shown, so disconnecting the annunciator circuit, and, by pressing a push, makes the reply call. The operator at the transmitter then moves the hands over the dials until they point to the required indications, the hands of the receiver following step by step the movements of the hands of the transmitter. The hands of the receiver are re-set to zero by a bar, which disengages both escapement levers simultaneously, and so permits the movement of the hands until they are checked by a stop-finger at the zero point. 4 claims.

26,680. "Improvements in electric accumulators or storage batteries." A. Tribelhorn. Dated November 15th, 1897. The electrodes are made of a cup-like shape in order to form a receptacle for the electrolyte. The active material is spread on the upper and lower surfaces of the receptacle, or may be in the form of rods or bars projecting upwardly and downwardly from the receptacle. The electrodes are arranged in tiers as shown, insulators being placed between each pair of electrodes, and the electrodes may fit closely together so as to form a sealed battery provided with suitable gas exits. 1 claim.

26,682. "Improvements in electro-medical and exercising apparatus." W. A. Webb. Dated Nov. 15th, 1897. (Date applied for under Patents, &c., 1883, Act, Sec. 103, June 2nd, 1897, being date of application in United States.) Relates to a pair of dumb-bells, Indian clubs, &c., used in connection with an induction coil and a battery, for electro-medical and exercising apparatus. A dumb-bell connected by insulated wires to the induction coil having a contact-breaker, and enclosed in a casing which rests on the chest is shown. The insulated wires leading therefrom pass over the shoulders, and carry at their other ends, resting on the back, any suitable dry battery enclosed in a casing. The coil is arranged in an eccentrically-arranged recess of the casing having wires leading to the battery, and a vibrating contact-breaker in a recess closed by a sliding-cover. Each bell has a metallic tubular handle connected to hemispherical metal ends, the latter being connected together by a screwed rod passing through the whole bell. The handles are provided with binding-screws for connecting up the bells with the induction coil. Small spring bolts are arranged beneath slits or openings in the adjoining edges of the hemispheres, whereby metal discs or coins may be forced into the heads to increase the weight as required. 7 claims.

26,727. "Improvements in electric brakes for cars." O. J. Menzies and J. A. Bell. Dated November 17th, 1897. Relates to electric brakes.—An electro-magnet is secured to the axle upon which the armature is loosely mounted and connected by a chain to the pivoted lever for operating the brake beams. The electromagnet, which consists of a number of coils in series arranged around the hub, when energised attracts the armature and thus produces a resistance to the movement of the latter on the car axle, thereby winding up the chain and applying the brakes. 6 claims.

26,728. "Improvements in and connected with alternating electric current electric motors." W. L. Wise. (A. J. Churchward, United States.) Dated November 17th, 1897. Relates to the construction and mode of operation of a single-phase self-starting alternating-current motor, combining in one machine the principle of an alternating current synchronous motor, with that of the ordinary continuous current motor used for non-synchronous or starting purposes. The motor is arranged so as to operate first as a non-synchronous motor, and after attaining the requisite speed, it is converted by suitable switch mechanism into a synchronous motor. An application of the invention in its simplest form to a bipolar motor comprising an ordinary continuous current armature with its commutator, and a field magnet, the poles of which are each wound with a shunt coil and a series coil is shown. Upon the armature shaft are also mounted two slip rings and a rectifying commutator, and the various parts are connected as shown with two series of terminals, which in conjunction with a pivoted switch bar, carrying suitably disposed contact plates, enable the connections to be changed from those necessary for non-synchronous to those necessary for synchronous running. In starting the motor, the switch bar is depressed so as to close the contacts; the field circuit is now in series with the armature, and both carry an alternating current. When the motor has run up to synchronism, the bar is raised so as to close the contacts; the field circuit is again in series with the armature, but it is now supplied with a continuous current through the rectifying commutator; at the same time the shunt circuit is closed, and the motor runs as a synchronous motor. A self-induction coil, or a condenser, is arranged as a shunt across the brushes of the commutator so as to equalise the current in the field circuit. For efficiently starting the motor, a regulating coil wound on a circular core is placed across the mains. The switch bar may be operated by hand or it may be operated automatically by means of a centrifugal governor, and the switch arm of the regulating coil may be operated simultaneously by the same mechanism. Means are also provided for retaining the bar in either of its two positions and for automatically releasing it, by the action of the two electromagnets, when the motor attains the synchronous speed or falls below it. The lead of the commutator brushes may also be automatically varied by the switch mechanism, so as to avoid sparking. 18 claims.

26,732. "Improvement in or relating to systems of electrical distribution." L. Andrews. Dated November 17th, 1897. Relates to systems in which current is supplied from a central generating station to sub-stations or distributing plant, and consists in arranging magnetic cut-outs on the feeders, so that should one fail and the current be reversed, then that feeder would be cut out. An electro-magnet is arranged in series with the feeder to be controlled, and its pivoted armature is wound with a coil connected to the working circuit. In normal working, that is, as long as the feeder supplies energy to the system, the armature tends to rotate clockwise, but is prevented by a stop. In this position it supports the weighted arm of a switch. Should the feeder under abnormal conditions absorb energy, the armature rotates in the opposite direction and releases the arm. The construction of the cut-out is described in specification No. 3,496, A.D. 1898. 2 claims.

26,733. "Improvements in magnetic cut-out apparatus." L. Andrews. Dated November 17th, 1897. Relates to a magnetic cut-out for cutting out an outgoing lead should the generator fail. Generators connected in parallel to the conductors are shown, also a switch which is operated automatically to break the circuit should the generator fail, and be driven as a motor or otherwise. A field-magnet is in series with one of the leads, and its rotary armature core is provided with a shunt winding. The end of the armature is a catch supporting the weighted arm of the switch. Normally the armature tends to rotate clockwise, but is held by a stop. On reversal of the current it rotates in the opposite direction and releases the arm. 1 claim.

26,752. "Improvements in flexible conduits for electrical conductors." E. T. Greenfield. Dated November 16th, 1897. Flexible conduits are formed by alternating layers of rubber or other flexible insulating material strips. The inner layer forms a closed spiral, or may be a complete tube, while the outer layers form open spirals which break joint throughout. In the form shown the outer layer is corrugated centrally so as to force the underlying rubber between the metal spiral. In another form the inner metal spiral is concave in section and has a central row of projections, the outer layer being convex and having internal cross ridges to form a locking connection. The layers are attached by rubber, &c., cement, and the whole may be vulcanised as desired. 7 claims.

27,598. "Improvements in electrical fusible cut-outs." G. Byng. Dated November 24th, 1897. Electric cut-outs.—In order to minimise the dangers from arcing, the fuse wire is led through a chamber or compartment lined with a refractory material which will not volatise at the high temperature of the arc. The base, cover, &c., may be of china or the like, with suitable partitions covered or lined with plaster of Paris, cement, firechay, &c. In modifications, the fuse wire is led through a tube or handle suitably lined. 3 claims.

27,619. "Improvements in incandescent electric lamps." R. Nordmann. Dated November 24th, 1897. Incandescent lamps.—The body of a lamp consists partly of a lens attached by fusion. The filament is made of a sinuous form in a plane near the lens. 2 claims.

28,157. "An improved form of relay applicable to pneumatic or electric organs or to other apparatus." R. Hope-Jones. Dated November 30th, 1897. The invention relates to a form of relay applicable to organs and other apparatus where a movement started by hand is completed by electric or pneumatic agency. A wind chest containing air under pressure communicates by a port with a bellows, and by a second port with a second bellows. The ports are controlled by valves on a rod connected by a friction clamp with a key. On depressing the outer end of the key, the first port is opened to the atmosphere, and the second port to a chest. The remainder of the motion of the key is thus effected by the bellows. The movement is reversed by slightly raising the key. 5 claims.

28,159. "Means for use in lighting cars or carriages by electricity and for regulating the current for the same." S. Watkins. (American Railway Electric Light Company, United States.) Dated November 30th, 1897. The generator is carried on the axle of the car, and means are provided for automatically regulating the current and for maintaining its flow constant as to direction though the rotation of the armature be reversed. A bearing sleeve is also described for carrying the armature. The dynamo is enclosed in a casing, and is supported partly by the axle and partly from the undercarriage of the truck, a lug on the frame resting on a spring carried by the pendant. The current is regulated by varying a resistance in the field-magnet circuit, an arm being moved over the contact disc by a ratchet mechanism controlled by an electro-magnet in the main circuit. The coil has a movable core pivoted at the bottom to an arm and normally forced upwards by an adjustable spring. A shaft rotated by worm gearing from the armature carries a crank engaging with a fork on a rocking shaft carrying pawl fingers adapted to engage when in the proper position with one or other of the reversed ratchet-wheels on the shaft of which the contact arm is carried. When the current exceeds the limit, a core with its extension is drawn down, allowing a finger to engage a wheel which causes resistance to be put in the circuit. When, however, the current falls, the core rises under the action of the spring and one of the fingers come into play and cuts out resistance. In order to automatically reduce the action of the spring when the lights are in use, a magnet is included in the circuit, its armature being attached to a lever which is connected at one end to the spring. The current is kept constant as to direction in the external circuit by a rocking reversing switch, which is controlled by means of a sleeve having a helical groove in which works a stud connected to the switch arm. 9 claims.

28,242. "Improvements in or relating to negative plates for secondary batteries." P. J. K. Dujardin. Dated November 30th, 1897. Secondary batteries.—Relates to that class of battery in which the negative electrode is amalgamated zinc, cadmium, or the like, and consists in constructing that electrode so that the mercury shall not be liable to flow from the upper part of the electrode to the lower part. For this purpose the plate is made up of a number of separate strips of zinc or the like, which are suitably mounted and enamelled at their ends. The strips may be made of wire twisted into the form of cables. The electrode may consist of a single plate with a number of horizontal slots in it, and the strips may be twisted into a horizontal position. The electrodes may be made of woven wire fabric, or may be perforated or pitted. 3 claims.

28,246. "An improvement in safety electric fuses." H. C. Gover and W. Muller. Dated November 30th, 1897. The base is formed with slots adapted to receive sliding inverted T-pieces carrying the terminals to which the wires are secured. The wires pass in through holes and are secured by screws, and the fuse wire is threaded through a tunnel and secured by screws. Slots are cut in the screw thread, and communicate with a groove which is in communication with the exterior through openings. 3 claims.

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THE

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THE INDUSTRIAL DEADLOCK.

ATTENTION has been drawn recently in these columns to the difficulties that beset the electrical industry in being unable to cope with the constant stream of orders that is flowing in. There are some philosophers who maintain that to have a plethora of orders is almost as bad as having none. Probably there is a certain amount of truth in the assertion, but there is this marked difference, when a man has no orders he may be credited with doing his best, but when his shops are so full that he cannot keep up to time he receives the obloquy of all. It must be admitted that the manufacturers of electrical apparatus have met with most generous consideration at the hands of both consulting engineers and municipalities. Probably this indulgence arises to some extent from the difficulty in enforcing penalties, but whatever there may be in this, there has been no disposition to harass manufacturers in spite of their delinquencies.

If orders remain unexecuted a few weeks beyond the specified period it may be highly inconvenient, but when weeks pass into months and occasionally into years before electrical plant is delivered, the matter goes beyond the bounds of reason. Yet it is well known that makers of electrical machinery, in one or two cases, have been over 18 months behindhand with their machines. These are probably the worst instances, but they show in the clearest possible manner either that some shops are overrating their capacity, or that there is some strikingly bad management. In the comparatively early days of the electrical industry, when manufacturing concerns rarely or never paid dividends, it was urged, possibly with some reason, that extravagant prices of patents, with the resultant over-capitalisation, were responsible for the inability to make profits. But nowadays all that is changed; the electrical industry is practically free from patents that touch the main features of electrical supply, and the chief effects of over-capitalisation have been swept away. How is it, then, with the prospect of fair profits, with the accumulated experience of years, and the employment of the most highly skilled labour, that so many English manufacturers are unable to keep their promises? To some extent the matter is capable of explanation. Up to a certain point the demand for electrical machinery was a gradually increasing one, and manufacturers were able to complete contracts somewhere near the specified time. So far as we are aware, however, there appeared to be little disposition on the part of the managers of workshops to look a little ahead, and make some provision for the boom in electrical plant that was bound to come; so long as the work in hand was completed the morrow might take care of itself. We are not for a moment suggesting that every manufacturer in the country was imbued with this policy of *laissez faire*, but we do not exaggerate when we say that the great majority have acted on this principle. What is the result: the boom in electrical enterprise has come and filled the English shops to overflowing, and the orders have followed so rapidly on

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one another that the energy of a portion of the staff has been devoted to carrying out extensions of the workshops. Orders for plant have been taken with a sort of blind faith that everything will come right in the end, and probably it will, but in the meantime there is a reckoning to be paid. It is never pleasant to turn work away from one's doors, but assuming one has a clear knowledge of the possible output of a shop, it seems the height of folly to endeavour to double it. A harsh term would be applied to a person who sought to put more than a pint into a pint pot, yet that is precisely what the home manufacturer has been attempting. There may have been an idea that when the large towns had put down electrical machinery there would be very little more required; but the systems at present in existence have done little more than merely demonstrate the commercial possibilities of electric lighting and power supply. Before electricity is supplied to the average householder enormous plants will need to be erected.

Just when electric lighting had become established on a sound commercial basis, municipalities and tramway authorities became convinced of the economy of electricity when applied to tramways. But the demand for tramway plant and materials that followed has found our English works totally unprepared to meet it. Our American friends very readily perceived our state of unpreparedness, and they have quickly filled the breach. The consequence is that some of the very best orders for electrical machinery are to-day crossing the Atlantic. We are quite aware that the strength of the Americans in this country may be exaggerated. If the newspaper reports are to be relied on, the chairman of the Midland Railway Company has declared that the engines which have been recently supplied by the Americans were not nearly so good as those constructed at home. There are authorities in this country who maintain that many of the engines supplied from America for tramway work are inferior to those of English manufacture; but whatever truth there may be in that opinion, it is obvious that if American engines can be relied upon to perform fairly satisfactorily, they will, by reason of quick delivery, continue to be used to a considerable extent.

Although we have pointed out the delay that has arisen in the delivery of a good deal of electrical plant, we readily enough admit that the majority of firms will not at the present moment accept orders for machinery under a somewhat protracted period. That must necessarily divert orders either to America or to the Continent, but regrettable though that may be from a merely insular point of view, it is, from the standpoint of the electrical industry, infinitely to be preferred to keeping customers waiting for long periods.

Here and there workshops spring up, and for a time, at least, their chief advertisement is "early delivery," and apparently on the strength of that alone they secure a large number of orders, but their shops are soon overstocked with work, and very speedily they join the ranks of the great majority who are too busy to promise delivery under six or nine months. The cry of too much work is an irritating one, and it is doubtful if the manufacturers are doing any good to themselves by constantly repeating it. It may give rise to the reflection among men that either English works are limited in their capacity, or they lack organisation. In some industries it is astonishing how the supply keeps pace with the demand; we take it that neither Whiteley's nor Lipton's would ever have succeeded if they had become too busy. A growing demand needs courage and a long head in order that it may be properly met.

It is almost unnecessary at the moment to enlarge upon the superior position of the American firms to English houses in their ability to deliver plant quickly. At different times we have endeavoured to analyse the causes that account for these marked differences between the American and English electrical industry, but whatever may be the true reasons, the effects are occasionally brought before us in the most forcible manner. The demand for electric motors must be already a very large one, but when electric driving becomes properly recognised, both in large and small factories, an enormous number of motors will be required. With the present limited use, however, English manufacturers cannot supply them under some months. Quite recently a well-known engineer endeavoured to obtain a considerable number of electric motors for a client, but it was impossible to secure them within a reasonable period in this country; yet within three weeks an American firm was able to deliver the complete set of 40 of varying horse-powers. English manufacturers would have designed and made them specially, the American firm took them from stock.

American Workshops in England.

It will be a matter of great interest to watch the developments of American enterprise in establishing workshops in England. If the Westinghouse Company at their new works are likely to employ 5,000 men as anticipated, the question arises, Where are these men to come from? If skilled men are wanted they will have to be drawn by superior inducements from other employment. These being obtained, and working, we may suppose, equal hours with men in other shops—they will hardly be allowed to work shorter hours by an American management, accustomed to the long hours of America—will there be any trouble with the trades unions when the American method of multiple tools is, as it will be, insisted upon? Will the now discredited Amalgamated Society of Engineers make a fight over the employment of floor-labourers to attend to automatic machine tools? We feel much inclined to welcome the American company in establishing its works in England. English wages are not much less than American, in many cases they are higher. Per unit of output under the paralysing influences which have crippled English practice, the wages cost is distinctly higher all round. Assuming that the American company can effect no good with its workers, it will be a very simple matter to charter a large steamer and land 1,000 men at once from New York at the works on the Ship Canal at Manchester. There are plenty of workmen in America who would, if required, make the change. They might not at first like the change, for an American is intensely conservative in his habits of life, and does not mind sleeping in a windowless cell if he can only get green corn to eat. But he would in time find that climatically and otherwise he was better off here than at home. Bar the lack of transit facilities, England is a pleasanter country to live in than America. We may take it that a sufficient force of American workmen could be permanently maintained at the new works. In receipt of good wages and well housed no outcry could be raised against them, and they would be safe from outrage in a way they would not be in America. We should then have the spectacle of the new works underselling most competitors, simply because of its cheap output. This could scarcely go on; the closing of works unable to compete would follow. It might be necessary to do this before the trades unions recognised the folly of opposing new methods any longer. The new works would, however, be a centre of influence, from which surely better ideas would radiate. Secure against the tyranny of a works' stores, too common in America, by the protection of our Truck Act, and generally under the protection of English law, we do not see that the American works could become an evil. The methods of the Carnegie Company would be impossible, and Pinkerton men to shoot at sight could not be employed. On the whole, therefore, a healthy competitive influence may be anticipated. It must strike the more thoughtful of trades unionists that one consequence of their efforts to defeat modern methods of production should have been the planting of a large works right in our midst to carry out such methods. While we have assumed the possibility of a struggle, we scarcely think this will arise. Those behind the scenes know that many English workshops have been enabled to make great changes since the strike of 1897, and probably the new works will simply serve as a stimulus all round, and hasten the adoption of better methods. There is room for more manufacturing in England; at present it is impossible to obtain anything in decent time. Steam engines, cars, motors, boilers and all classes of engineering work can only be obtained in reasonably short period from America. It is quite time this was changed.

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A "FIN-DE-SIECLE" MACHINE SHOP.

By FRED. BATHURST, A.M.I.E.E.

(*Concluded from page* 279.)

FIG. 10 shows a most compact and important machine, being a simple combination which avoids a separate pumping

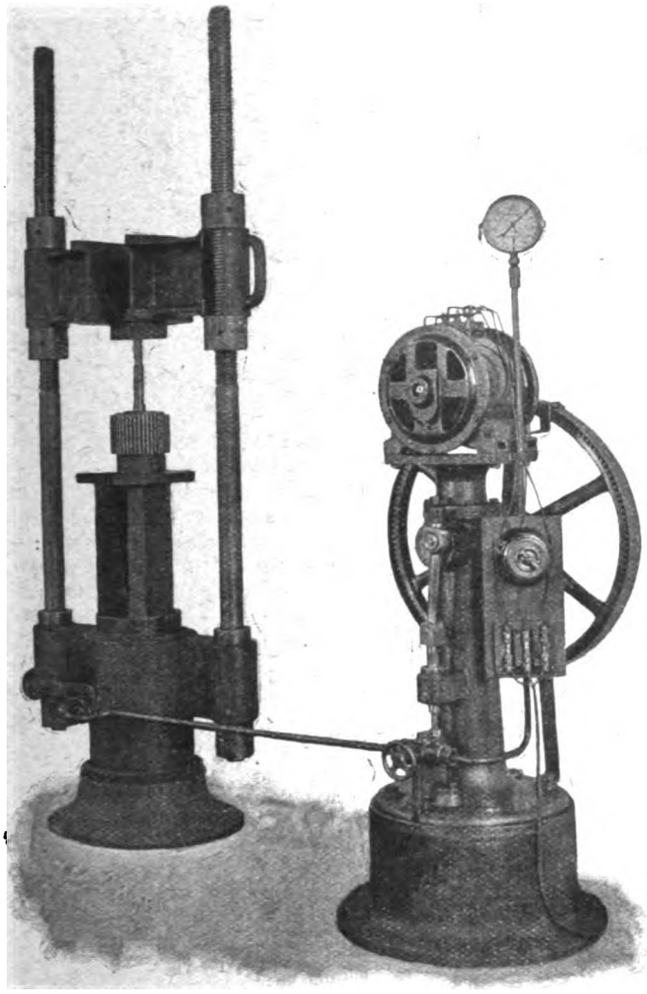

FIG. 10.

engine and its unnecessary gearing. It represents a convenient design of vertical type hydraulic press for compressing small armature bodies, commutators, &c.

A 1½ H P. motor is single geared to a small single-acting pump, the pipe from which connects to the plunger chamber of the press. In this particular press a total pressure of 15 to 20 tons can be obtained, complete control being maintained by the indication given on the recording gauge seen at the side of the pump, and which indicates up to 2,000 lbs. per square inch. With the specially constructed cross head fitted to this press, it will be seen that the laminated armature discs for a drum-wound armature body can be quickly pressed together, or the machine is equally suited for pressing a shaft into the carrying spider for a gramme ring body.

Fig. 11 shows an excellently compact and well designed field magnet spool winding machine. This special machine is driven directly by a 1 H P. motor arranged on a sliding base and controlled by a rack and pinion. The winding shaft is driven through a train of gears from a flat circular friction plate. Any speed of winding can be obtained by moving the motor in or out along its base plate, so that the pulley on its armature shaft drives against the outer or inner periphery of the friction plate, according to the relative position of the motor. The machine is fitted with a wire-holding or tension gear, and the usual train-wheel counter for registering the number of turns of wire wound on to the spool is provided. Its approximate cost is about £70.

Incidentally this combination shows the simplicity of the application of a separate motor to a machine requiring comparatively small power, and which may have to be run at varying speeds and yet be started and stopped at pleasure. The field magnet winding machines usually employed in dynamo shops are designed on the lathe principle, and have the loose pulley running continuously, but inasmuch as considerable time must be spent in adjusting the insulation of each spool, and spools when filled with wire have to be changed and replaced by others, it has been found to effect a considerable daily saving in the main engine driving power to adopt winding machines of this type.

Fig. 12 is interesting as an illustration, in that it shows the size of the tools that will have to be provided in shops laid out for the manufacture of the multipolar generators, which must ultimately take the place of the comparatively small machines at present employed in English station practice. This represents one of the large lathes specially constructed in the Kolben shops for the purpose of tackling pieces of work up to 80 feet in diameter. The work shown in the illustration is a 64-pole revolving type magnet wheel, weighing over 55,000 lbs. The pole faces are being trued off, so that the magnet will set accurately within its correspondingly immense and stationary armature ring. The main construction required in this lathe is its solid bed-plate, with the necessary well-hole and adjustable bearings, capable of accommodating removable plummer blocks for carrying the bearings of any sized shaft. The tool head is comparatively only an insignificant part. The work is revolved on its own shaft by being belt-driven from a 8 H P. motor, which in order not to further encroach upon the floor space occupied by the bed-plate, is bolted to the side of the shop wall well up above the machine. The turner has complete control of the operation of this lathe by means of the motor switch and loose belt levers arranged near at hand.

Fig. 13 shows a small portion of the armature-winding department, and is interesting in that it shows side by side the "ancient and modern" in armature construction. On the left, supported on their wooden rests (easily recognisable

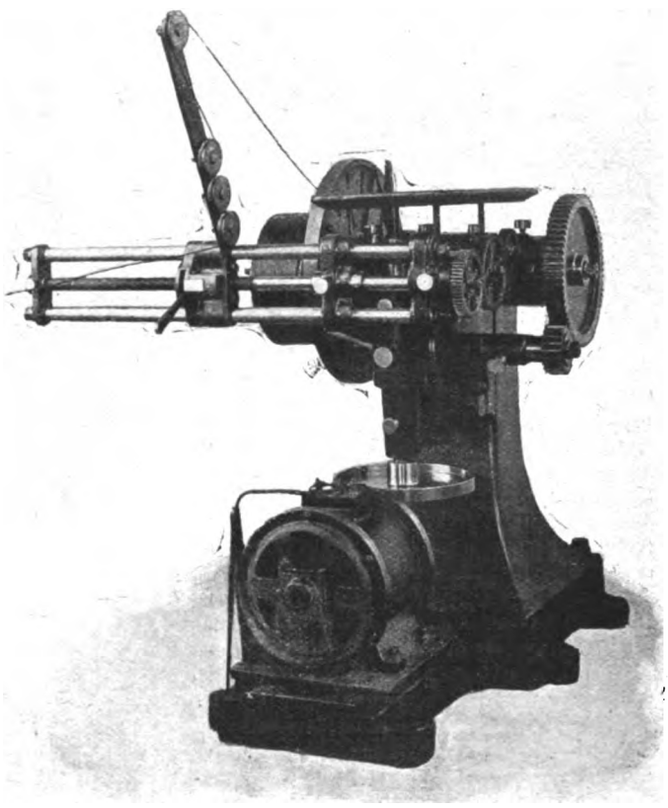

FIG 11.

from their compact and solid form and comparatively small diameter) can be seen "gramme" ring, and "drum" wound armature for machines of varying size, from 25 KW. to 200 KW. On the right can be seen the two huge semi-circular shaped castings, which are ultimately to form the

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stationary armature of a 1,000-H.P. three-phase generator. This side-by-side comparison sufficiently accentuates the kind of change that may have to be encountered when a dynamo shop proceeds from the manufacture of small to that

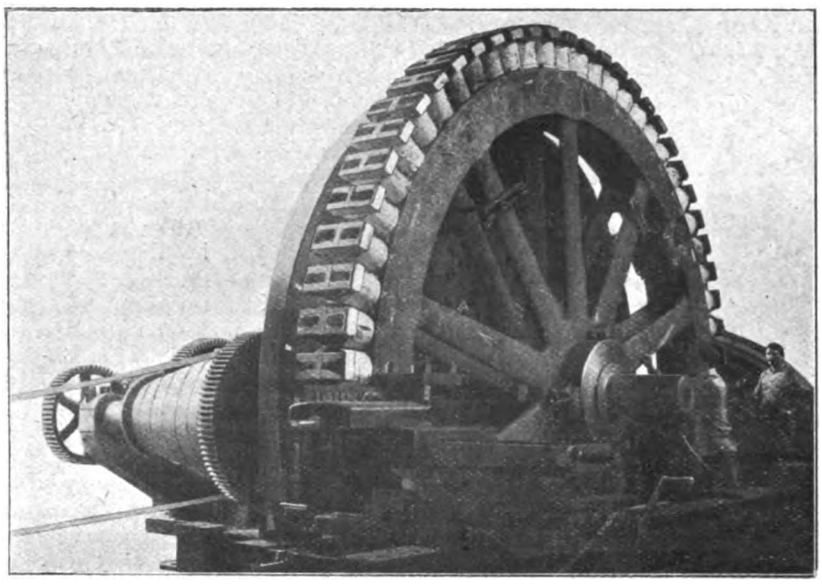

Fig. 12.

of large generators. In the distance will be seen the assemblage of two large armature body rings, one arranged inside the other; and further in the distance, on the left, the erection of the wrought-iron frame of a large switchboard.

Overhead may be seen the bottom of the controlling cage and the hanging chain of the travelling crane that runs over this section of the shop. Every modern shop designed to handle large castings will, of course, be equipped with electric travelling cranes which can run the whole length of the shop and work over a system of shop tramway rails, so that the castings can easily be passed on from one shop to another. Although the Kolben Factory consists of only two large main buildings, one of which is divided centrally, accommodation is found for no fewer than *six* large travelling cranes, two each of 5, 12, and 15 tons, having spans of 30 and 40 feet respectively.

Fig. 14, although not actually photographed in the Kolben shops, shows a 50-ton three-phase motor crane, made by this firm for a neighbouring locomotive works, with double travelling trolleys, so as to be capable of handling small locomotives *en bloc*. In this case the longitudinal motion is given by a 12-H.P. motor, the travel of the trolley by 8-H P. motors, and the lifting by 20-H P. three-phase motors.

The application of three-phase current to crane work might, at first sight, be criticised on account of extra complication in respect to wiring connections, but these practical examples show convincingly that all difficulty is easily avoided. The three main trolley wires required along the shop are easily provided for, and although 11 contact strips or wires must be provided on the crane girder itself, the greater simplicity and compactness of the regulating boxes more than counterbalances any objections which might be raised as to complicated connections.

In addition to the main shop cranes, the side bays of the shop, which cannot be covered by the travelling cranes, and in which the smaller kinds of tools are placed, are provided with separate hand-power cranes, either travelling or stationary, as demanded by the nature of the work to be handled. The upper parts of some of the side bays are made to provide extra working galleries in which the small detail parts are assembled or finished, and switch or other small work made. One finds in these cases that the labour of handling material is reduced to a minimum by the provision of electric elevators to convey material from the shop floor to the upper level.

Fig. 15 shows the complete elevator equipment. The machines are designed to raise an ordinary flat platform cage, loaded up to 1,100 lbs., at a speed of 60 feet per minute.

The winding drum is driven by a 8-H.P. three-phase motor, which runs at 1,440 revolutions. The gearing arrangement adopted was originated by the Kolben Works. A specially made phosphor bronze screw is arranged on the motor shaft, so that it drives on to a hardened and polished steel worm wheel on the drum shaft; by this means a direct reduction of 1 to 40 is obtained without other gear apparatus, and a very compact and economical combination effected. This elevator runs without any attention, being quite automatic in its action; the movement of the starting rope raises the brake on the motor shaft, and operates the three-contact armature resistance controller at the same time, so that the cage starts slowly and smoothly.

The complete motor and winding drum equipment weighs about 600 lbs., and costs approximately £120. The overall dimensions are:—Height, 2 feet 2 inches; width, 2 feet 10 inches; length, 3 feet 2 inches.

The liberal use of cranes and portable power apparatus in this shop not only reacts favourably upon the time taken in finishing and assembling the complete machines by almost entirely superseding the "gangs of labourers" ordinarily required in busy shops to move the heavy castings from

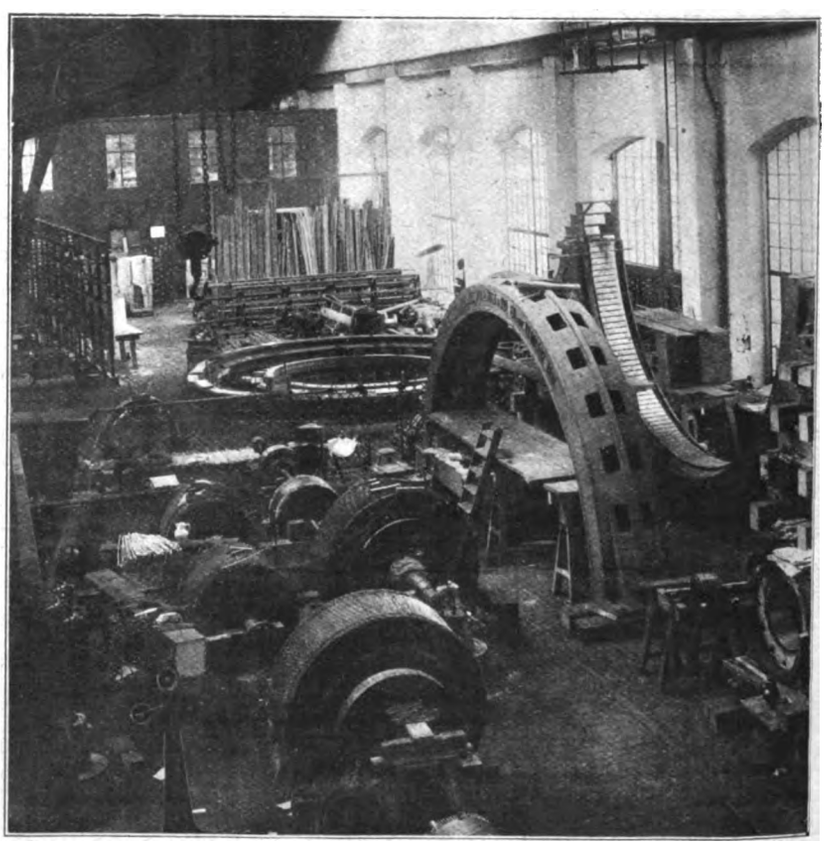

Fig. 13.

place to place, but materially reduces the usual standing charges of shop production. In fact, throughout the whole of the shop every possible economy in time and labour seems to have been considered, for on passing from the machine shop to the foundry, not only is it found that

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the pig iron and coke is served to the cupolas by elevators of the type shown in fig. 15, and the draught furnaces maintained by means of 20-H P. three-phase motors driving the air-blowers, but recognition has been taken of the fact that the foundry is usually behind time in keeping up with the production of the machine shop. When working upon such large castings, it is obvious that a comparatively small

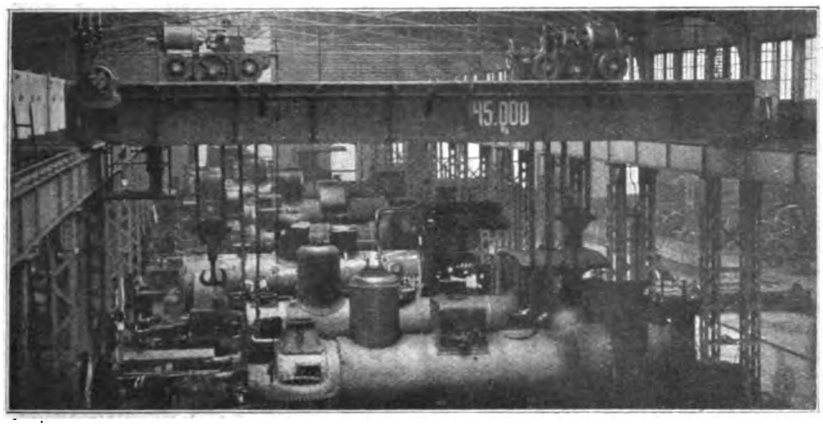

FIG. 14.

number of patterns will occupy a large amount of floor space for moulding purposes, and inasmuch as these large moulds, even when formed, may take many hours and even days to properly *dry out*, delays may, under ordinary conditions, ensue. The output of the Kolben Factory has practically been doubled without any increase of floor area by laying around it a comprehensive system of piping, through which a current of air can be forced to any desired part. If a large mould has to be finished as quickly as possible a portable coke oven is placed about it, and a flexible pipe connection made from the air pressure system, so that a steady current of warm air can be passed into any part of the mould as required. In this way moulds of awkward shapes and sizes can be dried out far more evenly and rapidly than when left for the usual open air drying, and the floor space accommodation is utilised to its utmost capacity, the same spot often being used three or four times over in the time originally required, as when the moulder, leaving the drying to Dame Nature, could take "his own good time" and regulate the floor output to suit his own particular view or fancy.

As the main object of this article has been to describe a series of important labour-saving processes and tools, the matter descriptive of the factory itself has so far been kept in the background, that the casual reader interested in shop practice may probably have formed the opinion that the tools illustrated could only be found employed in one of the oldest and largest machine shops. In truth, however, it is scarcely four years since the acre of ground upon which these shops stand was first broken, but so rapidly has demand followed upon ability to turn out the highest class of work, that to-day we find 300 skilled Bohemians busily employed, and working in day and night shifts, with as much method and order as if the whole establishment were practically one huge machine. The transformers made vary in size from 100 watts (used for voltmeters and switchboards) to 500 KW., and the motors and generators from ½ H.P. to 2,000 H.P., the bulk of the work being the larger sized units required for important town lighting and power transmission plants; hoists, cranes, railway motors, switchboard equipments, all come as extra grist to this electrical mill. The turnout increasing proportionately with the growth of the works may well be envied, the present year's output alone in transformers, generators, and dynamos of all sizes being estimated in the aggregate at 50,000 KW. total capacity.

The power transmission plant of the shop is also unique in its way, as it illustrates how much can be effected from small resources, provided the guiding hand has the requisite knowledge and experience.

Whereas it would be thought that a factory employing so many machines must require a main steam plant of considerable horse-power, one is surprised to find that the whole factory is driven from a 120-H.P. engine. Two Lancashire boilers of 120 H.P. and 60 H.P. each respectively (180 H.P. total) supply steam at 120 lbs. pressure, which is then passed through a superheater (utilising the heat of the boiler flues) and raised from 170° C. to 270° C., at which temperature it is passed into the parallel cylinders of the compound engine. By such superheating the condensation losses are kept very low, and a very high steam efficiency obtained. The exhaust steam warms the shop in winter, or gives a hot water supply for the boilers.

Both boilers and engines are housed side by side in a building 40 feet × 40 feet, the actual size of the engine room being only 40 feet × 16 feet, which explains the difficulty of obtaining a better general view of its arrangement, than that shown in fig. 16.

The engine is belted directly to a 120 H P. three-phase current generator of 91 per cent. efficiency (50 cycles), 220 volts, and provided with its own fixed exciter. Some 50 electric motors, having capacity from ¼ to 20 H.P., are employed in the shops, the majority being operated at 200 volts. Owing to the comparatively small size of motors employed, and their consequent high speed and the difficulty of gearing them down, the shop shafting is run at 270 revolutions per minute instead of about 180 revolutions, the usual standard speed for ordinary machine shop practice. This higher speed is, of course, advantageous and quite possible under the conditions of lighter and shorter shafting runs.

The shop wiring is arranged with an earthed neutral, so as to prevent the possibility of the workmen receiving shocks, and to allow light to be supplied on the single phase from either of the three wires at 125 volts. The lighting can be taken

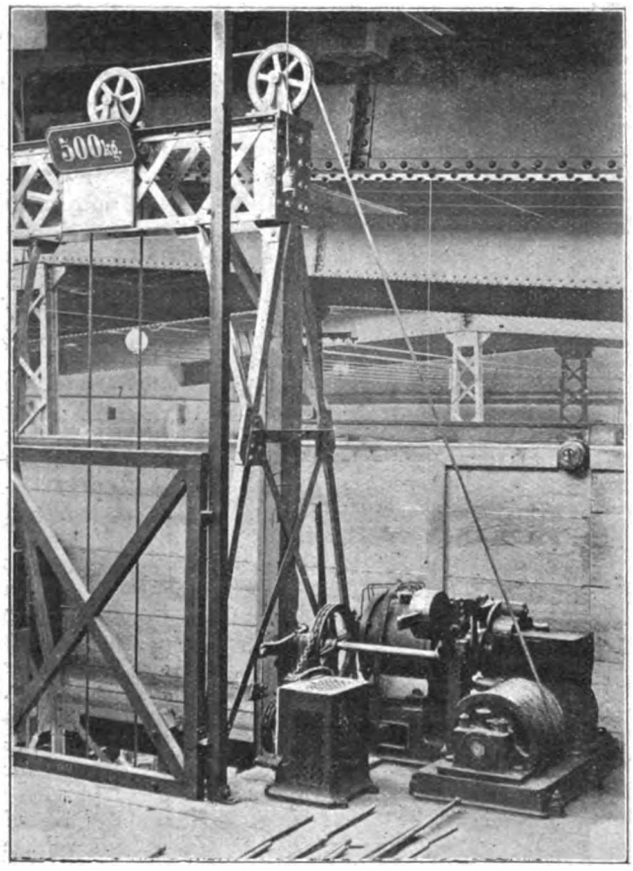

FIG. 15.

direct from the power wires throughout the shop, or, if desired, from a set of accumulator cells.

The accumulator is charged from the three-phase generator by the intervention of a rectifier. This rectifier of 6 KW. capacity, although only in an experimental form, affords a simple and economical method of changing a three-phase alternating into a continuous current. It consists simply of

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series of contacts and collector rings, arranged on a shaft, which is driven by a ½-H.P. three-phase synchronous motor, running off the main generator. A three-phase stationary transformer is connected to the mains from the generator, and the sections of the coils connected to contact rings on the shaft. These contact rings are again connected to a suitable commutator, so that the three-phase current from the transformers is collected as continuous current. This 6-KW. rectifier occupies less than 15 cubic feet of space, and the loss in the transformation does not exceed 5 per cent. Excessive sparking and other troubles would, of course, follow in large

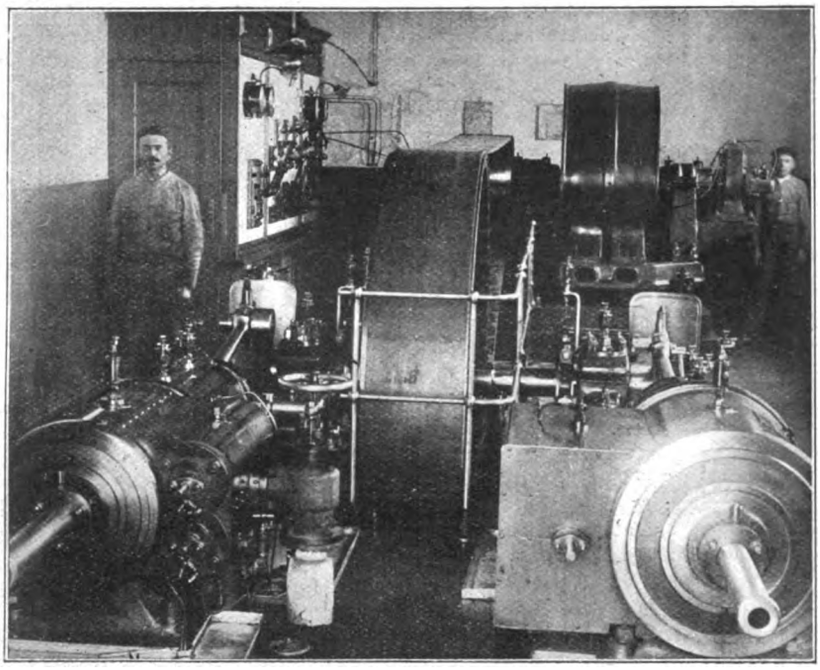

FIG. 16.

sizes, but Herr E. Kolben considers that it may eventually compete with the standard type of motor-transformer (three-phase to continuous current, with a loss of 8—15 per cent.) for capacities less than 30 KW. This suggestion has already been made by Mons. Le Blanc, of Paris, but does not seem to have been properly worked out. Mention is made of this apparatus, as it forms a very cheap and effective means of providing for an auxiliary accumulator for lighting and other purposes in connection with three-phase power plants.

A corner of the small engine room is allotted to the switchboard, which contains the ampere and voltmeter necessary for controlling the large generators, and switching out the feeder, supplying the current for power to the various shop circuits. The engine room arrangements are thus relatively as small and compact, as the number of tools and appliances provided for is large.

In connection with the utilisation of three-phase current in this factory, and looking to the fact that at last in England we hear of some important three-phase plants being projected, notably in Manchester for its lighting, and in South Staffordshire for power (this latter scheme proposing to instal two 1,000-KW. and four 2,000-KW. generators), it may be of interest to mention that the Kolben Works are already well advanced with the manufacture of the three-phase generators, and suitable motor transformers for the first instalment of a 15,000 H.P. three-phase plant for the city of Prague. The units in hand are five of 1,000 H P. and five of 2,000 H P. The high voltage distribution is to be effected at a pressure of 3,000 volts, and motor-transformers of 700 H.P. (or 450 KW. each) 240 revolutions, will re-deliver the electrical energy as continuous current at 600 volts. The main object of the scheme is to supply and extend the present electric street railway system in the town of Prague.

Comparisons are proverbially odious, but may not the consideration of this work undertaken by a *single* town as the outcome of its *immediate* necessities, lead us to ask how it is that a Continental town *only fairly* prominent in reputation and commerce, can give the lead to the whole of England in electrical supply undertakings of this nature?

Whatever schemes English electricians may have in contemplation for the *future*, the shortest visit to the Continent must convince them that we lag far behind in respect to street-railway and power-installation practice. From the fact that we have relatively so many large towns cooped up within our little island, in the matter of electric lighting, we may possibly find ground for debate; but here, again, a fair judgment must admit that we are also behind. The "slow and sure" and "wait till it comes along" policy that forms the keynote of English electrical development may, it is true, be best in the *long* run, but with Continental examples of electrical enterprise of all kinds before us, surely it is time that a little more "initiative" and "go" should be instilled into our "authorities and rulers," "professors," and "consulting engineers," lest in the competitive race we are now running, the idea that we are "already too old and fossilised" should become too deeply rooted, and even impossible to eradicate?

This article, however, must not become controversial, being intended merely to serve as an index for our dynamo manufacturers, as to the kind of shop practice that prevails in the "more progressive" Continental factories.

Conclusion.— Enough has, it is hoped, been said to show that throughout the practice of this factory such advantage has been taken of the most up-to-date ideas and methods of manufacturing as to justify the heading under which it has been introduced.

NOTES ON THE CAREER OF EMIL KOLBEN.

He passed through the ordinary Bohemian school course and entered a technical college to undergo an engineering training.

In his holidays, particularly the long summer vacations, he used to enter the neighbouring factories working as an ordinary hand. After serving in an engineering works near Prague for a short time, he decided, in 1886, to go to the U.S.A., and there entered the drawing office of the Edison Machine Works, in Schenectady, N.Y. He made rapid progress as a draughtsman designer, and became head man. He then set himself to work out the designs for the improved Edison bipolar machine with the shortened magnetic circuit, carrying out at the Edison Works what was proposed in England by Dr. John Hopkinson.

It was the thoroughness with which these old-type machines were re-designed that made it possible for the Edison bipolar machines to gain the reputation for reliability and solidity that they hold in America even to-day. From head designer Mr. E. Kolben became chief engineer, the Edison Works having grown during these few years from three workshops employing 300 men to over a dozen shops employing 1,500 workmen.

In 1891 Herr Kolben returned to Europe on a tour of inspection, and in order to make a report as to European practice. This revived in him the love of his native country, and he returned to the States as a married man, and with a predetermination to exchange the haste and bustle of American workshops for the more even and steady going progress of the European. Within a year he came back to take up the position of electrical engineer to the Oerlikon Works in Switzerland, just then vacated by Mr. C. E. L. Brown, now of the Brown-Boveri Works. At Oerlikon, Mr. E. Kolben again showed his aptitude for dynamo design by completing and putting into standard shape a complete range of three-phase motors, and working out to practical and commercial success several important three-phase and other power transmission plants, besides finding a sphere of activity in the introduction into Europe of his American street railway experience. In these early days of commercial power transmission work, Mr. Kolben's name was well known to the technical press for his contributions and notes on dynamo

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machinery designing, and it is not too much to say that his paper "On the Best Periodicity," published in the *Electrotechnischen Zeitschrift*, in 1894, led to the general adoption of 50 cycles as the standard for three-phase apparatus. During his sojourn in Switzerland, Mr. Kolben had every opportunity for indulging his passion for recreation in the shape of mountaineering, and with Mr. E. Huber (proprietor of the Oerlikon Works) as an experienced companion, many difficult and so-thought inaccessible peaks in the neighbouring Alps were assailed and conquered. Whether, however, it was due to Mr. Kolben's love for the hills and heights of his own native country, or "the homing" of his Bohemian nature, in 1896 he decided to return to Prague, the town of his birth, and start there as an electrical manufacturer in his own name. He evidently chose the proper moment, for to-day we find Austrian manufacturing activities rapidly developing all along the line, and to judge from what has been accomplished in this factory within so few years, Mr. Kolben will have the satisfaction and reputation of having initiated an industry which will grow to be one of the not least important. Mr. Kolben is quite a young man—not yet out of his "thirties"—and has all the talent, energy, and experience necessary to develop his factory, so that, retaining his good health, he ought long to enjoy its fruits and reward.

INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(*Continued from page* 262.)

Fig. 72 shows the connections of "Ajax" lightning arrester for isolated plant, and fig. 73 shows the connections

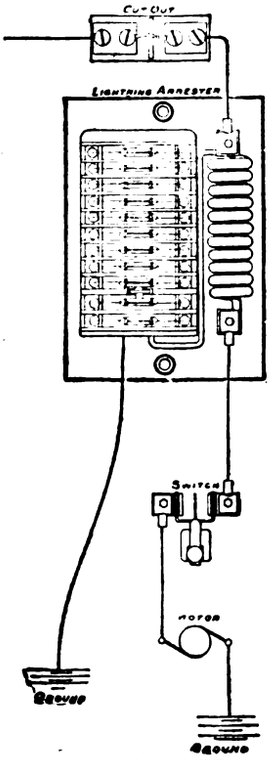

Fig. 72.—Connections of "Ajax" Lightning Arrester for Isolated Plant.

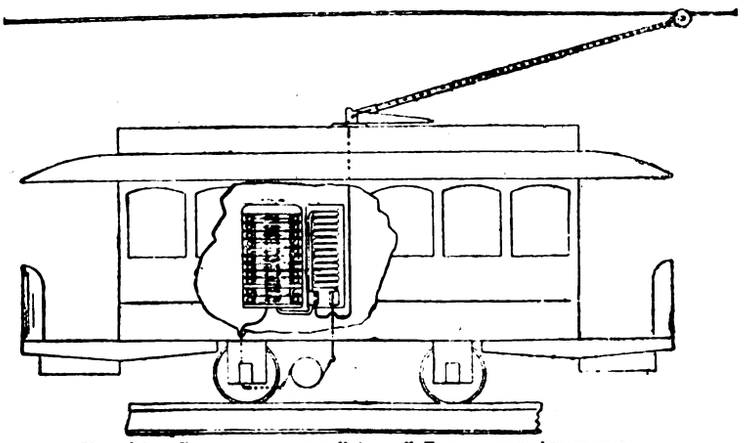

Fig. 73.—Connections of "Ajax" Lightning Arrester for Motor Car.

for a motor car. These should have appeared with last week's section of this article.

Trolleys.

In this country the type of car generally in use is the double-decked car, which is a legacy bequeathed from the stage coach through the omnibus and the horse tramcar to the electric tramcar. It is problematical whether this double-decked car is an unmixed benefit, but certain it is that to our eyes the single-decked car would look as strange as the double-decked variety does to American and Continental eyes. The form of swivelling trolley suited to and used for the single-decked variety is not suitable for cars having seats on the roof, and a special type has had to be evolved to meet the requirements of the latter. The trolley pole, instead of starting from the roof of the car, has had to be raised on a standard of sufficient height to prevent it and all moving parts from interfering with passengers. The chief desiderata in a trolley to ensure satisfactory working are the following:—

1. The head must be of a form having no angles or projections save the edges of sheave slot, in which the wire can catch and prevent the head from being hitched readily into position when the trolley has left the wire. It must be fixed so as to swivel freely at right angles to the wire, and it must be completely insulated from the trolley arm by a non-conducting sleeve.

2. The sheave must be of the "V" groove type fitted with non-heating (graphite) bushings, and mounted so that its axis is on a level with or below the end of the trolley arm, and in this way lessen the possibility of the sheave striking a span wire or bracket arm. It must be provided with ribs to hold the flanges in position after they are cut or worn through, and thus prevent the disabling of the car before the sheave can be replaced.

3. The trolley arm must be tapered throughout its length and reinforced at the butt, and it must be insulated at the carrying socket by insulating material of the nature of mica. It must be supported by outside springs fixed, so that the pull shall be as near as possible at right angles to the arm when the latter is inclined at its normal angle.

4. The springs must be arranged so as to exert a pull which shall maintain a pressure of 18 lbs. between the trolley sheave and the overhead conductor; this pressure remaining approximately constant while the arm moves through an angle of 30° on either side of its normal position; the tension of the springs being susceptible, however, of instant release or adjustment.

5. The socket for carrying the arm should be of malleable cast-iron, mounted on a pivot, and fitted with an adjustable stop to prevent the super-elevation of the trolley head, and should be pivoted on a malleable iron swivelling sleeve.

6. The sleeve carrying the arm socket should rotate on two sets of ball bearings round a steel tube socketed in the standard, a complete revolution being prevented by a stop.

7. The standard in which the steel tube is fixed should be an annealed steel casting, the base being arranged so as to be fixed on to the car roof by coach screws.

8. The cable should be run straight through from the head to the heavily insulated connection box in the standard where the motor leads end, and be so arranged as not to twist or chafe; its connection with the head should be easily accessible, and its insulation throughout should be as perfect as possible.

The accompanying figure, 74, shows a recent type of trolley (Dawson's patent) which complies with all the requirements above mentioned, and whose use renders it easy to work a road where the trolley wire is horizontally 8 feet to 10 feet or

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more distant from the side of the car, as it instantly follows any variations in the line of the trolley wire from that of the track. It greatly facilitates construction, decreases the number of poles, and diminishes the necessity for span wires.

Trolley Pole Catcher and Reel.

The accompanying figure (No. 75) shows an indispensable adjunct to a satisfactory trolley. From one cause or another trolley sheaves are bound occasionally to leave the wire, and the long bamboo fishing rod with its hooked end is a fruitful source of delay and expense, besides being awkward and unsightly. This adjunct consists of an enclosed reel fixed to the dashboard, or any other convenient part of the car where it is readily accessible to motorman or conductor, on which a cord attached to the trolley head is wound. The movement of the reel is regulated by a coiled clock spring, which, as long as the trolley sheave is running on the wire, instantly takes up the slack rope or pays it out to meet the inequalities of the overhead conductors. Immediately the sheave leaves the wire and the pole jerks upwards under the influence of the springs, the jerk brings a device resembling a centrifugal governor

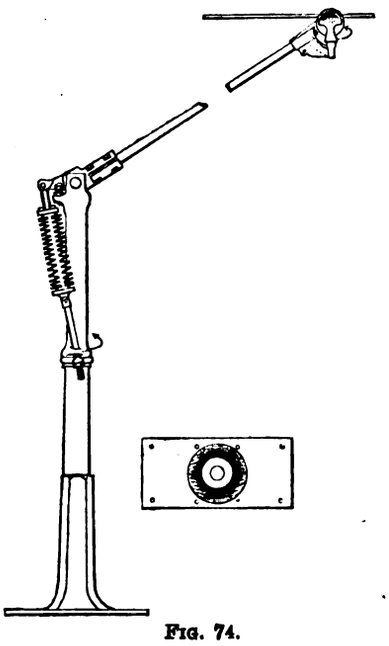


Fig. 74.

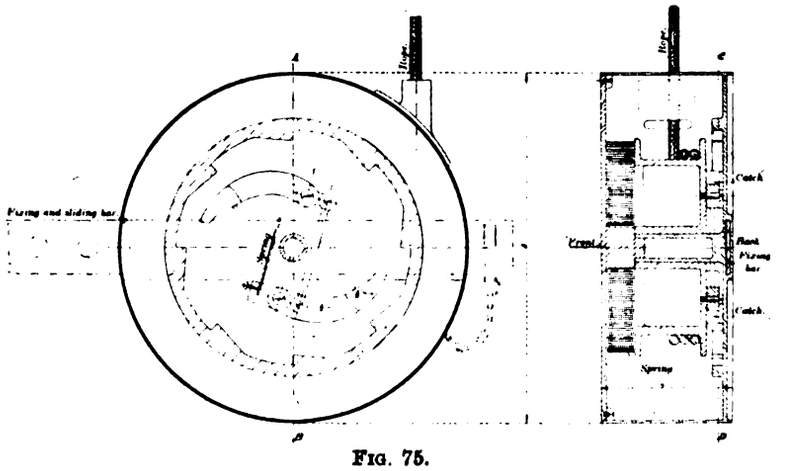
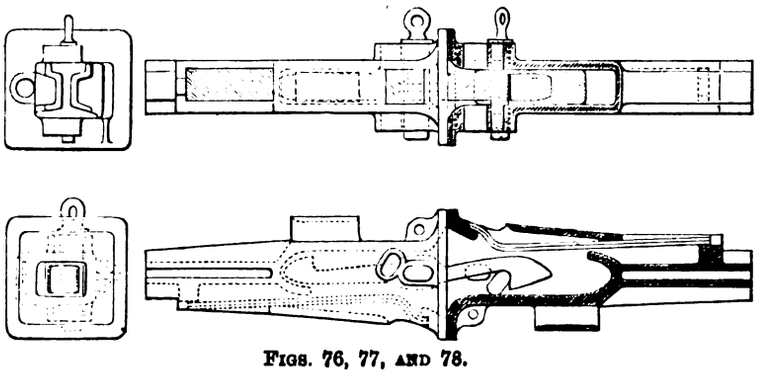


Fig. 75.



Figs. 76, 77, and 78.

into operation, which at once catches the rope and securely holds the pole until it is released by the conductor. The catching of the pole and the holding of it in position presents the double advantage of preventing wear and tear and injury to the wire, and of permitting the adjustment of the spring pull on the trolley pole to either a higher or a lower standard than the one which is imperative where no such adjunct is used. This device is also the invention of Messrs. R. W. Blackwell & Co.

Couplings.

Automatic couplings, or, as our American cousins prefer to style them, "couplers," have been very much in the air of late in connection with goods waggons in the United Kingdom. The authorities of the Board of Trade have at last realised that their adoption will diminish the rate of mortality among long-suffering railway servants in a way no other innovation could effect. Many excellent patents and devices have been known, and to a certain limited extent, used, for the purpose of automatically coupling up railway carriages and waggons in the United Kingdom for years past, but have mostly languished or practically died a natural death from lack of the support of railway companies and waggon owners, which nothing short of the unanimous insistance of their employés or of the Board of Trade could have brought about. Fortunately, in the case of electric traction, no such vested reluctance exists, and the adoption of automatic couplings is more or less assumed as a matter of course on this side of the Atlantic just as it is on the other side. What is required of an efficient automatic coupling is that it shall be—1st, perfectly automatic; 2nd, absolutely reliable; 3rd, impossible to get out of order; 4th, capable of coupling cars so solidly together so as to ensure perfectly smooth running, free from all jerking motion under all conditions of service; 5th, capable of coupling and uncoupling readily with the least possible longitudinal motion of the car; 6th, capable of use without alteration with any type of non-automatic coupling in general use; 7th, simple in construction and lasting in details. The first requirement entails the introduction of springs in the heads of the couplers, and requirement No. 5 demands that they shall be so set that they will engage or disengage with the coupling hook in a distance of, say, $\frac{1}{64}$th of an inch, or in practice $\frac{1}{16}$th of an inch. The second requirement demands that the spring shall be so carefully shielded, from casual injury and wear and tear, within the solid head of the coupling that they shall last as long as any other portion of the coupling and continue reliable to the very end. Solid coupling and absence of jerky motion is ensured by the same conditions as No. 5, but their subsistence under all conditions of service requires certain structural peculiarities which merit careful consideration, and are well exemplified in the Van Dorn coupling under consideration. In going round curves both coupling and draw bar must be free to swivel so as to assume a true tangential position to the curve at the point midway between the car ends. With the single or four-wheel type of truck this is effected by fastening the drawbar by a universal joint to a draw plate which is bolted to the centre of the underframe of the car body. This universal joint is free to act in two planes only, so as to avoid all twisting in the coupling head. The ball piece is attached to the drawbar by fishplates which allow of wear in the ball, to the extent of $\frac{3}{8}$ths of an inch, being taken up, and the joint is cushioned with India-rubber washers. This practically ensures at least a life of five years in the joint without repairs or sensible elongation. In double bogie and maximum traction cars the drawbars extend to the king pins and swivel around these. The draw bar

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consists of either a plain flat steel bar or of a "T" section, the latter being specially suitable for very heavy traffic. In the case of the flat bars, which are often of 1 inch × 8 inches section, the coiled springs, which cushion the pull, are fitted in the car end of the coupling head, while in the T-section bars (80 lbs. to the yard) they are placed in a special holder close to the king pin. The heads are supported by steel carriers beneath the car balcony ends, as shown in the accompanying figures. The coupling hook forms a common pin and link coupling at one end, which meets requisite No. 6, as it is capable of use with any non-automatic coupler. The heads are furnished with two pins either of which can be used and their life consequently doubled. Fig. 76 shows the coupling heads ready for coupling, and fig. 77 the two heads united. The coupling can be placed in either of the drawbar heads, when the hook enters the opposite one with the pin in the sloping hole, the springs in the inner side of the head are sprung out sufficiently to allow the hook to pass round the pin and lock. To uncouple, the pin in the sloping pin hole is pulled up, and coupling and uncoupling is readily effected if required in $\frac{1}{64}$th of an inch.

(To be continued.)

ELECTRIC HEATING INSTALLATION.

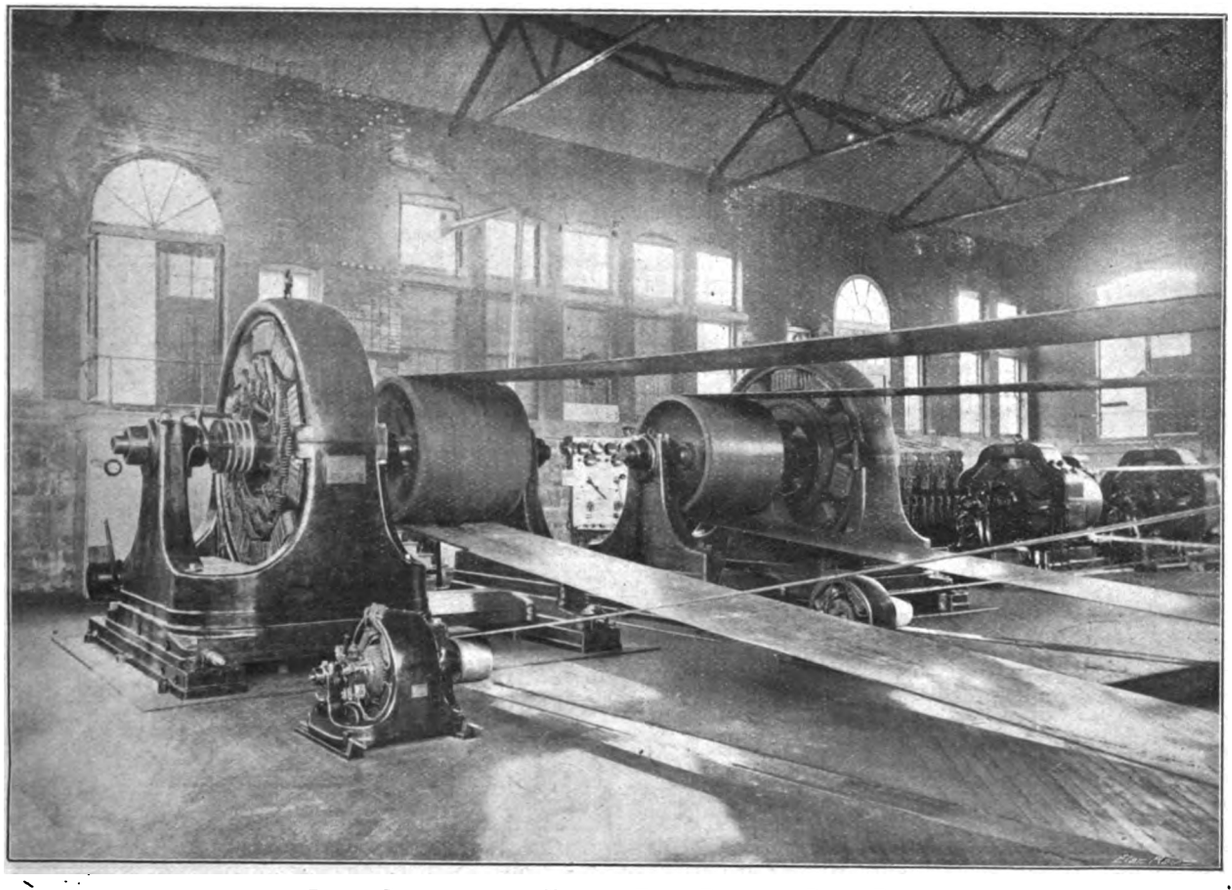
By O. E. DUNLAP.

In their new Hospice of Mount Carmel, at Niagara Falls, the Fathers of the Order of Mount Carmel in America have taken advance steps in the matter of electric heating, and the installation they have perfected is not equalled in the world.

Away back in the early twenties the first little chapel or shrine was built, and in this place the Catholics from all countries have worshipped. In the grandeur of the great cataract the late Archbishop Lynch, of Toronto, early saw an inspiration for devotion, and petitioned Pope Pius IX. to grant all the favours and privileges of the European sanctuaries to the little shrine at the Falls, with permission to transfer the privilege to a new shrine when completed. When the structure is completed as planned it will form one of the greatest buildings for architectural beauty and completeness of detail in America. At present the structure consists of the main building and one wing, and in the course of time the hospice and shrine will be combined. Then the shrine will occupy the centre between the two wings, the northernmost one of which will be the home for guests or pilgrims, and the southern one will be used as a monastery. The institution is on the same original plan as the famous hospice of Mount Carmel on the Mount of that name in Palestine. However, the hospice at Niagara Falls is modern in every particular, and founded on the latter day principles of the order of Carmelite Fathers.

Standing on the bluff back of the Falls, the hospice occupies a site unequalled in the world for beauty of surroundings. It is far enough back from the Falls so that the spray cloud does not reach and fall upon it, and from the upper windows the magnificent panorama of the Falls and gorge is spread before the eye. The present wing forms an L, the length of the sides of it at the foundation being 200 and 250 feet, while the height from the ground to the top of the towers is 85 feet. The buildings are of stone, the front being beautified with an arcade having massive granite columns.

The hospice is located about two miles from the power house of the Niagara Falls Park and River Railway, in which station the Canadian Niagara Power Company have two generators installed for a temporary power service. It is from the Canadian Niagara Power Company that the Carmalite Fathers get the electric power used in the building. As it stands to-day the building contains 200 16-C.P. incandescent lights. For lighting the building, for cooking, and for heating water 25 H.P. is being used, while 75 H.P. is, in time of need of such service, used for heating the lower floor of the building, which comprises 11 bedrooms, a dining room, reception room, office,



Power Station of the Niagara Falls Park and River Railway.
Where the Temporary Plant of the Canadian River Power Company is located. Showing Generators.

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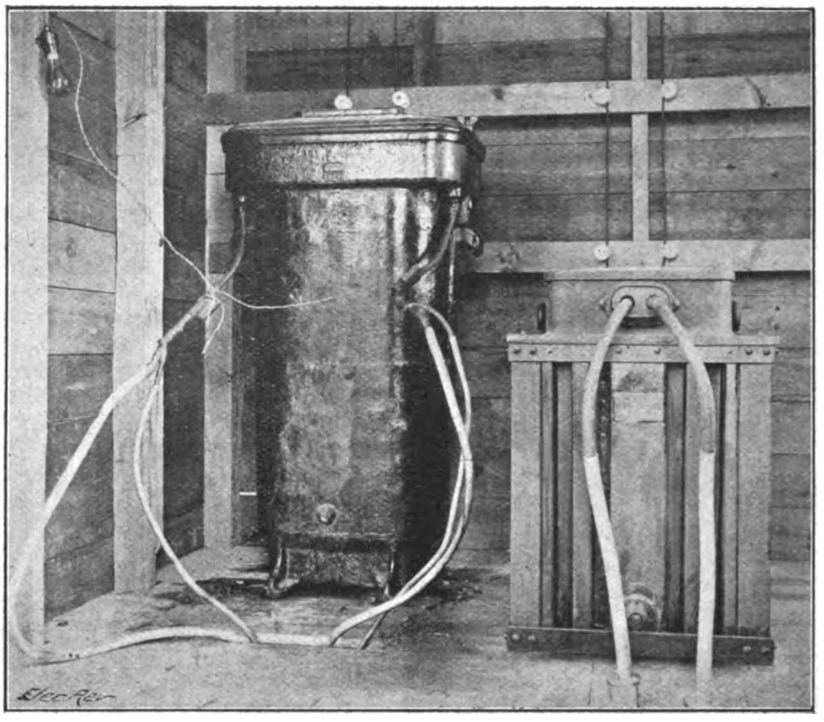
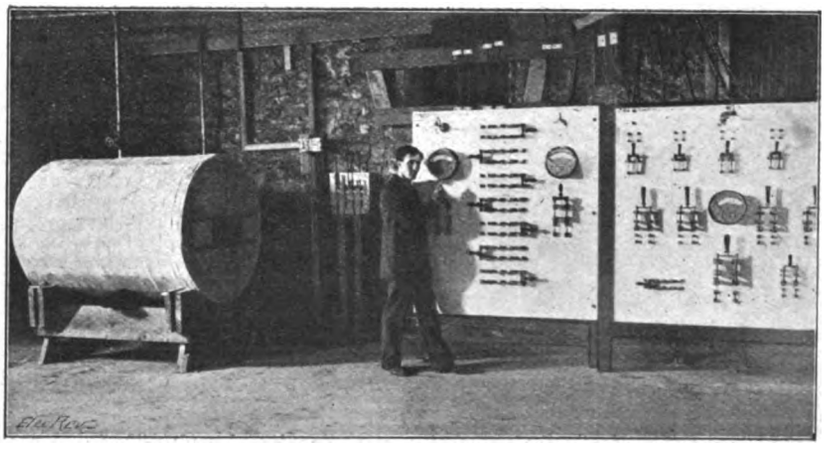
and the corridor. The corridor is 120 feet long, 10 feet wide, and the ceiling has a height of 15 feet. In this corridor are located nine 4-H.P. heaters. The bedrooms are 10 by 12 by 15, and in each is located one 4-H.P. heater with changeable heat switch of two heats.

The hospice transformer house is located about 150 feet west of the main building. It is a small wooden structure,



Transformers.

and over it tower two poles with a double cross-arm from which the wires descend to the station. In this transformer house are located two 30-KW. Westinghouse and one 25-KW. General Electric transformer, primary 2,200 volts, and three-phase secondary 110 volts. From this station the current is transmitted to the switchboard in the main building through an underground cable.



Switchboards and 400-Gallon Tank (water electrically heated).

The switchboards of this novel installation will be seen in the illustration. The panels are of white marble. The switchboard with double-throw switches controls two phases of the current, while the third phase is controlled by the other switchboard adjoining, and is used for cooking, lights, &c. Both switchboards are so arranged that either transformer can be used independently of the other for either purpose.

The hospice is also equipped with two hot-water boilers, both of which are operated by electricity. One of these has a capacity of 400 gallons, and is to be seen to the left of the switchboard in the illustration. The other has a capacity of 150 gallons, and is located in the south corner of the switchboard room. The 400-gallon boiler is used to heat water for the laundry and bath room. It takes a current of 120 amperes, being divided into three heats. The 150-gallon boiler takes 125 amperes, and is also arranged for three heats. This boiler is used for quick boiling. Both boilers are covered with 2½-inch asbestos covering. An important feature is that all water is boiled when the current is not being used for any other purpose. In the 400-gallon boiler water is raised from 60° to 212° in six hours with full heat.

In the butler's pantry there are three 5-gallon urns and a chafing dish, all electrically operated. In the kitchen are found an electric combination range and three ovens. The range has a heating surface of 6 square feet, and each square foot of surface has a switch and can be controlled to either full or half-heat. The largest oven takes 50 amperes, and is so arranged as to cook four 25-lb. roasts at one time. The two small ovens each have three compartments, and each consumes 23 amperes at 10 volts. On the door of the large oven there is a thermometer, which shows the heat and states the temperature through the

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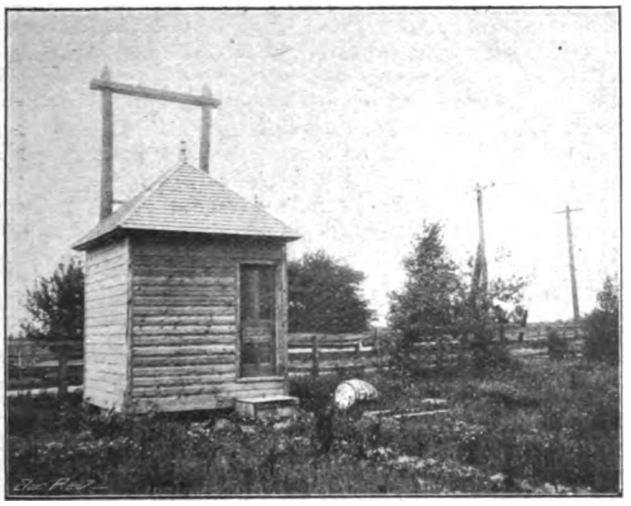
different time of roasting and baking. As the point of baking or roasting is indicated, the cook can make no mistake. As the heat is uniform, the cook is enabled to have her output of food uniformly cooked, and there is no burning or over-roasting. In the small ovens, bread can be baked in 18 minutes, and one day in June a dinner for 250 people was successfully cooked in this electric kitchen. One most gratifying feature to the cook in charge of this kitchen is the manner in which she can regulate the heat. Then all the pots and other dishes are always nice and clean, there being no deposit of dirt on them as from gas or other fuel.

While it is not possible at this time to make a very extended comparison of the cost of the work done by this installation, with what the same results would cost by other means than electricity, some general statements can be made that are of interest. If the cooking and heating were done the old way, they would require the services of



Transformer House.

two men, whereas they now require the services of a woman only. The man who has charge of the electric plant also looks after the office, and, in fact, has general supervision of the building. No extra help is required to look after the installation, the man in charge simply looking the plant over occasionally.

The annual cost of the electric energy used in the building for cooking, lighting, and heating water, is $625, which is 25 H.P. at $25 per H.P. If these things were done with coal as fuel, the cost would be $1,140. In the power the monastery or hospice uses for heating, it is at present exceptionally fortunate. Such supply of power is required for only about six months in the year, and as the power station from which the supply of current is received has not such a great demand on it for its energy during these months, as in summer, owing to fewer cars being run, there is a surplus of power which the hospice enjoys at a rate about one-fifth that paid for the 25 H P. above referred to. This is indeed an exceptional consideration, but under such circumstances it is evident that they can afford to use electricity for heating purposes.

In previous winters the power station of the Niagara Falls Park and River Railway has been greatly annoyed by the gathering of anchor ice at the inlet, and this has resulted in the installation being shut down for days at a time. Of course, when the Canadian Niagara Falls Power Company get their proposed new station running, it is not at all likely that the ice will bother its operation to this extent, but then the ice on the Canadian side above the Horseshoe Fall is likely to be far more troublesome than it is to the Niagara Falls Power Company on the New York side, the water conditions being quite different. However, the experience of the past winter, which was most severe on all the Niagara power companies, has developed the conviction that under such conditions, where ice is likely to bother a plant used for electric heating, it would be wisdom to instal a combination electric and fuel system of heating water, so that when the ice bothers the operation of the electric apparatus fire could be put under the boiler to heat the water which would otherwise have been heated by electricity. In other words, instead of carrying the electric current through the building for heating purposes direct, it would be better to apply the current to the boiler, and have a hot water system of heating. Then, should there be an interruption of the electric service, the fuel combination could be effectively used. It would seem that in a case like the hospice, this would be an ideal system, for all the results obtained at Niagara have been thoroughly satisfactory.

The electric plant in the Carmelite hospice was installed by Mr. A. Harth, an electrical engineer who has given much attention and study to the question of heating and cooking by electricity. The apparatus was made by the Hathaway Electric Heating and Engineering Company, of New York.

CORRESPONDENCE.

Converting Old Electric Lamps into New.

I have read your article on the subject of "Renewable Incandescent Lamps," also the various remarks of your several correspondents, with pleasure. Now, as I claim to be the *first and original Inventor* of the above process, perhaps a few remarks from me may be interesting and of use to the electrical trades, also tend to put the subject matter on a solid base. For in the face of facts, why £100,000 should be asked for a presumed patent is more than I can comprehend. For in the face of my completed patent No. 11,802, which is dated as far back as June 30th, 1888, everything of importance relating to the subject of converting "old lamps into new" is covered in my patent, and more, too, than is claimed by Messrs. Howard and Mayer; therefore, in the face of these facts, I do not consider their patent is worth a "£10 note," much more the £100,000 asked for it. Any electrical firm desirous of going into the renewable lamp industry, can do so without the least fear of infringing anybody's patents; moreover, the elongated and expansive type of bulb used in the proposed new system, upon which so much importance is laid, was also patented by me in a former patent taken out by me as far back as December, 1883, and, singular to say, my 1883 patent, covering the elongated and expansive bulb, was procured by Messrs. Hazeltine & Lake, the very agents who have taken out the patent for Messrs. Howard & Mayer, and if my memory serves me right, the latter gentleman, at the time I was in Germany teaching my system of manufacture, acted as consulting engineer to the very firm who purchased the German interests in my renewable lamp patents, but probably the German-Edison Company, the Seel Company, or Mr. Carl Rhoeder, of Vienna, all of whom know of its existence, would be able to confirm this point, as they all were conversant with my work, the two latter firms having founded the lamp industry in Germany and Austria partly under my patents of 1883, and any expert sufficiently interested in the subject of lamp manufacture has only to compare the drawings and descriptive matter of my 1883 and 1888 patents to decide the questions under discussion and prove who is the original inventor of the system. I may here say in my patent of 1888, that the invention clearly states that the chief object was to re-use and make up soiled or damaged incandescent lamps, repair same, and to convert old lamp materials into new lamps, which I proposed to do by utilising the waste materials previously used in lamp manufacture, a description of which my patent agents said would cover everything appertaining to the converting of old lamps into new and a direct bar to future inventions of this class. Probably the best and most profitable part of my invention is explained in the following descriptions, viz.:—

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(*a*). The methods of standardizing the filament.

(*b*). The manner of utilizing the old filaments to manufacture new lamps of lower voltage and candle-power.

(*c*). The improved method adopted in making a good mechanical joint between the filament and leading-in wires.

(*d*). The methods adopted for carrying the multiple connectors through the bulb for high candle-power lamps of, say, 100 to 1,000 C.P. A very important feature which is now generally adopted by all lamp makers.

(*e*). The methods adopted for reducing the vacuum of the lamps prior to remaking same up into new lamps.

(*f*). The methods of making semi-metallic filaments which I still maintain are the best (when you know how to make them), for very low volt lamps when used for battery electric lighting, and especially for night lights or photographic purposes where a great light is only required for short durations, and the watts used to produce the light of no moment as to cost of energy consumed, for which this class of lamp, which can be greatly overrun, is specially applicable for the purpose named.

I may also say that I was the first inventor who made multiple filament lamps, and monopoly of which could have been easily secured by this patent had the claim been upheld against infringers of my rights. My inventions were also patented in France and Belgium, also patents applied for in Germany and America, all of which several rights were sold, and certain parts of the said invention have been ever since profitably used by the purchasers of the said patents, who have sold millions of lamps made under my patents, although sold under other names. I have no doubt your readers will say, when they read these facts, Why on earth did not Shippey Bros., Limited, sell this patent, or work the Shippey process in England? Why was it not sold for £50,000 or £100,000 when it was apparently the only lamp patent in existence of its kind under which lamps could be made and repaired without infringing Edison & Swan rights? That is just the point which requires explanation, and which has puzzled everybody until counsel's opinion was obtained, and, in fact, the patents were privately sold for £20,000 to a company of promoters, and a prospectus was actually printed re-selling my patents to the proposed company for £100,000 for payment of patent rights, and also providing £40,000 for building the works and plant, and providing capital for working the inventions. But it was not to be; fate willed it otherwise. A splendid and profitable business could have been established, certainly with a far greater success in the year of 1888 than now, for the simple reason that in 1888 electric lamps were selling by the Edison and Swan Company, and other makers, at from 3s. to 25s. each, according to type of lamp and candle-power. Consequently, at such splendid prices it can easily be understood that it was then well worth while repairing old lamps and re-using the materials for making up new lamps; but to-day it is another matter, and a horse of different colour, considering the low market price of incandescent lamps to-day; consequently the repairing of same is not now worth the candle. As an instance, my company holds in stock to-day, as is well known, some 20,000 to 25,000 lamps of different types and voltages, 50 volts up to 110 volts, as made in Germany, Holland, and America, many of which have been made by the manufacturers under my own original patents, under *nom de plume* titles, in the very works originally founded by us and our associates, and these special lamps, I may say, we are selling at the following market prices:—German make, 5s. 6d. per dozen; Dutch and Belgium makes, 6s. 6d.; and selected Americans at 7s. 6d. and 8s. per dozen for gross lots, and, moreover, from which price we allow regular consumers of our lamps 1s. per dozen for all cap and lamp ends returned to us intact with platinum supports, for which parts and materials there is always a demand, as the holders and platinum can be used over again, and to-day there are three or four firms who make a regular business in collecting from users the old and used-up electric lamps, a business which was not thought of until the advent of my patent in 1888; and, in fact, the only parts of any value are the platinum and brass base caps, for since the Edison and Swan patents have all expired the old glass and filament is no longer of any value, it being much more expensive to re-make up the old lamps than by making a perfectly new lamp with improved filament and new glass bulb. Therefore the idea of asking the public to subscribe £150,000 to carry out the objects proposed by the Renewable Lamp Company seems absurd in the face of my expired patents, and I cannot but express my astonishment to find certain names who have associated themselves with the development of such a scheme, and I fear with such dead weight of useless capital; if the shareholders expect any dividends they will be woefully disappointed, and I would say if there is any money flowing about the Stock Exchange or in electrical circles for business of this nature, or for even incandescent electric lamp manufacture, I will undertake as an expert lamp maker to construct the finest factory, with all the necessary plant, machinery, and appliances required to turn out, say, four million of lamps a year for less than £40,000, and with £10,000 working capital as ample to carry out the objects in view, and pay good dividends on capital to this extent. Now comes the pith of the whole business, viz., the real cause and reasons why my "renewable lamps patents" were never exploited in England simply rested on one legal point. Eminent counsel's opinion was obtained prior to the registration of the "Shippey Electric Lamp Company," for under legal advice his opinion killed the whole business and covered by a few works, for eminent counsel, after complimenting my patent agents on the construction of their specification and upon the merits of the invention, his opinion was briefly as follows:—"*The very making up of an incandescent lamp of high resistance with any type of carbon filament in vacuo which could be used successfully in electric lamp circuits would be a colourable infringement of the Edison and Swan patents, no matter how the filament was made or even the class of materials used.*" Even though it was proved that royalty had been paid on same, it was considered by counsel that it would still be held to be an infringement of Edison's memorable patent, and as I was personally already legally restrained by law from making incandescent lamps of any kind of a colourable nature during the unexpired term of the Edison & Swan rights, and having already sold the patents to the present company, not a cent of the £20,000 to be paid by the promoters would have come to me for my personal benefit, and having no desire to be committed to Holloway for contempt of Court, I thought it best to take a back seat rather than run the risk or expend more money in law, having already expended over £4,000. Hence the matter fell through, and the only reason why the Shippey Electric Lamp Company was never formed; for this reason alone a valuable invention was prevented being worked, and a good and profitable business frustrated by the arm of the law, although a bitter pill for me and my then associates, that the matter fell through upon facts stated.

I enclose you copies of the specification of my patents for your perusal, which I think covers the whole ground of the subject matter under discussion; and as my patents have run through the second and third editions, it clearly shows that these inventions have interested lamp makers, although at heavy costs to me as the inventor. I must apologise for the length of this communication, but as the subject matter is one of national importance to the electrical trades, and especially lamp users, this must be my excuse for fully explaining the position of affairs, so far as it concerns my patents. If you can find space to record these facts, please do so and oblige.

Arthur Shippey.

Copper.—The *Mining Journal* says that owing to the development of the electrical industries in Germany, the increase in consumption of copper and lead appears to be greater than in any other country. In 1897 the consumption of copper was 92,148 tons, and that of lead 133,239 tons, whilst in 1898 the consumption of copper was 98,160 tons, and that of lead 159,229 tons. Germany produces 7 per cent. of the world's supply of copper, and consumes 22½ per cent., whilst its production of lead is 17½ per cent. of the world's supply, and its consumption 20 per cent.

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SOME NOTES ON THE ELECTRICAL MACHINERY AT THE COMO EXHIBITION.

By KENELM EDGCUMBE, Assoc.M.Inst.C.E.

(*Continued from page* 265.)

The Technomasio Italiano had on view a number of continuous current motors in which speed regulation was performed by varying the length of air gap. Each of the two magnet limbs (the motors are of the ordinary horse-shoe type) is capable of sliding towards, or away from, the other. They are actuated by a right and left handed screw, which is turned by a hand-wheel at the side of the machine. A small pointer at the top indicates the relative separation of the poles, and hence the speed at which the motor will run. What advantages such a system possesses, as compared with the ordinary method of varying the shunt resistance, is not very clear. The alteration of speed can, of course, be made more gradual than is possible with this latter method, but on the other hand, it is necessary to go to the motor each time, instead of it being possible to have a controlling switch placed in some convenient position.

Messrs. Schuckert, among a fairly large number of machines, showed a so-called "Licht und Kraft" three-phase dynamo, which, as its name implies, is designed to supply a mixed load of power and light, without its being necessary to equalise the distribution of the latter over the three phases. The arrangement would appear to consist in running the motors off all three phases in the ordinary way, while the lamps are connected across two phases only, of the star coupled armature. As these two phases have obviously to carry more current than the other they are consequently wound with larger wire. It may be remembered that a somewhat similar system is in use at Schwytz in Switzerland, where Messrs. Brown, Boveri & Co. have adopted the expedient of joining the step-down transformers in mesh, and of connecting all the lamps on to one only of them. Messrs. Schuckert also exhibit a high tension quick-break switch for use with pressures up to 6,000 volts, in which the break takes place between a number of smooth brass cylinders, which are normally in series and touching one another, but which can be suddenly drawn apart, thus dividing the arc up into a large number of parts.

In the Dynamo Gallery was to be seen a 15-ton travelling crane, designed and constructed by Messrs. Larini, Nathan and Co., of Milan, and driven by three-phase motors built by Messrs. Gadda & Co., also of Milan. Each of the three motions is actuated by a separate motor, an ingenious device being employed in starting. Instead of the resistances being cut out of circuit by a cord or lever, a species of centrifugal governor is fixed to the motor shaft in such a way that as the latter gets up speed the switch arm is slowly moved over the resistance contacts. It will be at once seen that by this means it is merely necessary to close the motor circuit, and the maximum permissible starting torque is automatically obtained, without any fear of destroying contacts, &c. It may, at first sight, appear a needless complication to replace so simple a process as switching on a motor by one which is comparatively complicated. But when it is remembered to what rough usage a crane is ordinarily subjected, it will probably be admitted that it is a step in the right direction. Since, in the case of a three-phase motor, it is impossible to vary the speed electrically, it is in this instance done in the following manner:—The load is carried by an endless chain passing round two chain wheels, of which one revolves four times as fast as the other. For slow speeds only the latter is caused to rotate, while for high speeds (5 : 1) an electro-magnetic clutch sets the other wheel also in motion. Steel worms, gearing into phosphor bronze worm wheels, are used throughout, the thrust being taken up by ball-bearings. Extremely high efficiencies are claimed for these gears, while the commercial efficiency of the hoisting motor and tackle is said to exceed 50 per cent.

Messrs. Siemens & Halske had a fairly large exhibit of instruments, fittings, &c., of which their system of "safety fuse cartridges" may perhaps be mentioned. The objects kept in view in their design were: firstly, to produce a fuse which should act with absolute certainty on 250-volt circuits, and, secondly, to devise some means by which it should be rendered impossible to accidentally replace a given fuse by one of greater carrying capacity.

The fuse wire is wound, in two parallels, under and over radial projections. Thus, when a fuse blows, the resulting vapour is split up into six parts, so that the formation of an arc from terminal to terminal is absolutely impossible. The box containing the fuse wire is made of a special cement which, after repeated tests had been made with porcelain and other materials, was found to give the best results.

The fuses are made in various sizes to carry from 2 up to as much as 30 amperes, lead wire of the following dimensions being used:—

Amperes ...	2	4	6	10	15	20	30
Area in sq. mm.	·75	1	1·5	2·5	4	6	10

It will be gathered from what has been said that while preventing *accidental* mistakes, the system does not in any way prevent the *wilful* substitution of one fuse for another.

This same firm also shows several forms of lightning protector for overhead lines, and it may be mentioned that their now well-known "horn" type (see fig. 8) is in use throughout

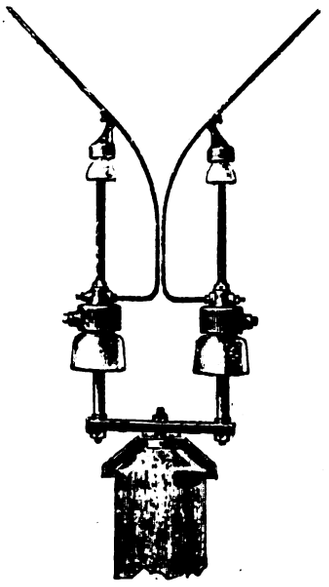

Fig. 8.

the grounds of the Exhibition, and, in fact, is to be seen on almost all the overhead lines of Northern Italy. Fig. 9 shows diagrammatically the method of connecting these protectors to a three-phase system. A is a fuse between the line and the protector, and B is a small self-induction, consisting of, say, 8 or 12 turns of cable, which is usually placed where the line enters the power station.

Of the large number of primary and secondary cells exhibited three of the former class may be briefly noticed. One of these is the "Hydra" dry cell manufactured by the Elektricitäts Actien Gesellschaft Hydrawerk, of Berlin. The chief peculiarity of this cell is that it contains a reservoir of solution, so that it never dries up, the life being thereby greatly prolonged. Prof. G. von Knorre gives the following table showing the capacity of various dry cells, tested by himself. From this it will be seen that the "Hydra" has by far the largest capacity, but as the relative weights of the different cells are not given, the comparison is not of much value:—

Type of cell.	Resistance of circuit.	Capacity in ampere-hours.			
		No. 1.	No. 2.	No. 3.	No. 4.
Liman & Obenlander ...	1 ohm.	1·703	1·721	·933	1·104
Vogt	1 „	1·180	1·165	1·511	·918
Gassner	5 „	·614	·230	·487	·321
Hydra	1 „	5·569	2·246	4·822	4·859

Messrs. Marelli showed the "Cupron" cell, which is a modification of the well-known Edison-Lalande cell, and consists of two plates of amalgamated zinc, between which is

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a plate of copper oxide (CuO), the whole being immersed in a solution of caustic soda. The advantages claimed for this cell are, firstly, that it does not deteriorate by standing idle (a thin layer of oil is poured on the top of the liquid to

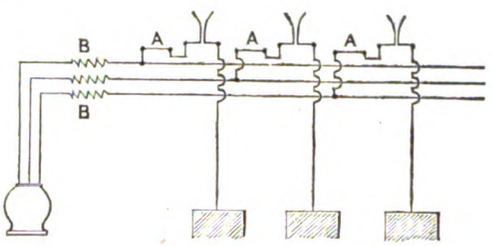

Fig. 9.

prevent the absorption of carbon dioxide from the air), and secondly, its great constancy and freedon from polarisation. The curve, fig. 10, shows the variation of voltage at a comparatively heavy rate of discharge, namely, 1·55 amperes. From this it will be seen that after the first five hours the voltage remains practically steady at ·8 volt. The high initial voltage of 1·1 is said to be due to the free oxygen occluded by the copper oxide. The capacity of the cell under these circumstances was 53 ampere-hours, while at a discharge rate of ·15 ampere the capacity rose to 60 ampere-hours. The internal resistance of a cell of this size is only ·06 ohm, and

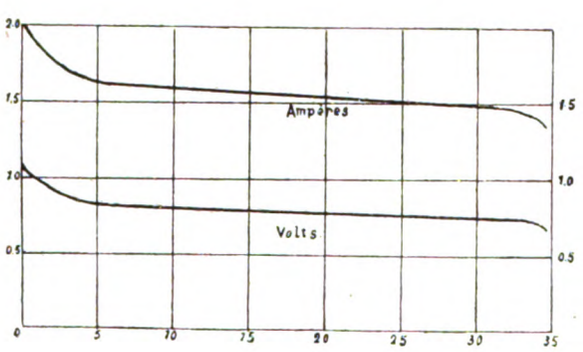

Fig. 10.

its weight 3 lbs. The consumption of zinc is said to amount to less than 2 grammes per ampere-hour, and that of the caustic soda to 4 grammes, at a total cost of about 2s. 4½d. per KW.-hour. The "regeneration" of the copper oxide takes about 24 hours at the ordinary temperature.

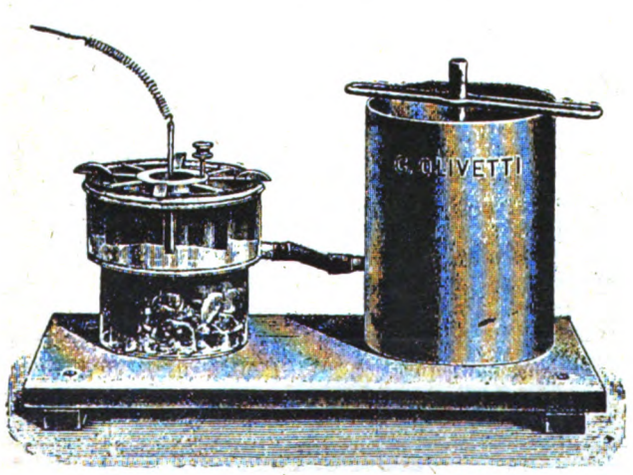

Fig. 11.

One other cell deserves mention. This is a modified Daniell manufactured by C. Olivitti, and intended especially for intermittent use. Fig. 11 shows this cell which, as will be seen, consists of two vessels connected by a short rubber tube. In the lower half of the left-hand vessel is the copper plate and copper sulphate solution, while in the upper compartment is the zinc electrode. When required for use a plunger in the right-hand vessel is lowered, thus forcing the solution it contains into the other receptacle, where it surrounds the zinc. After use the plunger is again raised, and the solution drains away from the zinc.

Among some instruments, &c., exhibited by the Museo Industriale, of Turin, was to be seen a novel device, due to Prof. Guido Grassi and Signor F. Lori, for starting single-phase motors of the Brown type. These motors, it will be remembered, require capacity in their running coils at starting, and, as ordinarily constructed, the condenser consists of a large number of parallel metal plates, dipping into a solution of carbonate of soda. It will be readily seen that for a large motor the apparatus becomes extremely cumbersome, and that short circuits are likely to occur. In the device shown by Prof. Grassi, the condenser is replaced by a simple form of Wehnelt interrupter, consisting of one or more carbon rods dipping into dilute sulphuric acid, and surrounded by a sheet of lead, forming the other electrode. The electrostatic capacity of such a cell is extremely high, and when applied to a 10-H.P. Brown motor, the starting torque was greatly in excess of that obtained with the ordinary condenser, though the latter was considerably more bulky. Further particulars of this system will be awaited with interest.

Two companies were offering power on the large scale for factories and other purposes. One, l'Elettricita Alta Italia, of Turin, supplies current partly drawn from a water-power station at a distance, and partly generated by a steam engine station in the town. The other is the Societa Generale Italiano Edison, of Milan, who receive their current from the water-power station at Paderno on the Adda. The distance is some 22 miles, a three-phase 12,000-volt transmission being employed. It may be of interest to note the charges made by these two companies. In the case of Milan, the following will give a rough idea of the cost of light and power. For light, by meter, the price is roughly 9d. per unit, with discounts of from 4 per cent. to 22 per cent. according to the energy consumed. For power, the cost of a unit ranges from 4½d. to 6d., varying, of course, with the size of meter used and with the consumption guaranteed. Thus for a 20-H.P. motor, the price per unit would range from 2¼d. to 1d., according to the number of hours run per day. Up to the present there has been no demand for current for electrolytic purposes. The company also let out arc lamps at the rate of 19s. per annum. This charge includes repairs and recarboning daily, the carbons, however, being supplied by the user.

The Turin Company supply power for small motors (up to 7 H.P.) at 1d. to 1¼d. per unit according to the consumption. For larger motors, *e.g.*, those above 50 H.P., the charges vary from £9 10s. to £7 10s. per H.P. per annum. For lighting the price per unit ranges from 8d. to 5¾d.

Of the various applications of electrical energy, one which seems so far to have received but little attention, is the electrolysis of water for the production of oxygen. Probably the chief reason for this is that twice the volume of hydrogen is simultaneously produced, and that the market for this latter gas is extremely limited. To overcome this objection, Messrs. Garuti & Pompili, of Tivoli, who are the makers of an apparatus for the electrolysis of water, are endeavouring to introduce the oxyhydrogen jet for various purposes. For its use in the various metallurgical processes the advantages which they claim are :—(1) The reduction in first cost of plant, which is said to amount to upwards of 50 per cent. ; (2) reduced loss owing to oxidation ; (3) smaller space occupied ; (4) the time taken is often reduced by one-half ; (5) the possibility of producing at will either an oxidising, reducing, or neutral flame. For welding, its adoption in place of the electric system is recommended for the following reasons :—(1) The plant required is cheaper, more portable, and less complicated ; (2) the temperature of the electric arc is too high for many purposes ; (3) it is difficult to regulate ; and (4) it is deleterious to the eyesight. It must, however, be remembered that the oxyhydrogen flame has been known for a long time, and it is doubtful whether it is merely on the score of expense that its adoption has been delayed.

(To be continued.)

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COSMICAL MAGNETISM AND ELECTRICITY.

By ARTHUR EDGAR COTTERELL.

A very interesting article under the title of "Atlantic Earth Currents," from the pen of Mr. E. Raymond-Barker appeared in the Electrical Review on June 9th, 1899, pp. 925-6, and it has occurred to me to subject the details which head page 926 to an analysis or examination. A serial article of mine, entitled "Electric Earth Currents Viewed Astronomically," appeared in the Electrical Review in 1897 (commencing on page 527, Vol. 41, No. 1,039, October 22nd), and was followed in 1898 by another on "Terrestrial Magnetism" (which commenced on page 370, Vol. 43, No. 1,085, September 9th). In the former I endeavoured to submit a

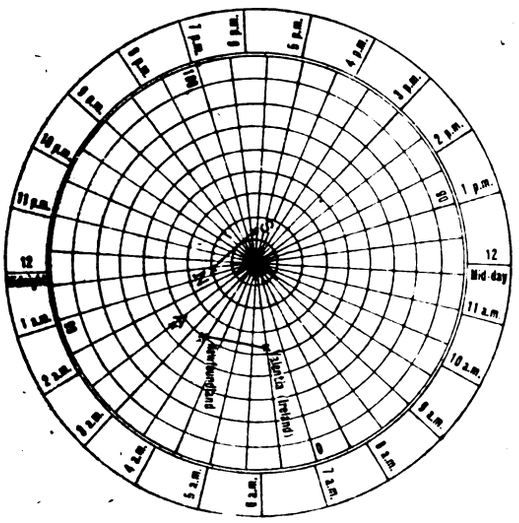

Fig. 1.

cosmical hypothesis in explanation of "Earth Currents," and in the latter I approached the question of "Terrestrial Magnetism" by asking, "Is the earth a huge magnet or merely the recipient of an ethereal line of force?" my endeavour being to substantiate the latter suggestion.

In the former articles I ventured to suggest an analogy to the dynamic production of electricity with certain celestial motions, in which the earth with a magnetic axis set eccentrically to its rotative axis formed the armature, as it were, of an immense dynamo, having the sun as its field.

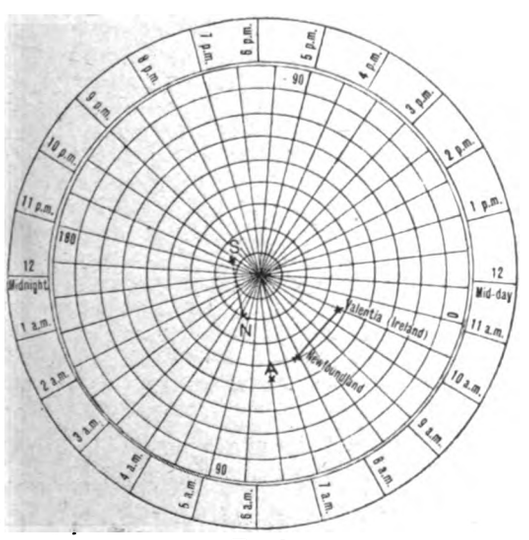

Fig. 2.

In the course of the arguments adduced I exhibited certain charts illustrative of the varying positions of the terrestrial magnetic axis in relation to the sun, which it seemed to me displayed remarkable coincidences with observed current effects as recorded at the Irish end of the Atlantic cables.

Mr. Raymond-Barker presents us with a brief summary of his records at the American side of the Atlantic, and I have ventured to apply the same to a similar analysis. The result is so very striking that I think that it is worth having attention drawn to the same. For simplicity I take the mean value of his figures from which we have the following:—

Date. 1898.	Zero.	Max. neg.	Zero.	Max. pos.	Zero.	Max. neg.	Zero.	Max. pos.
	a.m.	a.m.	a.m.	p.m.	p.m.	p.m.	p.m.	p.m.
July 14—18 ...	2.20	6.32	8 54	12 2	3 25	6 2	9 34	11.48

In order to examine the various magnetic phases as compared with the mean times above stated, let us take a chart of the Northern Hemisphere on which we must mark down the relative positions of the north and south magnetic

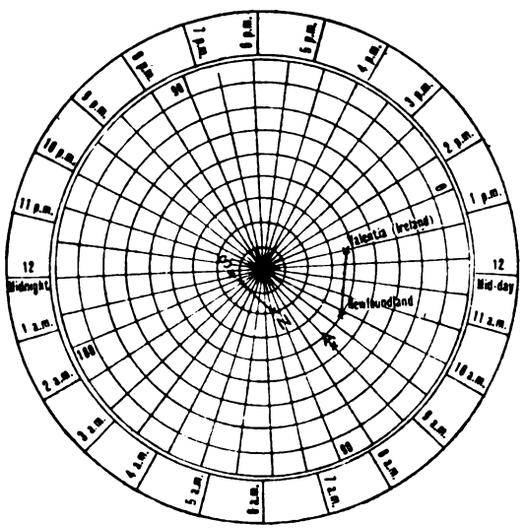

Fig. 3.

poles. This will enable us to not only see the position of the north magnetic pole, but also the relative position of the southern one.

Mr. Raymond-Barker's observations having been made on the shores of Massachusetts, we must now mark down the

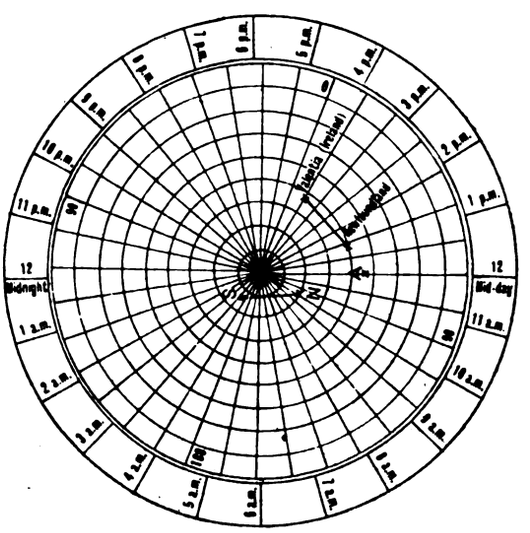

Fig. 4.

position somewhere about longitude 70° and north latitude 42° at "A." We also mark the direction of the Atlantic cable which runs more or less perpendicular to the axis of the magnetic poles, and so really forms a segment of an electro-magnetic wrapping as it were.

Around the outside of this hemisphere, we must now draw

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a dial representing the 24 hours of the Solar day, the sun obviously being situated in the line of noon. If now we cut the hemisphere from the dial, and rotate the former within the area of the latter, a ready and simple comparison can be made of any desired positions.

The various positions occupied by the terrestrial magnetic axis in relation to the sun at the different mean times above stated are very full of interest, and are shown very clearly in the accompanying diagrams.

We will now proceed to turn our hemisphere with the dial to the various hours mentioned, bringing that line marked

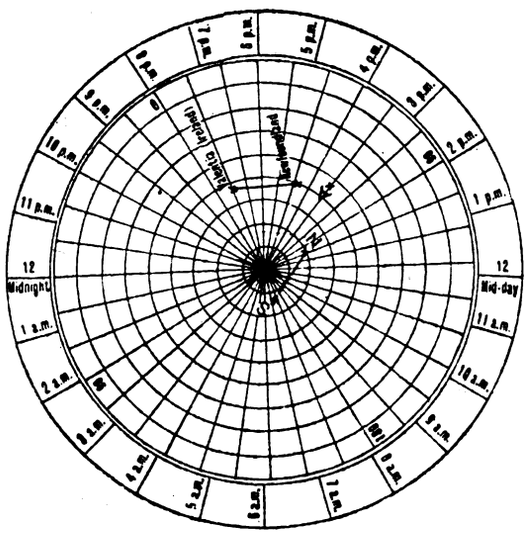

Fig. 5.

"A," and representing the American station, successively into its due positions.

First of all then (fig. 1) on turning A into line with 2.20 a.m., we notice that the north magnetic pole is at its greatest distance from the sun, which, as before stated, is in the line of noon on the dial. Next we move A forward to 6.32 a.m. (fig. 2) when the north and south magnetic poles assume a position approximately rectangular to the line towards the sun.

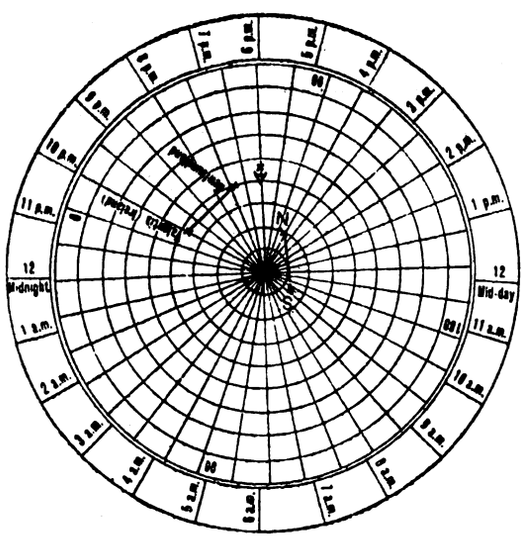

Fig. 6.

At 8.54 a.m. (fig. 3) the south magnetic pole is situated at or about its greatest distance from the sun, whilst at 12.2 p.m. (fig. 4) we notice that the north magnetic pole is very close to its nearest possible position, and the line of magnetic axis parallel to the Solar line.

At 3.25 p.m. (fig. 5) the positions are not quite so striking as those which have preceded. It must be remembered, however, that as the records were taken in July, when the inclination of the earth's axis is such that the northern hemisphere is almost at its greatest projection towards the sun, the north magnetic pole would be subjected to greater solar influences than at other seasons of the year (the Solstice, June 21st, and adjacent days, excepted). It is most interesting, however, to note that the north magnetic pole is at this time, viz., 3.25 p.m., just receding from its nearest daily proximity to the sun.

At 6.2 p.m. (fig. 6), the next position, we notice that the magnetic poles have reached their rectangular position in

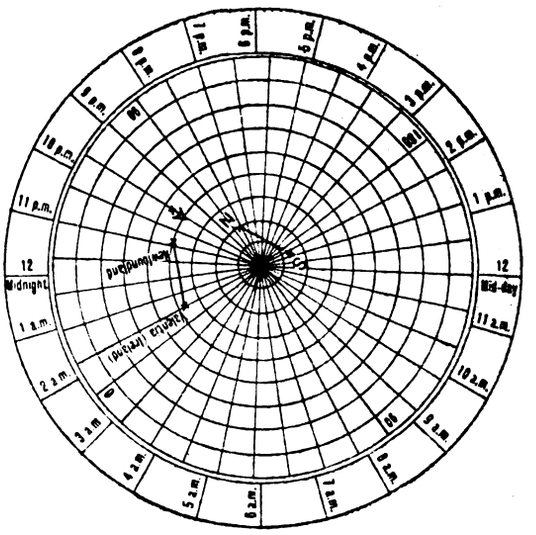

Fig. 7.

respect to the line to the sun, and in this connection it is interesting to remark that similarly with their rectangular phase at 6.32 a.m., or thereabouts, the currents are maximum negative. Turning our hemisphere again to 9.34 p.m. (fig. 7) we observe that the south magnetic pole is somewhere about its nearest position to the sun, another very striking phase.

And lastly, on bringing A round to 11.48 p.m. (fig. 8), we notice curiously enough that the north and south magnetic poles are parallel to the Solar line.

Briefly summarising these phases it may be said that :—

The maximum negative currents arise when the negative axis approximates to the rectangular position, as at about

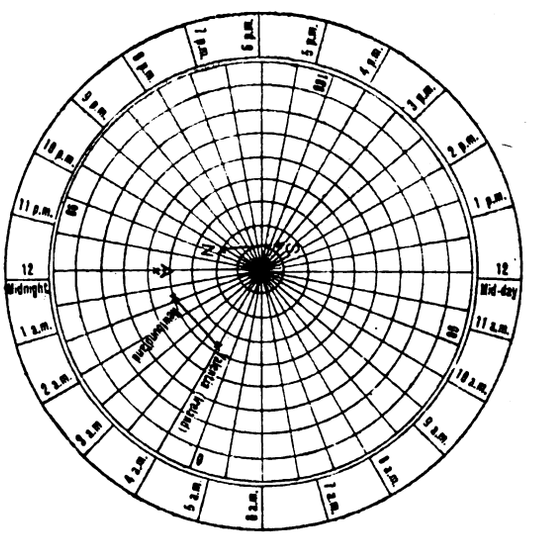

Fig. 8.

6 a.m. and 6 p.m., and the maximum positive somewhere near 12 noon and 12 midnight, when parallel to the Solar line.

The four positions when currents are zero occur when the north or south magnetic poles occupy their nearest and farthest positions in relation to the sun.

Remembering, then, that the earth's magnetic axis, which is set eccentrically to the rotation axis, must revolve around the latter, it is impossible to help being struck by the coincidence of the above-mentioned phases, and, moreover, it would seem proved that the magnetic electric relation

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between the sun and the earth is of the most intimate order. The sun would appear to be quite capable of altering the earth's magnetism whether by magnetism of its own or by its heat rays.

ALUMINIUM PATENT LITIGATION.

Our Niagara Falls correspondent informs us that it is expected that the now somewhat famous suits over the patented process for the manufacture of aluminium will be heard on appeal in United States Court for the Northern District of New York, to be held in Utica, N.Y., next October, Judge Cox presiding. The case is titled the Cleveland Electric Smelting and Aluminium Company *v.* The Pittsburg Reduction Company, and is some years old. The suit is one wherein the Pittsburg Reduction Company is sued by the Cleveland Electric Smelting and Aluminium Company for alleged infringement on two patents issued about January, 1892, to Charles S. Bradley, involving, as claimed, the process practised at Niagara Falls in the manufacture of aluminium. In all there are 10 claims attached to the papers being prepared by the Cleveland Electric Smelting and Aluminium Company in the case. The patents were applied for in February, 1883, and therefore they date back to this early date as a pioneer inventor in the electric smelting field.

The nature of the claims set up may be judged from the following paragraphs taken from the patents:—

> The process of obtaining aluminium from its ores or compounds, consisting in passing an electric current through a forced portion of the aluminium ore or compound contained in an unfused body or heap of said ore or compound.
>
> The continuous process of separating or dessicating aluminium from its ores or compounds, consisting in fusing and maintaining the fusion and electrolytically decomposing the ore or compound by the passage of the electric current therethrough, and charging the pots with fresh quantities of the ore or compound as the reduction proceeds, substantially as set forth.

It is understood that these patents were purchased by the Cowles people, who are interested in the Cleveland Electric and Smelting Company, but who were then in Lockport in 1885. After their issuance from the Patent Office in 1892, a long litigation followed between the Cowles Electric Smelting and Aluminium Company and a patent lawyer in New York, Grosvenor P. Lowry by name, who had also made a purchase of the patents from Bradley, probably under the assumption that the so-called original assignment to the Cowles people was not perfect. This suit against Lowry was decided in favour of the Cowles Company, and they began the present suit against the Pittsburg Reduction Company.

In 1891 the Cowles Company sued the Pittsburg Reduction Company, under patents covering the same ground practically as those issued to the Cowles Bros., but that suit had to be withdrawn because of the Bradley patents, bearing an earlier date of application than the Cowles patents, issuing from the patent office and assigned to Lowry, who was then the American representative of the great aluminium company at the Falls of the Rhine, in Switzerland.

Charles M. Hall, the inventor of the process now used by the Pittsburg Reduction Company, is now with that company at Niagara Falls. It is said his early experiments were carried on in the Cowles plant then in operation in Lockport, N.Y. In 1892 the Pittsburg Reduction Company sued the Cowles Company under a patent that Mr. Hall secured. On trial the United States Court in Cincinnatti construed the Hall patent very broadly, and enjoined the Cowles Company from continuing the manufacture of aluminium, since which time their plant in Lockport has been closed. This suit has not as yet reached an appeal.

The process of making aluminium consists of fusing the materials from which the aluminium is produced in a large iron tank open at the top and lined over the bottom by a heavy mass of carbon. The electricity passes into the material fused by means of a number of heavy carbon rods 3 or 4 inches in diameter, the ends of which hang down into the liquid bath. The aluminium is deposited very much the same as nickel is deposited by electrolysis, and collects as a mass of molten metal below the fused bath of aluminous material. No heat but that evolved from the electric current is used.

As the litigation is already extended, the outcome of the suits will be watched with much interest at home and abroad.

EFFICIENCIES.

One of the evil effects of published tests is the use made of the figures obtained. It is well known that under carefully conducted tests a machine, or other appliance, will produce results that cannot be obtained in every-day work. This is particularly noticeable in stoking. Under the spur of some temporary incentive a stoker will secure results very much superior to his every-day work, and he will do it without actually knowing that he is doing beyond his average. A continual incentive cannot be maintained except by financial pressure in the shape of a bonus. When a bonus can be earned, and where an addition to the weekly earnings is particularly desirable, much may be done by the use of such instruments as a water-meter or the newer econometer. We have known in a steel works where the appearance of the chemist with his apparatus at the gas producers has at once improved the gas which was being produced, simply because the attendant knew that tests would reveal the degree of attention given to the furnace. All machines, be they engines, turbines, pumps, or boilers, have certain known efficiencies. The maximum efficiency ever obtained is known to some degree of approximation, and there is a tendency to use such maximum record in designing new plant, with the result that every detail of a new plant is probably proportioned to some maximum figure which is little else than ideal. If every item in a chain of machinery were thus designed, perhaps one might reach the efficiency alloted to it, and the remainder might fall short to an amount up to 10 or 20 per cent. In electrical transmission work, between the coal heap and the motor spindle, there is a chain of seven links, viz., a boiler, a steam engine, dynamo, step-up transformer, line, step-down transformer, and motor, the maximum efficiencies of which, may, for illustration, be assumed to be 75, 90, 95, 95, 90, 95, 80. The product of these efficiencies is 41·6.

Let each of the efficiencies fall off by the small amount of 2 per cent., and the final efficiency will be 34·8, or less than 84 per cent. of the first product. In other words, if a steam engine of about 840 H.P. was originally designed, the small average reduction of 2 per cent. in the efficiency of each link in the chain would demand an engine to be employed of about 1,000 H.P. Assuming the 840 H.P. engine to have been built to work at its maximum efficiency, it will be overloaded if worked up to 1,000 H.P., and all through the chain each link will be too small for the duty placed upon it, with the result of excessive depreciation and wear. The practical designer, who knows how far below the best results are the efficiencies secured in daily work, will provide for such by assuming what we may term the efficiency of the efficiencies. In a chain of efficiencies such as given above, the mean of the seven efficiencies is 88·5 per cent. If the product of the seven efficiencies or 41·6 be multiplied by this eighth efficiency, the final product is 36·8, or not seriously greater than the number 34·8 found by assuming a slightly reduced efficiency in each element. Investigated mathematically, the variation of the different efficiencies might perhaps be determined in respect to the relative probability of each variation, and the efficiency factor might be some figure more or less than the arithmetic mean we have employed for illustration. But it is extremely improbable that the probabilities of variation from the maximum could really be established with any marked accuracy, seeing that such factors enter into the problem as the personal equation of a stoker, and the behaviour of a long line of transmission in all kinds of weather, and the experiences of practice would seem to be met by using a final multiplier derived from the average value of all the efficiencies in the chain. Probably there are not sufficient existing data from which to estimate how far actual efficiencies fall below test values. Calling the various efficiencies in the chain $e_1, e_2, \ldots e_n$, the mean efficiency suggested above is

$$\frac{e_1 + e_2 + \ldots e_n}{n} = E,$$

the efficiency of the efficiencies. Should E, as thus found, prove to be too large a number, it would probably be sufficiently corrected by a constant, becoming $E - c$, where c is such a constant as a few practical trials showed to be necessary. c would obviously be a variable constant according to the probable nature of the plant, the attention likely to be bestowed upon it, its size, and importance. The effect of such a constant, substractive from the mean of the efficiencies, would be relatively greater in the case of a short chain than in a chain of many links. This is as it should be, a chain of few links being more affected by an abnormally low efficiency in one link than would be a longer chain, and this risk the constant would tend to eliminate with greater effect in the fewer links. In any assemblage of machinery there is almost a certainty of some one item being below expectation, either from inherent fault or from misproportion, whereby it is unable to work at its most efficient rate, and it is never safe to take a series of maximum efficiencies as the probable efficiency basis for the whole plant under the idea that, while some of the items will fall below the test efficiency, others will exceed their expected efficiency. Practice does not bear this out.

Where machinery is specially devised to be at times worked at part power, as turbines at part gate, or throttled centrifugal pumps, the item efficiencies to be taken as factors in the continued products for efficiencies must not be the maximum, or test efficiency, of the turbine, for instance, at full gate, but its test efficiency at such part gate. This is especially necessary in case of hydraulic machines of which the efficiency falls off so rapidly at part gate. In trying the method suggested above upon an example recently encountered, we find that the efficiency of a combination actually obtained accords very closely with the results given by the method.

BUSINESS NOTICES, &c.

Accumulators in France.—A new company has just been formed at Clichy with a capital of £22,000 to be known as La Société Nouvelle de l'Accumulateur Fulmen.

Anglo-Swiss Trade.—A report has been prepared by the British Legation in Berne, proposing a scheme for the increase of trade between Great Britain and Switzerland. The establishment at Zürich, the commercial centre of Switzerland, of an Anglo-Swiss chamber of commerce with a depôt of samples of British goods is proposed.

Arc Lamp Coupling.—Mr. G. Braulik is placing upon the market a new coupling for arc lamps, by the use of which it is claimed that the unsightliness caused by lengths of conducting cable having to hang down is obviated. Counterweight methods are

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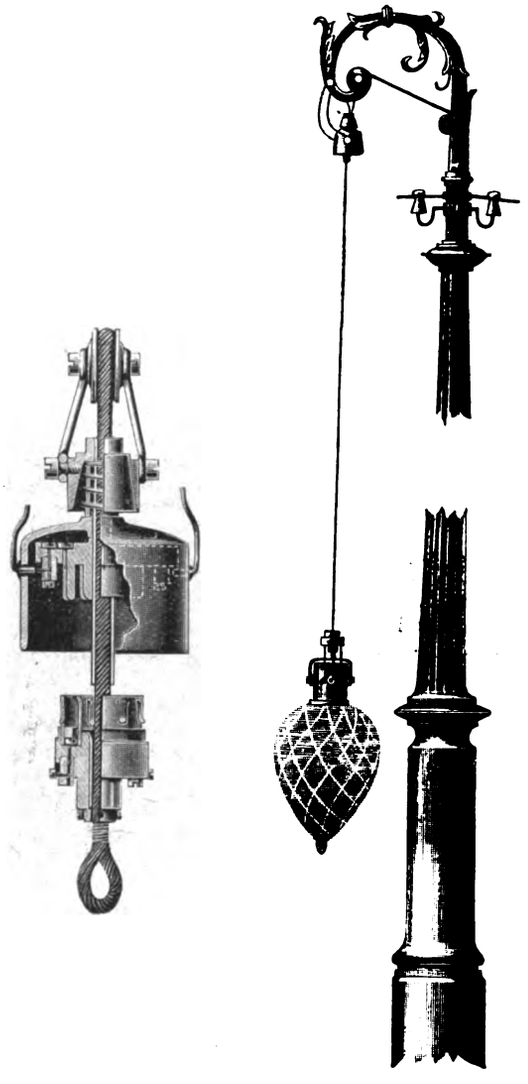
asserted to have rendered handling of the lamps a more complicated process as well as endangering the insulation of the cable. Mr. Braulik's coupling, which is shown in the illustration (fig. 1) can be fitted to existing arc lamps (fig. 2). It is said to be suitable for all installations, and to be specially adapted to high tension. It consists of two contact boxes, one fixed for fitting on the roller where the lamp is to hang, and a movable one attached to the lamp. The contact springs are so arranged that all these parts are fixed on the lower plug for easy examination when the lamp is receiving attention, while on the top part they need not be so accessible, only a solid contact ring being used. The contact parts consist of solid metal rings with springs; the rings lie concentrically one in the other, so that swinging or turning the lamp does not break contact. The conducting



tube in the top part is insulated from the lower plug, so that any moisture that may drop from the cable used for raising the lamp does not touch conducting parts. The suspending cable goes through the whole of the coupling to ensure a meeting of the two contact boxes. All current-carrying parts are well mounted and highly insulated with porcelain, and protected from the weather by a solid cap. The apparatus, when hung, is supported by a spring, and pressure does not fall on the contact springs, nor are they affected by jolting. The fitting is hung by fixing a hook on the axle of cable roller, while the lower part with screws are fixed through the terminals on to the cable. In lowering the lamp, current is switched off, as by a double-pole switch, and shock accidents are impossible.

Bankruptcy Proceedings.—Mr. Sydney F. Walker, electrical engineer, Cardiff, filed his petition in bankruptcy on Thursday last week. It is said that the liabilities will not exceed £2,000.

Liquidations, Dissolutions, &c.—The Electrical Pioneer Syndicate, Birmingham, is winding up voluntarily, Mr. A. H. Gibson, 39, Waterloo Street, Birmingham, being liquidator. Creditors must send particulars of debts, &c., to Mr. Gibson by October 31st.

Creditors of the London and Lancashire Electric and General Engineering Company must send particulars of debts, &c, to the liquidator, Mr. F. A Franklyn, 48, Upper Thames Street, by September 30th.

Catalogues, &c.—Messrs. Baxendale & Co., of Manchester, send us illustrated price lists of switch blocks, pendants, brackets and other electric lighting and ball accessories, also the "Saxon" enclosed arc lamp.

The Bullock Electric Manufacturing Co., of Cincinnati, U.S.A., sends us a pamphlet in which there are described and well illustrated the Bullock engine type of generators. The various parts, field coils armature, armature coils, yoke, and a Bullock generator direct connected to a gas engine are illustrated, and an efficiency curve of a 200 KW. machine is included. There is a table of dimensions and code words.

Electrical Engineering in Sweden.—The Swedish State Railway Authorities have placed a contract with Messrs. Siemens & Halske for the establishment and equipment of electrical power stations at Abiskojokk and Kadeyokk, near the new railway between Gellivaia and the Norwegian frontier.

Infringement of Patent.—Judgment was given some days ago by Lord Justice Romer in the case of the British Motor Syndicate, Limited, and the Great Horseless Carriage Company, Limited, v. J. E. H. Andrew & Co., Limited, which was an appeal against a decision of Mr. Justice Kekewich. According to the *Times* report the plaintiffs, as the registered proprietors of letters patent (No. 5,479 of 1890) granted to Frederick William Lanchester for "improvements in gas motor engines," brought the action to restrain the defendants from infringing the patent. Mr. Justice Kekewich held that there had been no infringement, and he dismissed the action with costs. The decision was based on the ground that the patentee had by his specification claimed only his main method of carrying out his invention, and not two subsidiary methods. The defendants had raised the other objections usual in patent cases, such as "disconformity," anticipation, and want of subject-matter. The plaintiffs appealed. Mr. Moulton, Q.C., Mr. T. Terrell, Q.C., and Mr. A. J. Walter were for the plaintiffs; Mr. Cripps, Q.C., and Mr. J. C. Graham were for the defendants. The appeal was heard in July, when the Court reserved their judgment. Last week the Court allowed the appeal. His Lordship discussed the nature of the subsidiary methods, and then proceeded to consider the points taken by the defendants. With regard to the point on which the defendants succeeded in the Court below, his Lordship said that it was too narrow a construction to be placed on the specification. The patentee in the body of the specification clearly referred to the subsidiary methods, and intended them to come within the scope of his invention. His Lordship added that the wording of the first claim covered the subsidiary methods. This objection, therefore, failed, as also did the contention founded upon it that there had been no infringement by the defendants, because in their machine the flame does not strike back in the precise way covered by the patentee's main method. His Lordship then discussed other objections taken by the defendants, all of which he overruled, and concluded that the plaintiffs are entitled to succeed. He granted an injunction restraining the defendants from further infringing the plaintiffs' patent, and ordered an inquiry as to damages. The plaintiffs were granted their costs here and in the Court below, including the costs of the particulars of breaches.

Recent Motor Wagon Trials at Liverpool.—It may be noted as a fact of some importance that the second series of trials of heavy traffic vehicles held at Liverpool early in August, included no vehicles except such as were steam-driven either by oil or coke fuel. It appears that the winner in the first series of tests in May, 1898, namely, the Leyland vehicle, only received a silver medal this year, the winning vehicle being in both classes a Thorneycroft vehicle from Chiswick. Progress has evidently been made, for the trials this year not only included the same routes of 30 miles each as the trials of last year, but also some special hill climbing and descending trials, comprising gradients as steep as 1 in 9 upon very rough paving. The larger Thorneycroft wagon is said to have done specially fine work with a full load of 6½ tons carried up and down hill on a rutted road. On the long distance runs also the Thorneycroft vehicles did well, averaging 5 miles per hour. It appears to us that the motor vehicle industry is now fairly established, and that very soon considerable numbers of vehicles will be seen at work. We also anticipate a considerable crop of very serious accidents. Without a horse in front to push a person out of the way, these heavy motor vehicles have their leading wheels well thrust out in front and absolutely devoid of safeguards of any sort. To be run over by a heavy motor car will be as bad as to be run over by an electric tramcar, yet the latter are compelled to provide safeguards and the former have absolutely nothing, and come quietly upon a foot passenger from unexpected quarters and in diagonal directions, whereas an electric car does run on a recognised track. The motor van, or vans, of Messrs. W. H. Smith & Son are particularly noticeable in London as presenting the dangerous appearance above noted, in conjunction, we may add, with not too careful driving. We certainly think wheel guards should be provided by compulsion. It would be easy to do this, and the absence of such guards will cause accidents that may give another set back to the motor-car industry, accidents which, in the mind of any sensible juryman would, we hope, exercise a salutary effect on the "damages," while a coroner's jury, in our opinion, would rightly give its verdict in a fatal accident as one of manslaughter against those responsible for the deficiency.

Water Level Indicators.—Messrs. John Hopkinson and Co., Limited, of Huddersfield, have recently published a treatise on the "Indication of Water Levels in Steam Boilers," having special reference to water gauges fitted with automatic valves. The liability of gauges to indicate false water levels is pointed out, and Hopkinson's patent "Absolute" water gauge is suggested as a means for preventing this. This gauge is described and beautifully illustrated in the list before us. A serious form of accident which may arise where gauge plugs are blown from the body of the gauge is mentioned, together with a suggested remedy against accidents arising from this cause. After 27 pages of matter of this description, which is accompanied with several sketches, a list of prices of the various sizes and patterns of water gauges is given.

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Electrical Wares Exported.

Week ending Aug. 23rd, 1898.		Week ending Aug. 22nd, 1899.	
Albany	Value £16	Amsterdam	Value £20
Amsterdam	115	Auckland	75
Bangkok	20	Beira	1,377
Boca	37	Bombay	69
Buenos Ayres	193	Boulogne	25
Calcutta	121	Buenos Ayres	2,307
Cape Town	144	" Teleg. mat.	155
Chinde	941	Cadiz. Elec. machinery	240
Christiansande	16	Calcutta	75
Copenhagen	65	Christchurch	12
Durban	58	Colombo	498
East London	85	Delago Bay	59
Fremantle	96	Durban	710
Gibraltar	600	Fremantle	105
Hamburg	380	Grenada	213
Launceston	7	Havana	20
Malta. Teleg. cable	120,000	Hiogo. Teleg. mat.	118
Melbourne	588	Liban	93
Ostend	176	Malta	10
Perth. Teleg. cable	664	Melbourne	60
Port Elizabeth	1,517	" Teleg. mat.	2,193
Rangoon	86	Odessa	15
Stockholm. Teleg. wire	125	Ostend	148
		Penang	15
		Port Elizabeth	142
		" Teleg. wire	483
		Rio Janeiro. Teleg. mat.	1,424
		Rotterdam	20
		San Sebastian	35
		Santos	20
		Singapore	107
		Stockholm. Teleg. wire	161
		Sydney	1,548
		Wellington	46
		Yokohama. Teleph. cable	95
Total	£125,940	Total	£12,698

Foreign Goods Transhipped.

Melbourne .. .. .. Value £89 | Calcutta. Elec. supplies.. Value £64

Orders Revoked.—The Board of Trade have given notice that they have revoked the Waterford Electric Lighting Order, 1892, and the Kilkenny Electric Lighting Order, 1892.

Testing Batteries.—Messrs. Niblett & Sutherland, of Chandos Street, W.C., have recently introduced some new forms of portable storage testing batteries. A battery giving 500 volts was recently supplied to the Liverpool Corporation Tramways. A smaller set is the ordinary pattern testing battery which gives 100 volts. It is considered that to those who are accustomed to the ordinary forms of testing batteries the size and weight will come as a revelation. As an illustration of the current-giving capacity of the batteries, the 500-volt battery mentioned was tested and ran five 100-volt 16-c.p. lamps placed in series, fully incandescing them for some considerable time. The total weight of the battery in question is only 50 lbs, and it is quite portable and can be handled with ease. For convenience of recharging, every battery of this type is divided into two sections, and is so arranged that these two sections can be placed in parallel or in series by means of an ingenious switching device with which it is fitted. In the construction of these batteries no soldered or burnt lead connections are used between cell and cell, so that trouble from defective connections is entirely obviated, and as a mechanically solid disphragm is used as a separator, internal short circuits are prevented. The internal resistance is so small that, as has been previously stated, an 8 or even a 16-c.p. lamp can be run from them, thus rendering the batteries useful for making continuity tests as well as the usual insulation tests. The 100-volt battery only weighs 14 lbs., and when the two sections of the battery are placed in parallel it can readily be recharged through, say, an 8-c.p. lamp on a 100-volt circuit. It is obvious that anyone about to use this battery for a test would naturally insure its being full by previously giving it a recharge, but the local action in the cells is so small that the batteries have been known to hold their charge and give their full potential after standing idle for over a month. Messrs. Niblett & Sutherland have supplied quite a number of these batteries, ranging in voltage from 100 to 500 volts, to various corporations and central stations. Among these may be mentioned the Charing Cross and Strand Supply Company, the British Electric Traction Company, the British Insulated Wire Company, the Belfast Corporation, &c.

Tests of Electric Light Engines.—From copies of tests made at Morley, by Mr. Hammond, upon some non-condensing engines of Pollitt & Wigzell's make, and at Bath upon the same firm's condensing engines, in each case fly-wheel alternators being driven, we find the following results:—The non-condensing sets are 125 kw., with horizontal engines having high-pressure cylinders, 14 inches; low-pressure, 23½ inches; stroke, 30; speed, 100; pressure, 130 lbs. The cylinders are side by side with fly-wheel alternator between, Corliss valves with trip gear. The alternators generate at 2,000 to 2,200 volts, and are 13 feet diameter over poles, and weigh 10 tons. The efficiency is 82 per cent. The steam consumption was 35½ lbs. per kw.-hour average of the two sets. The running was perfectly steady without vibration, and the governing good. At Bath, the engines are vertical, with cylinders 17 inches and 34 inches by 30 inches stroke at 124 revolutions with 150 lbs. pressure, these also have Corliss valves with trip gear. The fly-wheel alternator is 15½ feet diameter over poles, and weighs 12 tons. The efficiency is 82 per cent., as at Morley, for the combined plant. The boilers are water-tube type. Water was measured in a tank, and showed 24 lbs. per kw.-hour for one set, and somewhat less for the other set, the i.h.p. averaging 480, and the steam per i.h.p.-hr. 14·45 lbs. The results of all these English engines are very good, better, we think, than are obtained with most of the foreign made engines so far sent to England. But we must not despise the foreign made engine. It has kept us going in England when our own makers have been too busy—too saucy, a steam user puts it—to give any attention to the would-be purchaser. Patriotism is a good virtue, but it is apt to wear thin when asked to wait a year for a small steam engine.

Trade Announcements.—Mr. Carl Quiltmann, electrical importer, has removed from 17, Jewin Crescent, E.C., to 3, Cloth Street, Aldersgate Street, E.C.

Messrs. Wm. Coates & Son, Limited, have opened premises at 5, Leinster Street, Dublin, as electrical engineers, contractors, &c., and have appointed Mr. Martin Olsson, A.M.I.E.E., resident engineer.

The "Vril" Launch.—On the occasion of the Prince of Wales's recent visit to Cowes, H.R.H. having heard of the merits of the "Vril" launch as supplied by Messrs. Laing, Wharton & Down, Limited, issued instructions for one of these boats to be submitted for his inspection. The launch, which was 28 feet in length, was sent to the Royal yacht *Osborne*, and the Prince then gave orders that it should cruise towards the *Meteor*, whither the Prince went in his steam launch, accompanied by the Duke of York, Admiral Stevenson, and Capt. Fortescue. The party then inspected the performance of the boat from the deck of the *Meteor*, and the Prince was so pleased with it, that he afterwards, together with the others, boarded the boat, and went for a cruise round the fleet. Subsequently the chief engineer of the *Osborne*, Mr. Babb, went on board the boat, and made some suggestions which will doubtless prove of considerable value. The Royal party afterwards expressed great pleasure at the trip.

Water-tube Boilers.—We understand that the patent rights outside the United States for the Morrin "Climax" water-tube boilers have been acquired by Messrs. B. R. Rowland & Co., of Exchange Street, Manchester, which firm is now manufacturing the "Climax" boiler in this country. It may be mentioned that seven of these boilers of 500-h.p. and two of 600-h.p. are used at the works of the People's Light and Power Company, New Jersey.

ELECTRIC LIGHTING NOTES.

Aberdeen.—The Harbour has been equipped with 60 arc lamps on posts 25 feet high and 40 yards apart, arranged on two circuits, as well as with three beacon lights, each consisting of four arcs on a post 80 feet high. The lamps and posts were supplied and erected by Messrs. Lucy & Co., Oxford, at a contract price of £2,110; the mains have been laid by the Corporation at a cost of £5,000. The annual cost is estimated at £1,700. It is expected that the supply will be begun in a few days.

Banbury.—The Council has referred to the General Purposes Committee a recommendation made by another Committee that the town clerk take steps to obtain a provisional order for electric lighting.

Barnstaple.—The Town Council has resolved to apply to the Board of Trade for a provisional order for electric lighting.

Bermondsey.—The Vestry clerk has issued a circular pointing out that the Vestry has obtained an Act of Parliament authorising the Vestry to supply electrical energy; the system decided upon is low tension continuous current.

Bridgend.—The intention of the Council to transfer its provisional order to the English Industrials, Limited, is filed in the usual way in the *London Gazette* for August 18th.

Brighton.—The Local Government Board has given its sanction to the loan of £64,000 for 24 years for purposes of electric lighting.

Chadderton.—The District Council is considering the question of obtaining powers for the electric lighting of the district.

Cleckheaton.—The District Council is taking steps towards obtaining a provisional order for electric lighting.

Colchester.—An inquiry was held on August 16th by Mr. E. S. Fawcett, for the Local Government Board, into the application of the Corporation for leave to borrow £6,500 for electric lighting; this is in addition to a loan of £14,900, sanctioned in February, 1897. The present plant is capable of supplying 4,250 8-c.p. lamps; the new machinery is to consist of a 350-h.p. engine, coupled to a Siemens dynamo.

Dewsbury.—At a meeting of the General Committee of the Co-operative Society last week, it was resolved that on account of the heavy charges for the supply of electricity by the Dewsbury Corporation, the time had arrived to put down a plant for the purpose of generating electricity on the premises. The society's electric lighting bill at the Central Stores for the year ending June last was no less a sum than £508! The society has at present about 1,100 lights at the Central Stores.

(*Continued on page* 321.)

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WEST HAM ELECTRICITY WORKS.

The question of electric lighting in West Ham first assumed practical importance early in 1896; Mr. G. H. C. Risch was appointed electrical engineer by the Corporation, and prepared a scheme to cost £67,000. Mr. Risch, however, was obliged to resign his post six months later on account of ill-health, and Mr. J. J. Steinitz, then at Leicester, was appointed in his place. A new scheme was drawn up by Mr. Steinitz, and after a Local Government Board inquiry in November, 1896, a loan of £50,000 was authorised. Before the completion of the works further loans of about £14,400 were also sanctioned, for the lighting of public buildings and other purposes.

Supply was begun on December 10th, 1898, but it was immediately found that extensions were necessary, and a further expenditure of £51,000 was decided on. It was in connection with the contracts for these extensions that a difficulty occurred, which aroused the interest of the whole industry. The Corporation insisted on the insertion in the contracts of a so-called "fair wages" clause, which was, to use a Hibernicism, more fair to the workmen than to the employers; the contractors, Messrs. S. Z. de Ferranti, Limited, refused to accept these conditions, which constituted a subversion of the settlement arrived at as the result of the engineers' strike, and after a stiff fight Messrs. Ferranti gained their end. The present capacity of the plant is 700 KW., but so bright are the prospects of the undertaking, that two additional steam alternators of 2,400 KW. joint capacity were put in hand, and the sum of £29,000 was voted for extensions to the mains.

The generating station is situated close by the Abbey Mills pumping station, one mile from the Stratford division of the borough and two miles from the Canning Town district. The station was built by Messrs. Gregar & Sons, Stratford, under the supervision of Mr. J. G. Morley, deputy borough engineer, and includes, in addition to the electrical works, a large pumping station in connection with the sewerage system.

The electricity works comprises a dynamo and engine room, pump room, workshop, various offices and storerooms, drawing office (also used as testing room), and a share in the boiler house, which is common to the pumping and electricity departments. A neat telephone switchboard provides ready means of communication between the works and various Corporation offices in the borough.

The boiler house, 129 feet by 47 feet, contains at present nine Lancashire boilers, made by Messrs. Spurr, Inman and Co., Limited, of Wakefield, working at a pressure of 120 lbs. per square inch. Each boiler is 30 feet long, by 7 feet 6 inches in diameter, and is capable of evaporating 10,000 lbs. of water per hour. The boilers are fitted with automatic stokers made by Messrs. Bennis & Co., Limited, Bolton. These are fed by their patent chain conveyor and an elevator, which raises the coal from the coal stores through a height of about 60 feet. The coal is scattered by the stoker over the whole surface of the grate. The latter is of Messrs. Bennis's new compressed air type, in which air is blown into each bar with great force, ensuring perfect and smokeless combustion. The makers claim that by this means the nine boilers are enabled to do the work of 16 hand-fired boilers, while two men are able to attend to the whole range.

A Green's economiser, consisting of 384 tubes 4 inches in diameter by 9 feet long, is fitted in the main flue, with the usual bye-pass. The shaft is 150 feet high, 8 feet diameter inside, lined with firebrick to a height of 56 feet, and is much more handsome, or, rather, less unsightly, than such structures usually are.

As will be seen in our illustration of the boiler house, the conveyors are not quite complete. This explains the presence of the coal heaps. In future the coal, which is brought up the Channelsea River in barges, will be delivered direct into the underground coal stores by a steam crane on the wharf.

In addition to the boilers described above, the foundations are laid for three water-tube boilers, each capable of evaporating 15,000 lbs. of water per hour, which Messrs. Babcock & Wilcox, Limited, have in hand. These will be fitted with their patent chain grate stokers and superheaters. The same company, which supplied the whole of the steam and feed piping already installed, has also on order three of its patent purifiers; two sets of surface condensing plant of Messrs. W. H. Allen, Son & Co.'s manufacture, capable of dealing with 20,000 lbs. of steam per hour; two Weir feed pumps, and the necessary steam, exhaust, and feed pipes. There are at present in use two feed pumps of Messrs. G. and J. Weir's standard type which draw from a feed water tank, 4 feet by 6 feet by 22 feet, in the pump room, through coke filters, and deliver to the boilers through another filter under pressure. The pumps are of the vertical double acting type; the dimensions are 7 inches diameter, 18 inches stroke, and they are capable of discharging against a pressure of 180 lbs. per square inch. As the East London water is hard, an Artesian well has been sunk to a depth of 450 feet, and is now being tubed; an ample supply of water for condensing is obtained from the canal close by.

The pump room contains, in addition to the feed water tank, one of Messrs. W. H. Allen's surface condensers of the marine type, having a tube surface of 1,000 square feet, and capable of condensing 12,000 lbs. of steam per hour. The air and circulating pumps are built up with the condenser, as will be seen in our illustration of the set. The air pump is single acting, 16 inches diameter by 8 inches stroke; the circulating pump is double acting, 12½ inches diameter by 8 inches stroke. India-rubber valves are used. The pumps are driven by a vertical compound engine, 9 and 14 inches by 8 inches stroke, running at 120 revolutions per minute, with fly-wheel.

The steam pipes are of mild steel, duplicated as far as the engine room but single to the engines, and are fixed with the exhaust pipes beneath the floor of the engine room, which is of York stone carried on steel joists, and cellared 8 feet deep; by this means the pipes, steam traps, &c., are kept out of sight, while the electrical connections and the lower portions of the alternators are readily accessible. The steam traps are of the Geipel type, one to each set, and the separators by Messrs. Holden & Brooke, of Manchester.

The engine room is 82 feet long by 42 feet wide, and contains ample room for the additional machinery which is on order.

The generating plant consists of one 100-KW. and three 200-KW. steam alternators, made by Messrs. Ferranti, Limited; our bird's eye view shows the general arrangement of the plant, which is very compact, while another illustration includes the front view of one set and the back view of another. The engines are compound, with cranks at right angles, and are fitted with Ferranti's patent valve gear, with separate balanced steam and exhaust valves; the high pressure valve is controlled by the governor, while the low pressure cut-off can be varied by hand while the engine is running. The receiver, which forms the connection between the cylinders, is provided with a superheater fed with live steam; means are also provided for admitting live steam to the low pressure cylinder for starting. Forced lubrication is employed throughout, and the governor is provided with a separate oil pump; there is also an auxiliary oil pump, which may be worked by hand. The oil is circulated through a filter, which is seen in the illustration standing on the ground near each engine. Outside the main bearing, next the alternator, a roller bearing is fixed, the upward pressure of which is adjustable by means of coiled springs, to assist the main bearing; this fitting may also be used to lift the shaft and armature clear of the main bearing, should it be desired to remove the latter.

The alternators, which work at 2,100 volts, 250 revolutions per minute, are of the usual Ferranti air core type, the coils being mounted on porcelain insulators round the circumference of a fly-wheel about 6 feet in diameter, and weighing 9 or 10 tons. They run quite silently, and work perfectly in parallel, while they are able to withstand a heavy overload without overheating or any other injurious effects being met with. The two opposing sets of field magnets can be drawn back simultaneously by a right and left-hand screw at each end, the whole operation being performed by means of chain and worm gearing from one point. One terminal of the armature is connected with an insulated slip ring; the other is earthed to the frame, and the connection made by brushes bearing on the internal periphery of the fly-wheel. The exciters are of Messrs. Thos. Parker's hinged-pole type, with Eickemeyer windings, and are driven by ropes from the alternator shafts.

The switchboard is of Messrs. Ferranti's standard pattern,

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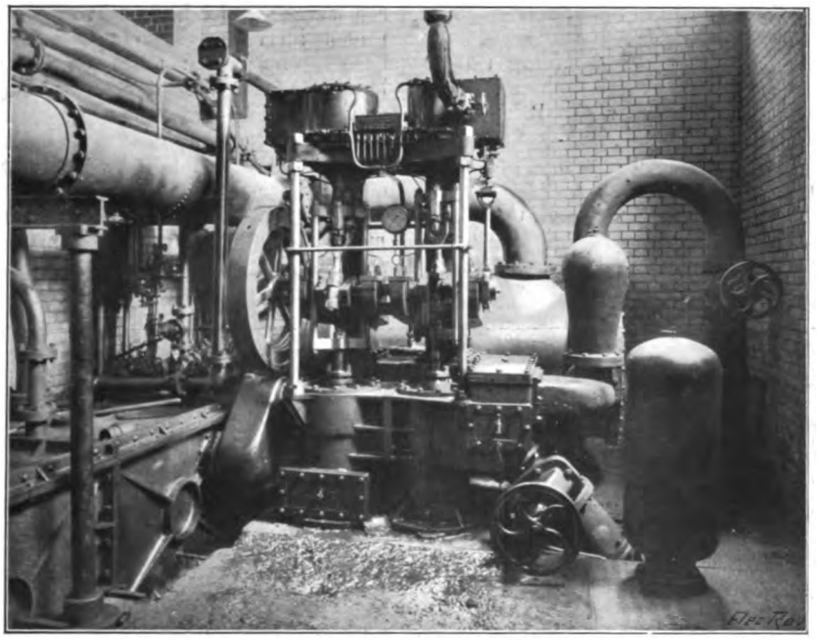
and is at present arranged for four alternators and four feeders, two to Stratford and two to Canning Town. All the switches are in series with the inner conductor of the concentric cables, the outer being earthed. There are two Kelvin voltmeters, made by Messrs. White, of Glasgow, reading from 1,900 to 2,200 volts, and a Hartmann and Braun hot-wire voltmeter with open scale at 100 volts. A synchronising transformer is fixed over the switchboard. The ammeters are of Messrs. Ferranti's edgewise type, with ranges varying from 50 to 150 amperes. The exciting current is controlled by Siemens regulators, with Nalder ammeters. The small space occupied by the switchboard is well seen in our general view. A Thomson-Houston watt-hour meter is placed in series with each feeder.

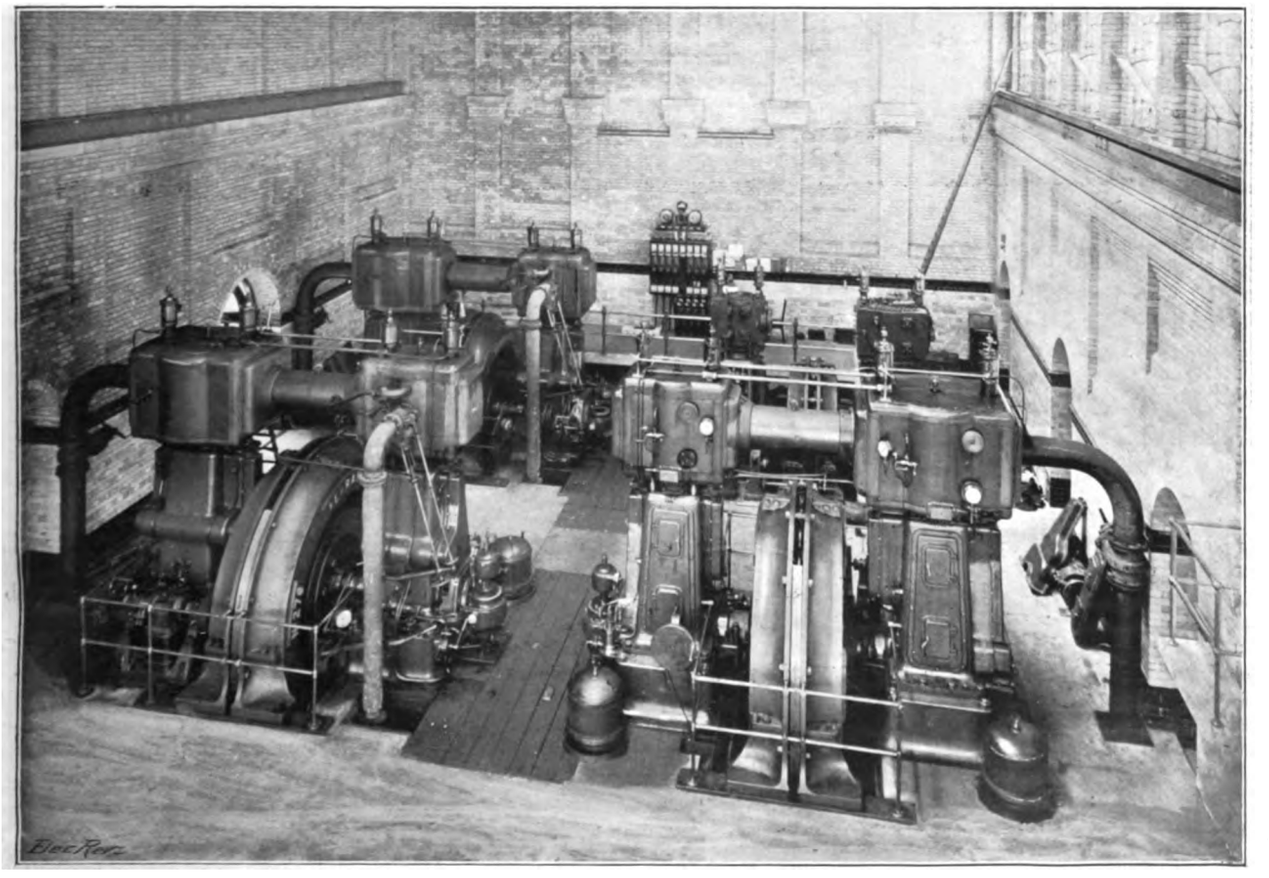


West Ham.—Condenser and Pumps.

A 10-ton travelling crane, made by Messrs. Taylor and Hubbard, of Leicester, traverses the whole length of the dynamo room.

Extreme care has been taken in the design of the sub-stations to ensure safety to the operators; the high pressure chamber is separate from the low pressure, and no one is allowed admission to the former except in the presence of the chief engineer or the foreman of mains.

The principal sub-station is in the basement of the Stratford Town Hall, and contains at present two 30-KW. transformers; two more are to be added shortly. There are two main feeders direct from the works to the sub-station; any transformer can be switched on either of these. A maximum demand indicator is placed in circuit with each transformer, and a Pitkin recording voltmeter is connected between the low pressure bus bars. The high pressure switchboard provides for five feeders to street transformer boxes, which can be switched on either of the main feeders; a Nalder ammeter is in series with each feeder. Two of these feeders run to the Empire Theatre, where 2,000 lamps are installed.



West Ham.—General View of Generating Plant, from Crane.

The distributing system is carried out by means of sub-stations and street transformer boxes; the whole of the latter, and the switching gear in the sub-stations, were made by the Brush Electrical Engineering Company, Limited. All the conductors in the sub-station are painted, the inners red and the outers black, to distinguish them from one another.

The arc lighting switchboard is so arranged that it can

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be operated from the low pressure chamber, by means of insulated handles passing through the wall; there are six arc circuits, feeding about 60 lamps in all. A Shallenberger meter is placed in each circuit.

The sub-station at the Public Hall, Canning Town, is generally similar to the one described above, but has only four arc circuits, feeding 30 lamps. There are three other sub-stations, which are supplied from the principal ones, and 15 street boxes of the Brush patent type, containing transformers of 15 to 30 KW.

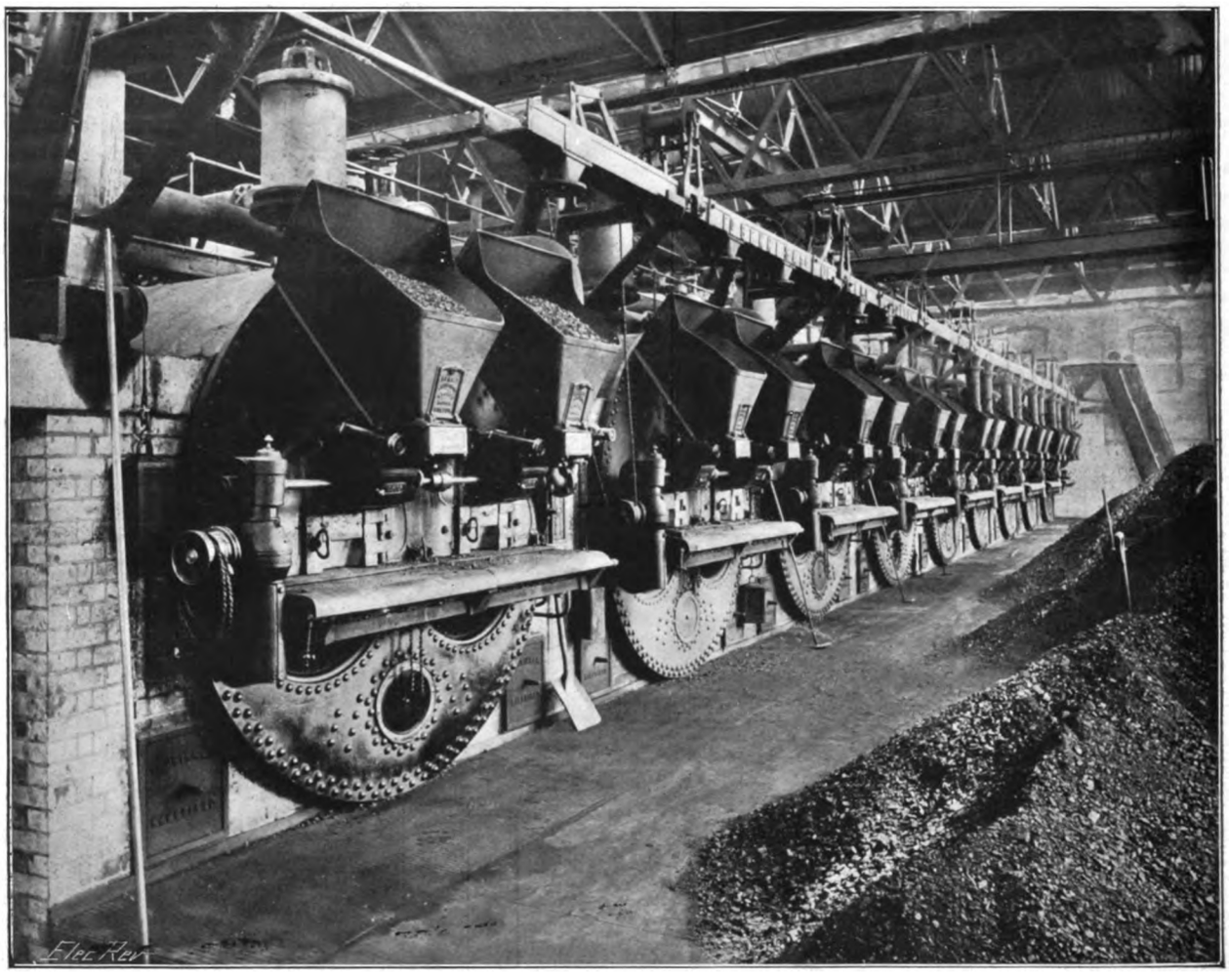
The whole of the cables were made by the British Insulated Wire Company, and are concentric, lead-covered and armoured. Both high and low pressure mains are laid direct in the ground in the same trench; to distinguish them, a copper wire is laid up with the armour of the high pressure cables. The main feeders to Stratford are 0·15 square inch, and to Canning Town 0·047 square inch. The low pressure distributors are mostly 0·15 square inch, the largest being 0·2 square inch.

For public lighting there are at present 88 arcs of the Thomson-Houston enclosed type, supplied by Messrs. Drake and Gorham, run in parallel across the high pressure mains, with a transformer in each post reducing the pressure from 2,000 to 83 volts. The number is to be increased by 100 lamps.

The low pressure supply is carried out on the two-wire system at 100 volts.

The charges for lighting are based on the Wright system, and are as follows:—For lighting, 7d. per unit for the first hour, and 3d. afterwards; for power, 5d. per unit for the first hour and 2d. afterwards. Thomson-Houston and Chamberlain & Hookham meters are used to measure the supply.

It seems to us to be a matter for regret that no attempt was made, so far as we are aware, to work the Corporation pumping machinery in conjunction with the electricity supply. It is commonplace nowadays to dwell on the advantages of a steady load; nevertheless, we rarely see a scheme laid out with a view to profiting by those advantages. Electricity supply for lighting purposes gives a daily load curve showing an extremely wide variation, which cannot be controlled. Pumping, however, is under the direct control of the engineers in charge, and by the addition of a reservoir it should be possible to regulate the load, so as to obtain, with the electricity load, a practically constant output. In the present instance the two departments are supplied, indeed, by the same boilers, but there is no provision to prevent overlapping of the loads. Single-phase synchronous motors to drive the pumps would have given perfect satisfaction, being under the direct supervision of the engineers; but, for that matter, there would have been no difficulty in the way of using two-phase alternators and motors, with benefit not only to the works, but to the power consumers also. There *may* have been insuperable difficulties in the way of such a scheme in this case, but we doubt it. As a case in point, we may cite the Bedford electricity works, where very similar conditions were met with; the sewage pumps are driven by alternate current motors, with the result that a considerable day load has been obtained.



West Ham.—Range of Lancashire Boilers.

In conclusion, we tender our thanks to Mr. Steinitz, who, we may add, has recently accepted the post of engineer to the Electrical Power Distributing Company; to Mr. J. K. Bock, the present borough electrical engineer, and the various contractors, for their assistance in the preparation of this article.

The British Association.—Wireless telegraphy will naturally be much in evidence at Dover during the meeting of the British Association. It is stated that, previous to his departure for America, Mr. Marconi will make all necessary arrangements for the demonstrations, which will be under the control of Prof. J. A. Fleming.

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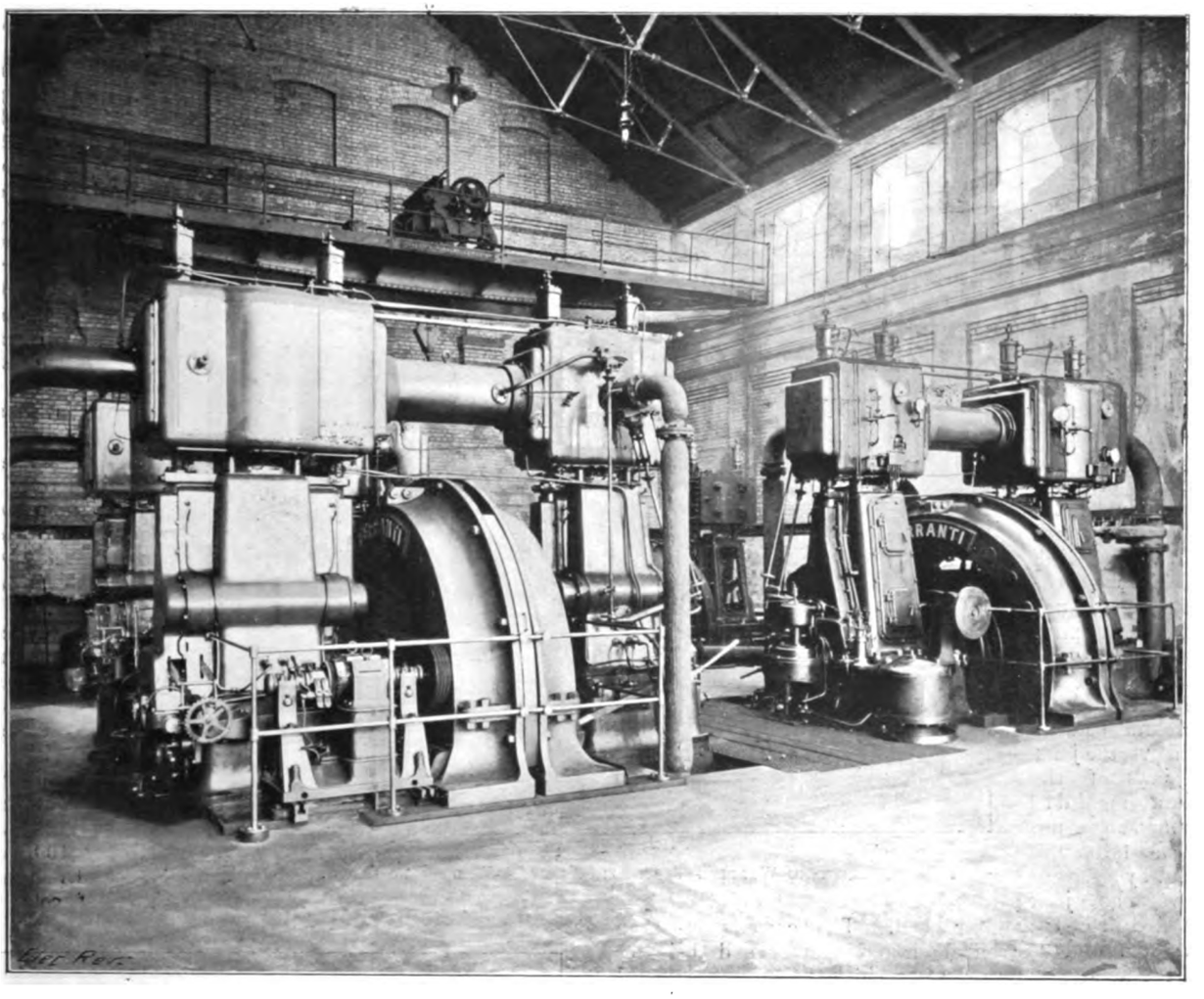
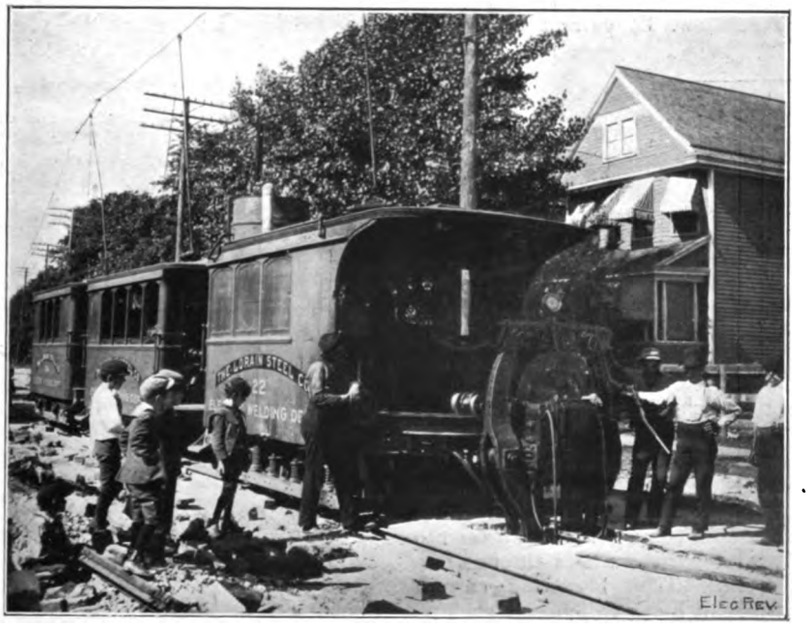


West Ham—View of Steam Alternators.

ELECTRIC WELDING TRAM-RAIL JOINTS.

[FROM OUR NIAGARA FALLS CORRESPONDENT.]

The Lorain Steel Company, of Lorain, Ohio, have one of their welding plants in operation in the city of Buffalo, where this year about 50 miles of track of the International Traction Company is to be welded. Of this length of track fully 25 miles will be of 60 feet 9 inches rails, with the ends left blank for the style of joint adopted. The Lorain Steel Company has succeeded to the business of the Johnson Company, and at present it has three plants in operation in as many cities in the United States. The process of rail welding has, it is felt, been perfected after years of experiment, and the results that are obtained are seemingly all that can be desired. As to the cost, it may be said that for the popular 9-inch girder rails, now so universally used, it is less than for any other style of so-called welded joint, while as a bond it is said to be the solution of the problem of electrolysis. In Buffalo the bar that is used for welding is 1 × 3 × 18 inches, and this joining of steel to steel, and the increased carrying capacity owing to the bars at the joints, results in the joint being the place of least resistance. The claim is made that a track electrically welded is of lower resistance than a rail itself.



Electric Welding Tram-Rail Joints.—Machinery Cars.

The plant in operation in Buffalo consists of five cars. One of these is the sand blast car which runs in advance of the welding car, and prepares the joint. The other cars are the welding car, the transformer car, the motor and booster car, and a car that follows in the rear to smooth any rough places about the joint. In the adjoining illustration a train of three cars is shown, and these are moved along by power taken from the trolley service. The first car carries the welding apparatus, the car following has a transformer, and the rear car carries the booster and motor. The booster car weighs 34,000 lbs. A voltage of 500 is necessary for the

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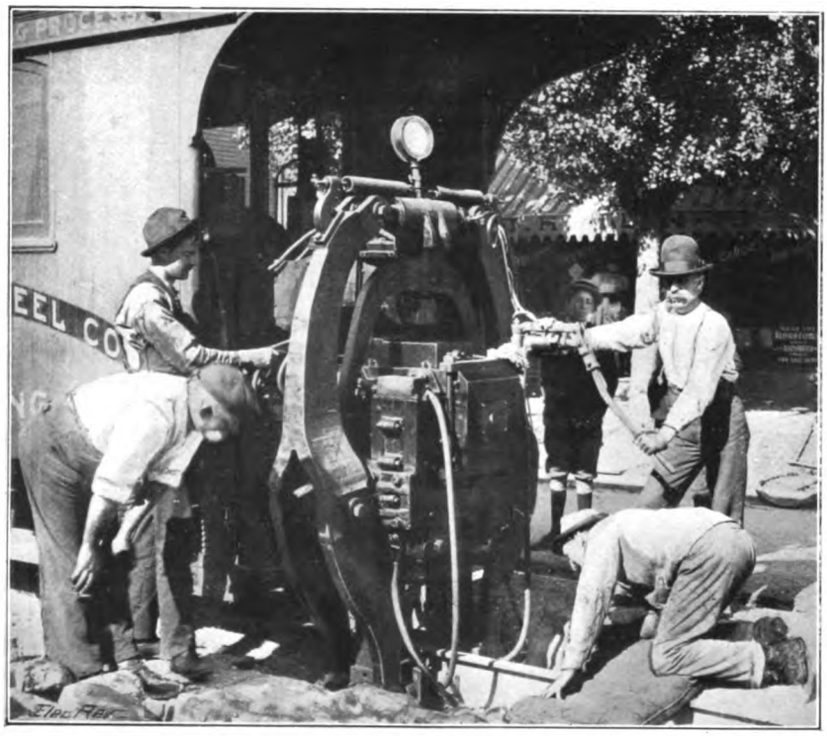
rotary transformer and apparatus. About 15 minutes are required to weld a joint, but the current is not in use all this time. In Buffalo the work of welding progressed night and day, there being no disturbance to residents of the street.

In streets where new track is laid the welding can be done before the pavement has been put down, or on old tracks, openings 17 by about 21 inches can be made in the pavement about the joint so that the welder can work. In other cases the pavement may be laid and openings of this size left until the welding machine has been applied. While at work the train attracts much attention, its operation and the results obtained being remarkable. After the welding bars are placed over the joint the jaws of the welder are applied to them, and a pressure of about 1,400 lbs. applied by means of a hydraulic jack connected to the upper end. The current is then turned on, and the metal heats brighter and brighter until the weld is completed, after which the current is turned off and the pressure increased to about 35 tons. While under this pressure the weld is allowed to cool, after which the car is moved back about 6 inches and the jaws applied to the other end of the bar, where the process is repeated. The other end is treated in the same manner. In other words the centre weld is made first and then the end welds. Artificial means of cooling are used, and as the bars cool they exert a powerful influence in bringing the rail ends close, so as to make a tight joint.



Electric Welding Tram-rail Joints.—Welder in Place.

The current for the operation of the plant is taken from the regular trolley wire service, and its application is well portrayed in the diagram given below. The current comes down

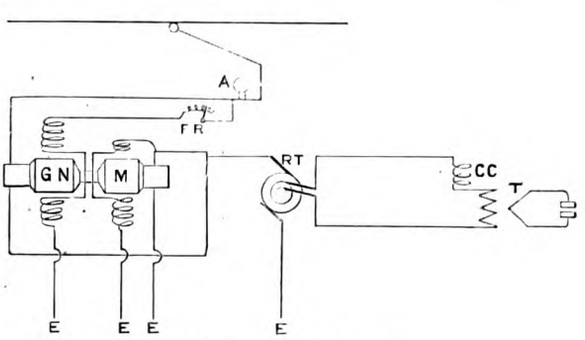
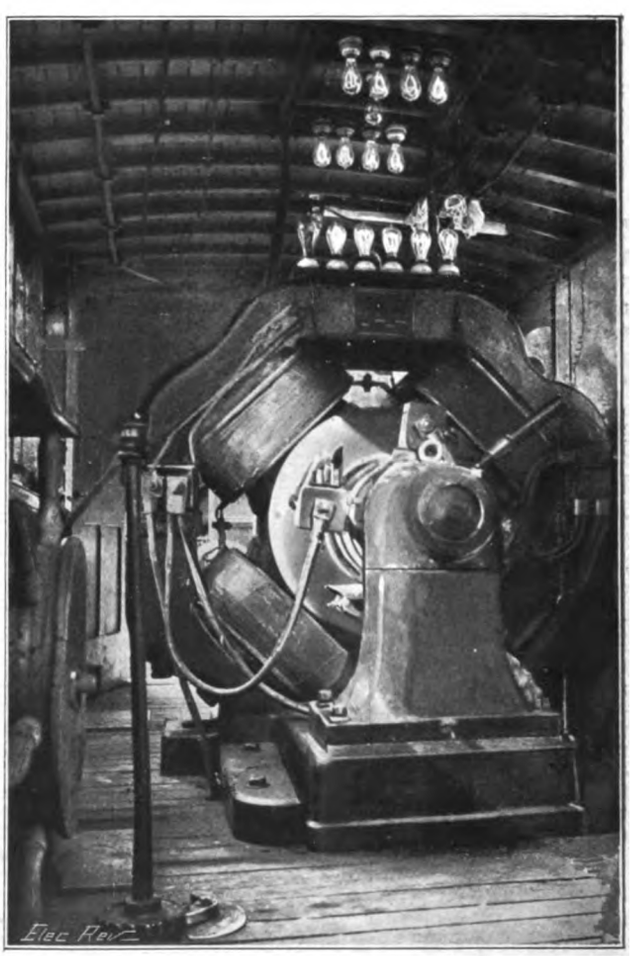


Diagram of Connections.

the trolley through the ammeter, A, and thence through a circuit breaker, which is not shown. It passes through the armature, G N, of generator end of booster, and then by one path through the armature and field of motor end of booster to earth. By the other path the current passes through the rotary transformer to earth. The alternating current from the rotary is led through a break switch and choking coil C, C, to the stationary transformer, T, between the welder jaws, the secondary of which consists, as shown, of one turn of copper. The terminals of the secondary are the clamps that grip the weld. In the diagram, F R represents a rheostat in the field circuit of the generator end of booster, by means of which it can be made to boost any amount desired to compensate for drop in the line voltage.

In reviewing this process one is naturally led to ask if heat will cause the rail to buckle, or cold cause the rail or weld to snap, but all these difficulties are overcome by the simple expedient of applying the immense pressure to the material during welding, therefore the length of a continuous rail made by this process is said to have no limit except that of the line itself. In summer, whatever expansion of the rail takes place is said to occur in the size, an effect not visible to the eye, but which, it is said, can be detected by careful measurements. In support of this claim as to the effect of cold in contracting the rails, it is said that given a continuous rail 10 miles long and one 100 yards long, under an equal degree of cold and



Electric Welding Tram-rail Joints.—Generator.

surrounded by the same paving, the contraction at the ends of the rails will be practically the same in inches.

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By way of explanation it may be stated that the bars with which the welds are made have three bosses, this having been found preferable to a flat bar. Thus the boss is the only portion that comes in contact with the rail, and all the heat is concentrated at that point. It has been stated that artificial means are provided for cooling while under pressure, and at this time the comparatively colder portions of the bar about the boss serve to prevent the softer metal from spreading. As the pressure confines it there is practically no opportunity for coarse crystallization, and the effect obtained is identical with that of hammering the steel.

The Lorain Steel Company gives due credit to Mr. A. J. Moxham for the perseverance that has led to the triumph and success of the welding process.

ELECTRIC LIGHTING NOTES.

(*Continued from page* 315.)

Dingwall.—At the last Council meeting it was stated that with reference to the electric lighting of the burgh, the Council had signed an arrangement with Mr. Yorke, electrical engineer, binding the Council for 12 months not to entertain any other scheme. The 12 months were now up, and he asked what was to be done. The delay was caused by the fact that the Countess of Cromartie, not having attained her majority, was not in a position to grant water to them in perpetuity. The Countess being now of age, the Council could get on with the scheme.

Dumfries.—The Provisional Order Bill has received the Royal assent, and the Town Council is now in a position to proceed with the installation. Copies of the Act are being prepared for the use of councillors.

Eastbourne.—The electric lighting works are to be taken over by the Corporation on January 1st, and a resident engineer appointed at a salary of £300 a year. He will be required to devote the whole of his time to the duties of his office. Applications are to be sent in by September 1st.

Elland.—The District Council has appointed a committee to take steps to procure a provisional order for electric lighting.

Felixstowe.—The Felixstowe and Walton District Council has resolved to obtain a provisional order for electricity supply.

Fremantle (W.A.).—The harbour has been lighted with arc lamps.

Glasgow.—At the meeting of the Council last week Bailie Maclay, in moving the adoption of the accounts of the electricity department, said it would be seen from the figures that at the end of last financial year, after providing sinking fund, writing off liberally for depreciation, and after paying interest on capital account, they had a balance on the right side of £1,940. He thought this was satisfactory, especially as they had passed through a very trying year. They had spent largely on capital account, and that capital had been to a large extent unproductive. They had spent £100,000 in laying down cables in the streets of the city. These were still unproductive, but they thought it better to go on with the work vigorously, so that when the new plant was in working order there should be no delay in consequence of there not being cables to carry the electric current. He was happy to say that during the past year the output of electric current had increased 36 per cent., the number of consumers 30 per cent., the number of 8-c.p. lamps by something like 17 per cent. They had laid throughout the city 18 miles of new feeders and 28 miles of distributing mains. In regard to street lighting, in the previous year they had 119 street lamps; last year the number was 227, or nearly double. These lamps did not yield much, because they were only used towards the close of the winter. This year they would be used at the beginning of the winter. The original charge for street lamps was £26; some little time ago they reduced it to £18. Now they had reduced it to £14 which he believed to be the lowest charge for a street lamp in Great Britain. They had done this to encourage street lighting, and he was pleased to learn that the Watching and Lighting Committee had considered this question, and were prepared to go on with an extensive system of electric lighting of the streets of the city. Bailie Maclay further stated that the roofs were now on the new works at Port Dundas, that they had four new engines with dynamos coupled, and that they would be in full working order against the beginning of this winter. They were making great progress with the buildings on the south side of the river, and they had a large amount of plant on order both for Port Dundas and also for Pollokshaws Road station.—Mr. D. M. Stevenson said the interest on loans amounted to over £7,000, and of that £3,000 was on unproductive capital expenditure. He trusted that the Council would support him in getting a clause put into the next Omnibus Bill to be promoted in Parliament to place the interest on unproductive works to the capital account.—The accounts were approved.

Godalming.—The proposal of the Council to transfer its provisional order to the Urban Electric Supply Company, Limited, is recorded in the *London Gazette* for August 18th.

Heckmondwike.—The District Council has agreed to apply for sanction to borrow £14,000 for electric lighting purposes.

India.—The Indo-European Telegraph Company's offices at Kurrachee are to be lighted by electricity, an 8-H.P. Hornsby-Ackroyd oil engine and dynamo being installed for the purpose.

London.—Paddington Chapel, which is under reconstruction, is being lighted throughout by electricity and ventilated by means of motor fans. The contract has been entrusted to Messrs. Palmer & Watson, of Charing Cross Road, W.C.

The electric light has superseded gas at the Foundling Hospital, Guildford Street, in all parts of the building, including the chapel.

Lynn.—The electricity works is now almost complete, and the theatre supply has already been begun, as well as that of the Town Hall.

Montrose.—The Town Council has given its sanction to the contract between the Angus Electric Light Company, Limited, and Messrs. Edmundson's Electricity Corporation, Limited; the capital to be expended amounts to £15,000, which, in the opinion of Mr. W. Lackie, the Council's electrical adviser, is fair and reasonable.

Newbury.—We think that the Board of Trade's attention should be called to the recent decision of the Newbury Council not to proceed with a municipal lighting plant, yet to refuse the sale of the provisional order to the Electrical Power Distribution Company, to English Industrials, Limited, or to any other company that may express willingness to take the matter up. Furthermore, any application which may be made for a license or provisional order will be opposed. We have no doubt that at the proper time these companies or others will ensure an alteration in this state of affairs being brought about. During the past few weeks the Board of Trade has issued several notices of revocation of orders, and where, as at Newbury, a municipal authority has distinctly stated that it will not carry out the work itself, there seems to be no reason why an order obtained in 1892 for the execution of certain powers within two years should be in existence any longer. Revocation seems to be urgently called for at Newbury. Under the Board's extension grant the order expires within the next six months, but even that seems to us a needless delay after the matter has been shelved so long.

Paisley.—Although the electric lighting scheme for the burgh is not yet completed, so many orders for the new light have been received that the Electric Lighting Committee has asked the Town Council for powers to extend the machinery already placed in the works at Blackhill.

Penarth.—The District Council has yielded to the request of the Electrical Power Distribution Company for an extension of the time before purchase, and has increased the limit from 15 to 38 years.

Penzance.—The Town Council has decided to proceed with the application for a provisional order under the Electric Lighting Acts. The borough surveyor, Mr. Latham, suggests that the losses of the first three years, estimated at £4,150, should be provided for in the loan to be raised, and made part of the capital cost of the undertaking. In eight years he anticipates that the demand will reach 200,000 KW.-hours, and that there will be a profit of £1,000 at least on the working.

Pontefract.—The Guardians have been advertising for an electrical engineer to advise *re* an electric lighting scheme for the Union Workhouse and premises.

Portsmouth.—Last week, in connection with their summer excursion here, a party of the Institution of Junior Engineers visited the Corporation electricity works, and was shown round by Mr. Price, the superintendent.

Sheldon.—The District Council has resolved that Messrs. Hancock & Dykes be employed to make a survey of the district, and report on its suitability for the purpose of electric lighting, this firm having offered to send an expert for the sum of £25.

Walker.—Application has been made to the Estate and Property Committee of the Newcastle Corporation by the Walker authorities for the erection of a power station to generate electricity.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Barcelona.—The directors of the Barcelona Tramways Company, Limited, report for the year ended December 31st that the receipts for 12 months were £62,255, against £73,043. The gross profit on working was £8,081, against £12,064. The falling off in traffic receipts was due to a variety of causes, chief among which were the interruption to traffic occasioned by the change of traction, the depression caused by the late war, and the stoppage of streets by the extensive system of municipal drainage works. The increase in traffic receipts to date in 1899 has already covered the total decrease of the year 1898, although the electric traction has only gradually come into working and has still to be extended to a small portion of the system.

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Blackpool.—A serious accident happened on the Blackpool and Fleetwood tramroad in Warbrick Road, Blackpool, on Saturday afternoon last. A milkman named Swift was driving a horse and float, and got into the lines. A tram came up, and before it could be stopped it smashed the milk cart to pieces. Swift was pitched out, and the wheels of the tram passed over his left arm. He was taken to the hospital, where the arm had to be amputated; he had previously lost the other. He had a serious scalp wound, and was then in a critical condition.

Bradford.—Complaints having been made as to the delay caused by the electric cars stopping at Southfield Lane, on the Great Horton section of the tramways, we learn from the *Bradford Observer* that this is unavoidable, because of the restrictions as to speed imposed by the Board of Trade since the unfortunate accident which took place there. It appears that by order of the Board, 35 minutes must be occupied in the down journey of 2¾ miles, and, however the drivers may check the speed, it is hardly possible to go slowly enough to avoid getting there too soon! Hence the wait, for the express purpose of losing time to comply with the order. We have heard of coaches being driven through Acts of Parliament; here is a tramcar standing still through a Board of Trade regulation! It is unnecessary to point out the absurdity of the order, which, however well-meant, is absolutely ineffective in limiting the actual speed at any moment.

It is now practically decided that communication shall be set up between the Leeds and Bradford tramway systems by means of a light railway from Thornbury to Stanningley, the total length being two miles. The line will be worked with steam by the Bradford Tramways and Omnibus Company until the expiration of the leases in January, 1903. The Leeds Corporation will probably extend one of its lines to meet the new line at Stanningley.

California.—A short description is given in the *Mechanical World* of a power transmission scheme which has been carried out at Mount Whitney, California. Water-power to the extent of 1,800 H.P. is obtained from the Kaweah River, whence the water is carried in a flume six miles long and a pipe line 3,300 feet long to the generating station. Electric power is generated and transmitted at 17,000 volts, three-phase, to Visalia, 29 miles away, and at 34,000 volts to Tulare and Porterville, 40 miles away. It is used chiefly for irrigation and lighting.

Dewsbury.—The Councils of the Spen Valley are troubled about the decision of the Light Railway Commissioners in favour of the British Electric Traction Company, and are discussing ways and means of reversing it. Some stress will probably be laid on a clause in the Dewsbury Improvement Act, 1884, giving the Corporation the right to refuse permission to place electrical apparatus along the streets of the borough. This clause, however, if the Board of Trade confirms the decision of the Commissioners, will *ipso facto* be repealed, and confirmed it will be, unless the five authorities concerned bury their differences and unite in opposition to the measure.

Driffield.—The District Council has been approached by the Drake & Gorham Electric Power and Traction Company, Limited, with a view to the construction of a light railway between Driffield and Beeford. A line has already been sanctioned from Beeford to Beverley, and it is said that the North-Eastern Railway has taken over the project.

Dublin.—The southern district of the Dublin United Tramways Company, which is operated entirely by electricity, shows for the first half of 1899 an increased net profit of £4,600. the gross revenue increased 50 per cent. in the past year, and the net revenue rose from £6,200 to £16,200. Evidently the benefits of electric traction are not confined to the passengers—the shareholders also have reason to congratulate themselves. The Tramways Committee of the Corporation, however, in view of the unfortunate accidents which have occurred lately, has requested the company to instal a third man on each car to look after the trolley pole. We should anticipate a very different balance-sheet if this extraordinary request were complied with. There are more rational ways of dealing with the matter—detachable trolley heads, for instance.

Another accident has occurred due to the trolley jumping the trolley wire; the guard wire was broken, and a carman named J. Caffrey was struck by one of the falling ends and rather seriously injured.

Last week the Tramway Company made some trial journeys to Terenure and back with a number of electric tramcars. Special interest attached to this trip, as these cars were the first worked by the new power station at Ringsend, which is to take over the working of all the electric traction in Dublin. The trials were in every way satisfactory.

Eccles.—A conference is shortly to be held at Eccles between representatives of the various local authorities, to consider the project of the United Kingdom Electrical Tramway and Light Railway Syndicate, Limited, for light railways in the district.

Factory Driving.—Messrs. Waterlow & Layton's new factory in Clerkenwell has been equipped with a system of electrical power transmission by Messrs. Crampton & Co., of Norwich and Cambridge. The generating plant consists of a 50-H.P. gas engine and dynamo, which supplies both the lamps and the motors. Each machine is provided with a separate motor.

Greenock.—The Law and Finance Committee has decided to recommend the Police Board to make arrangements for leasing the burgh tramways as an electrical tramway, and that the Committee be instructed to draw up conditions upon which offers will be received.

Goods Traffic.—The Isle of Man Tramways Company has commenced a service of "Bonner" rail wagons, which can be drawn by horses on ordinary roads to collect goods, and are afterwards mounted on bogies running on the tramway lines for transport. In this way the goods are transmitted the whole distance without being re-handled.

Grimsby.—The Lighting and Tramways Committee has come to terms with the Grimsby Street Tramways Company for the renewal of road leases; various improvements are to be carried out, and electric power is to be supplied by the Corporation, which has the option of purchase at the end of 10 years.

Halifax.—The Tramways Committee has under consideration the choice of routes to Brighouse and other districts to which the tramway system is to be extended.

Hastings.—A mass meeting and procession is to be held early next month in support of the tramway movement at Hastings.

Huddersfield.—The City Borough Council of Huddersfield on August 16th appointed Mr. J. Williams to be charge-engineer at the electric supply station, and Mr. W. E. Warrilow to be electrician-in-charge.

The Tramways Committee have decided to extend their system of tramways (which will in part be converted to the electric trolley system) to Llaithwaite and Marsden and to Brighouse and Bailiff Bridge.

The borough accountant reported the cost of the various works in connection with the adoption of electric traction to be:—(*a*) Power station, £8,000; (*b*) equipment of power station with boilers, machinery, &c., £17,120; (*c*) equipment of Outlane section with cables, poles, &c, £5,374 2s. 4d.; (*d*) equipment of Marsden Road section, £2,331; (*e*) equipment of Longroyd Road section, £3,457; (*f*) electric cars, £11,500; total, £47,782 2s. 4d. This is the portion of the whole system to be carried out forthwith. The work is already commenced, and the construction is expected to occupy two years. The estimated life of the works is (*a*) 30 years, (*b*, *c*, *d*, *e*) 20 years, and (*f*) 15 years.

Italy.—An electric tramway has been completed and put in operation in the town of Como. The line, which is only about a mile long, has been constructed by the Helios Company, of Ehrenfeld, Germany, and will be extended later.

Kelso.—Proposals are on foot for the utilisation of the water-power of the Kelso flour mills for working tramways, electric lighting, and pumping the town's supply of water. At present, about 100 H.P. is available from the turbines.

"Let Glasgow Flourish!"—A deputation of gentlemen from Copenhagen visited Glasgow last week, for the purpose of inspecting the tramways and electric lighting of the city. This is rather a novelty—we are more accustomed to seeing *our* deputations cross the ocean, than to receive visits from abroad. Things are looking up!

Liverpool.—An exchange says that a start has now been made with the proposed electric tramways from Seaforth to Crosby. It is anticipated that the line will be completed before next Easter.

Mytholmroyd.—The District Council is endeavouring to induce the Halifax Town Council to include a branch line down Cragg Vale in the projected extensions of the electric tramways.

Newcastle.—On August 18th the Tramway Committee of the Corporation had before it the question of adopting some form of conduit or surface contact system in the centre of the city in connection with the general overhead or trolley system outside. After a long discussion it was agreed that the Council be recommended to apply the trolley system throughout, as in the opinion of the committee it would not be wise, in the present state of uncertainty as to the suitability of the conduit system, to lay down any system of the kind.

Oldham.—The town clerk reported to the Surveyor's and Tramways Committee on August 17th that the Tramway Bill had become an Act of Parliament, receiving the Royal assent on August 8th. The Tramways Committee intends to ask the Electric Light Committee to supply the power for the tramcars. It was decided that the resolution passed some time ago, adopting the trolley system, be presented to the next meeting of the Council. A complaint was made that power had not been obtained in the Bill, which has just received the Royal assent, to increase the number of double lines in the borough. It appears that when the measure was under consideration, it was authoritatively stated that they could not come nearer the footpath than 9 feet 6 inches from the outer rail, but members of the Committee have since observed in Leeds tramrails within a yard of the kerbstones. The only way to get over the difficulty now is by another Bill, which is a somewhat expensive proceeding.

Portsmouth.—Mr. A. Bannister, whose appointment as tramway engineer was recently recorded in our Traction Notes, has withdrawn his application, his present employers having made it to his advantage to remain at Norwich. The Tramways Committee has therefore recommended Mr. Rotter's application for acceptance, and the Council has approved of his appointment.

Printing Press Equipment.—According to the *Newspaper Owner*, the proprietors of the *Scotsman* have contracted with the Bullock Electric Company, Cincinnati, through their London agents, Messrs. Bergtheil & Young, for a complete equipment of electric motors for driving the new quadruple and four-reel presses which are now being built for them by Messrs. R. Hoe & Co., of

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London and New York. The motors are of 50 H.P. each, and are interchangeable in all parts. This installation is part of the complete newspaper plant about to be placed in the new *Scotsman* offices now in course of erection in Edinburgh.

Rawdon.—At a meeting of the Joint Tramway Committee of the Horsforth, Rawdon and Yeadon District Councils, held at Rawdon last week, it was stated that, contrary to its original purpose, the Leeds Corporation was willing to extend the city tramways as far as Yeadon. The Horsforth members objected to the Leeds Corporation having anything to do with the scheme. The Joint Committee will confer with the committee of the Corporation on the subject.

Southend.—The Town Council has appointed a committee to carry out the Light Railways order. The question of electric lighting is to be considered in conjunction with that of traction.

Tees-side.—The returns for last week show that the Middlesbrough, Stockton and Thornaby electric tramways carried 275,000 people between the three towns; this enormous traffic was dealt with without a single accident, although 50 cars were running with a three-minute headway. The necessity of doubling the line between Middlesbrough and Thornaby has been clearly proved. Mr. Clifton Robinson himself took an active part in directing the traffic, and on one occasion was instrumental in preventing a serious collision.

Tunstall.—The District Council will oppose the application of the Potteries Extension Tramways Company for an extension of time to October 1st next for the completion of their lines so far as the application regards the sections from the Council's boundary in Scotia Road to the terminus at Goldenhill.

TELEGRAPH AND TELEPHONE NOTES.

Cable Communication with the West Indies.—As the Halifax and Bermudas and the Direct West India Cable Companies' cables terminate at Jamaica, the recent interruption of the connecting companies' cables between that island and Puertorico prevented the acceptance of messages for the West India islands east of Jamaica at the usual rates. The Halifax and Bermudas Company announces, however, that it has been advised by the West India and Panama Company of the repair of the broken cables, and that messages to the West Indies may be sent "*viâ* Bermuda," as before, at the usual charges.

Interruption of Australian Trunk Landline.—According to the *Sydney Morning Herald*, of 13th ult., "At half-past 3 o'clock this morning we received word from the Electric Telegraph Department that the overland line to Port Darwin was interrupted north of Powell's Creek. We are consequently without our cricket cable news giving the result of the third day's play in the match at Edgbaston, Birmingham, between the Australians and the Midland Counties Eleven, in which the game is at an interesting stage."

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa	April 4th, 1898	...
Bonny-Cameroon	May 29th, 1899	August 21st, 1899
Latakia-Cyprus	June 20th, 1899	...
Para-Maranham	April 10th, 1899	...
Accra-Grand Bassam	August 1st, 1899	...
Corea-Japan	August 7th, 1899	...
Iquique-Valparaiso	August 15th, 1899	...
Jamaica-Colon	June 30th, 1899	...
Jamaica-Porto Rico (Ponce)	August 15th, 1899	...
Jamaica-Porto Rico (San Juan)	August 15th, 1899	August 22nd, 1899
Cape Haitien-Puerto Plata ...	August 21st, 1899	...
Cape Haitien-Mole St. Nicolas	August 21st, 1899	...
Cable communication with West Indies except—Jamaica, Cuba, and Haiti Republic.	August 21st, 1899	August 22nd, 1899
Cable communication with United States of Columbia, except Isthmus of Panama	August 17th, 1899	August 21st, 1899
Nagasaki-Fusan	August 20th, 1899	...
Serena-Valparaiso	August 18th, 1899	...
Zanzibar-Mombassa ...	August 17th, 1899	August 18th, 1899
Landlines.		
Communication between Salonika and Monastir ...	March 23rd, 1899	...
Communication between Bolama-Bissao	July 28th, 1899	...
Lines from Haiti to Gonaives, Gros Morne, Port de Paix Plaisance, and Cape Haitien Port au Prince to Miribalais and Jacmel	August 18th, 1899	...

Natal Telephones.—The *British and South African Export Gazette* says that the estimates of the Natal Government for the year 1899-1900 include £2,700 for improvements in the telephone system, besides £4,480 for additional telephonic communication; £1,500 for the installation of electric light in Government buildings; and £1,120 for batteries, instruments and materials.

The Reduction of Rates to India.—We are glad to see that the leading journals in India are now interesting themselves in a movement, which we hope will prove to be of ultimate benefit, both to that empire and to this country. Although we have treated of this subject very frequently, and for several years, we cannot refrain from again calling attention to the heavy tax, by comparison so utterly inequitable, which is imposed on Indian commerce, and on those whose social relations with India, oblige them to telegraph, even at the present excessive rates. To be obliged to pay 4s. per word for a telegram between Bombay and London, is a serious matter; but this is all the more to be objected to when we know that a message in transit between England and Australia is carried for about 1s. 5d., over exactly the same distance (and entailing, if anything, less work), as that which costs 4s. per word to the persons who telegraph from India to England, or *vice versâ*. There is not the slightest doubt that the existing "joint-purse" system keeps the charge for telegrams to or from India at an exorbitant figure. We understand that the Indian Government purpose to make another attempt to procure a reduction; but stronger measures than banal protests at triennial conferences may be looked for. Although we do not see eye to eye with Mr. Henniker Heaton in his proposed methods of reforming this scandal, we cannot help being impressed by some of the arguments he advances in the following letter which appeared in the *Times* of last Tuesday:—

Osborne Villa, Carlsbad, Austria, August 19th, 1899.

Dear Lord George Hamilton,—The question of reducing the present high telegraph charges to India is, I know, engaging your attention. I beg that you will not come to any decision on the matter until you have heard Sir Edward Sassoon and myself. We take the ground that any subsidy given by the Indian Government will considerably hamper competition and block the way of really cheap telegraph rates to India, Australia, and the East for many years. I have shown in articles in the *Nineteenth Century* and in the *Times* that all that is necessary is to link up the present land lines in order to have sixpenny rates to India; I have pointed out that land lines can be constructed at a fourth of the cost and will carry five times more messages than cables; I have pointed out that to-day the cost of a telegram from St. Petersburg to Vladivostok, nearly 6,000 miles, is about 2½d. per word, whereas from London to India by land the charge is 4s. per word by the Indo-European Telegraph Company's lines; finally, I have indicated four different land routes to India where "linking up" can be effected. The only reply to these statements is that the Ameer of Afghanistan will not consent to our constructing a telegraph line into or through his territory. It appears incredible that the enlightened Ameer, who receives a very large sum of money every year, from England or India, in the shape of a subsidy, declines to allow us to construct a telegraph line. He is surely aware that a telegraph line will not steal even the air or injure him in any way. My information, however, is that the permission of the Ameer can be obtained. [A statement of mine (questioned by a correspondent of the *Times*) that the Ameer had allowed telegraph lines to be laid to Kandahar and Kabul is borne out by the enclosed map issued by the Eastern Telegraph Company, in which you will see such wires are duly marked.] At all events we (with your sanction) intend to make an effort through other agencies to get the Ameer's consent. Even if it cannot be obtained, there are three alternative lines open to us. You are aware that both the Eastern Telegraph Company, its joint purse partner the Indo-European Company, and the Imperial Telegraph Committee of the House of Commons recognise that it will take many millions of money to secure an entirely round the world all-British telegraph cable line. It was alleged by representatives of the first-named company that, as everything is disarranged in times of war, it is better to depend on fast cruisers than on cables, because it is impossible to patrol a cable 2,500 miles across the ocean. We send our English mails to India and Australia every week through two foreign countries, France and Italy; then why object to telegrams (98 years in 100 we are at peace) going through foreign countries? We are now struggling on behalf of the merchants, tenders, and social classes against a great monopoly—a monopoly condemned in the strongest terms by your colleagues. Our work will be seriously impeded and we shall be crippled for another generation if you give your sanction to a further subsidy to these cable companies.

I am your faithful servant,

J. Henniker Heaton.

Sydney Telephones.—Part of the telephone system of Sydney (N.S.W.) is being changed over to the metallic return method at a cost of about £30,000. This is a precautionary measure taken by the Post Office in view of the conversion of the tram system from steam to electrical working.

South African Telegraphs.—Dispatches from Cape Town to the daily press say that the Imperial telegraph line has been opened to Maseru, the capital of Basutoland.

The Telephone Service.—The Cardiff Chamber of Commerce is of opinion that the Government Telephones Bill "will be infinitely less satisfactory to the country than if arrangements had been made for placing the whole service under Post Office control." Cardiff delegates to the autumnal meeting of Associated Chambers at Belfast are to be asked to ascertain the feelings of other delegates on the matter, and to submit a resolution to the above effect if thought desirable.

The Postmaster-General having asked whether the Council proposes to renew its application for a licence to transact telephone exchange business, the Council has instructed the town clerk to make the necessary application.

Wireless Telegraphy.—A *Times* telegram from Odessa says that trials of Signor Marconi's wireless telegraphy will shortly be made between Sevastopol, Nikolaieff, and the Black Sea fleet.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barnsley.—September 16th. Tenders are wanted for electric light wiring and fittings at the Harvey Institute, Eldon Street, for about 700 lights. See "Official Notices" August 18th.

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Battersea.—August 31st. The Vestry wants tenders for an overhead travelling crane (hand or electric), and batteries for the electricity works. See "Official Notices" July 7th.

Battersea.—August 31st. The Vestry wants tenders for steam pipes, pumps, condensers, economiser, tools, &c., also switchboard and booster. Specifications at the office of Prof. Kennedy, 17, Victoria Street, S.W. See "Official Notices" July 28th

Brighton.—August 30th. The Borough Council wants tenders for the installation of a system of telephonic intercommunication between the various offices of the Town Hall. Specification, &c., from the office of the borough engineer, Town Hall.

Carlisle.—September 11th. The Corporation wants tenders for extension to steam, drain, and feed pipes, feed pump, and extension of economiser at the electricity works. See "Official Notices" August 18th.

Devonport.—August 31st. The District Tramways Company invites tenders for the following contracts: Permanent way, road bed, paving and bonding of about 4½ miles of double line, overhead construction for about 4½ miles of route. See "Official Notices" August 11th.

East Ham.—September 9th. The Urban District Council wants tenders for combined electric light and traction plant, engines, generators, overhead line equipment, cars, switchboard, arc lamps, &c., water-tube boilers, condensers, and other steam plant, electric light cable. Mr. W. C. Ullmann, The Limes, White Post Lane, East Ham, is the Council's electrical engineer. See "Official Notices" August 4th.

Germany.—September 20th. Tenders are being invited until September 20th by the Cotton Wool Exchange authorities in Bremen for a complete installation of electric lighting in the new Exchange. Tenders are to be sent to Das Banbureau für die Bremer Baumvoll börse la Dechanatstrasse, Bremen, whence particulars may be obtained.

Hackney.—September 12th. The Vestry wants tenders for four sets of direct current steam dynamos (either high or low speed). See "Official Notices" August 11th.

Heckmondwike.—September 20th. The District Council wants tenders for the supply of water-tube boilers, economiser, pipe work, steam dynamos and motor boosters, accumulators, switchboard work, travelling crane, mains, arc lamps and posts, and station lighting. See "Official Notices" this week.

Ilfracombe.—September 25th. The District Council wants tenders for boiler plant, engine plant, dynamos, condensers, switchboard, mains, lamp-posts, accumulators, meters, crane, buildings, &c. See "Official Notices" August 18th.

Ingleton.—The Ingleton Electric Light and Power Company wants tenders for the supply of dynamos, switchboards, batteries, and wiring. See "Official Notices" August 4th.

Leeds.—August 30th. The Tramways Committee wants tenders for the electric lighting of the car sheds, Kirkstall Road. See "Official Notices" August 18th.

Luton.—September 22nd. The Council wants tenders for boilers, superheaters, engines, dynamos, switchboard, steam and other piping, batteries, street conduits, boxes, feeders, arc lamps and posts, and various other plant and machinery for the electric lighting installation. See "Official Notices" this week.

Malmo.—September 1st. The Gas Works' directors want tenders for the erection of electricity works for the city. Particulars on application to the clerk of the Gas Works (deposit 12s).

Moscow.—*Commercial Intelligence* says that next month electrical engineers and contractors will be invited to compete for the electric railway for Moscow. The contract will probably require an expenditure of about 20,000,000 roubles.

Perth.—August 28th. The Commissioners want tenders for boilers, condensers, steam dynamos, switchboard, underground mains, and accessories. See "Official Notices" July 28th.

Poplar.—September 6th. The Guardians want tenders for high speed engine and dynamo, electric motors, Lancashire boilers, economiser, and other plant, as briefly particularised in our "Official Notices" August 18th. Mr. Warden-Stevens, the consulting engineer, asks us to notify that Section L., Steam Jet Plant, relates to ejector condensers, jet pumps, and injectors; and Section M., Auxiliary Pumping Plant, to air compressors, centrifugal pumps, and three-throw pumps.

Portugal.—September 6th. Tenders are being invited by the municipal authorities of Cascaes, Portugal, for the concession for the electric lighting of the town.

St. Annes-on-the-Sea.—September 11th. The Council wants tenders for high speed engines, continuous current dynamos, and balancing booster, for electric lighting. See "Official Notices" August 18th.

Southport.—The Corporation wants tenders for the supply and laying of tram rails, points, crossings, bonding, permanent way; also overhead equipment, including poles, wires, &c. See "Official Notices" August 11th.

Sunderland.—The Corporation wants tenders for four 270-kw. three-crank direct current steam dynamos, and two surface condensers and cooling tower. See "Official Notices" August 18th.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

CLOSED.

Belfast.—Messrs. Wimshurst, Hollick & Co., are to convert a 2-ton jib crane from steam to electric power for the Belfast Harbour Commissioners.

Brighouse.—The Council has given a contract (£329) to Mr. T. H. Churton, of Leeds, for electric lighting plant for the sewage disposal works at Cooper Bridge.

Glasgow.—In addition to the recommendation that the contract for main engines be given to Messrs. Allis, the Tramways Committee also recommended that the following tenders should be accepted, the whole sum involved, including that of the main engines, being £253,653 13s.:—

	£	s.
Auxiliary engines—E. P. Allis Company	8,375	7
Exciter engines—W. H. Allen, Son & Co.	3,054	0
Boilers—Babcock & Wilcox Company, Limited	21,280	0
Three-phase generators—British Thomson-Houston Company, Limited	25,670	0
Auxiliary generators—British Thomson-Houston Company, Limited	5,348	10
Exciter generators—British Thomson-Houston Company, Limited, London	1,711	0
Transformers—Westinghouse Electric Company, Limited, London	34,420	0
Rotary converters and boosters—Westinghouse Electric Company, Limited, London	39,215	16

Grimsby.—The Corporation Special Committee last week considered the tenders for the supply of machinery and plant for the electric lighting scheme. Seven tenders were sent in for the boilers, and that of Messrs. Anderton & Co., of Accrington, was accepted. Nine tenders were submitted for the engines and dynamos, Messrs. Mather & Platt being successful. The Tudor Accumulator Company obtained the contract for the batteries in competition with six other firms, and Messrs. Jas. White, Limited, were selected to supply the switchboards. The contract for the mains was secured by the British Insulated Wire Company. No tender was accepted for the supply of arc lamps, as Prof. Kennedy wished to test a certain make before advising the Corporation. The amount of the tenders is stated to exceed the original estimates. The explanation given for this is that the plans have been extended, and that the prices of materials have gone up 15 or 20 per cent. since the estimate was made.

Harrogate.—The Town Council has resolved to order the following plant:—A 600-H.P. engine with necessary pipes, &c., from Messrs. Maclaren, at £2,398; a 300-kw. alternator from Messrs. Ferranti, at £1,700 (less £215 for dayload plant returned); an ejector condenser from Messrs. Korting Brothers, at £550; an additional trunk main from the British Insulated Wire Company, for laying from the central station to the high pressure distributing centre. The surveyor is to prepare plans, &c., for the necessary buildings extensions for the above.

NOTES.

An Interesting Question.—The following query comes to hand as we go to press:—"Gentlemen,—I should be very much obliged if any of your readers will inform me why it is that alternating current motors spark so much more than do continuous current motors.—A. P."—[They don't.—Eds. Elec. Rev.]

The Renewable Lamp.—We are afraid we cannot congratulate the Renewable Lamp Company upon the line of action adopted by its advocates. We published a letter the week before last from "Charles Clifford," purporting to give us enlightenment regarding the lamp. In the usual way we placed our columns at Mr. Clifford's disposal, he having expressed a wish to go further into details. So far, no letter signed by Mr. Clifford is to hand, but we have, instead, received one giving an entirely different name and address, and signed "Lancastarian" (*sic*). The spelling of Mr. Clifford's letter was edited by us before publication, but in order that our readers may see for themselves how strikingly the errors of the two communications are in agreement, we print them both in parallel columns, the errors in each case being shown up distinctly. There is strong evidence of an attempt to disguise the handwriting, but the similarity is so palpable as not to require an expert to detect it. We think it will be clear that the writer of the two letters is the

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same. Curiously, in one letter he is a "friend of the patentees," and in the other he assumes the *rôle* of "an impartial observer."

Re the Patent Renewable Glow Lamp.

Anent your remarks on above in last weeks issue of your enterprising journal, will you permit an old reader, and a friend of the patentees, & one cognisant of the incomparable advantages of which the above lamp is alone capable, to clear the ground of certain misapprehensions in this relation? First let me say that, had I space & your permission, to give in detail the unique capacity of this lamp to prolong its utility, at such a small outlay of material, time, labour, & money, & to explain how through the continuous interchangability of its filaments the thorough utilisation of all its material is effected to the utmost extent, the commercial value & complete public service claimed for this innovation by those of the highest repute & honour as practical experts who have submitted it to the most crucial tests, would be so manifest that, even your hypercritical correspondent *"Experiments Docet"* would admit the justice of the claim that this lamp will not only be the salvation of the enclosed globe, but supplies the longfelt public want among consumers of the current, by revolutionising the present system of lamp replacements, & doing away with the practice of having new lamps, & paying full prices for same.

And so far from *efficency* being sacrificed for cheapness it will be found, by comparison, that it is the highest ever recorded so soon as the lamp is on the market.

Surely it must be a great commercial achievement in any industry to reduce maximum waste of material & labour, has instanced in the Glow Lamp Industry at present, where incomputable & broadcast waste of Glow Lamps takes place the moment the lamps at present in use, reach the end of their first, and only, life?

True, many have tried to solve the problem of interchangeability of filaments even Westinghouse with his glass stopper, &c., how impracticable these devices were doubtless you are aware sir, but none hit upon the simple design of a tubular neck & expeditious method of exhanging filaments devised by C. Howard.

Depend upon it, Sir, if the advantages claimed were not genuine & had not been actually demonstrated neither Sir W. H. Preece, nor Major Cardews names would have been on the front page of the prospectus to bear testimony to the same, neither would Mr. Jacob Atherton of The British Insulated Wire Co., a most successful Compy, been identified with it unless it was the inimitable lamp the inventor asserts it to be. The economy claimed will on comparison be found to be actual and enduring, & be assured that its come to stay, despite *"Experiments Docet,"* whose friends will find shortly that their large stock of lamps &c. &c. are *obselete* and unsaleable. Without attempting to answer his assertions let me say that, all his objections have no relation, or bearing, to the above lamp, & proves conclusively "how little" he knows of the invention. In conclusion, let me add that (1) the Compy only claim to renew their own lamps, it is impossible to renew any other, (2) The filaments are of that peculiar kind that the bulbs are free from deposited carbon, (3) The glass too is unique & manner of opening, & fusing, so practicable that breakages will be very rare. (4) The detachable socket as withstood the most severe tests & is a perfect success & will admit of being used perpetually. (5) In all other lamp factories there is a certain loss of between 25 & 30 % on lamps made, through some non-glowing defect, broken filaments &c., in the manufacture of this lamp such loss will be unknown, has the least, or most serious, defect can be at once rectified by opening at neck where renewal of filaments takes place. That the economising & prolonging utility of this lamp is without parallel in this Electrical age, goes without saying, & consumers will ere long have the *oppertunity of verifieing.*

I could add to what I've said, but for fear of incurring your displeasure Mr. Editor. Thanking you in anticipation of your inserting this, & apologising for its length I remain faithfully yours

CHARLES CLIFFORD.

Re "The Renewable Lamp."

Dear Sir,—May I draw your attention to the fact that you made a favourable allusion to the above in your January number of 1897? As an impartial observer, I would endorse all your correspondent, Mr. C. Clifford, claims for the above, because the said claims are endorsed by gentlemen whose names are beyond reproach, and whose capacity to judge of this new lamps amplified utility, and peculiar *efficency* cannot be doubted.

That a renewable lamp is a most desirable agent, & would prove a most economical boon, to consumers must be admitted even by such detractors as *"Experiments Docet,"* whose line of attack was most "Unenglish" to use the mildest term, especially in face of the support accorded this remarkable lamp by Sir W. H. Preece, Major Cardew, &c., &c.

I consider all credit and support is due to any inventor, who finally achieves what previous experts failed to accomplish, & it is the worst of form, and betokens a carping disposition to be in haste to damn anothers brainwork before understanding the essence, or basis, of the invention, and before the public have had an *oppertunity* of *verifieing.* Possibly *"Experiments Docet"* is in the lamp trade, and, as C. Clifford reminded him, is afraid of his stock becoming *obselete.*

One fact is clear, present Glow Lamps are out of date, from their powerlessness to prolong their utility after their first filaments have burnt out; the majority of them lack *efficincy* & uniformity, and although they claim to burn 1,000 hours they only burn about half this period, and then throw off that "red glare" which is so distressing to us poor observing consumers, yet so profitable to the supply companies.

I for one shall range myself under the testimony of the above universally known experts, & accord this renewable glow lamp a fair trial when I can purchase them, & I assure you, Sir, I shall be one of your first correspondents to report my experiance. Hoping I have not transgressed,

I remain yours obediently,

LANCASTARIAN.

Electric Power at Niagara.—Prof. George Forbes has written the following interesting letter to the *Times*:—

SIR,—It was with unmixed pleasure that I have been able to pay a long-promised visit to Mr. W. B. Rankine, one of the vice-presidents of the Niagara Falls Company, to see how the commercial developments at Niagara were progressing; and I believe that a concise statement may be of interest to your readers. In June, 1892, and again in December, 1894, when the first works were nearing completion, I gave the *Times* some account of what was being done, and since then the public has taken much interest in similar electric developments of water-powers.

It is four years and a half since I was last here, and the first thing to strike one is the great number of enormous new factories which have been established on the company's land. Nearly every one of these consumes a very large amount of power, as is shown by the following statement, which anyone can verify, showing the names of the factories and the amount of power used in each:—

	H.P.
International Paper Company	7,200
Pittsburg Reduction Company (aluminium)... ...	3,050
Carborundum Company...	1,000
Buffalo and Niagara Falls Electric Light Company...	500
Electro-Chemical Company (peroxide of sodium) ...	400
Buffalo and Niagara Falls Electric Railway	200
Niagara Falls and Suspension Bridge Railway ...	250
Buffalo and Lockport Electric Railway	350
Oldbury Electro-Chemical Company	1,000
Mathieson Alkali Works	2,000
Cataract Power and Conduit Company (Buffalo) ...	8,000
Tonawanda Power Company	500
Union Carbide (of Calcium) Company	10,000
Surface Coating Company (enamelling)	20
Niagara Development Company (workmen's dwellings)	75
Niagara Waterworks	45
Total	34,590

To these additions are to be made in October, and two new works, the Atchison Graphite Company and the Lead Reduction Company (Litharge), will be supplied, bringing the total up to 45,190 H.P. contracted for, bringing in an income of over £150,000. The operating expenses do not exceed £25,000 per annum.

This is a most interesting result in three ways—(1) It shows that the original promoters were right in believing that the locality, with cheap railway transport, was favourable; (2) it shows that the general plan of the works, by which any customer could have any kind of electric current he desired, has been appreciated; and (3) it gives an indication of the enormous strides which have been taken of late years in electro-chemical and metallurgical processes.

Regarding the machinery, the dynamos, which were totally new, not only in size but in their general design, never give the slightest trouble; and the transformers, ranging up to 2,500 H P, have answered their purpose perfectly, even with the low frequency of alternations, which was generally condemned by theorists when I introduced it, but which is recognised now by everyone at Niagara as contributing largely to the success of the scheme. The rotary transformers, for converting alternating into continuous current, which are used for nearly half of the power, gave some trouble at first, being the first which had ever been commercially used. But the difficulties have been successfully met. A good deal of the other machinery was of a new character and bold in design, but has generally worked well. The setting-up and working of the transmission line to Buffalo reminds one of the earlier electric light stations in the United States, but this is bound to be one of the most important applications in the future.

The general conclusion arrived at, after thoroughly inspecting everything under the best auspices, is that the boldness of the originators of the scheme has been justified, and that the wants of manufacturers who require power in any form can be supplied. It must be remembered, however, that much depended upon the favourable locality, and this warning may be given, that it would be rash to develop a large water-power in this way without demands for power. At the inception of all these schemes there is one thing more important than overcoming the engineering difficulties, and it consists in ensuring the support of those who require large quantities of power, electrical or mechanical.

GEORGE FORBES.

Niagara Falls, *August 4th.*

Appointment.—The Oldham Surveyor's and Tramways Committee received 17 applications for the appointment of an assistant to Mr. Pickering (surveyor) in connection with the tramway works. Mr. Harry Clegg, of the Sheffield City Surveyor's office, has been appointed.

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Institution of Electrical Engineers.—The following notice has been issued by the Council:—

In accordance with the Standing Orders of the Council, papers offered to the Institution are, on receipt, submitted to Council referees for report. If subsequently accepted by the Council, they are either read and discussed at an ordinary general meeting, or are published as original communications in the *Journal*. The Council, subject to the usual conditions, offer the following premiums for the session 1899-1900:—For papers read before the Institution—The Institution Premium, value £25; the Paris Electrical Exhibition Premium, value £10; the Fahie Premium, value £10. For original communications, not read at a meeting, but published in the *Journal* of the Institution—One premium, value £10; one premium, value £5. The next award of the Willans Premium by the Institution of Electrical Engineers will be made in December, 1903, and all eligible papers read before the Institution from January, 1898, up to that date will then be taken into consideration.

The Council will be pleased to receive communications on the following or other suitable subjects:—

1. Best methods of generating steam and steam power for variable loads. 2. Comparison of double and triple-expansion engines for varying load conditions. 3. Automatic handling of fuel in power stations. 4. The present position and applicability of gas or oil engines for electrical power stations. 5. Description of plants for the utilisation of water or wind-power in the generation of electrical energy. 6. The present position and prospects of the application of liquid and of powdered fuel in electrical power stations. 7. The utilisation of blast-furnace gases or other waste products of manufactures in the generation of electricity. 8. The application of dust destructors to the generation of electricity. 9. Electric light and power station chimney shafts; specialities of their construction and equipment. 10. Experiences with vibration from electric light and power stations. 11. Bearings of shaft and shafting running at high speed. 12. Improvements in dynamos. 13. Comparison of speed and cost of dynamos. 14. Comparison of single and multiple central stations. 15. The wholesale supply of electricity to towns and factories from centres where very large generating units are employed. 16. The distribution of electrical energy from a distant generating station through districts served from a different source of supply, or under a separate local authority. 17. Examination of relative advantages and disadvantages of direct current and alternate current transmission. 18. Examination of relative advantages and disadvantages of two-phase and three-phase transmission. 19. Methods of controlling speed of alternating current motors. 20. Practical methods of measurement in connection with polyphase distribution. 21. Methods for the conversion of direct current into alternate current. 22. Methods of providing for electrical supply during hours of small demand. 23. Utilisation of lighting plant for other work during the hours of small demand. 24. The electrical equipment of large blocks of offices in a city. 25. Description or comparison of systems of house wiring. 26. Economy of design in the manufacture of small electric fittings. 27. Portable electric lamps of the "safety" type, or otherwise. 28. Enclosed arc lamps. 29. Improvements in incandescent electric lamps. 30. Incandescence electric lamps with filaments other than pure carbon. 31. Application of electrical transmission in factories:—(*a*) Detailed description, giving sizes of motors and power provided. (*b*) Comparison of separate or combined direct and alternate current methods. (*c*) Combination of light and power for such purposes. 32. Electricity meters. 33. Description of electrical methods, or comparison of these with other methods, of propelling vehicles. 34. The supply of electrical energy for tramway purposes. 35. The use of electrical methods of traction on railways served by steam-driven locomotives. 36. The economy and design of electric elevators. 37. The design and economy of electrically-driven pumps. 38. The utilisation of electrical energy in mining. 39. The applications of electrical energy in warfare. 40. The use of electricity in the textile and other industries. 41. The application of electricity in musical instruments. 42. Electro-therapeutics. 43. The establishment of public time services by electricity. 44. Recent advances in telegraphy. 45. Applications of alternating currents in telegraphy. 46. The transmitting capacity and load factor of telegraph circuits. 47. Hertzian telegraphy. 48. Methods, in aerial telegraphy, of restricting signals to selected stations. 49. Recent improvements in telephony. 50. Descriptions of systems tending to simplify the interchange of telephonic communications. 51. The talking capacity and load factor of telephone circuits. 52. The application of electricity to the generation of heat for domestic purposes (cooking, ventilation, heating, &c.). 53. The construction and use of electric furnaces. 54. The application of electricity to the welding or annealing of metals. 55. The application of electrical heating methods in chemical or metallurgical operations. 56. The applications of electricity in metallurgical processes. 57. The applications of electrolysis in the smelting or refining of metals, or in the chemical industries. 58. The electrical equipment of chemical factories. 59. Chemical generators of electricity theoretically considered from a practical standpoint. 60. Improvements in and applications of primary batteries. 61. Examination of the present position of secondary batteries in electrical engineering. 62. Secondary batteries with plates other than lead. 63. The economic employment of thermo-generators. 64. Improvements in the apparatus for producing, and in the applications of, cathode and Röntgen rays. 65. The relative suitability and efficiency of the different materials available for any of the requirements of electrical engineering. 66. The electric strength of di-electrics. 67. Recent advance in the manufacture or use of insulating materials. 68. New insulating materials. 69. Electrical applications of aluminium, sodium, &c. 70. The electrical uses of the rarer metals. 71. The treatment, testing, specifications, or uses of iron or steel, or of iron alloys, for magnetic purposes. 72. The manufacture of permanent magnets. 73. The relation of chemical composition and physical condition to the electrical or magnetic properties of substances, considered in its bearing upon electrical engineering practice. 74. High resistance metals for instruments or resistance coils. 75. New resistance alloys. 76. The protection of laboratories and observatories against magnetic disturbances due to local causes. 77. Recent legislation in its relation to electrical undertakings. 78. The relations between electric lighting or power corporations and municipal authorities.

In Sheep's Clothing.—For many years we have directed the attention of our readers to the friendly financial relations which have existed between the Eastern Extension Telegraph Company and the Colonies from which this company derives the most considerable part of its income. Recent events have somewhat deranged this pleasant intimacy, and a policy of renunciation is now being adopted by those who were formerly the tyrants of the telegraphing public of Australasia. In the future there are to be no more subsidies. This announcement sounds well and reads well, but, in our opinion, any agreement which this cable company proposes to the Australian Governments requires the closest scrutiny. The Eastern group have only very recently abandoned a portion of their demand for subsidies of over £100,000 per annum for laying an "all-British" cable to Australia, with a branch to India *viâ* the Cape. Remembering the tenacity with which these companies have clung to State aid, as well as other points connected with their history, we decline to believe that this repentance is really heartfelt. Rather would we suggest that the Colonial Office should keep well advised of the arrangements concerning the the collection of telegrams which the Eastern Extension Telegraph Company are now attempting to conclude with some of the Australian Colonies. A joint-purse agreement between this company and South and West Australia at least might, were it considered among other conditions of Australian Federation, prove a serious difficulty in the way of the receipts of the Pacific cable, in the success of which the Colonial Office is interested. The following is from an Australian newspaper which has just come to hand:—

The Eastern Extension Cable Company has made an important proposition for an improved service between Australia and England. The company entirely waives its demand for a renewal of the subsidy of £32,400 per annum for 20 years in consideration of laying a cable from the Cape, and it does not now ask for a guarantee against competition, which it proposed in February, 1898. Further, in addition to providing a cable from the Cape all the way to Glenelg, *vid* Perth, the company will agree to at once reduce the tariff from 4s. 9d. to 4s. per word, and make a further reduction on a sliding scale as the traffic increases. In return for this the company only requires the same privilege in Perth, Adelaide, and Melbourne *as they have hitherto enjoyed in Great Britain, of directly distributing and collecting their international telegrams to and from the public.*

Fire in the Tape Shop at Messrs. Johnson and Phillips.—Early on Sunday morning last a fire broke out in the tape and insulation shop, which is one of the original buildings at Messrs. Johnson & Phillips. Several workmen were about at the time, and the hose was quickly connected up, but the fire spread so rapidly that the whole shop was soon in a blaze. Fortunately the wind was in the north-east, and so the general offices of the company escaped with only a few broken windows. We understand this particular department is very full of orders for the Eastern Telegraph Extension Company and Telegraph Construction and Maintenance Company, but we are sure that, with their usual energy, the firm will overcome the temporary difficulty, and within a few weeks' time be able to meet their most urgent orders. The building was not insured. Messrs. Johnson and Phillips write that the work in the electric light and power department and electric cable works will in no way be interfered with. By Tuesday they had been able to restart the greater portion of the machinery in the department concerned, and it was then hoped to have the rest of the plant in full work within the next 24 hours. The firm desires to thank its friends for the numerous sympathetic letters and offers of help received.

Personal.—As may be seen from our advertisement pages, Mr. Sydney F. Walker, who has for many years been connected with the electrical industry at Cardiff, is open to accept an engagement.

We learn that Mr. Charles Bright, F.R.S.E., is shortly to marry Miss Isabella Charlotte Gosling, of Hassobury, Essex, and Portland Place.

The freedom of the borough of Carnarvon is to be conferred upon Sir William Preece on Thursday, September 21st. A banquet follows the ceremony.

Negotiations with Prof. Röntgen, as to his acceptance of the Professorship at the University of Munich, are still proceeding.

The Trade Union Congress and the A.S.E.—The Amalgamated Society of Engineers has been suspended from the Trade Union Congress for two years. The reason is that when the smiths at Tyne Dock struck work because a poor boy, who had served a rather broken apprenticeship, was put to a fire, the A.S.E. allowed their members to take the strikers' places—a proceeding contrary to the rules of Trades Unions. One union must not thus interfere with another, however unjustifiable the strike may be. That the strike was unjustifiable we fully agree with Mr. Barnes, but, and we

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confess to a strong bias against the ways of Mr. Barnes, we do not feel that Mr. Barnes's new-found zeal for the unfortunate and lowly placed is altogether what it appears on the surface. During the progress of the great strike of 1897, we frequently expressed our sympathy with the labourers of the engineer's shop, often men of infinitely better education than the tradesmen. At that time did we find any zeal in Barnes for an unfortunate class? Now he overflows with pity for one solitary individual who has not even the burden of a wife and family. We think there must be a nigger in the wood pile. It is matter of common knowledge that the general body of trades unions resented the high-handed action of the A.S.E. in 1897. The A.S.E. had waxed fat and gross, and would be a king among the unions, and this affair of a poor smith's apprentice boy seems to be merely the opportunity of getting even with the A.S.E. on the part of the other unions, while Mr. Barnes's sympathies with the boy, come in well to back up his conduct in letting his members fill up the places of strikers—also probably an aftermath of 1897, when Mr. Barnes did not feel he had the support he desired. Considering the way in which trades unionism has been carried on for some years, it is perhaps as well that they should fall out, by the way, amongst themselves. There is an old proverb which says that honest men get their own under certain circumstances. At the same time it is to be regretted that trades unionism should have fallen to so low an ebb. Trades unionism has its proper and legitimate functions, and employers are by no means immaculate, and because of this, is it the more important that the trades unions should so comport themselves as to retain the public sympathy. It is, after all, to public opinion—not to their war chest—that a trade union must look when it fights. If public opinion upholds it, no combination of employers can resist a demand by a trades union, and similarly, no secretary of a union, be he ten times less careful of funds than Mr. Barnes, could hope for success unless he had a much better excuse for war than that put forward to excuse the error of 1897. We little thought two years ago to be able to record to-day any expression of Mr. Barnes's feelings on behalf of the oppressed. It is possible Mr. Barnes has turned over a new leaf? If he has really done so, and honestly intends to live up to the blessed doctrine which he now professes, for his protests are almost paraphrases of our own expressions of two years ago, then we are willing to bury the hatchet. Unfortunately, however, Mr. Barnes claims retrospectively a position for the A.S.E. in which we cannot for a moment admit it took its stand. The A.S.E. cared for no one outside its own members, and not very much for them. The fight of 1897 was engineered by a clique for particular purposes, and the individual members had less say in the matter than a drummer boy in the army has over a plan of campaign.

Appointments Vacant.—An electrical assistant is wanted for the electrical engineering department at Hartley College, Southampton. See "Official Notices" this week.

The Wakefield Corporation wants a junior assistant electrical engineer and a dynamo and switchboard attendant. See "Official Notices" this week.

The King's Lynn Corporation want an assistant electrical engineer for the electricity works. See "Official Notices" this week.

Simla Water-Power Scheme.—A *Pall Mall* Simla correspondent writes with reference to the Simla water-power scheme which is shortly to be taken in hand by a London syndicate. It seems that at Bilaspur a cutting through a neck of land round which the river now makes a detour of some eight miles will give a head of 300 feet, with the whole volume of the Sutlej River behind it. The power, therefore, is practically unlimited. It is to be developed by turbines set at the bottom of the fall, and converted into electricity to be utilised partly on the Kangra Valley Railway, the North-Western, and partly on the Simla-Kalka Railway, the balance being taken on to Lahore and Simla for electric lighting and other purposes.

Electrician's Insulated Screwdriver.—The American *India-Rubber World* describes the screwdriver shown in the drawing, a patent for which has been applied for by Messrs. F. E. Ducharme & Son, of Shelbourne Falls, Mass. The handle of the tool is insulated with hard rubber, the latter

being made to surround entirely the portion of the blade in the wooden handle. The whole is said to be so well fitted, and the rubber is so fastened that no part can become loose or pull out from use. It was designed for use by electricians, though it is adapted for all purposes for which a screwdriver is desired, the cost being only a very little more than for the ordinary non-insulated screwdriver.

CITY NOTES.

Dublin United Tramways Company.

The directors' report, submitted to the shareholders at the Imperial Hotel, Dublin, on Tuesday last, says that the directors have declared a dividend at the rate of 6 per cent. per annum on the preference shares, and at the rate of 5 per cent. per annum, free of income-tax, on the fully paid ordinary shares, numbered 1 to 17,150, and at the same rate on the sums paid up on account of the fully paid ordinary shares, numbered 17,151 to 51,450. This dividend will absorb £29,401 4s. 7d., leaving a balance of £484 10s. 11d. to be carried to next account. Out of the profits of the half-year dividends have had to be provided on a considerable amount of capital which is not yet remunerative. The directors report that the reconstruction of the tramways, the laying of the underground conduits and cables, and the erection of the overhead electrical equipment throughout the whole system, are practically completed, and they expect that power will be available before the end of this month from the new generating station at Ringsend, to operate by electricity the remaining lines which are now worked by horses. Mr. William Anderson, the secretary and manager, having resigned these positions, has been co-opted to the vacancy in the board created by Dr. Carte's death, and appointed managing director. The positions held by Mr. Anderson have been filled by the appointment as secretary of Mr. R. S Tresilian, formerly assistant secretary, and as manager of Mr. C. W. Gordon, a gentleman of large experience in tramway management. Mr. Wm. M. Murphy has been elected chairman of the board of directors. The dividend warrants will be sent out on 31st inst.

The ordinary general meeting was held at Dublin on Tuesday, Mr. William Murphy presiding.

The Chairman, in moving the adoption of the report, said that as the result of the operations for the past half-year, they were enabled, after paying all the fixed charges, including 6 per cent. on the preference capital of £600,000, to repeat the dividend of 5 per cent. on the ordinary shares of the company. The secretary had calculated that not less than £385,000 of their capital expenditure in relation to the electric charges was unproductive during the past half-year. During the period the company's cars travelled 2,445,802 miles, carrying 16,851,309 passengers, on the three electrical lines in operation—namely, Donnybrook to Phœnix Park, Nelson's Pillar to Dalkey, and Nelson's Pillar to Dollymount. The total expenses were £23,308, while the amount earned was £45,471, showing that the working expenses were just 51 per cent. of the passenger receipts. He believed the change from horse-power to electricity would increase the profits threefold. In a few days the Rathmines line would be worked electrically, and in a couple of months or so the horse system of working their cars would be relegated to the domain of ancient history. Having referred to the authorisation by the Privy Council of some new lines of tramway in the city and suburbs, the chairman said the trolley scare got up by certain newspapers was really a clumsy piece of journalistic work. Nobody, he said, now paid any attention to the sensational statements "which have so often been found to be pure invention or gross exaggeration." The directors were fully alive to the necessity of taking every precaution that care and science could suggest for the safety of their passengers and the public, and they believed they had succeeded well having regard to the tens of thousands of miles the cars travelled and the millions of passengers they carried. Constant improvements were being made, the latest being a new trolley head, the invention of their electrical superintendent, Mr. Towell. He had been asked, with reference to the town clerk's letter, which had appeared in the newspapers, whether the Corporation had power to compel the company to put three men on each car. His answer was that they had not. The chairman mentioned that the directors intended to introduce a system of stopping the cars at fixed places (a plan which works well in Glasgow, Leeds, and elsewhere).

The report was adopted unanimously.

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The Chloride Electrical Storage Syndicate, Limited.

The directors in their report for the year ending June 30th, 1899, say:—"During the year the business of the syndicate has continued to increase, as will be seen from the diagram which accompanies this report. In order to cope with the continuously increasing demand the works have been still further enlarged and considerable additions made to the plant. The ground lease of the land on which the works stand has also been purchased during the year. The users of the battery still continue to express their full confidence in its merits, and this is best evidenced by the large number of repeat orders which are constantly received. Many new customers have also been added both in this country and abroad. Since the date of last meeting the directors have entered into a revised arrangement with the Electric Storage Battery Company, of America, which they consider will be to the advantage of the syndicate. The balance-sheet, as required by the articles of association, is enclosed with this report, and from this it will be seen that the profits for the year, including the surplus on the sale of certain patents and shares, after providing for debenture interest, amount to £13,487 1s. 5d., which the directors consider satisfactory, especially when the large increase in the cost of raw material is taken into consideration. After writing off from several accounts £5,160 16s. 9d. (an amount which the directors think necessary) there remains a balance of £8,326 4s. 8d., to which must be added £2,903 5s. 10d. brought forward from last year, making £11,229 10s. 6d. After deducting the cumulative dividend of 7 per cent. up to June 30th, 1894, upon the "A" shares allotted prior to that date, paid by the directors in November, 1898, and March, 1899, the directors propose to carry forward the balance, out of which a dividend may be paid at their discretion. The first mortgage debentures have been paid off, and a fresh issue of £20,000 completed. The retiring director under the articles of association is Mr. A. R. Harvey, who, being eligible, offers himself for re-election. The auditors, Messrs. Parkinson, Mather & Co., also retire, and offer themselves for re-election.

The meeting is to be held at the Works, Clifton Junction, near Manchester, on Tuesday, August 29th.

The Brush Electrical Engineering Company, Limited.—The directors have decided, subject to audit, and after placing £5,000 to the depreciation reserve fund, to recommend payment of a dividend to the preference shareholders at the rate of 6 per cent. per annum for the half-year ended June, 1899, (making the full dividend of 6 per cent. on the preference shares for the year) and a dividend at the rate of 5 per cent. on the ordinary shares for the year, leaving a sum of about £5,000 to be carried forward to next account. The share transfer books of the company will be closed from August 28th, 1899, to September 8th, 1899, both inclusive.

British Westinghouse Electric and Manufacturing Company.—At an extraordinary general meeting of this company held at Cannon Street Hotel yesterday (Thursday), a resolution passed at a meeting held on August 9th, altering Article 83 with respects to powers for appointing directors, was confirmed. Mr. Benson presided.

Stock Exchange Notice.—Application has been made to the Stock Exchange Committee to appoint a special settling day in and to grant a quotation to Hampstead Electric Supply Company, Limited—13,334 ordinary shares of £5 each, and 13,334 5 per cent. preference shares of £5 each.

House-to-House Electric Light Company.—An extraordinary meeting of this company was held at Winchester House yesterday afternoon to confirm resolutions passed at a previous meeting altering the name of the company.

Nernst Lamp, Limited.—A meeting of this company was held on Wednesday at Winchester House to confirm the winding-up resolutions passed at the last meeting, and recorded in our issue of August 4th, page 203.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending August 19th, 1899, were £1,919 7s. 4d.; receipts for week ending August 19th, 1898, £1,295 18s. 5d.; aggregate for half-year to date, £9,900 11s. 4d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending August 18th, 1899, were £3,484 14s. 2d.; corresponding period 1898, £3,941 4s. 2d.: decrease, £456 10s. 0d. Visit of Barnum and Bailey's Show three days last year.

The City and South London Railway Company.—The receipts for the week ending August 20th, 1899, were £1,080; week ending August 21st, 1898, £1,044; increase, £36. Total receipts for half-year, 1899, £7,746; total receipts corresponding period, 1898, £7,828, decrease, £82. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending August 19th, 1899, were £321 13s. 5d.; week ending August 20th, 1898, £272 15s. 11d.; increase, £48 17s. 6d. Total receipts to date, 1899, £6,141 4s. 3d.; corresponding period, 1898, £4,979 8s. 3d.; increase, £1,161 16s. 0d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,916; 1898, 3,744. Number of cars, 1899, 12; 1898, 10.

The Liverpool Overhead Railway Company.—The receipts for the week ending August 20th, 1899, amounted to £1,695; corresponding week last year £1,664; increase, £31.

The Dublin United Tramways Company.—The receipts for the week ending Friday, August 18th, 1899, were as follows:—D. U. T. Co., horse cars, £2,944 19s. 10d.; ditto, electric cars, £1,316 2s. 8d.; D. S. D. Co., electric cars, £1,157 10s. 8d.; total, £4,718 12s. 4d.; corresponding week last year—D. U. T. Co., horse cars, £3 016 5s. 10d.; ditto, electric cars, £646 16s. 0d.; D. S. D. Co., electric cars, £1,218 14s. 1d.; total, £4,881 15s 11d.; decrease, £163 3s. 7d. Aggregate to date, £32 889 10s. 2d.; aggregate to date last year, £31,802 5s. 4d.; increase to date, £587 4s. 10d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 12 miles electrically, and 30 miles by horses, for the corresponding period last year.

The South Staffordshire Tramways Company.—The receipts for week ending August 18th, 1899, were £712 13s. 1d.; aggregate receipts for 33 weeks, £21,667 4s. 0d.; week ending August 19th, 1898, £735 19s. 2d.; aggregate receipts for 33 weeks, £20,589 2s. 4d.

STOCKS AND SHARES.

Wednesday Evening.

While business still shows itself shy of returning to the electric market, a continuance of the firm tone upon which we commented last week is still the principal feature. Holders of Electricity Supply shares are recovering from their recent nervousness, and show a marked disinclination to accept any sort of a price which may be offered when they want to sell, although it was only a few weeks back that they were grateful to come across a buyer at all. The shares showing the biggest rise on the week are House-to-House and Westminsters, each of which is 10s. to the good, and the former company is finding supporters at last. There has been a fairly brisk demand for Edmundsons, and buyers have also come along for Charing Cross Preference, which, at the present price, yield about 3½ per cent. to the purchaser. A further call of 30 per cent. has been made upon County of London 4½ per cent. Debenture stock, and the price has fallen a point, some of the holders electing to sell their scrip rather than pay the instalment. The market for Citys is very quiet, but the shares have developed a stronger tone, and there are a few bears about in the market.

A correspondent asks us some questions about the Smithfield Electric, and as many of our readers are interested in this concern, we may here state that the price of the shares is 3¼—3⅜. They are much easier to buy than to sell—in fact, the last seller who appeared in the market only got £2 a share. Since then the price has improved a little, and the Debentures have also moved up to about 90. No official quotation exists for either description. We should not recommend the shares for an investment, and the price of the Debentures points conclusively to the fact that the security is not altogether "gilt edged."

The principal feature in the telegraph market is the advance which has taken place in the Anglo-American Telegraph Stocks. This is due mainly to the increased activity in the American railway market. A "Yankee boom" being invariably productive of good business to the Anglo-American companies. No alteration, however, has taken place in the prices of Direct United States or Commercial Cable stocks. Eastern Ordinary is once more on the up-grade, and it is understood that the company has benefitted, rather than the reverse, from the calamity in the West Indies.

The West Indian Telegraph stocks are all steady, but, of course, there is not much inducement to buy until it is known definitely how much damage has been done to the company's lines. A bull point, however, is afforded by the announcement that two of the companies have now restored their rates to the West Indies, which it is hoped will bring about some acquisition of fresh business. Globe Telegraph have recovered the 5s. which they shed a fortnight ago.

We have repeatedly called attention to the excellent prospects which appear to be in front of the Electrical Manufacturing Companies, and although the market in these is very restricted, there has of late been a distinct tendency to put prices better. This week it is Callender's which have risen, and the Preference are quoted 5⅞. Brush Electrical shares have also enjoyed some little popularity, and the ordinary have managed to attain the price of 2½ middle. The increased dividend is largely accountable for the rise. British Electric Traction are inclined to dulness, and the Preference have fallen ¼, despite the fact that the company has entered into negotiations with the Leamington and Warwick Tramways, which should prove remunerative to the former.

The chairman of the London General Omnibus Company in his speech at the meeting last week, threw out a most interesting hint with regard to the future traction to be adopted by the company, expressing his opinion that "electricity would come some day." Should any change be found conducive to the shareholders' interests, he added, the directors would not be long in making it.

Barcelona tramway shares remain at 12—14, although no dividend is forthcoming on them. Now that the whole of the company's lines, with a small exception, are being worked electrically, some return to prosperity may be anticipated. Buenos Ayres and Belgrano "A" Preference are unchanged at 4½, and the market for provincial trams is very quiet.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, August 16th.	Closing Quotation, August 23rd.	Business done during week ended August 23rd, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	62 — 65	63 — 66	63⅜	63½
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	114 —115	115 —116	116	115
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	13¾— 14¼	14½— 15	15	14⅛
205,151	Brasilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	15¼	15 1/16
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3 xd	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105½	104¾
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,009	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,981	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	4	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
80,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3¼%	3½%	11¾— 12¼	11¾— 12¼	12¼	12
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	151 —156	153 —158	156	153
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	98 —102	99 —102	100½	99½
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	101 —104 xd	101 —104	...	...
1,482,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	115 —120	116 —121	118	114½
250,009	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14½— 15	14½— 15	14⅝	14½
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	114 —119	115 —120	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	103⅛	103
300,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	4 %	...	...	102 —105%	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	5½%	10½— 11	10⅝— 11¼xd	10 1/16	10¾
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15 — 15½	15 — 15¼xd	...	...
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	30¼	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	⅝— 1	⅝— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½%	6 %	6 %	5¼— 5¼xd	5¼— 5¼xd	5 7/16	5 5/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14 xd	13¾	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14 xd	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5½	5¼— 5¼xd	5⅜	5¼
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	100⅛	99
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	⅞	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	106½	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,281	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	4⅜— 5¼	5⅛	5
151,783£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	100 —103	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	101 —104	101 —104	...	...
389,521	Western and Brasilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	1 %	2%	...	1⅜— 1⅝	1⅜— 1⅝	1½	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10¼— 10⅝	10¼— 10⅝	10 5/16	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	103 —106	103 —106	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11 xd	10 — 11 xd	10⅞	10½
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅜— 6¼	6 — 6¼xd	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8½	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	113 —115	113 —115	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11 — 12	11 — 12	12	11 9/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13¼xd	12½— 13¼xd	12 15/16	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	123 —128	123 —128	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 11½	11 — 11½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13½— 14½	13½— 14½	...	...
220,000	Do. 4½% Deb. Stock, Prov. Certs (£30% to be paid) Rd.	...	...	...	...	51 — 53	81 — 83	82¼	82
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5½ — 5¾	5 — 5¼xd	5¼	5 3/16
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	7½— 8¼xd	8 — 9 xd	8½	8 7/16
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10 xd	9 — 10	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 7	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	105 —107	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16 xd	15 — 16	15	...
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14½— 15¼xd	14½— 15½	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	16 — 17	16 — 17	...	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	9⅜	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3⅞— 4⅛	3⅞— 4⅛	4	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½—15½	15 — 16	15¾	15 9/16

* Subject to Founder's Shares.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.
† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Aug. 16th.	Closing Quotation Aug. 23rd.	Business done during week ended Aug. 23rd, 1899. Highest	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3 — 3½xd	3 — 3½xd	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	17½— 18½	17½— 18½	18⅜	18⅛
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	14 — 14½	13¾— 14¼	14 7/16	13⅞
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	...	...	...	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	128½	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	*nil*	...	1⅜— 2	2 — 2¼	2⅛	1 15/16
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	*nil*	4 %	...	2⅛— 2⅜	2⅛— 2⅜	2¼	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½%	15 %	13 — 14	13½— 14½	14	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10⅜	10¼— 10⅜	10⅜	10 7/16
178,303	Do. do. do. £8 paid	10	...	...	...	8¼— 8⅜	8¼— 8⅜	...	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	2¾— 3¼	2¾— 3¼	3	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	5¼— 5⅜	5¼— 5⅜	5¼	...
630,000*l*	City and South London Railway	Stock	1 9/16 %	1⅞%	2⅛%	65 — 67 xd	65 — 67 xd	...	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6¼— 6⅜	6¼— 6⅜	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 —102	99 —102	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½%	6 %	6 %	1⅜— 2¼xd	1⅜— 2¼xd	2⅛	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½%	6 %	6 %	4 — 5	4 — 5 xd	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2¼	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	102 —105	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ⅞	⅝— ⅞	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	25 — 26	...	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	20 — 22	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½%	4½%	...	111 —114	111 —114	113½	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	...	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	103	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞%	3½%	3½%	7⅝— 7⅞	7⅝— 7⅞	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½— 14	13¼— 13⅜	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	38 — 42	38 — 42	40½	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9⅜	9¼— 9⅜	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	102 —105	102 —105 xd	103¼	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8¼—9¼.
British Aluminium, Ordinary, 9—10; 7 % Pref., 10—11.
House-to-House, 4½% Debentures of £100, 105—108.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13—14; 1st Preference Cumulative 6%, £5 (fully paid), 7⅛—8. Debentures, 106—109. Dividend, 1898, on Ordinary Shares 10%.
National Electric Free Wiring, 10s. paid, 1/16—7/16.
Smithfield Market Electric, 2—4.
*T. Parker, £10 (fully paid), 19.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, August 23rd.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a ,, Nitric .. .. .. per cwt.	22/-	22/-	..
a ,, Oxalic .. .. .. per cwt.	32/-	32/-	..
a ,, Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	35/-	35/-	..
a Ammonia, Muriate (crystal) .. per ton	£25	£25	..
a ,, ,, ... per ton	£23	£24	£1 dec.
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a ,, (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25	£25	..
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a ,, White Sugar .. .. per ton	£31	£31	..
a ,, Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks .. per lb.	3¼d.	3¼d.	..
a ,, Caustic (75/80 %) .. per ton	£24	£24	..
a ,, Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a ,, Recovered .. .. per ton	£5 10	£5 10	..
a ,, Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a ,, Crystals .. .. .. per ton	£8	£8	..
a ,, Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£294	£294	..
b ,, Sheet, in ton lots .. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2' to 12') basis per lb.	8¼d.	8¼d.	..
c ,, Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c ,, Wire, basis .. .. per lb.	..	8¼d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f ,, Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g ,, Wire (basis price) .. per lb.	10½d.	10½d.	..
g ,, Sheet .. .. .. per ton	£88	£88	..
g ,, Rod .. .. .. per ton	£88	£88	..
a German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/3	4/2 to 4/3	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i ,, Pig (Cleveland warrants) per ton	65/-	68/6	1/6 inc.
i ,, Forgings, according to size per ton	From £11	From £11	..
i ,, Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i ,, Wire galvanised No. 6 .. per ton	£13 15	£13 15	..
g Lead, English Ingot .. .. per ton	£14 10	£14 10	..
g ,, ,, Sheet .. .. per ton	£15 7 6	£15 7 6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 7	£8 7	..
d Mica (in original cases), small per lb.	1½d. to 6d.	1½d. to 6d.	..
d ,, ,, ,, medium per lb.	1/9 to 2/6	1/9 to 2/6	..
d ,, ,, ,, large per lb.	3/6 to 7/-	3/6 to 7/-	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p ,, r'l'd strip & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£8 10	£8 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	to £40	From £15	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£146 10	£146 10	..
g ,, foil .. .. per lb.	1/6	1/6	..
n ,, wire Nos. 1 to 16 .. .. per lb.	1/10	1/10	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	..
j ,, Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j ,, Hemp, 8 ply 10 lbs. .. per lb.	3½d.	3½d.	..
j ,, ,, Russian, 10 lbs. per lb.	4½d.	4½d.	..
j ,, Jute, 180 lbs. rove .. per ton	£13 10	£13 10	..
j ,, Manila, 24 thread .. per ton	£35	£55	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£28	£28 10	10s. dec.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakespeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

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n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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UNFAMILIAR APPARATUS.

The receipt of a large illustrated sheet of Blake's, of Accrington, hydraulic rams, brings to notice an unfamiliar appliance. Few know of the hydraulic ram, though there are considerable numbers in use. We believe the hydraulic ram was invented by Montgolfier. Its principle of action consists in allowing a considerable body of water to flow down hill in a pipe of some capacity and suddenly stopping the outlet. The descending water cannot be thus instantly checked, and its stored energy, being considerable, manifests itself as pressure, this being sufficient to open a small additional escape valve which communicates with an escape pipe up which a small quantity of the water is caused thereby to flow to a considerable height. The apparatus has no moving parts, except the large and small escape valves, the first of which is held open against the large flowing stream by a light spring or load, and closes when the decending stream attains such a velocity as to overcome the spring, while the second is kept shut by the pressure in the delivery pipe and only opens during the short period when the pressure in the outlet vessel is momentarily increased. Hydraulic rams are of two varieties; those in which part of the actuating water is delivered for use, and those in which an impure supply of water may be used to force a pure water up the delivery pipe. A ram may be counted upon for an efficiency of at least 50 per cent., and even 75 per cent. is claimed to be at times secured under favourable conditions. As rams call for no attention and will work continuously, it is surprising how a constant small supply aggregates during a 24 hours' day. Rams are made to give as much as 400,000 gallons per day, and rams are made that will force water as high as 800 feet. It is very much a question of proportion. To the engineer, the interest of the ram is that it can be employed in situations where any other form of water-raising apparatus would be much less suitable, and it can thus be conveniently used to force water from a distant stream to a steam-power station. As a rule, in this country a ram will be unaffected by weather. They are usually placed in a brick chamber, well protected by earth banking from frost, and their supply can generally be drawn from the stream at a protected point, sufficiently so to ensure constant working so long as there is a flow in the stream. We have ourselves known hydraulic rams to have been at work many weeks without even being seen during the time. We think station engineers might with advantage consider the question of using rams under certain circumstances.

CO-OPERATIVE PRODUCTION.

It is an easy matter for the working man to combine for purposes of purchasing and distributing goods. When he does so we do not find that he inquires too curiously into the origin of the goods he purchases nor as to whether they have been produced by sweated labour!—all he appears to care for is that the price shall be low and the quality high, and the bonus, or dividend, or surplus, call it what you will, shall be high. But co-operative production has far less attraction for him, and this was well brought out by Mr. Gerald Balfour when opening the Exhibition of the Labour Association for Promoting Co-operative Production on the 15th inst. From the tenour of Mr. Balfour's remarks, it would appear that he regarded the comparative failure of co-operative production as due to the fact that the co-operative societies, unlike the joint-stock company, did not employ the highest talent to be obtained, they did not pay the necessary salaries, and they did not invest the manager with the necessary supreme authority to command success. These necessary elements of success do not commend themselves to the workman who, as a small shareholder, is also, perhaps, a low-paid worker. He is apt to consider himself as badly treated if ordered about by the manager, who, perhaps, holds no shares. The so-called Co-operative Cotton Mills of Lancashire are often held up as examples of what can be done in the way of co-operation, but they are not fair examples. They are not strictly co-operative concerns, but are really only joint-stock companies with a free market for their shares. Mr. Balfour counselled moderation in the undertaking of production by co-operators. He pointed out as above and otherwise that co-operation involved several weak points, and his advice was to restrict co-operative efforts, for a time at least, to such industries as involved the fewest of such weak points. Curiously enough, though the statistics of English and Scotch co-operative production were not favourable, in Ireland they were better. Though the Irish movement was only 10 years old, there were already 400 co-operative societies in Ireland—banks, agricultural societies, but chiefly, we believe, dairies. Those who know anything of the conditions which obtain on an Irish farm, and the absolute heedlessness of dirt, cannot but appreciate well the reasons for the defeat of the Irish by the Danes. Equally will they appreciate the great advantage of the clean built dairy away from farm buildings, to which each small farmer may bring his few gallons of milk, and have it converted, in a cleanly manner, to a marketable article. But after all, the co-operative dairy in Ireland was undertaken by men who did not seek employment in the dairies; they are themselves the producers of the raw material, which we presume they are credited with, according to its value, by lactometer or other recognised system. As Secretary for Ireland, Mr. Balfour no doubt has had opportunities for gaining an insight into the Irish movement, which he so well referred to, and with which he rounded off his speech. But while we fully recognise the great benefits to be obtained from co-operative dairies in Ireland, we see, as we fully believe Mr. Balfour sees, that this is no real argument for a general co-operative production. It is really an argument for production on a larger scale than is possible to the owner of only two or three cows; it is an argument for cleanliness, for probably the majority of small Irish farmers have not a sufficient supply of clean water to hand, whereas the dairies are able to afford the expense of a bored artesian well, and of steam for cleaning utensils. They can afford De Laval separators; but a co-operative engineering shop cannot afford anything that is not within the reach of a wealthy private firm or of a joint-stock company. None of the reasons usually advanced in favour of co-operation operate to make Irish dairies a success. The Irish dairies employ paid servants, who are not co-operators in the sense of being proprietors, and any private capitalist could establish a dairy with equal success, and many would do so but for fear that some fine day their raw material would be withheld from them without reason. They would awake to find they had been boycotted for some fancied wrong they had done. The small farmers are not likely to boycott their own dairy, which must succeed if only it be kept clean. What they need is a sense of the presence of dirt. This sense seems to be strangely absent. Toleration of the stranger is also required; a stranger may do his best to establish an industry, and he will meet with every possible form of obstruction. There is no incentive to lay out capital in such a country, and the result is the general ruin which is so apparent in the South and West. The success of the co-operative movement in Ireland does prove what is possible in the country, but it tells us only too plainly that all this late success could have been achieved years ago but for the uncertainty under which capital is invested in Ireland. Exactly the same process has been going on in England for some years under the auspices of the Amalgamated Society of Engineers, and if the check of 1897 be not permanent, it will reduce English industry to as low an ebb as that of South and Western Ireland.

THE GLASGOW TRAMWAY ENGINE CONTRACT.

The following important letter on the above subject, to which we make reference at length in another column, appears in the *Manchester Courier*:—

"Soho Iron Works, Bolton, *August 16th*, 1899.

"Sir,—The *Manchester Courier* of to-day contains a paragraph to the effect that the Glasgow Tramways Committee had yesterday accepted the tender of an American firm for the engines required for the new power station at a price rather more than twice that tendered by a Glasgow firm of engine builders. We also submitted a tender for the engines, our offer being some £20,000 below the tender which is now stated to have been accepted, and we think we, and other British engine builders, may fairly complain of having been specially invited to incur the serious expense involved in the preparation of designs and estimates if it was a foregone conclusion that only the engines of one, and that an American, firm would satisfy the requirements of the committee and their engineer. Our experience in connection with this contract will probably be of interest to engine builders.

"On perusing the specification we found it to contain a number of anomalies which required explanation before we could prepare any reliable tender, of which the following are examples:—(1) Crosshead pins as large as, or larger than, the crank pins. (2) A piston rod 10 inches in diameter for both a single 88-inch low pressure cylinder and for each of the two 60-inch cylinders named as alternatives, the high pressure rod in each case being 9 inches in diameter. (3) A single 88-inch cylinder named as the equivalent of the two 60-inch ones, 85-inch being the actual equivalent, though a still smaller one might reasonably be used, owing to the loss by friction being less with the two-cylinder design. (4) A coupling apparently desired between the 100-ton fly-wheel and one of the bearings supporting it. (5) Crank discs, apparently of cast-iron, in place of the steel or wrought-iron cranks universally used in English marine practice for similar shafts. (6) A 32-inch crankshaft for transmitting 4,000 to 5,000 I.H.P. at 75 revolutions, against the 18-inch shaft which would about accord with English marine practice, the strengths of the two being as 5½ to 1. (Owing to the fly-wheel being interposed between the engines and the generator, the stresses on the crankshaft would be much less severe even under the conditions of electric traction than in the case of marine engines, liable to race in heavy weather.) (7) The suggested number of bearings and sections of shafting would not fit any usual arrangement of shafting that we could think of. (8) An oil pump specified to be of 'equal capacity' to a 2-gallon lubricator.

"With these anomalies before us, and being anxious to go fully and seriously into the matter, we sought and obtained an interview with the committee's engineer, visiting London for the purpose. No explanation was forthcoming, but it was pointed out that the dimensions, &c., were only 'suggested,' and we were requested to tender in accordance with our practice. This we did, submitting full designs and particulars, and adding—'We have given a great deal of consideration to the design and cost of the engines for which we have now the pleasure to quote you, being very desirous of obtaining the

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order for them; but we fully recognised that even the somewhat voluminous papers we are now sending to you do not by any means cover the whole ground, and we wish to express our readiness and desire to have the opportunity of discussing the various points with your engineer, should our tenders be acceptable to your committee; and, in such case, we have no doubt that we could come to a full and satisfactory understanding as to both the general design and the details of the engines which are required.'

"We next received an official communication to the effect that whilst the total weight of our engines seemed satisfactory, our dimensions differed so much from those specified that it was desired to know whether we were prepared to accept the latter. We replied that the specification not being quite clear we could not give an unqualified answer, but asked an interview in order to arrive at an understanding. This being declined, we submitted further designs, explaining the nature of our difficulties, and offering to go further into the matter on being informed as to the wishes of the committee, also renewing our offer of a personal interview.

"On the evening of August 14th we received an official telegram from the town clerk, inviting our attendance at a special meeting of the Tramway Committee to be held the next day 'in order to explain any points in connection with our offer.' We gladly made a special night journey to Glasgow for the purpose, but, after waiting outside the committee room for some time, were told that the committee had declined to see any tenderers, and decided to recommend the acceptance of an American tender.

"So much is heard at the present day as to orders going to America which ought to be executed in this country that we think the above account of our experiences and the difficulties thrown in our way cannot fail to be interesting to other contractors as well as to the Glasgow ratepayers.

"We desire specially to call attention to the fact that in such a highly technical matter as that in question we were denied the opportunity of discussing or explaining a single technical point in connection with our tender or obtaining an explanation of difficulties involved in the specification. Whilst personally we received every courtesy from the officials with whom we came in contact, we must maintain that we as a firm were treated in an unbusinesslike and inconsiderate way, if only on the ground that we were invited to tender for, though apparently deemed incapable of carrying out, so important a contract. On this point we venture to quote an extract from a letter received from one of the most important South African houses, to whom we have supplied a number of large engines for gold mining purposes, and from whom, in view of this business, we asked a comparison of our own and American engines. After explaining that these engines are employed under very arduous conditions, they add:—'Coming to the point of the actual quality of material and workmanship, we may say that your engines are distinctly superior to the American engines that we have seen, and which cover those made by the leading makers in the States. For instance, where you employ cast and wrought-steel the Americans generally use cast-iron. We are bound to say that these American engines work well, but we are convinced that, in point of durability and the important question of repairs, they do not compare favourably with your engines, and in cases where stoppages would involve serious consequences, we should certainly prefer to put down one of your engines rather than any American engine we have seen, and we have had very considerable experience. We may inform you that the leading American engineers have inspected the engines supplied by you, and have expressed their admiration of same. As far as we are concerned, we can only express our entire satisfaction with the engines you have supplied us.'—We are, Sir, yours, &c.,

"For Hick, Hargreaves & Co., Limited,

"Andrew Reason, Secretary."

The E. P. Allis Company, of 39, Victoria Street, S.W., sends us the following copy of a letter adressed by it to the *Manchester Courier*:—

"August 22nd, 1899.

"To the Editor of the *Manchester Courier*.

"Sir,—We are builders of Corliss steam engines, and have for many years made a speciality of electric traction plant. In its interest we tendered to the specification issued by the Corporation of Glasgow for its tramway station engines. The Tramway Committee favourably considered our tender. The Council refused to pass the findings of the committee, and we are informed that a new competition is to be opened.

"We are, of course, unable to more than guess at the reason for such action. There was nothing in the specification at which anyone familiar with the demonstrated requirements of large electric traction plants could cavil. Naturally it did not follow British practice, for the exceedingly simple reason that there is no such application of electric power in the United Kingdom. It was simply a model plant, designed in the light of great modern experience, with a view to rendering the best economies to the municipalities to which it was offered.

"It was presumed by us that the committee to which the interests of the Corporation were committed knew what it was about, both in the selection of its engineers and in approving the specifications prepared by them. We did not think it necessary to visit Glasgow to make personal appeals to the members of the Local Government, or to resort to the columns of the public press for support while the matter was under consideration. We tendered absolutely to both alternatives of the specification, and we certainly believed that an American house, invited to an open competition by a great Corporation, might reasonably expect to be squarely and fairly dealt with.

"We repeat that the specification, as submitted to competition, embodied nothing but the results of the best accepted practice of similar installations. The only 'anomalies' discovered by our competitors arose out of their ignorance of the conditions that exist, and their inexperience of those methods of construction which have been found to best meet those conditions. Furthermore, every advantage lay with the British builder. The engines are special, therefore all who tendered were on the same footing as regarded design, plans, patterns, &c. The Allis Company were handicapped by a 1,000 miles of inland and 3,000 miles of ocean freights. Its engineers made that long and costly voyage to prepare their tender, not the 'special night journey to Glasgow' (from Bolton!), which one competitor so pathetically deplores in an open letter to the press.

"We did not take it upon ourselves to instruct the Glasgow Corporation as to how a cheaper and less substantial and effective machine might be secured for its use. It could afford to purchase the best thing that money could buy, and we were luckily in the position of having at our disposal the men and tools and facilities which could turn out the best—and the best was specified to us.

"Our competitors have devoted much time and space to a demonstration of the various methods whereby they proposed to apply data derived from marine and other practice to the needs of the Glasgow tramway plant. That discussion may be of absorbing professional interest, may possess charms to the student of acrostics or anagrams, but we regret to say that we are unable to discover its practical value or its relevance to the question under discussion. The modern tramway power plant has been developed from 15 years' experience with tramway plant, and from some 50 millions sterling which has been expended on such plants, and the day when workers on traction problems drew inferential designs from marine, or shop, or rolling mill practice is now ancient history.

"The long and short of it is, that instead of meeting the question openly and fairly, our competitors have endeavoured to bring such pressure upon the Glasgow Corporation as may induce it to accept an article of their manufacture, even if it be inefficient, unreliable, or antiquated.

"If that end be attained, we fail to see that any result is gained by the Corporation from the long and careful study of electric traction which has been made by the Tramway Committee and its engineers, involving expensive journeys to visit the representative modern systems of the United States and Europe.

"We feel ourselves aggrieved, and, we think, justly.

"Our tenders, prices, and specifications have been openly discussed and every advantage now given to our competitors. We can see little of that 'fair play' so hypocritically invoked in a 'competition' which is reopened whenever a home competitor fails to secure the contract, or in re-casting specifications until the favoured bidder finds them adapted to his limitations. To invite American houses to offer under such conditions is not only absurd but radically wrong. If the game is to be played under such rules it would be vastly fairer to exclude the American manufacturer altogether, and not invite him to expend his time and money needlessly.

"It is undoubted that a municipality has every right to decide to support home industry to the exclusion of all outsiders, but it may very properly be questioned whether the proper time to arrive at that conclusion is after outsiders, at the request of the municipality, have placed at its disposal all their data under the mistaken supposition that serious business was offered.

"Referring especially to Messrs. Hick, Hargreaves & Co.'s criticisms which were set out at length in your columns a few days ago, we beg to say that the various dimensions of pins, piston rods, and cylinders on which they animadvert, coincide very closely with the accepted best American practice in such engines, and we would repeat that there is no other source from which practical results can be drawn. It is useless to discuss why this be so, especially as we do not presume that you would care to have the whole theory and practice of steam engineering as applied to traction and wherein it differs from marine work, set forth at length in your columns.

"In our copy of the specification no mention was made of a coupling in the two-crank engine. One was specified in the three-crank engine, but it was between the outer bearing and the generator, not as stated by Messrs. Hick, Hargreaves & Co. All crank discs supplied by the Allis Company for such engines are steel, and the specification called for cast-steel throughout. They were not 'apparently cast-iron,' as Messrs. Hick, Hargreaves & Co. put it.

"Their statement as to proper strength of shaft is also incorrect. The shaft would have to stand a torsional strain equivalent to 10,000 H P. or more (instead of the 4,000 or 5,000 H P. they refer to.) It would also have to carry some 100 tons of fly-wheel. Messrs. Hick, Hargreaves & Co. evidently disregard the trifling fact that the necessary area of bearing and lubricating surface has something to do with shaft dimensions.

"That the suggested number of bearings would not fit any 'usual arrangement of shafting,' of which Messrs. Hick, Hargreaves & Co. have cognisance, is eminently possible. It is, however, one very usual in traction practice. Possibly, they may have overlooked that bearing between the 100-ton fly-wheel and the coupling, already referred to.

"We are naturally interested in the somewhat lengthy but exciting account of Messrs. Hick, Hargreaves & Co.'s various peregrinations and failures to meet the Tramway Committee and its engineers before their tender was considered. May we venture to suggest that 'the officials with whom they came in contact,' evidently went to a considerable length of politeness when an engine maker, who was confessedly chasing them down to get them to take something they did not consider met their needs, 'received every courtesy' at their hands. Our own experience leads us to believe that scant courtesy would usually be meted out under such conditions.

"We have no objection to the '6-inch ad. reading columns' which Messrs. Hick, Hargreaves & Co. have ingeniously worked into their letter. That is good business, and we are not at all above doing the same ourselves when opportunity offers. We have a book of those ourselves which we are prepared to distribute broadcast. It would

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have been better though if Messrs. Hick, Hargreaves & Co. had taken their comparison between 'American' and English machines nearer home than Africa. The Allis Company now show a considerable number of engines of their make running in England, which are already available for purposes of comparison. By the end of this year, when the large plants we have now in hand for the Central London Railway, the Dublin, Bristol, Isle of Thanet, Sheffield, Cork, and London United Tramways, the London (Bankside and City Road electric lighting stations), and the Ellesmere Port Smelting Works are fairly finished, we shall be delighted to afford every opportunity for further comparison of design, material, and performance.

"We must, however, say that we note that Messrs. Hick, Hargreaves & Co.'s African friend can only compare their engines with the somewhat indefinitely stated 'American' type so far as 'material and workmanship' goes. Possibly the reason the Glasgow Committee approved of the Allis proposition was on the score of that economy in working and strength which the African gentleman does not touch on.

"At all events, we learn from Glasgow that our proposal surpassed all others in the guaranteed steam consumption, the weight and strength of the engines offered, and the rapidity with which delivery could be made. All good points, and well worth serious consideration.

"With our very sincere apologies for intruding so greatly on your valuable space, and like Messrs. Hick, Hargreaves & Co., 'appealing to your sense of fair play to insert this letter in your paper.'

"We are, Sir,

"Your very obedient servants,

"The Edward P. Allis Co."

The following letter appears in the *Glasgow Herald*:—

"Caledonian Hotel, Fort William,

"*August* 18*th*, 1899.

"Sir,—On a holiday in Scotland I have been following with interest the question of the Glasgow electrical tramways and the recommendations of their American engineer. Your report to-day is especially interesting reading, and if you will permit, I should like to make one or two remarks. Mr. Paton must be in ignorance as to what other countries in Europe have achieved in the matter of electric traction, or he would not state that 'almost the whole traction engines working for tramway purposes in the world had been made by American engineers.' Allow me to remark that on the Continent he would not find many American engines, but absolutely as good, efficient and economical machines by makers such as the Goerlitz Company (Germany), Franco Tosi (Italy), and Vanden Kerchove (Ghent). The Corporation of Glasgow, if real Free Traders, could therefore quite as well have asked any of the above Continental firms to tender, and I know they would have got quite as good an engine, delivered and erected within 12 months. But really there was no need to go outside the United Kingdom. Engineers such as Messrs. Hick, Hargreaves & Co., of Bolton, or Messrs. Browett & Lindley, of Patricroft, Manchester, could easily supply what was required without fear of constructing fly-wheels that burst, as they do in the U.S.A. But one cannot blame Mr. Parshall. As an American, with purely American experience, he has a bias in favour of engines he knows; and that is natural. Glasgow appointed him, and must take the consequences. To many of us engineers, however, it appears strange that the Scottish city did not consult one of the highest British authorities—namely, Prof. A. B. W. Kennedy, F.R.S., himself a Scotsman—than whom none probably has greater experience in matters relating to steam engines, as well as in matters electrical. I have the honour to be connected with the English branch of the largest German firm of electrical engineers, the 'Allgemeine Elektricitäts-Gesellschaft'; and, although we could have offered Glasgow quite as good a plant as any American firm, we did not tender, as it appeared a foregone conclusion that the orders would go to American firms, such as the Allis Company, the Thomson-Houston and Westinghouse Companies. Charles Weiss."

SOME COMMENTS ON THE HARTFORD LONG-DISTANCE TRANSMISSION PLANT.

By E. K. Scott.

The introduction of the rotary converter into practical electrical engineering has brought forward a number of special features, and one of the first papers to give particulars of these in any detail is that recently presented to the National Electric Light Association at New York by Prof. W. L. Robb. The author of the paper describes the conditions under which the two-phase transmission plant at Hartford is operated; the difficulties met with; the way they have been overcome, and the advantages which have been found in the combination of rotary transformers and accumulators for electric lighting.

As the system described is more or less on the lines which are about to be introduced at Manchester by the Metropolitan Electric Supply Company, the Blackheath and Greenwich Electric Supply Company, &c., the following summary of the main points in the paper, and the discussion, may be of interest:—

GENERATING PLANT.

Power is taken from the Farmington river, about 11 miles from the city of Hartford, and the water-power at present developed is capable of delivering 1,200 H.P., the energy being transmitted by two-phase current at 10,000 volts and 60 cycles per second.

Steam Plant.—There is an auxiliary steam plant in Hartford itself, consisting of two compound condensing Corliss engines having a combined capacity of 1,600 H.P. These engines supply the power to operate one 600-KW. alternator and one 400-KW. rotary transformer, the latter so arranged that it can be connected with engines and operated as a direct or as an alternating current generator. The type is known in America as a "driven rotary." This rotary machine is worked as a generator whenever, owing to low water or repairs on the transmission line, the supply of alternating current is insufficient for the alternating current load and all the rotary transformers.

Parallel Running.—The three generating units—two operated by water and one by steam—have been continuously run in parallel during the last three years, and no difficulty whatsoever has been found, although the two sets of plant are of course 11 miles apart.

ROTARY TRANSFORMERS.

Three rotary transformers supply direct current to the three-wire direct-current system. One, mentioned above, has a capacity of 400 KW., and is located at the steam plant. Two others have a capacity of 250 KW. each, and are located in a battery sub-station, which is situated in the heart of the business section of the city, and about three-quarters of a mile from the steam plant.

Speeding Up.—Two of the rotaries are started and brought into synchronism by induction motors built on their shafts; the third is speeded up as a direct current motor, the current necessary for this being supplied from the accumulators.

Alteration of Voltage.—The machines are so designed that, by cutting in or out turns of the primary of the static transformers the voltage on the continuous current side may be varied between 230 and 360 volts. This wide range of voltage is necessitated by the fact that the rotaries are at times run directly on the line, and at other times used in charging the battery. The rotary transformers are two-wire, and simply supply the current to the outside wires of the three-wire system, the neutral wire being connected with the middle point of the secondaries of the two static transformers. This point being always midway as regards electric pressure between the two terminals of the rotary transformer.

Treatment of Carbon Brushes.—When first started there was considerable sparking at the commutator. It was found that very soft carbon brushes gave the best results, but without special treatment the sparking, although diminished, was still excessive. The following method of treating the brushes was found effective. The carbon brushes are first raised to a red heat, and then plunged in ordinary lubricating oil and allowed to cool.

Pumping of the Rotaries.—At the outset considerable difficulty was met with in preventing pumping when the engines were supplying power to the system, the pumping being traced to the variation in the angular speed of the engines. It was found that the tendency could be checked by varying the field excitation of the rotary transformers, or by temporarily throwing a portion of the load on to the storage battery. The 400 KW. rotary transformer, when tested by itself, proved to be free from any tendency to pump, either when operated from the steam plant, or from the water-power. When, however, it was thrown on to the line with the two other rotaries, they immediately began pumping, and it was found impossible to run the three machines together. The pumping in a rotary system seems to be cumulative; it is very easy to stop it if the proper remedy is applied as soon as the tendency is noticed, but if allowed to go on, it quickly gets beyond control. The impossibility of running the three rotaries together necessitated some cure, and this was found in attaching copper strips to the pole-pieces of the machine.

SYSTEMS OF DISTRIBUTION.

Two systems of distribution are used:—(1.) In the central portion of the city distribution is on the three-wire, 220-volt, direct current system. The feeders are lead-covered cables, drawn in cement lined ducts, and the distribution partly by Edison tubes and partly by lead-covered cables drawn in ducts. (2.) Outside the central portion of the city the feeders are supplied with two-phase alternating current at 2,400 volts pressure, and the distribution is on the three-wire, 220-volt, system, supplied from 10 or 20 KW. transformers. This service is partly underground and partly overhead.

Continuous Current Motors.—The direct-current system of distribution was adopted for the central portion of the city, as being the only one on which all kinds of service could be given from the same wires, especially if those wires were placed underground. In this section of the city a large number of motors are being frequently stopped and started, and it was considered that induction motors operated under these conditions would seriously interfere with the lighting service.

Induction Motors.—In certain sections of the city where the motors are in continuous use—for example, when they are used for running machinery in factories, and consequently are only started twice a day, there is no difficulty in operating induction motors and lights from the same system of mains.

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Arc Lighting.—The arc lamps are all of the enclosed type, some being operated by direct current from the three-wire network, and the others worked in series from constant current alternating transformers. About 400 watts are supplied to each alternating current lamp, the transformers being operated from sub-stations. The inspector of the district turns the lights on and off, and visits the transformer house once only during the night. The transformers were practically automatic. They were made of two stationary coils and two movable coils, balanced on knife edges. The only motion is at the knife edge when the transformer is started and stopped.

ACCUMULATORS.

The storage battery has a capacity of 2,500 H.P.-hours at a five-hour rate of discharge. All three rotaries and the battery supply currents to the same three-wire direct-current system, the battery being at all times kept on the line for the purpose of regulation, and to meet any emergency call for extra power.

Maintenance Guarantee.—The battery was bought under a five-year guarantee, which has since been renewed for five additional years. The renewals have not been in excess of what was expected, and no investment of the company has been considered more satisfactory than the battery. Whenever any plate or number of plates have lost one-third of the original capacity, they are replaced by new ones; in this way the battery capacity is never less than 90 per cent. of its original amount.

Advantage of Combining Rotaries and Cells.—The advantages of the rotary transformer and battery system to the Hartford Company have been very great, for they have been able to use a great quantity of water-power that would otherwise have gone to waste. This has been utilised at the peak of the load at the time when power is most valuable. The total output of the water-power during the past year was over 90 per cent. of the possible output.

When operating by steam the engines have been run at an economical load, the advantages of the storage battery being nearly, if not quite, as great in connection with the operation of the steam plant as of the water plant. The regulation of the system is much better with the battery than it could possibly be without it, and the service is much more reliable. The interlocking of the battery with the alternating current by means of the rotary transformers makes the battery act as a regulator on the alternating current system as well as on the direct. During the day time on Sundays the entire load, both direct and alternating, can be carried by the storage battery. The battery has frequently been allowed to feed the alternating system through the rotaries. The transformer and battery station is operated by three men—the superintendent (an expert in the care of batteries) and two switchboard attendants.

It will be seen from the above that Prof. Robb is most enthusiastic as to the value of a storage battery in connection with electric lighting. It is a curious thing that the American engineers should be only just recognising that, for regulation, and to carry over the peak of the load, there is nothing to equal the use of accumulators. The guarantee of 90 per cent. for five years is a particularly good one, and shows that the American accumulator manufacturers are more enterprising than the British firms.

The method of varying the voltage on the continuous current side of the rotary by cutting in and out coils of the static alternating current transformers is interesting; if for nothing else, that it shows that the subsidiary booster is not an absolute necessity for charging cells in large stations. The writer thinks, all the same, that the booster has come to stay.

If the method of quenching carbon in lubricating oil does all that is claimed in the way of stopping vicious sparking, it ranks as an important discovery. In any case it is easily tried, and the writer trusts some engineers-in-charge will write saying whether they find the method beneficial on English machines.

The question of the pumping of rotary converters brings forward an important question for engineers on this side, as there are very few places in England where the even turning of a water-power plant is obtainable. It is true that we have the three-crank high speed engine, and if pumping does occur, the method employed at Hartford can be used. It is just a question, however, whether it would not be better to fight shy of the rotary converter altogether, and employ instead a self-starting induction motor, coupled to one or two ordinary multipolar machines, as has been advised by the engineers connected with the Blackheath and Greenwich Company. Unless some method of greatly increasing the speed is adopted, as, for example, the writer's suggestion for running transformers vertically, the number of poles of the rotary converter must always be very much out of proportion to the output. If a draughtsman were to set to work deliberately to design a very bad continuous current multipolar machine, he would make it with three or four times as many poles as it need have, and place a set of brushes at each pole. Well, this is exactly what he has to do in getting out a rotary converter, because the number of poles is governed entirely by the speed and the frequency, and the armature must of necessity be parallel wound to get the proper connections to the slip rings. For power work only, there is something to be said for the rotary, because then the frequency may be low, say, 25 or even less, and the number of poles so kept within bounds. For various reasons, however, 50 cycles per second is more likely to be used in this country.

The neutralising of the armature reactions by having continuous current and multiphase alternating currents circling round one armature core saves something in material (just as a single core continuous current transformer is cheaper than if two machines are simply bolted together), but it must be remembered that the rotary converter has to be brought up to synchronism either by a separate self-starting motor or else with current from the continuous current side. This latter method presupposes that there is continuous current to draw upon, which, of course, may not always be the case.

Assuming that 250 KW. have to be dealt with, and that the live current is two-phase alternating current at, say, 3,500 volts and 50 periods per second; also that the lighting is from a three-wire continuous current network, with 440 volts across the outers, then a comparison of the two methods stands somewhat as follows:—

Rotary converter (running synchronously).	Self-starting induction motor, coupled to two ordinary multipolar dynamos.
Two static alternating current transformers, one in each phase.	None required, the full voltage being taken straight to the induction motor.
Four heavy low tension cables from the transformers to the slip rings of rotary.	None required.
Rotary running at, say, 500 revolutions, will have 12 poles. As armature must be parallel wound, there will be 12 sets of brushes to care for.	Dynamos built in the ordinary way on the most efficient lines. With series-wound armature there would be only two sets of brushes per machine.
To get the machine into synchronism, a small self-starting motor is required; or else switch-gear, to enable it to be speeded by working the continuous side temporarily as a motor.	The combination is always self-starting by means of auto-transformer. There is thus no need for special switch-gear on the continuous current side.
Voltage 460 volts across outers, with middle wire brought back to middle point of secondaries of the two static transformers. No regulation possible on each side of middle wire.	The voltage on each commutator, say, 230, the middle wire connected up in the usual way. Wide variation of voltage on each side by merely regulating field current.
For charging cells the voltage is varied by cutting in and out turns of the primary windings of the static transformers requiring special switch gear.	For charging cells the voltage may be temporarily raised by strengthening the fields of the dynamos, or if preferred a booster can be used.

The rotary converter takes up less floor space, but there is very little, if any, difference in price. Something may be saved in the second case by using a two-commutator dynamo instead of two separate machines, or a single commutator machine feeding direct on the outers may, of course, be employed.

THE LONDON UNITED ELECTRIC TRAMS.

THE London United Tramways Company has favoured us with drawings relating to its electrical lines within the County of London. The details of the scheme and the equipment were given in an article in our issue of July 7th. The line from Acton to Shepherd's Bush,

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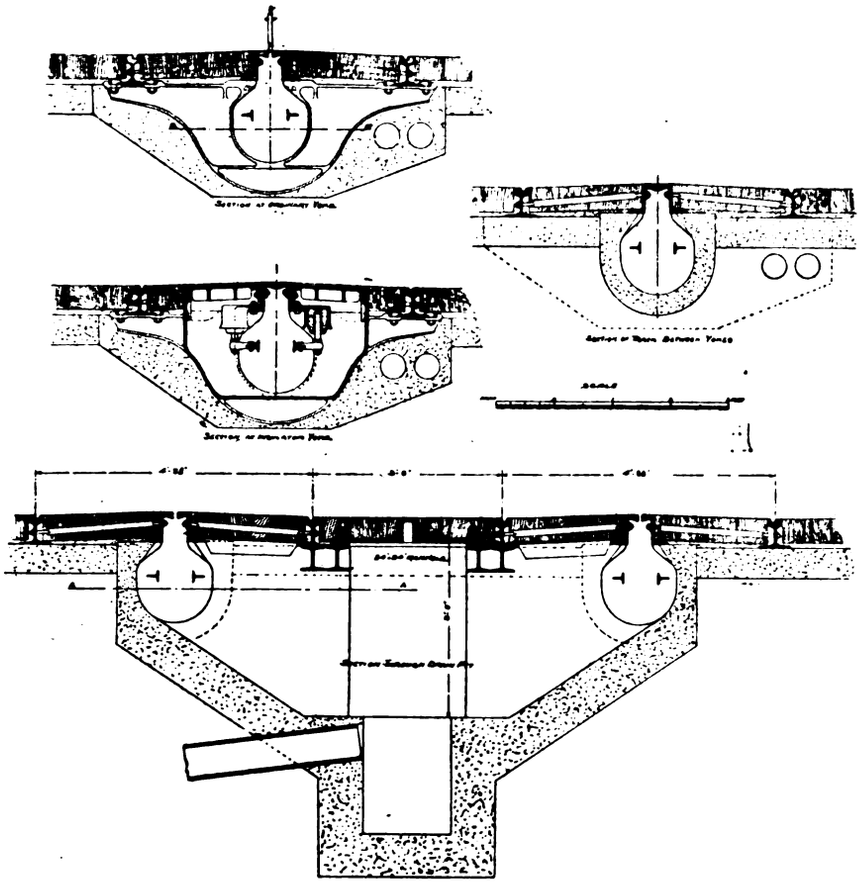
and from Shepherd's Bush to Young's Corner, at the western boundary of Hammersmith, will be electrically equipped on the overhead trolley system, and will connect with the Kew and Hounslow line at Young's Corner, so that the overhead trolley system will extend from Acton by way of Shepherd's Bush to Hounslow.



London United Conduit.

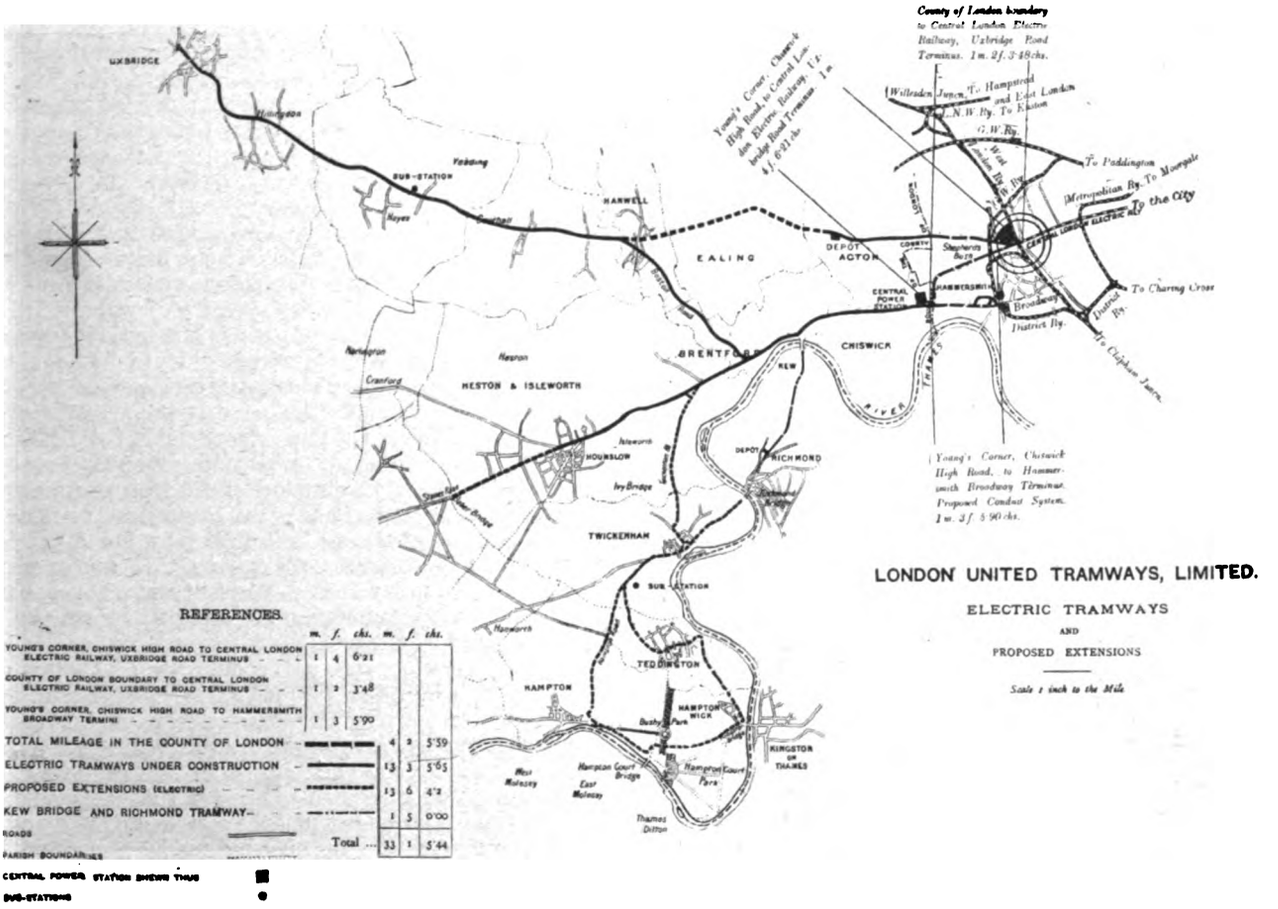
The proposed conduit system as shown on the drawings, which we reproduce, is for that portion of the company's lines between Young's Corner and Hammersmith Broadway, as required by the London County Council, a distance of about 1 mile. The roadway will be supported on yokes spaced 5 feet apart, bedded on Portland cement concrete; the depth of excavation required will be 3 feet from the upper surface of roadway, and there will be a slot ¾ inch wide in the centre of each line of track. Handholes with covers will be placed every 15 feet, and manholes connected with the sewers for draining the conduit will be provided at intervals of 150 feet.

In view of the importance of this system of the London United Tramways, and the great interest which is being taken therein, we reproduce a map showing the districts to be served by the several sections, with the extensions proposed up to June, 1899.

Mr. J. Clifton Robinson is the engineer to the company, Mr. H. F. Parshall being the consulting engineer.

THE NATIONAL PHYSICAL LABORATORY.

The definite initiation of this important step in the progress of scientific engineering in England has now taken place. We reviewed the proposal in its general aspect last year, when the stage had been reached of a consensus among the different authorities concerned as to the practical mode of carrying it out. At that time the committee appointed for the purpose had devised a scheme the Treasury was likely to accept, and now Parliament has voted



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the money, and the governing body of the new institution has been appointed for the purpose. The *Times* of August 15th gave some details of the arrangements that have been made.

The laboratory is to be an extension of the Kew Observatory in the Old Deer Park at Richmond, and for the purpose of the extension the Treasury is to find £12,000.

The annual income of the new institution will consist of £458, the endowment of the old laboratory from the Gassiot trust, of £4,000 from the Treasury, and of the fees received for the verification of instruments. These last have amounted annually to £2,700, and should produce a considerably larger income in the future. Thus the institution begins with an income of upwards of £7,000 a year.

The ultimate control is in the hands of the Royal Society, the immediate control in the hands of an executive committee and a general board, any alteration in the constitution of the two latter bodies requiring the consent of the Treasury. This is, of course, the usual arrangement of public institutions in England, and is immediately modelled upon the constitution of the Greenwich Observatory. An executive authority, a visiting authority, and an authority capable of altering statutes seem to combine in a convenient way the rigidity of a continuous rule and policy with the flexibility necessary for changing circumstances. Its success usually requires that the executive should be fairly susceptible of external influence, and the constitution in this case, so far as can be judged from the information before us, promises well. The executive committee will ultimately consist of 17 members, of whom five are official; viz., the chairman of the committee, the president, treasurer, and one secretary of the Royal Society, and the permanent secretary of the Board of Trade. Of the other 12, six are appointed, one by each of the principal technical societies; viz., the Civil, Mechanical, and Electrical Engineers, the Naval Architects, and the Society of Chemical Industry. How the other six are to be appointed is not mentioned. In the first instance, the existing Kew Observatory committee will be represented by six members, but on the expiry of their term of office their places will not be filled up.

This executive committee will report annually to the general board, a relatively large body, and will submit to them its scheme of work for the ensuing year. Six members of the general board will be nominated by the six technical societies beyond the six appointed to the executive council, and it is evidently anticipated that this strong representation of the commercial interests will keep the body fairly in touch with the practical requirements of the country.

The council of the Royal Society has appointed Mr. R. J. Glazebrook, the principal of University College, Liverpool, to be director of the National Physical Laboratory, and the following are the members of the executive committee:—

Lord Lister, P.R.S., Lord Raleigh (chairman), Mr. A. B. Kempe, Treas. R.S., Prof. A. W. Rücker, Sec. R.S., and Sir Courtenay Boyle (*ex officio*), Capt. W. de W. Abney, Sir N. Barnaby, Mr. G. Beilby, Sir E. H. Carbutt, Capt. E. W. Creak, R.N., Prof. R. B. Clifton, Prof. G. C. Foster, Mr. F. Galton, Prof. O. J. Lodge, Sir A. Noble, Prof. J. Perry, Sir W. Roberts-Austen, Prof. A. Schuster, Mr. A. Siemens, Gen. Sir R. Strachey, Prof. J. J. Thomson, Dr. T. E. Thorpe, and Sir J. Wolfe Barry.

In addition to the above, the following are also members of the general board:—Sir M. Foster, Sec. R.S. (*ex officio*), Sir F. A. Abel, Prof. W. G. Adams, Prof. W. E. Ayrton, Mr. H. Bell, Mr. A. Buchan, Mr. R. E. Crompton, Prof. G. F. Fitzgerald, Prof. J. Joly, Lord Kelvin, Mr. J. T. Milton, Sir W. H. Preece, Mr. W. F. Reid, the Earl of Rosse, Dr. R. H. Scott, Mr. W. N. Shaw, Mr. C. E. Stromeyer, Admiral Sir W. Wharton, and Sir W. H. White.

The following have also been requested to serve on one or other of the sub-committees above referred to:—Messrs. E. D. Archibald, C. V. Boys, Prof. H. L. Callendar, Messrs. Forbes, Carpenter, W. H. M. Christie, J. H. Dallmeyer, Prof. J. A. Ewing, Mr. S. Z. de Ferranti, Prof. J. A. Fleming, Messrs. R. E. Froude, E. H. Griffiths, J. Mansergh, T. Matthews, W. H. Maw, Dr. L. Mond, Hon. C. A. Parsons, Prof. A. W. Reinold, Captain H. R. Sankey, Messrs. J. Swinburne, G. J. Symons, H. A. Taylor, Prof. S. P. Thompson, Messrs. J. I. Thornycroft, C. H. Wordingham, and A. F. Yarrow.

Mr. Glazebrook is to enter office at the beginning of the new year, and a definite scheme of work is to be arranged during the autumn. The announcement of this will be of great interest, as it seems certain that some of the electrical questions must be among those to be dealt with first. Of all the appointments Mr. Glazebrook's is, of course, by far the most important, and we hope he will obtain a reputation for energetic administration and initiative not inferior to that which he now enjoys for scholarly exactness. He has hitherto come into contact with electrical engineers principally through his official comparisons of standards of resistance at the Cavendish laboratory at Cambridge.

SOME CONSIDERATIONS AFFECTING GAS ENGINES.

In connection with our recent remarks on the Westinghouse gas engine, it may not be amiss to go further into the subject with a view to establishing some fixed idea as to the working of gas engines in the production of electricity. When the gas engine was first introduced it was wasteful. It is wasteful still, but it was more especially so in its early days. Almost the whole of the endeavours to improve gas engines are along the line of economy. Something of this is due to the fact that gas engines were more essentially the small manufacturers' motive power, and the only available source of gas was the town main. Economy of gas was more valuable than regular turning. It mattered very little that a chaff-cutter or a small printing press had a very variable speed, and the gas engine, as developed in Europe, has almost invariably been constructed on the hit-and-miss principle of governing in order that the superior economy of this principle of action might be secured. Illuminating gas has been so costly in America, that the progress of the gas engine has been very slow up to recent dates; but now that it has been proved capable of being constructed in large sizes, the gas engine has appeared to Americans as eminently suitable for use with their cheap natural gas and with producer gas, and we cannot but think that in abandoning the more economical principle of hit-and-miss governing in favour of more wasteful moderated charges, American constructors have followed correct lines. Unless a gas engine is worked up to its maximum load, it cannot be other than irregular in action under the hit-and-miss principle, and so far irregular as to unfit it, in the opinion of some, for direct connection to lighting dynamos.

The Westinghouse engine, when using London gas at full load, will generate 40 KW.-hours on a consumption of 1,000 cubic feet of gas. At 2s. 6d. per 1,000 feet, this is equal to ¾d. per KW.-hour, or 1½d. including attendance, maintenance and depreciation, which compares favourably with the prevailing price of 4d. to 6d. per unit.

But 2s. 6d. is a very high price to pay for gas, and far away in excess of the cost of an equivalent capacity of energy in the form of producer gas, and there can be no doubt that a H.P.-hour can be produced by means of gas engines with not more than 1 lb. of fuel. Under these circumstances, it may well be doubted whether it is worth while to neglect the gas engine simply because it works to best advantage when governing on the system of moderated charges. Obviously, under any system of governing, the gas engine will be most economical when it is working up to its maximum effort. When working near to its maximum capacity, it cannot matter much whether one or the other system of governing is practised, for it is only at reduced load that the difference of the two systems is felt. There is no difference in the engines to account for any difference of economy—it is simply a question of the gas mixture. In the Westinghouse engine, the less economical system has been adopted, a system so far adopted by few others, and we believe by no maker of large engines. If the purchaser of a gas engine can lay down a gas plant and produce power with the requisite steadiness for less cost than he can produce the same power by means of steam engines, we are inclined to think he will adopt such gas plant, even if he is told that he might purchase other gas plant, say, 20 per cent. more economical, but not productive of equal regularity of turning. The large power user must have a certain steadiness of turning effort. This is his *sine quâ non*. Give him this and he will use that agent which gives it to him for least money. Offer him less regular turning at half the cost, and if he be a cotton spinner, he must decline the offer because he cannot produce an even yarn, and will also make much waste; if he be an electrician, he will have to decline again, because irregular turning shows itself in an unsteady light; if he be a water-

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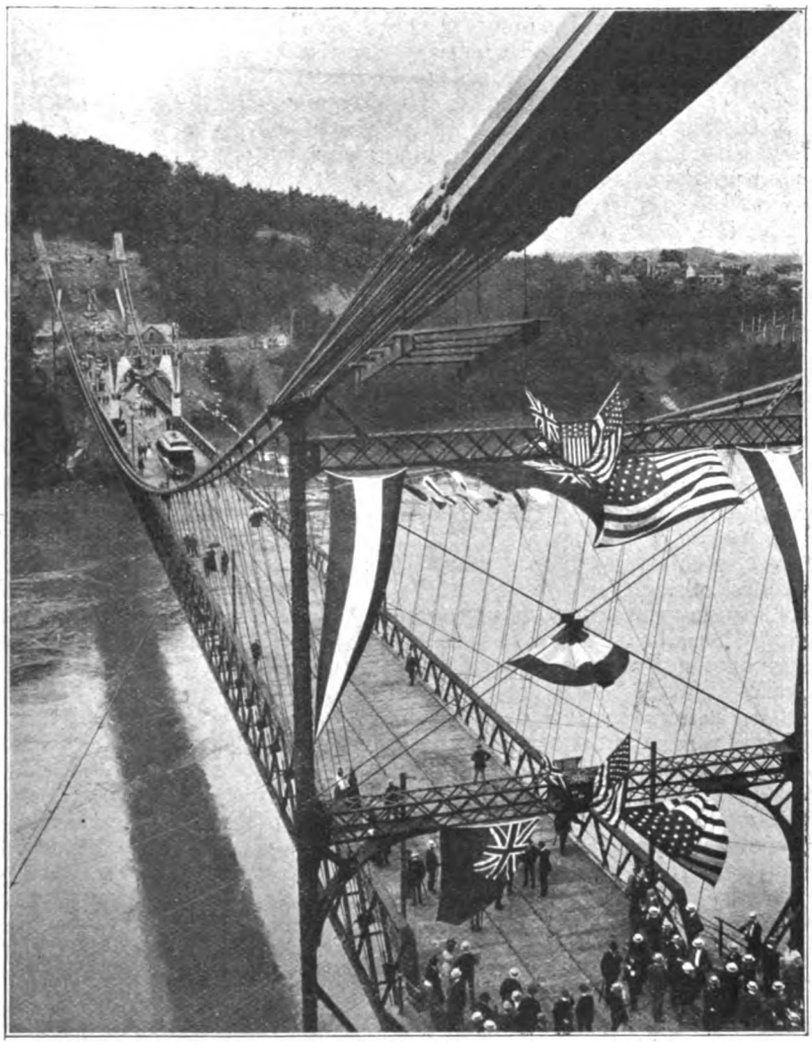
works engineer, he will accept because a few per cent. matters nothing in pumping, and it is worth while to save even 5 per cent. of fuel and accept a speed variation of, perhaps, double as much in doing so. It is claimed by the Westinghouse Company that the cost of power produced by gas engines fed by gas from a central gasworks, the engines being placed where now the rotary transformers are placed, should not exceed 50 per cent. of the cost of power produced by steam plant with high tension and step-down transformation. The suggestion is worth considering, but it should not be overlooked that if producer gas be intended, its volume per unit of capacity is very considerable, and a large gas engine will demand a gas main of correspondingly large capacity.

Natural gas will be consumed in a Westinghouse engine at the rate of 10½ to 12 cubic feet per H.P.-hour. It must be remembered that this gas is very rich; it has a calorific value of 1,000 B.T.U. per cubic foot; it is thus about tenfold richer than producer gas. Taking the case of an engine of 1,000 H.P., the consumption being 10 cubic feet of natural gas per H.P.-hour, we have no less than 100,000 cubic feet of producer gas to be conveyed to the engine. For argument, we will assume a velocity of flow of 100 feet per second. The engine is using 1,666 cubic feet per minute, or, say, 28 feet per second, so that the pipe area must be nearly 36 square inches. Thus each 1,000-H.P. engine would require a supply pipe 6 inches square, and for gas at low pressure square pipes would be quite suitable. According to Unwin, a desirable initial velocity of flow is 45 feet per second, at which velocity an initial pressure of 16·71 lbs. per square inch will transmit 31,815 cubic feet of gas per hour through a 6-inch round pipe 5,000 feet long, a rate less than half we have assumed above. Obviously, therefore, the question of gas transmission is of some importance, though the laying of a 6-inch pipe is not expensive, and 500 H.P., which could be carried by it, according to Unwin, is no small power at a sub-station. Considering the cheapness of gas-power under modern conditions there appears every reason to anticipate a considerable use of gas engines in the near future, if only gas engine makers will give an engine of sufficient regularity of turning effort as the Westinghouse Company now propose to do, and as any of our English makers are at full liberty to do if they will accept the system. Is it not better to use 1 lb. of coal by gas power than 2 lbs. by steam power? Yet the latter is adhered to, because when using its 1 lb. of coal the gas engine is not at its best. It is clear that if economy is specially desirable the gas engine must be worked as closely to its maximum duty as is consistent with certainty of action. If hit-and-miss governing be retained for its economy then must it be considered—we refer here to power purposes only, and more particularly to traction work—whether the voltage variation, which goes with economy of gas, can be permitted. The question is very much one for compromise between the best economy, steady turning and voltage, and fly-wheel weight.

THE NIAGARA SUSPENSION BRIDGE.

THE new electric railway suspension bridge of the Lewiston Connecting Bridge Company and the Queenston Heights Bridge Company, now controlled by the International Traction Company, was formally opened to the public on Friday, July 21st, in the presence of a notable assemblage of guests. Invitations of an elaborate character were issued by Hon. W. Caryl Ely, president of the International Traction Company, and these had the Stars and Stripes and the Union Jack in colours at the top.

Electric cars are now running across the bridge, but, says our correspondent, the belt line, of which the new structure is to be a link, has not yet been inaugurated, owing to the lack of connection on the New York side with the upper steel arch. This connection will be made as soon as the Commissioners of the New York State reservation grant the necessary right. The new bridge has a cable span of 1,040 feet, and a suspended span of 800 feet. It is 25 feet wide, and a single track for electric cars is laid through the centre of the floor. It is expected that



THE NIAGARA SUSPENSION BRIDGE.

all the cars of the Niagara region will be fitted so that they can make the round trip. On the day of the opening the structure was beautifully decorated from end to end, forming a magnificent scene. The American and British flags waved at both ends, and both were cheered to the echo.

WHAT'S A' THE STEER, KIMMER?

So far as we can gather from the local press and other sources, the Glasgow hubbub is, as the *Evening Times* dubs it, a case of "first she would, and then she wouldn't."

If our information is correct, the electrical adviser to the Tramway Committee was commissioned to draw up a general specification, so that all engine makers would be free to tender on their own standards, but for the purpose of assisting many British firms, the leading dimensions of the principal parts were set forth, qualified by the statement that these dimensions were not insisted upon.

Messrs. E. P. Allis and one English firm tendered to these

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dimensions, but the other makers varied greatly therefrom and from one another.

We understand that the E. P. Allis Company were considered to have sent in the best tender, both as to design, weight, guarantees as to efficiency, &c., and delivery, with one exception to this latter point. Messrs. D. Stewart & Co. could have delivered in the quickest time, but as their tender was only for about half the sum quoted by the Allis people, there was probably some misconception on the part of these contractors as to the nature of the specification.

We believe Messrs. Musgrave & Sons were well in the running for design and efficiency, but required 2½ years to complete, as against the 20 months of Allis.

Messrs. Stewart have apparently taken some decided steps over the matter, and the upshot of the whole thing is, that the Council has decided that a new specification be issued.

This seems hardly just to makers who have already tendered on a clear understanding of the requirements, since the Glasgow firm now knows what those contractors, whose estimates were in order, will again tender upon, and also their prices, and nobody seems to have thought that a similar course should be adopted with regard to the generators as well.

En passant, we may say that a good illustration of the Allis type of engine was given in the ELECTRICAL REVIEW for March 4th, 1898, but we have but little information on this side as to what renders American engines so superior to those of English manufacture for traction work.

During the discussion which followed the reading of Mr. Cuningham's recent paper on "Mechanical Traction by Electricity" before the Institution of Civil Engineers, considerable divergence of opinion was manifested as to the relative advantages of high speed and low speed engines for traction work, some of those taking part in the discussion manifesting a preference for low speed, others for high speed, and a third section stating that they used either type indifferently.

For our own part, we see no reason why the high speed of revolution which has become such a leading feature in English lighting practice should not be equally useful in traction work.

In the first place, the quick revolution engine is invariably a vertical, or, rather, inverted engine, whilst the slow speed engine, or, at any rate, the slow speed engine which has been sent over here from America is as invariably a horizontal one.

We are sure that there is no necessity for us to dilate on the many points of advantage which the vertical engine has over the horizontal type. It is quite sufficient to remind our readers that 30 years ago horizontal engines were common in marine practice, and that to-day the vertical type is universal, and that, moreover, in central station practice the same tendency has been manifested. We could instance numerous electric light stations which have been started with slow speed horizontals, but continued with vertical engines at more or less high speed of revolutions.

There is too much tendency on the part of those who have not the necessary ability to think for themselves to accept the view that the American practice is bound to be right because of the extensive experience they have had in matters connected with electric traction on the other side of the Atlantic. But is this necessarily so? We may remind our readers that in the States they were going on with belt drive and even using countershafts long after direct coupling had been recognised as the best practice and become of almost universal application here. We have no doubt but that in the States, as here, the vertical type of engine will become standard for traction work, and that the speed of revolution will be materially increased in the near future.

At present we take it that the type of engine which is being offered by the American builders as the best for traction work is either a tandem compound horizontal single-crank, with the generator at the side, as at Glasgow and Bristol, or a compound side-by-side double-crank, with the generator between, as for the Central London Railway. How does such an engine compare with those previously described at the Waterloo and City station, for instance, as representing English practice?

We have already pointed out the great advantage the vertical quick revolution engine offers in the way of space occupied. No doubt the experience at some of the lighting stations we know of will yet be repeated in connection with some of the power stations for traction work under conditions somewhat as follows:—

The necessity for additional plant is forcing itself upon the attention of the engineer, his station has been built in, and land for extension is unobtainable; it is necessary, therefore, to make the most of such area as he has left, or otherwise to incur the very considerable outlay involved in building an additional station elsewhere. Under these circumstances, although he may be prepossessed in favour of low speed engines, he succumbs to the logic of facts, and goes in for high speed sets.

We know of at least one important traction station at the present time where it is actually in contemplation to fill up the spaces between the existing low speed sets with a high speed set of three times the power of those originally installed.

Of course, with the reduced ground area, there is the smaller building to cover it, and lighter travelling crane of less span required. The reciprocating parts of the quick revolution sets are so much less massive and cumbersome than the similar parts of the low speed engine, parts which, in the quick revolution engine, can be easily handled by one man; in the other engine they require a crane and a man to work it before they can be moved. Compare, for instance, the size of the L.P. cylinder at the Waterloo and City station with that at the Glasgow station. Although the Glasgow engine is of approximately the same power the L.P. cylinder there is 24 diameter × 24 stroke against 14 diameter and 9 stroke at the Waterloo and City station. The disparity is startling, and when it is considered further what such a large piston involves in the way of load on the bearings and the much greater impact there will be on the crank pins, particularly if a load is suddenly thrown on when near the end of the stroke, it is clear that all the advantages do not lie with the low speed engine, bearing in mind that the piston speed of the so-called low speed engine may be, and often is, higher than that of its quick revolution rival, and that the impact depends on the piston speed and not on the speed of revolution.

Following on the large L.P. piston, it is not surprising to find that the American engine is distinguished by a large fly-wheel—in fact, for such an engine a large fly-wheel is a necessity if anything like even turning is to be had.

The fly-wheel performs a double function—first, to maintain a uniform angular velocity during each revolution; secondly, to serve as a reservoir of energy to meet the momentary variations in the load characteristic of the traction load diagram.

So far as the first of these functions is concerned, the Waterloo and City engine has, of course, an enormous advantage. A three-crank engine with a complete engine on each crank is the nearest possible approach to absolutely even turning, short of a steam turbine.

The American engine, with its single crank, is the reverse of this. Careful calculations we have made have shown that to attain the same degree of even turning with the Glasgow engine, as with the Waterloo and City set, the fly-wheel for engines of the same power would need to be 16 times as heavy.

The large fly-wheel is, of course, useful as a store of energy, but when the enormous dimensions and weights of the fly-wheels on some of the American engines are considered, one is constrained to consider whether the same result could not be obtained with something less. Take, for instance, the fly-wheels of the engines at the Brooklyn power station, particulars of which will be found in the *Proceedings of the Institution of Civil Engineers* for 1895-6, these being communicated during the discussion following Mr. Cuningham's paper on the Montreal Street Tramways. Fly-wheels 24 feet in diameter, and weighing 65 tons, for engines of 2,000 H.P., and working in conjunction with armatures 10 feet in diameter, and weighing 27 tons, are of truly Herculean proportions.

We estimate from the particulars given that the kinetic energy will not fall very short of 4½ foot-tons per E.H.P., the similar figure for the Waterloo and City station being 2½ foot-tons, and the perfection of governing attained shows that even this may be reduced for the future.

We have always understood that the close regulation on which American engine builders plume themselves was due

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to the perfection of their automatic expansion governors, but it would seem that the immense fly-wheel effects they use have more to do with it than the automatic expansion.

Unfortunately, too, these large fly-wheels have an awkward knack of going to pieces when least expected, with results worse than a boiler explosion; in fact, one might almost as well have a powder magazine in the engine room as some of the American engines, from the sensational narratives which are received from the other side from time to time.

We have seen some wonderful devices designed to meet this tendency of the fly-wheels to distribute themselves over the neighbourhood, but it does not seem to occur to our cousins across the water to alter the design of their engines, and so avoid the use of such monstrosities altogether.

The English type of engine for traction purposes is generally self-lubricating, which is a decided point of advantage; there is no running about with oil cans, careful adjustment of oil syphons, lynx-eyed supervision of numerous oil pipes to see that every bearing is getting its proper quantity of oil, and not too much of it either, no feeling the bearings at frequent intervals as with the low speed engines. This naturally results in a reduced cost for attendance. It is not unusual to enter a quick revolution station and find one man in charge of three or four 500-H.P. engines, but no one would think of running low speed sets of the same power with less than one man to each.

With respect to oil consumption, this again is in favour of the quick revolution type. The same oil is used over and over again, with the result that the consumption is reduced to a figure which is surprisingly low, and not only does the low speed or semi-high speed open engine use a great deal more oil, but the oil is thrown about the engine room with consequent discomfort and mess. Specifications for open engines used to read "Engines of the enclosed type will also be considered." It is now common to find a paragraph reading as follows:—"The engines must be of an enclosed or cased-in pattern so as to be clean running and to avoid throwing oil about the engine room."

Returning to Glasgow and its troubles, we may now consider what is likely to be the impression amongst engineers throughout the kingdom, since American firms have also carried off (if the Tramway Committee's recommendation is approved) three-phase generators, auxiliary generators, exciter generators, transformers and rotary converters, and boosters, to the tune of well over £100,000.

A consulting engineer is appointed to advise the Corporation at a fee not exceeding £10,000, whatever the capital expenditure. Presumably the object in view in making such an appointment is the saving of money by securing the best advice, so as to avoid, on the one hand, the risk of getting the work into the hands of incompetent contractors, who would land the Corporation in failure, and, on the other, to prevent paying through the nose to competent firms. If, however, the consulting engineer soars away over the heads of eminent engine builders, such as Hick, Hargreaves and Co., and Messrs. Musgrave & Sons, not to mention others, and recommends a higher American offer because the trans-Atlantic firm knows all about the work, having built so many similar engines before, does it not seem that money might have been saved by simply going in the first instance to a few of the best known American makers and placing oneself in their hands, without engaging an expensive consulting engineer at all?

The tramway department possesses a keen, shrewd, and able business man in Mr. John Young as general manager, an excellent and thoroughly practical engineer in Mr. Clark, and a perfectly competent and experienced electrical engineer in Mr. Le Rossignol.

These gentlemen were surely able to put the requirements of the department in such form that competitive offers could have been obtained from those firms which are known to have carried out such work before, and they would have had no difficulty in deciding to order all the dynamos from the British Thomson-Houston Company, the rotary converters and transformers from the Westinghouse Company, and the main engines from E. P. Allis & Co. The prices, probably, would not have been more than at present, and the consulting fee would have been saved.

We do not assert that this would have been the wisest course to adopt, but we do think that after employing a gentleman of such eminence as Mr. Parshall to draw up a specification, English engineers should have had no difficulty in complying with it; that this was by no means the case is evidenced by the letter of Messrs. Hick, Hargreaves & Co., which we publish on another page, although the E. P. Allis Co. contends that it contained nothing but the results of the best accepted practice. If everything had been plain sailing, and the American offers turned out lower with more speedy delivery, there would have been an end of the matter, but if the estimates of competent English builders are below those of the Americans, how is it that the expert is still obliged to advise the acceptance of the American offer at a much higher price?

What, in the eyes of the impartial observer, seems to have been done—and this is borne out by the Glasgow *Evening Times*—was to issue a specification with very little more than a general outline in it, and then a list of suggestions of what would be considered satisfactory, this list, however, not forming part of the specification, as there was no desire to hamper engine builders by tying them down to any particular pattern.

Quoting from the *Evening Times*, "Mr. Parshall, in his reports, pointed out that he had strongly hoped that some British engine maker could rise on this occasion and tender on an engine in all ways suited for electrical traction work. It was with the view to assist them in this direction that he gave dimensions and particulars in the specification. He should much prefer to be able to recommend the product of some first-class British firm, since he was alive to the feeling against engineers who recommended foreign-made apparatus. In the present case he had no alternative to recommending anything but the Allis engine. It was best for their purposes, the price was not unreasonable for what they proposed to supply, and this could be considered quite apart from the fact that they had greater experience than any other firm, and could supply what was required with absolute certainty, and without constructing anything that was new to them."

When the tenders were in, the process adopted seems to have been, judging from Mr. Paton's exhaustive comparative comments at the Council meeting, to take the Allis engine as the specification and judge all the others by it, condemning them in every detail wherein they differed from it.

A significant remark was that of Bailie King, who said that if anyone had given reasons for taking back the minute which was before the meeting, Bailie Paton himself had done so, when he stated that if Mr. Parshall drew out specifications for an engine, he could only draw one out for an engine such as the Allis people made.

We have tried to ventilate this very important subject, important alike to the English engineering industry and to the Corporation of Glasgow, with a mind free from bias, and we respect the sentiments of our evening contemporary which concluded its editorial comments with the following:—"If we must have the Corporation work done by purely British or purely Glasgow contractors, then the conditions of contract should be drawn out accordingly. That would be bad business, but it would certainly be more dignified than the system of inviting outsiders to tender and then searching for a loophole of escape. The city must above all things preserve its reputation for fair dealing."

One thing is quite certain—the Glasgow Corporation has perfect freedom to seek the best machinery in the market, and if, in the opinion of their expert, who, presumably, has an intimate knowledge of all and everything connected with the best electric traction practice, the plant is not forthcoming here, but is available and ready to hand in the States, he is within his rights in advising his clients to adopt a course which is based on the results of his own unique experience. If any blame attaches to anybody, surely it should rest from the beginning on the shoulders of the Tramway Committee.

We shall probably refer to this matter again in our next issue, when we hope to give our own opinion on the manner of drawing up the specification, which we have seen only since this article was written.

Presentation.—Mr. C. A. L. Prüsmann, who has left the Bradford electricity works, where he was assistant electrical engineer, to take up a chief engineership at Doncaster, was last Friday presented with a photograph of the members of the department, an illuminated address, and a travelling bag and dressing case, by the members of the staff at Bradford.

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NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

16,094. "A watchman's electrical tell-tale system." A. Eckstein and H. J. Coates. Dated August 8th.

16,132. "Improvements in method of and means for inducing and controlling magnetic circuits." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated August 8th. (Complete.)

16,133. "Improvements in alternating electric current motors." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated August 8th. (Complete.)

16,140. "Electrical resistances and heating bodies composed of metallic oxides." V. I. Feeny. (Allgemeine Elektricitats Gesellschaft, Germany.) Dated August 8th. (Complete.)

16,167. "Improvements in or relating to switches for electric traction systems." H. O. Joedicke. Dated August 8th. (Complete.)

16,175. "Improvements in and relating to electric batteries." C. Lievetus. Dated August 9th.

16,191. "Safety guides for trolleys used in overhead electric traction." A. W. Murray. Dated August 9th.

16,198. "Improvements in and connected with multiple switchboards." H. Oppenheimer. (Actiengesellschaft, Mix & Genest, Germany.) Dated August 9th.

16,199. "Improvements in and connected with switches for high voltage." H. Oppenheimer. (Actiengesellschaft, Mix & Genest, Germany.) Dated August 9th.

16,200. "Improvements in and connected with lampholders." H. Oppenheimer. (Actiengesellschaft, Mix & Genest, Germany.) Dated August 9th.

16,210. "Improvements in the manufacture of thin tubes or sheets of copper or other metal by electro-deposition." S. O. Cowper-Coles. Dated August 9th.

16,215. "Improvements in electrolytic baths." W. Walker, jun., F. R. Wilkins, J. Lones, and J. Lones. Dated August 9th.

16,225. "Improvements in conduits for laying electric cables." W. H. Nichols and W. T. Henley's Telegraph Works Company, Limited. Dated August 9th.

16,247. "A new material adapted for electrical insulation and also for many purposes for which ebonite, wood, and such like materials are used." A. Smith. Dated August 9th. (Complete.)

16,250. "Manufacture of colouring matters and their reduction products by electrolysis." R. M. Salher. Dated August 9th.

16,267. "Improvements in electrical apparatus for sorting articles according to one of their dimensions." W. H. Lock and J. J. Milner. Dated August 10th.

16,285. "Improvements in plugs for telephone switchboards." E. D. Pearmain. Dated August 10th.

16,290. "An apparatus for the temporary closing of an electric circuit-current by means of Herz's undulations." J. Levy. Dated August 10th. (Complete.)

16,293. "Improvements in the manufacture of leaden plates for secondary batteries or accumulators, and in moulds and tools to be used in such manufacture." P. J. Davies. Dated August 10th.

16,300. "Improvements in safety fuses for electric circuits." E. T. Goslin. Dated August 9th.

16,308. "An improved operating device for electric bells and house-telegraph signals." F. Schuchhardt. Dated August 10th. (Complete.)

16,311. "Improvements in or connected with dry core electrical cables." H. Savage and W. T. Henley's Telegraph Works Company, Limited. Dated August 10th.

16,330. "Improvements in switches for connecting electric machinery." W. F. Jones. Dated August 11th.

16,336. "An apparatus for controlling the supply of electricity." W. L. Hardman. Dated August 11th.

16,350. "A magnetic needle-threader." M. Molitar and F. Kern. Dated August 11th. (Complete.

16,352. "Improved system of telegraphy and transmission of currents of electricity." F. Bedell. Dated August 11th. (Complete.)

16,368. "Duplex electrical alarm." A. R. Warden and A. Hunter. Dated August 11th.

16,373. "Improvements in vibrating switches or contact breakers for induction coils, bells, and the like." J. Burns. Dated August 11th. (Complete.)

16,382. "Improvements in connection with spindles and the driving of the same by electricity.' J. G. Lorrain. (H. B. Sawyer and R. Robb, United States.) Dated August 11th.

16,387. "Improvements in brush-holders for electric machines." S. H. Short. Dated August 11th. (Complete.)

16,395. "A new and improved arrangement for controlling electric elevators." E. A. Wahlström. Dated August 11th.

16,410. "Improvements in electric arc lamps." A. Eckstein and A. E. Angold. Dated August 12th.

16,417. "Improvements relating to jointing electric cables." R. H. Hayne. Dated August 12th.

16,439. "Improvements in or relating to arc lamps." G. C. Dymond, of the firm of W. P. Thompson & Co. Dated August 12th. (Complete.)

16,444. "A method of receiving telegraph signals as displayed or photographed by magnetically deflected cathode rays." Siemens Bros. & Co., Ltd. (Siemens & Halske, Actiengesellschaft, Germany.) Dated August 12th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

12,714. "An improved insulating and carrying frame for accumulator electrodes." F. W. Schneider. Dated May 22nd, 1897. Relates to framework for insulating and supporting cylindrical or trough-shaped electrodes in vehicles and other places. It consists of perforated plates of hard rubber connected by bolts on which, between the plates, are fitted rubber sleeves. The bolts support the electrodes. 2 claims.

12,820. "Improvements in transforming continuous electric currents." A. Muller and H. Tudor. Dated May 24th, 1897. Relates to the transformation of continuous currents by means of secondary batteries. The batteries are divided into groups which are connected to the sections of a commutator, and an equalising battery is placed in shunt with the generator or translator. The conductors are connected to the brushes of a commutator driven by a motor. The secondary battery is divided into groups which are connected to the sections of the inner ring of the commutator. A high tension current is thus obtained in the conductors. To obtain a low tension current for the consumers, a similar arrangement of apparatus is employed, but the lamps, &c., take the place of the generator. To prevent sparking at the commutator, a separate contact-breaker is employed. It comprises a disc fitted with segments corresponding to the contacts of the commutator. Methods of arranging both batteries in groups to obtain any desired ratio of transformation are also described. 2 claims.

12,902. "Improvements in series parallel controllers for electric motors." P. V. McMahon. Dated May 25th, 1897. Consists of switching gear, of the kind known as series parallel controllers, for starting motors in series and placing them in parallel after a certain speed has been attained, as in the case of an electric locomotive or other electrically-propelled vehicle. An ordinary rheostat or starting switch, with contacts which are preferably circular, but may be rectilinear or of other convenient design, and a separate paralleling switch, with contacts mounted on the fixed insulating plate, are mounted on the same base and operated by the same handle. The brushes or the contact fingers of the paralleling switch are mounted on an insulating disc or arm, which is free of the handle of the rheostat switch, except during a certain portion of the movement of the latter towards each end of its throw when the projections engage with each other. It results that the change from parallel to series or *vice versâ* cannot be made without first putting in or out of circuit, as the case may be, the necessary resistances for preventing sparking. 2 claims.

12,942A. "Improvements in electrical ignition apparatus for explosion engines and for other purposes." C. M. Johnston. Dated May 25th, 1897. The sparking terminals in the cylinder of an explosion engine are connected with the secondary circuit of an induction coil. The primary circuit containing the condenser is excited by a battery, which is charged by a generator; it is broken and completed at the proper time by a switch. A large coil may be used without the condenser, or a large condenser without the coil. 8 claims.

12,945. "An improved electric arc lamp." F. Fouquet and J. W. Keys. Dated May 25th, 1897. Relates to arc lamps. A clockwork lamp, for continuous or alternating current at constant potential, is constructed as described. The upper carbon holder is attached to a long rod and the lower one to a short rod sliding in guide tubes. The rods are attached to the ends of a cord, which passes over two pulleys and under a pulley. The pulleys are carried by a lever at unequal distances from its fulcrum. The longer end of the lever supporting the lower carbon is drawn down by a spring separating the carbons when the lamp is not in use. The shorter end of the lever carries two cores within the two shunt coils of a fixed electro-magnet. The pulley turns on a stationary axis, and drives an oscillating balance when a pin on this is released by a notched plate on an arm of the lever by the action of the shunt magnet. The motion of the lever is limited by screws, and the tension of the spring is adjusted by a lever and screw. 1 claim.

14,010. "Improvements in electric motors for driving motor carriages, winches, and stationary machinery, also a portable motor for rotary hair and cleaning brushes for milling, drilling, and other purposes." H. W. Headlang. Dated June 19th, 1897. Relates to electric motors for driving motor carriages, tram-cars, winches, and stationary machinery; also, in a portable form, for drilling, milling, rock and blasting drills, rotary hair and cleaning brushes, dentists' tools and other purposes. The armature is fixed on its shaft, and the field magnets are carried by a casing running loosely on the shaft, and the shaft and casing are connected by bevel, skew, or worm gearing with one or more intermediate shafts which transmit the power. In a form shown, the armature shaft and field-magnet casing carry bevel-wheels which gear with bevel pinions on an intermediate shaft which by means of a worm may transmit the power to a motor-car axle. A second shaft and axle may be driven in a similar manner. The armature shafts and driven shafts are supported in ball bearings in a frame. This frame may be pivotally suspended from the underside of a motor-carriage frame. When employing worm gearing, worms of opposite pitch on the field-magnet hub and armature shaft gear with two parallel, which they drive in the same direction. The form of the supporting-frame may be variously modified. 6 claims.

14,023. "Improvements in alternate current motors." A. Semmes. Dated June 19th, 1897. To facilitate the starting of alternating current motors, the field-magnet is provided with two sets of windings, one of which is adapted to produce a larger number of poles than the other. The former is employed when starting the motor, after which it is switched out and the other brought into circuit for continuous running. A field magnet is shown, the running winding of which is composed of four coils in conjunction with their usual starting coils, while the other winding is composed of eight coils together with their starting coils. The armature may be wound with a single winding having a resistance adapted to the running winding of the field magnet; or it may be wound with two windings, one of which is operative at starting and the other in continuous running. 4 claims.

15,011. "Improvements in brush-holders for dynamo electric machines." J. H. Yearsley. Dated June 22nd, 1897. Brush-holders.—The brush is contained in a box and is pressed against the commutator by a pair of arms pivoted to a bracket on the box, and united by a bridge-piece acted on by a spring. The tension of the spring can be adjusted by means of a screw with nuts. 2 claims.

15,239. "An improved manufacture of electrical resistances." J. F. Bachmann, A. Vogt, J. Kirchner, A. Konig, C. C. Weiner, and A. Jorg. Dated June 25th, 1897. Resistances are made of mixtures of powdered conducting and non-conducting or badly constructed materials, which may be rendered plastic or liquid and moulded or cast to any desired forms, and dried or baked, or may be used as powders. The conducting material may be formed in the baking by using decomposable ingredients, such as tar, sugar, or metallic compounds, or may be powdered metal or carbon. The other materials may be aluminia, gypsum, cement, clay, &c., and binding materials, such as water, glass, zinc, chloride, sugar, gum, &c. The resistances may be hardened with alum solution, and may be glazed or otherwise protected. Such resistances may be moulded in the form of receptacles which can be electrically heated for cooking or other purposes; the powders may be enclosed between a pot and an inner receptacle. 1 claim.

15,288. "Improvements in electric arc lamps." L. Bardon. Dated June 26th, 1897. Relates to lamps. The regulating mechanism of a brake lamp for continuous or alternating current at constant potential is shown. The carbon holders, of which the upper is the heavier, are hung by pulleys in loops of a cord; this is attached at one end to the top plate of the lamp, passes round three pulleys on fixed supports, and is attached at the other end to a pivoted regulating lever; the third pulley is attached to a brake-wheel. The lever is bent to carry cores over two shunt coils, and is linked to a counterweighted lever. The wheel is acted on by a brake lever when this is not raised by the action of the coils on the regulating lever and a contact piece linked to it. On starting the lamp the cores hold up the brake until the greater weight of the upper carbon holder places the carbons in contact; they then allow the lever to move so that the brake is applied and the lower carbon lowered, an arc being thus struck. 3 claims.

26,660. "An improved electric arc lamp." R. W. L. Holsten and the Elektrische Bogenlampenfabrik Naeck and Holsten Gesellschaft mit beschrankter Haftung. Dated November 15th, 1897. Relates to arc lamps.—A weighted upper-carbon-holder and a lower one, not shown, are suspended by a chain on a chain-wheel and a pulley. The wheel is geared to a rotary fly in a fixed frame and normally is prevented from rotating by contact of the fly with a finger, supported by a feed-lever which is pivoted and acted on by a spring. The pulley is carried by a striking lever pivoted at and acted on by a spring. The levers carry cores near a shunt solenoid. When current is supplied, the lower carbon is raised by the action of the core and pulley, and an arm of the lever tilts the finger so that the fly is released, and the carbons move together; they short-circuit the solenoid, which drops the core, so that the lower carbon strikes the arc. For continuous current, the solenoid and cores may be replaced by an electro-magnet and armatures. 1 claim.

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THE

ELECTRICAL REVIEW.

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THE

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THE USE OF GAS AND ELECTRICITY.

SOME few weeks ago one of our building contemporaries, in summarising what is considered the peculiar condition of London gas affairs, stated that: "In spite of the increasing adoption of the electric light, the annual output of gas continues to increase, and has reached a volume almost inconceivable in its magnitude." The most pessimistic holder of gas shares could hardly fail to be favourably impressed with such a statement, and we feel sure that no member of the great rival industry would be sorry to learn that gas companies are generally having a good time. It is not long ago that orators on electrical subjects endeavoured to modify the scare among that section of the public interested in gas companies, by pointing out that wherever electricity had been adopted for lighting the gas company had gained in prosperity. If gas were used only for illuminating purposes, such a statement would soon cease to possess any significance, for it can hardly be doubted that the growing use of electricity must have had an appreciable effect on the consumption of gas for merely lighting purposes. It is not difficult, however, to ascertain the real cause of the continued prosperity of gas undertakings, for Mr. George Livesey, the chairman of the South Metropolitan Gas Company, declared in evidence before a Select Committee of the House of Commons that 50 per cent. of the gas sold by his company was used for purposes other than lighting. Unless some extraordinary changes take place in the method of utilising gas for illuminating purposes, electricity ought in the very nature of things to supplant it as a lighting agent; but what a long road to travel before we reach such a desirable consummation! At the present moment in some of the larger towns there is probably sold twenty times as much gas as electricity, and if such a demand were to be met by electrical works it would need a radical departure from the present system of carrying out extensions.

It is, of course, difficult to estimate precisely what effect the introduction of the Welsbach burner has had upon the electricity supply industry, for hitherto the only limit to the increased use of electricity has arisen from the difficulty in obtaining the necessary electrical machinery. In all probability the introduction of the incandescent burner has caused many people to retain gas, who otherwise would have adopted electric lighting, and it cannot be denied that it possesses some marked advantages. At the same time the disadvantages of the system are apparent, and in spite of the improvements effected from time to time, it cannot be expected to reach the pitch of perfection by providing a light that burns in a vacuum, and thus guarding against the vitiation of the atmosphere. The breakage of delicate mantles has still to be reckoned as part of the system, but according to our contemporary, other causes have tended to prevent the wider use of incandescent gas mantles, for we read that, "Owing to

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the manner in which the incandescent burner and mantle business has been handled in this country, the cost of every mantle to the London gas consumer is some 300 per cent. higher (1s. instead of 3d.) than to consumers in certain Continental towns. Similarly, the prices charged for incandescent burners are, in this country, absurdly high. Ceaseless litigation, and what we must consider the over-capitalisation of a great company, is largely responsible for the fact that in past years London consumers of gas have paid far too heavily for incandescent gas appliances, and the friends of the gas industry will have cause to rejoice when the master patents expire, and mantles and burners can each be purchased for a few pence apiece." If our contemporary is correct in its views, the rivalry of the incandescent gas burner might have been a more formidable affair than it has proved; but one cannot help remarking that, in spite of the cheapness of gas mantles on the Continent, electricity undertakings there do not appear to have suffered to any great extent. Probably by the time the master patents of the gas burners expire, a form of incandescent electric lamp may have been evolved, which will ensure for electricity a continuance of past favours; we have already indicated the direction in which investigators are working.

It cannot be denied that of late years the gas companies have shown remarkable activity in developing the use of gas for heating and cooking purposes, and doubtless the greater portion of the 50 per cent. of which Mr. Livesey spoke goes in this direction. Both as a means of cooking and heating gas has proved itself to be an economical agent, and the hiring out of appliances has aided very materially in advancing this side of the business. With even greater facility electricity can be applied to similar purposes, and that the merits of electric heating are fairly widely appreciated is evident from the use that is made of electrical heating appliances. The electric heater itself is probably one of the most efficient devices in existence, but it is doubtful, under present systems of generation, whether it will ever achieve a popularity similar to that of gas. We are not unmindful of the fact that electric heating possesses the features of cleanliness, convenience, and facilities for regulation and control that render it unapproachable under certain conditions, but, unfortunately, it is likely to remain expensive for some time to come. Mr. Alton D. Adams, in investigating the various systems of heating, showed the total combustive energy which could be derived from different devices. Steam heat, with good boilers, gave 70 per cent., steam heat, with ordinary house boilers, 40 per cent., hot water heat, with ordinary house boilers, 40 per cent., heat from stoves, 30 per cent., and heat from electric heaters, 7 per cent. The unfavourable position occupied by electricity arises from the losses in the boiler, the steam engine and dynamo, and the conducting medium. As we have indicated, there are many directions in which electric heating might be used with advantage, and in some cooking operations where the cost of labour was high compared with the cost of heat, there might be a favourable field, but for general every-day use there does not appear to be any immediate prospect of electricity competing very seriously with gas.

Where electricity can be obtained for motive power purposes, there does not appear to be any great likelihood of its being ousted by gas, for gas motors have none of the facilities of starting or of regulation that are possessed by the electric motor.

There are certain directions, however, in which gas ought to have been used to a greater extent, that is, in the driving of electric generators. We are not unmindful of the splendid work that has been done in private installations, but we have rather in view the use of gas in driving large public electricity works. It is true that two or three of the public instances in which gas-driven electric generators have been employed, have been comparative failures, but the causes are clear, and if they are properly recognised by gas engine builders, similar troubles are not likely to occur again.

There are many electrical men who are convinced that the most economical method of distributing electricity through a town would be to place dynamos and gas engines at substations and utilise the gas from the street mains for driving purposes. Such a scheme has much to recommend it, but it is doubtful whether the modern gas company would appreciate it sufficiently to bring down the price of a gas to a point at which the experiment could be tried. There was a time, not far distant either, when the gas companies of this country, by adopting some such policy, could have controlled the future of electricity supply; they missed their opportunity and have had to face a competition, which, with the apparently limitless possibilities before electricity, is bound to become more severe from year to year.

Viscosity.—A discourse, given by Prof. H. S. Hele-Shaw at the Royal Institution seven months ago, on "The Motion of a Perfect Liquid," has at last, after many retardations and eddyings, trickled through to the press, and appears in the form of an illustrated article in the *Engineer*. We are first shown diagrams representing the stream lines in the case of water passing through channels of various forms, and the tumultuous conditions under which water moves when it has to dodge through sluices, or along narrow river beds. The effect of a widening in the waterway is next discussed, the inertia of the particles is considered, and we are led to see that the impact of the particles in the wider portion necessarily involves greater pressure in that part. By introducing colouring matter or air-bubbles into the water, bands appear, whose widths indicate the local velocities and pressures. Having then determined the pressure at every point of the liquid, the directions in which the particles are moving, and their velocity at every point, we may know, or may think we know, all about its motion. Unfortunately, at this juncture viscosity comes into the problem, and hence arise immense differences between the flow of an actual liquid and the behaviour of a so-called "perfect" liquid. Viscosity turns out to be the cause of half the troubles and all the sea-sickness of the universe, but with some compensations. If there were no viscosity there would be no waves raised by the wind, there would be no tidal flow, rivers would move with incredible velocity, and rain would fall in one big unhesitating drop.

Naming the Motor Carriage.—Let it not be thought that there is an end to the American controversy as to what we are to call a motor carriage. Mr. C. E. Woods, of Chicago, does not allow our contemporary, the New York *Electrical Review*, to have it all its own way, for, although to our namesake's mind the matter was settled once and for all, he suggests to the public in the American *Electrician* a name claimed to fulfil all requirements:—

> That is the name *autobaine*, which, translated, means automatic waggon, *baine* being derived from an old Greek word, meaning waggon; so we have for the name of the vehicle, *autobaine*, *autobainer*, as applied to a man operator, *autobainess*, as applied to a woman operator, and *autobaining* or *autobaineering* for the act of using the vehicle, in addition to which, this name is applicable to any kind or form of self-propelled vehicle.

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THE GLASGOW CORPORATION CONTRACT.

Since our article of last week we have had the opportunity of perusing the specification of Mr. Parshall, which it will be remembered was issued as a guide, not as a binding specification. He states that he wished to allow the "fullest latitude" to contractors. Now, from the letters of the Allis Company and Messrs. Hick, Hargreaves & Co., it appears that the dimensions given by Mr. Parshall are some of the points in dispute. Though not forming a part of the obligatory specification, these dimensions are there, and may be assumed to represent Mr. Parshall's ideas of design. They are endorsed by the Allis Co. as the best practice. There are two alternatives in the specification, but both are for engines of 75 revolutions, 150 lbs. pressure, and for 2,500 KW. capacity. In each the stroke is the same, and it may be assumed that the cylinders should be the same. Yet in one case the H.P. cylinder is to be 42 inches diameter, in the other 44 inches. We do not think much of this discrepancy. H.P. cylinder proportions may be varied with little or no difference in economy. The difference, however, is there, and appears needless.

Two 60-inch L P. cylinders in one engine are assumed to be the equivalent of one 88-inch L.P. cylinder in the alternative. Is not this serious? Allowing for the rods, it amounts to almost exactly 8 per cent., and it is 8 per cent. the wrong way, for had any difference been made it should have been in the other direction.

Then, again, the diameter of the piston rods for 60-inch and for 88-inch cylinders is given as 10 inches. Is not this altogether wrong? When Messrs. Allis claim it as good practice, we feel inclined to ask them, Is this your practice? because if it is, your practice does not seem correct. At first we could hardly believe it was Messrs. Allis's practice, and were inclined to set down their letter as so much sheer bluff on this point. We must also say that Messrs. Hick, Hargreaves & Co. are perfectly correct in bringing up marine practice in large engines in respect of shaft sizes. The shaft stresses in a marine engine are much greater than in a traction engine. In marine practice, in heavy weather, the load varies from zero to a maximum with a suddenness equal to anything in traction work. The truth is, that far too much is, and has been, made of the stresses in traction work, and we would refer our readers to an article in another column, dealing with this point at some length. This supposed enormous engine stress has been worked for all it is worth in electric traction by American contractors. It may be perfectly true that the Americans have made their engines for traction work very much heavier than those they had been accustomed to construct, but we doubt whether American traction engines are so particularly substantial and strong as Messrs. Allis would have people believe. We very much doubt if they compare in strength with engines sent out by Messrs. Hick, Hargreaves & Co. to some of the Indian mills, engines very much larger than these Glasgow engines, and very considerably over what is necessary for 2,500 KW. The idea that American engines are so very heavy and substantial is quite a myth. Let us look about us at a few American engines in tramway work in such places as Stoke, Cork, Dudley, and Dublin. At Stoke there are some McIntosh & Seymour engines. They are not particularly substantial, according to our English ideas. At Dudley, some engines by another maker, Ball & Wood, have a distinctly light appearance, and like other American engines, lack the finish and neatness of English work. At Cork, another type of McIntosh and Seymour engine may be seen. Is it 200 or is 500 the number of joints and pins of that most fearful assemblage of valve gear? But, except for this, we do not think the engines can be called badly designed in respect of excessive weight, though, probably, the valve gear might be lightened a ton or two. At Dublin may be seen a vertical McIntosh and Seymour engine at the old Balls Pond station, and some fairly large Allis engines at the new station in course of erection at Ringsend. But surely Messrs. Allis do not wish to claim for these Ringsend engines any substantiality over English work! Messrs. Hick, Hargreaves & Co. wrote a perfectly courteous letter to the *Manchester Courier* and other papers, which we reproduced last week, and they did not sneer at their American rivals. The Allis Co. wrote in very questionable taste indeed, and endeavoured to imply inexperience and ignorance on the part of Messrs. Hick, Hargreaves and Co. It is a claim put forward by the Allis Co. that the valves of their engines are often placed by them in the heads of the cylinder to the great reduction of waste space. This is a good arrangement for horizontal engines if properly carried out, but it is not a monopoly, and is of very doubtful value in a vertical engine.

But to return to the specifications. Alternative designs were called for, the one with two, the other with one low pressure cylinder. It is usual, in asking prices for alternative schemes, to place the more desired plan first. We believe that, acting under this impression, the English firm tendered for the three-crank engines. If we are correctly informed, the American tender for the apparently secondary two-crank engine scheme appears to have been the one accepted. This is a point which may have arisen from Mr. Parshall's ignorance of custom, but it is one which, on the face of it, certainly calls for explanation. The Corporation of Glasgow are not noted for their courtesy in their dealings, but it passes all bounds that they should have invited Messrs. Hick, Hargreaves & Co. to meet them at a special interview to discuss tenders and then have refused to discuss the question of their tender. Mr. Parshall owes an explanation of this. He was advising the Corporation, and unless he can explain it, this extremely discourteous conduct will also be laid to his charge. It is admitted that Messrs. Hick, Hargreaves tendered for an engine of satisfactory weight. This disposes of the Allis Co.'s claim of special substance. It differed in detail, and it ought to have differed in detail from the Allis engine if this was so designed as Mr. Parshall's figures would appear to prove. Then the English tender was £20,000 less than Allis's, which disposes of their claim about competing at 3,000 miles distance. £20,000 is good pay for sending even a well-paid man round the world, while the carriage item from Milwaukee is probably less than what the Bolton firm would pay under the paralysing charges of the London and North-Western Railway.

The special features of the engines, such as the so-called emergency valves, are English in origin. The emergency valve is the knock-off motion of the factory engine, and there is nothing in the demands made that Messrs. Hick, Hargreaves & Co., or any other high-class engine maker, would not easily have filled. Even the boring out of crankshafts was first practised largely by the Bolton firm. In fact, throughout the specification there is nothing very abnormal, previous to the dimensions above referred to, which could not have been explained if it had been desired to afford explanation. What Mr. Parshall apparently wanted, and he might have plainly said so, was simply a vertical cross compound (two-cylinder) engine. It looks as if he made himself appear to want a three-crank engine, and having received a tender reluctantly decided to pay £20,000 more for the two-crank type. The engines he seemed to desire were of a type of which more have been made in Great Britain than in all the rest of the world put together. That they were to be used for traction work was a mere incident, unworthy of serious argument.

Taking into review the whole of the circumstances, it will probably be considered by many that there is strong evidence of a foregone conclusion. The Soho Works at Bolton may not be so large as the Milwaukee Works, but they are equal to making much larger engines than are required for those little 2,500-KW. sets. We know less of Messrs. Duncan, Stewart & Co., of Glasgow, who tendered at less than half the price accepted, but what we do know of that firm is to their credit. We have tested their engines and found them economical. The firm is well known as a rival of an eminent Manchester works in some departments of engineering, and is well able to carry out anything it may undertake, and to give good work even if its tender may appear low. The consulting engineer has practically specified for an ordinary Lancashire factory engine. The biggest cylinders in the primary alternative are 60 inches × 60 inches, the exact size, if we mistake not, of the single cylinder of the "Iron Duke," put down by Messrs. Hick, Hargreaves & Co. at Eagley Mill, near Bolton, about the year 1884. This engine has Corliss valves in the cylinder heads on Messrs. Hick, Hargreaves & Co.'s plan,

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and resembles one half of the engine asked for by Mr. Parshall. He has stated that Messrs. Allis had guaranteed a lower steam consumption than any English firm. This statement, we believe, is not in accordance with fact. Messrs. Hick, Hargreaves & Co., says the *Engineer*, guaranteed 1½ lbs. less than the Allis people.

So much in disagreement with the methods of Mr. Parshall, and of Glasgow. On the other side, putting aside any thought of undue partiality, the Allis Company may properly complain, if they can do so courteously, that they have not been fairly treated. They gave in, it is said, a shorter time for completion than any English firm. This is something. But there is a doubt whether they would, or could, have kept to time, and we find that the penalty clause is usually not enforced. There are always some extenuating circumstances. We hear that American contractors are by no means so punctual in delivery as a few specially reported cases—*e.g.*, the Atbara Bridge—have led people to believe. There is quite considerable delay in delivery of American machinery, and we cannot think that the difference in time was so serious as to warrant the rejection of the English tender. It appears that the Allis Company accepted the dimensions of Mr. Parshall *in toto*; it would be interesting to know how he arrived at them. But this does not prove the Allis designs to be good. They are not considered good by firms fully their equal in experience. Given only as suggestions, and put *outside the specification in order not to hamper contractors*, the non-acceptance of Mr. Parshall's dimensions is counted against Messrs. Hick, Hargreaves & Co. for sin. While, therefore, the Allis Company may feel aggrieved, they must have known there would be an outcry against such shabby treatment as was meted out to Messrs. Hick, Hargreaves & Co. by the Committee in refusing to discuss their tender after specially inviting them to be present for that purpose. After all, when a committee travels widely with a view to inspect foreign tramways, and learns so little as to require to pay an outside fee of £10,000, much surprise need not be felt at any blundering they may be guilty of, for, look at the matter as one will, Glasgow has blundered. Its Tramway Committee has blundered headlong into this traction business. They have their own employés fully competent to have dealt with the matter, and they must have been fully alive to the fact that if they employed an American consulting engineer, he was extremely likely to be partial to America. In a case like this of Glasgow, the step was entirely unnecessary. We say nothing of the electrical plant at present, as the case may be less strong in this respect, but in the matter of large steam engines we do say that no American firm has yet produced better steam engines than are turned out in our English shops. As regards finish, the English engine is far better. In material generally, the English engine is fully abreast of its rival, while in the wearing quality of the cylinders, we possess an undoubted and considerable superiority. As regards finish, however, it is probable that neither in England nor America is it equal to that of some of the work done in Switzerland. Whatever may be the final outcome of this Glasgow business, we hope it may draw special attention to the great amount of work to be done in electrical traction. Our English firms are many of them very remiss in pushing work. We have called attention to the excessively disagreeable tone of the Allis Company's letter, but this is as nothing compared with one shown to us a few days ago from a firm of electrical contractors to large users of electrical plant. The tone of this was downright insolent. Busy engineers are very little better than members of the A.S.E. in their callous disregard of the feelings of their customers, and we are not surprised that insulted customers should sometimes go elsewhere. Because the Bolton firm in their correspondence show evidence of a now too rare courtesy and refinement, in marked contrast to the quips and sneers of their American rival, we all the more regret their unfair and churlish treatment at the hands of the Glasgow Committee.

We have read somewhere the usual sneer that, after all, Englishmen are not free traders. But this is not a question of free trade. A gift of £20,000 is to be made to a foreign firm for an article in no way superior to the home production.

There is no feeling against American goods in England, as is well known. We are content to take them on their merits in fair competition, and to welcome them. But this Glasgow business goes altogether beyond the fair limits of competition. Lest it be thought we have made too much of what we deem the faulty designs of Mr. Parshall, we would observe that in the three-crank engine the crank pins are respectively 12 inches, 16 inches, and 20 inches diameter, and between these cranks come shaft bearings of 22 and 24 inches, while beyond the third crank pin the shaft suddenly jumps up to 32 inches diameter, a size altogether out of the way in respect of torsion, and unnecessarily heavy for a wheel of only 98 tons (220,000 lbs.). There is to be a 32-inch bearing on each side of this 98-ton wheel. We may conclude that the space occupied by the fly-wheel is small. The wheel carries no ropes or belts, and only needs to be wide enough to give the weight. Probably its bearings are not a yard apart. A dozen years ago a 72-ton fly-wheel 30 feet diameter placed on a shaft 12 feet long from centre to centre of bearings was allowed a shaft 19 inches diameter at the bearings and 24 inches diameter under the wheel. This was ample; it allowed a bearing intensity considerably below 130 lbs. of the projected area of the bearings. In one bearing of the proposed Glasgow engine the bearing figure is as low as 52 lbs. If the shaft should be very strong anywhere in a traction engine it is between the wheel and the generator. If a 32-inch shaft neck is required to carry the work of the engine increased, say, to double stress beyond the fly-wheel, how big a shaft is needed for torsion between fly-wheel and engine? Obviously if both shafts are bored out with a 12-inch hole the diameter would be 26 inches, which would have been ample in place of the 32 inches. Then, again, if a piston rod of 10 inches diameter is ample for a 60-inch low pressure cylinder, how does Mr. Parshall justify the same diameter for a rod of equal length on a cylinder of over double the area? As regards the Allis Company's remarks on the 100-tons fly-wheel and its bearings, it matters nothing to what duty an engine is put; this cannot affect the bearing pressure on the journals in direct driving, and the sneers at Messrs. Hick, Hargreaves & Co. on this point are quite unnecessary. The figures given look like misproportions, and if they do represent the best American practice, then so much the worse for it. They do not meet with the approval of engineers on the Clyde, and, after all, and despite the disclaimer as to marine practice made by the American company, something may be conceded to men who have engined a *Lucania*.

Since this article was in print the matter has been again considered by the Tramway Committee; the result of their deliberations may be seen in our "Notes" columns.

THE LABOUR CLAUSE QUESTION.

It may, perhaps, be thought that we have harped upon this string somewhat frequently during recent months. Our excuse must be that we are painfully impressed with the very serious consequences which municipal labour clauses must have upon the electrical engineering industry of this country unless a strong braking influence is speedily brought to bear upon the policy of labour interference.

The extent to which this intermeddling is carried on was shown very clearly in the statements contained in a Parliamentary return issued some months ago and published in abstracted form in the Electrical Review for *May 19th*, 1899. The data there collected may be re-studied with great profit at the present moment. Recognising at that date how general the practice was becoming, we stated that manufacturers would be compelled to offer combined resistance to it. Although, for certain reasons, one or two firms stood outside the combination, those who came to an understanding formed a very solid square, with the satisfactory results already recorded in the cases of West Ham and Sheffield electrical contracts.

But these are only two out of hundreds of Councils which may be expected to cause trouble within the next few years, considering that the great extension of electrical development is proceeding concurrently with the extension of the dictatorial policy. It is pretty certain that there are stormy times ahead for employers who determine not to submit to trade union interference as practised by local authorities.

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We hope, nevertheless, that they will stand firm, and insist upon the rights of capital being not only recognised but respected.

It seems to point to something rotten in the electoral system of this country, that an intolerable system of trade union wire-pulling should control the placing of nearly all municipal contracts. The fact is, that rational people are few and far between on local government bodies. The rights of the working man, whose rates are very low, are too often considered at the expense of the large ratepayer. But this part of the question is too political to enter into at length here, particularly as it is hopeless to look for any immediate improvement in the *personnel* of our Councils. It seems that the quality of the article supplied, efficiency, price, and delivery are of less consequence to the municipal member than the insertion of clauses to determine what wages the contractor shall pay his employés, and to impose onerous and unnecessary conditions as to hours of work and the manner of conducting the factory. We say unnecessary conditions because there is no such thing as sweating existing in the electrical engineering trades, and, generally speaking, the wages of workmen are excellent for the class of work performed. Were there no disorganising combination of the trade union class, employers would, we believe, be able to look after the best interests of their workmen by giving them freer chances of promotion than is possible under the restrictive *régime* of union management.

We fail to see what legal right local authorities possess to dabble in trade unionism at all. It seems out of their province altogether. If a council wants certain apparatus supplied, so long as it gets a good thing at a fair price it should have no power to interfere with the wages that are paid or the hours that are worked, unless there is clear evidence that sweating is carried on at the particular works in question. A higher contract price is an obvious corollary of the imposition of restrictive conditions. Additional outlay, trouble, and anxiety must be paid for somehow, and all contractors, in sending in estimates, will take good care that there is sufficient margin allowed for it. Therefore a municipal body not only pays for the actual goods supplied, or the work done, but it pays the contractor a sort of gratuity to fall in with its whims and fancies as to labour employment. We are tempted to ask whether the Local Government Board quite appreciates the position in which it is placed by this state of affairs. This body is very ready to come down upon local authorities when an extra £10 or £100 has been spent in an irregular way, but the matter under consideration at the moment seems to us to call far louder for redress. The Local Government Board holds its inquiries regarding proposals to raise monies for certain public works. In the course of the hearing it transpires that a contract is to be given to So-and-so at, say, £10,000. There is no question raised as to what percentage of this sum is included by the tenderer as insurance against the probable effects of labour clauses. It is a point that might be raised with considerable advantage, and we think it would be a revelation to the ratepayers, who may be filled with the most sympathetic regard for the working classes, until they have it brought home to them that the public pocket is drawn upon somewhat deeply. They might then be also awakened to the fact that what they are paying for is nothing other than a meddlesome interference with private enterprise. We believe if the British public knew what costly extravagance these clauses are bound to engender, the principle of trades unionism would not receive anything like the support which is now given to it. In this respect the matter is one of general interest, and we are surprised that the leading daily papers have not devoted more attention to it. It is a gross misappropriation of public monies, calling for some action on the part of Parliament.

But from the standpoint of the employer the position is even more serious than from that of public morality. If he accepts the conditions, he is handicapped in securing the best output from his works, and is left at the mercy of his employés, for if they like to lodge a fanciful complaint an inquiry must be held by the Council as to its accuracy. In a large works this might lead to a dozen or more inquiries at one and the same time, so that the poor employer would be for ever involved in disputes which would do nobody any good, and in view of the municipal partiality for the workman might lead to the cancelling of the order after it had been three parts finished.

When so much is being written and said about masters being old fashioned or too orthodox, it ought to be borne in mind that they have been to an enormous extent hindered in their operations by the hysterical cries of a party which has been too much pandered to of late. How far the labour problem has been responsible for their slowness in adopting heterodox methods would be difficult to define to a nicety.

When the great engineering strike came to a close, conditions of management were mutually agreed upon between the Federated Engineering Employers and the Allied Trades Unions. The general principle of freedom to employers in the management of their works was approved as follows :—

The federated employers, while disavowing any intention of interfering with the proper functions of trade unions, will admit no interference with the management of their business, and reserve to themselves the right to introduce into any federated workshop, at the option of the employer concerned, any condition of labour under which any members of the trade unions here represented were working at the commencement of the dispute in any of the workshops of the federated employers; but, in the event of any trade union desiring to raise any question arising therefrom, a meeting can be arranged by application to the secretary of the Employers' Local Association to discuss the matter.

Nothing in the foregoing shall be construed as applying to the normal hours of work, or to general rises and falls of wages, or to rates of remuneration.

This clause introduced no new condition of labour. It simply provided for equality of treatment between the Unions and the Federation by reserving for all the members of all the trade unions, as well as for all the federated employers, the same liberty which many trade unionists and many employers had always had. Special provision was made in the clause and in the subsequent "Provisions for avoiding future Disputes," to secure to workmen, or their representatives, the right of bringing forward for discussion any grievance, or supposed grievance.

It is a fact, however, that some municipal authorities are attempting to go behind this decision in the clauses which they are endeavouring to get inserted into engineering contracts to-day. Let us take the case of Sheffield. The "fair contracts" clause which the Council wished to impose upon Messrs. Ferranti was as follows :—

THE ORIGINAL CLAUSE.

The contractor will be required by the contract to agree that all workmen employed in carrying out the contract in the City of Sheffield shall be paid not less than the standard rate of wages recognised by trade societies in Sheffield in each branch of trade represented in executing the contract, and to observe the recognised hours and proper conditions of labour. And for all work prepared outside the City of Sheffield and to be used in the city the minimum standard rate of wages paid by trade societies where such work is prepared, and if there be no such standard of wages in such place, then the contractor will be required to adopt and pay the Sheffield rate of wages and abide by the other conditions, as if such work had been executed in Sheffield. The contract will prescribe as the liquidated damages to be paid by the contractor, in case of breach of that condition as to wages, a sum of money equal to three times the amount by which the actual rate of wages paid by him at any period during the execution of the contract for any particular class of work is below the minimum standard rate of wages ruling in Sheffield and district for the same class of work during that period. These conditions shall also apply to sub-contractors.

THE CLAUSE AS AGREED TO.

That all workmen employed in carrying out the contract shall be paid at a rate of wages and observe the hours and conditions of labour as recognised by the Masters' Federation and the representatives of the Men's Trades Unions for the Oldham District. These conditions shall also apply to sub-contractors.

The contractors further agree that the engineer for the Corporation shall at all reasonable times during the progress of the works, have free access to the workmen of the contractors, and to the wage books of the contractors, and to the factories or other places which shall for the time being be in the occupation of the contractors for the purpose of this contract, and shall on behalf of the Corporation, be entitled to make full inquiry with the object of ascertaining that the stipulations in respect of rates of wages, and the conditions of labour, are being duly observed by the contractors.

Messrs. Ferranti objected to the clause in its original form because it was in no sense a "fair wages" clause, and because it would put the contractor working under it into an exceptional position, differing from that generally existing in the engineering trade. The firm is working its shops on

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exactly the same lines as the rest of the engineers of the country as agreed upon between the Federation and the Unions as mentioned above. The firm proceeded to re-draft the clause so that it should comply with that agreement, and from the parallel columns arrangement on the previous page will be seen the difference between the suggested and the accepted terms. In one of their letters to the Council, Messrs. Ferranti wrote as follows:—

We objected to this clause, because, as a matter of fact, there is no such thing as a standard rate of wages which applies to all men of a class in any district. We fully admit that there is a standard rate of wages which applies to some of the men, that is, to the fully qualified men in their respective trades, and it is these rates which are called the standard rates of the district. At the same time, we must point out to you that it is the general custom of engineers to employ very various grades of men for doing the same classes of work, and to pay them lesser amounts in wages than the so-called standard rates, where the full amount of skill is not required for the work they are expected to do.

We have been into this matter very carefully with the Employers' Federation, and we find that we are in practice doing what is common amongst the various members of the trade, and what is, in fact, recognised by all the shops where trades unionists are daily at work.

It is to be deeply deplored that after a settlement had been arrived at in January, 1898, between the employers and the trades unions, the Sheffield Council or any other Council should use its influence to subvert that arrangement. It is quite in keeping, however, with the dishonourable and high-handed action which has characterised most of the dealings of the trade union party.

The extent to which the labour party is wrapped up in its so-called "fair" clauses is evident from a remark in a Sheffield paper:—

The electric light undertaking had far better go slow for another winter, if need be, rather than lead the Council into a reversal of its labour policy, while it tamely holds the candle for an organisation which is trying to undermine trade unionism.

It is but a short step further to say "we will place the order abroad." Of course, if this sort of thing were carried far the employés would find that they were working out their own damnation. And we wonder if in giving contracts abroad the Councils make, or would make, the least inquiry as to the conditions of workmen in foreign factories!

We note, by the way, that at Sheffield the local branch of the A.S.E. pledged itself to give its best "moral and financial" support to the labour councillors and the Trade Council in their endeavours to bring about a reversal of the committee's decision to submit to Messrs. Ferranti's terms. Presumably the A.S.E. never intended to adhere to the 1898 agreement with the Employers' Federation!

When the Council met to discuss the question, the rejection of the committee's minutes was moved in a very lengthy speech by Mr. Hobson, who referred to the breakdown of the West Ham labour clause, and quoted from the ELECTRICAL REVIEW'S comments upon that matter, and our forecast as to the determined stand which the Federation intended to make. He said that what was being done in regard to the Sheffield contract fitted in exactly with our prediction of May last. West Ham had left the fight to Sheffield; was Sheffield going to allow the employers to have their own way? And much more of this in the same vein fell from Mr. Hobson's lips. He failed to appreciate that the determination of the contractors rendered it a case of Hobson's choice! The amendment was rejected by 26 votes to 23.

By this decision Messrs. Ferranti are at liberty to apply the principle of paying wages according to merit to every branch engaged on the work, and sub-contractors may do likewise. This is nothing more than the 1898 settlement, to which we hope and believe the employers will stand firm.

The urgency with which this particular plant was required for the Sheffield electric lighting installation was, we suppose, a point in Mr. Ferranti's favour, as any delay in placing the contract would prevent the supply of the works keeping pace with the demand.

We have dwelt at some length upon this subject because, as we have said, it is one pregnant with the most serious consequences to our national industries. We trust that there will be the most solid unanimity on the part of all engineering employers, and that in due course, by gaining here a little and there a little, the true position of affairs may be better realised by the public, and the employers will reap the reasonable and just reward for their struggles. To bring this about we should rejoice to see the matter taken in hand by the writers of the leading daily journals, for it is really a national question. In that way, and with the wise local co-operation of borough engineers and electrical engineers, and electric lighting committees, the present suicidal policy of trade unionism may be effectually abolished.

REVIEW.

Journal of the Institution of Electrical Engineers. No. 141. London: E. & F. N. Spon, 125, Strand.

The general contents of this number are as follows:—Continuation of discussion on Messrs. W. Duddell and E. W. Marchant's paper on "Experiments on Alternate Current Arcs by Aid of Oscillographs." Paper by Mr. J. Elton-Young on "Capacity Measurements of Long Submarine Cables." Paper by Mr. P. V. McMahon on "Electric Locomotives in Practice, and Tractive Resistance in Tunnels, with Notes on Electric Locomotive Design."

Abstract of a paper read before the Students' Section by Mr. W. G. Royal-Dawson on "Alternating Currents of Very High Frequency." Abstract of a paper read before the Students' Section by Messrs. M. R. Gardner and R. P. Howgrave-Graham on "The Synchronising of Alternators." "Obituary Notices."

LIABILITY FOR STREET ACCIDENTS.

IN a case which was recently heard in the Court of Appeal, a question relating to the liability of a contractor for a street accident came before the Court for consideration. The excavation of the highway, which is so often a necessary part of the contractor's duty, is not infrequently attended with injury to the wayfaring public. In view of the number of foremen and sub-contractors which are often employed, questions relating to the liability of the original contractor sometimes assume considerable importance.

The laying of an electric cable or the establishment of a system of electric tramways involves the delegation of special work to the care of a sub-contractor, who selects his own workmen. What, then, is the liability of the head contractor for accidents which arise, whether by reason of the negligence of a foreman or not, in a department over which he has no direct personal control?

It will be seen that in the solution of this question we need not enter upon a discussion as to the liability of a master for accidents to his servants. Our sole object is to consider the liability of those whose actions are the cause of direct or indirect injury to the public, and whose responsibility is to be determined upon principles of common law unfettered by the existence of any contractual relationship between the parties. And this question is of no mean importance to the head contractor, for the injured party will generally seek to draw water from the deepest well by proceeding against the most substantial person.

Where work which, if properly conducted, can occasion no risk of injury to others, is placed in the hands of a builder or contractor, who selects his own workmen and servants for the performance of the work and directs the manner of doing it, it may be taken as a general rule that such contractor, and not the person who employs him, is the person responsible for injuries to strangers from the negligent execution of the work. Such is the state of the law in cases where evil consequences need not necessarily follow. But where a man orders work to be executed, lawful in itself, but from which, in the natural course of things, injurious consequences to others must be expected to arise, unless means are adopted by which such consequences may be prevented, he cannot relieve himself of his responsibility by employing someone else to do what is necessary to prevent the act he has ordered to be done from becoming wrongful.

In Black *v.* the Christchurch Finance Company, Limited, (1894) A.C. 48, which was heard in the Privy Council, the

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law upon the subject was fully discussed, if not finally settled, by the members of the Court. The plaintiff there sued the defendant company for damage occasioned by fire which had arisen on their land and had spread to the plaintiff's part of the bush. It was pleaded by the defendants that the mischief had been done by their contractor. It was held that the defendant company were liable in damages for the act of their contractor in negligently and improperly lighting a fire on their land, and permitting it to spread to the plaintiff's lands; even though such contractor in so doing, disregarded special stipulations contained in such contract relative to the time at which such fire would be lit.

The same principle was laid down in Hardaker *v.* the Idle District Council (1896) 1 Q.B. 335. In that case the defendant council, being about to construct a sewer under their statutory powers, employed a contractor to construct it for them. In consequence of his negligence in carrying out the work, a gas main was broken, and the gas escaped from it into the house in which the plaintiffs (a husband and wife) resided, and an explosion took place, by which the wife was injured, and the furniture was damaged. In an action by the plaintiffs against the district council and the contractor, it was decided that the council owed a duty to the public so to construct the sewer as not to injure the gas main; that they had been guilty of a breach of this duty; that, notwithstanding they had delegated the performance of the duty to the contractor, they were responsible to the plaintiffs for the breach; and that the damages were not too remote to be recovered.

In the case which forms the subject matter of this article, the facts were as follows:—The National Telephone Company were lawfully laying down wires along the pavement in Clapham. In order to make the connections at the joints, they left the trench open at those points along the lines of piping where the joints were to be made. George Highmore, a plumber, was employed for this work, which was to be done "to the satisfaction of the foreman in charge of the work for the sum of 12s. per connection, bends included. While Highmore was doing the work he found it necessary to plunge a benzoline lamp into a ladle of molten metal. It was proved that the safety valve on the lamp was out of order. The lamp exploded and injured the plaintiff, who now brought his action against the National Telephone Company. It was proved that a servant of the company was assisting George Highmore when the accident happened. It was contended by the defendant company that Highmore was an independent contractor, and that they were not liable for his negligence, which was not part of, but collateral, to the work which he had been employed to do. It was held by the Court, which consisted of the Lord Chancellor, A. L. Smith, and Vaughan Williams, L.J.J., that the defendants were liable. The Lord Chancellor said, "In my opinion the defendants, who authorised these works to be done, whether they delegated the execution of them to another person or not, were under an obligation to protect passers-by from injury arising from the execution of their works."

It will be seen from the above decision that the liability of the National Telephone Company extends to a very wide limit. Had the accident happened owing to the negligence of someone in their own direct employ, no question would have arisen, and this case proves that they cannot delegate their responsibility to a sub-contractor.

SMOKE PREVENTION IN BERLIN.

At present Berlin has no Smoke Act, but has been considering the question, a committee having been appointed in 1892. But Paris in the meantime has drawn up smoke prevention rules, and this has stirred up Berlin, and now it is announced that after January 1st, 1900, all black smoke will be forbidden. Thus has another "verboden" been added to the already formidable list. Being legally and properly verboden, the committee thoroughly believe that there will be no more black smoke.

It will cease suddenly at 12 midnight next December 31st. Efficient devices are believed to be obtainable, and no hardships are going to be inflicted by the rule on any proprietor of a scoty chimney. During a discussion on a paper read on the subject in Berlin, it appeared, however, that smoke was not looked on by all as so great an evil. Was not London one of the healthiest of cities? We expect that the Berlin committee will be wiser and sadder men before another year has elapsed. We read of a new form of forced draught grate not much different from one described by Mr. Foley in his paper at Newcastle before the Institution of Naval Architects, which employs hollow bars perforated on the top, and fed with air by a blower. It is said that excellent results have been obtained by this bar in the way of smokeless combustion. One man deliberately states, says the *Trades Journals' Review*, that the appliance has reduced his coal cost by three-fourths. We know what this means. It may represent sound practice, but it may equally represent merely a change of fuel. We have known where a much cheaper fuel has been used by some patented apparatus, and reduced costs enormously, but after all, the cheaper fuel would have shown even better results with the original apparatus. It was by such means as this that the Hopcraft furnace was floated, great stress being laid on the reduction of one-half the fuel cost in a particular case. We happen to know the boiler, and found it was simply a case where Welsh coal had been used, whereas the cheaper fuel used by the new furnace could just as well have been used all along. The ways of patent furnace men are so wonderful, that we have become sceptical of all appliances until we have actually seen them for ourselves under a combustion rate of 18 to 20 lbs. About 12 lbs. per square foot of grate per hour seems to be a favourite rate with patent furnaces.

THEORETICAL v. PRACTICAL EFFICIENCY.

By SYDNEY F. WALKER.

The development of the electric lighting industry, and still more, that of its big brother, the use of electric currents for power purposes, renders the question of efficiency more and more important. Every fraction of 1 per cent. efficiency that the engineer can obtain in any part of his apparatus is something saved in cost. But the writer believes that in very many instances the use of the term is really misunderstood, and that engineers and committees often specify, and insist on obtaining from manufacturers, a so-called efficiency which takes from, instead of adding to, the real practical efficiency.

Let us consider first what is meant by efficiency. At once we are met by the fact, well known to the engineer who has to study the commercial side as well as the engineering side of the problem, that there are two efficiencies. Every engineering problem consists in the transformation of some form of energy, which is inconvenient for the purpose in hand, into some other form which is convenient; and the final transformation is usually only obtained after a series of intermediate transformations. One kind of efficiency, therefore, is:—The proportion of energy we obtain in the final form in which we use it, of that which is present in our initial source. In the case of the ordinary electric lighting station, for instance, we have, as our initial source of energy, the heat generated by the combustion of the coal, oil, refuse, or other combustible we use in our furnaces, or the energy present in the water, wind, or other natural source of power, that we use to move our turbines, &c. The useful energy in its final form is the sum of the energy present in the light rays furnished by the arc or incandescent lamps on the service. The efficiency of transformation is the proportion which this latter bears to the energy utilised at the source, and, as engineers know, this is very small. But there is another kind of efficiency, more important even than the efficiency of transformation, and which may be termed the commercial efficiency, viz, the proportion which the cost of the article supplied, the

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electrical energy, bears to the price obtainable for it. The price obtainable for any article, even for electric lighting currents, is ruled by conditions over which usually the maker has no control whatever. When sold for lighting purposes the current has to compete with other means of illumination, and though the price obtained is in many cases higher than the cost of some of the rival illuminants, it is still ruled by how much extra the consumer can afford to pay for the increased convenience, increased safety, &c., and is still beyond the control of the supplier. The two forms of efficiency naturally work together over a large portion of the cycle of their operations; but, in the writer's opinion, there are many points at which, by an ill-judged extension of the efficiency of transformation, the commercial efficiency is lowered. One point that at once occurs to one is that of the cost of apparatus. In the commercial efficiency the interest on the capital expenditure is a most important factor. In efficiency of transformation it has no bearing at all. Now it may easily, and often does happen that in his efforts to obtain an extra 1 per cent. or 2 per cent. efficiency in any particular part of the plant, the engineer has added more to the interest on capital than he has taken off the bill for coal and other incidentals. On the other hand, by an unwise economy in certain other portions of the plant, the engineer may again be losing more on his station by current unaccounted for than he has gained in interest by the saving in cost. Again, it very frequently happens that an increase in the efficiency of tranformation is obtained by cutting everything very fine in construction, by "sailing very close to the wind," as sailors express it, with the result that very trifling extra strains, such as are unavoidable in practical work, cause a breakdown of the apparatus, a stoppage of whatever portion of the work it was performing, and a cost many times in excess of the saving due to the extra efficiency obtained.

Passing from the general question to details. If a natural source of power exists, such as water or wind, it may be economical, and therefore commercially efficient, to make use of it, notwithstanding the fact that a very large quantity of water may be used to perform the work that would be done by the combustion of a very small quantity of coal or oil. Yet, again, if, as often happens, the supply of water is uncertain, so that steam plant must be kept as a reserve, or if the cost of making reservoirs, laying pipe lines, &c., is above a certain figure, the interest may be so great as to neutralise even the full advantage of obtaining the source of energy for nothing. Again, coming to engines and boilers, the higher the pressure to which steam is raised the smaller is the proportionate quantity of coal or other combustible necessary to be consumed in the furnace, but this advantage is more than lost unless a large portion of the expansive force of the steam can be utilised. And here, again, the conditions of commercial efficiency and that of transformation do not always agree. For an ocean-going steamer there can be no possible mistake. Steam can be raised to the utmost pressure the appliances will warrant, and that can be economically utilised by means of triple and quadruple expansion engines; but the central station engineer who made use of the same engines would be most unwise, as he would add very largely to his coal bill. *En passant*, a very striking instance of the difference between real or commercial efficiency, and that of transformation, is the case of the tramp steamer. The economical speed for these ships is the low figure of 8 knots. Passing on again to the matter of engines and boilers, Welsh coal is by far the most efficient in the world, considered from the view of transformation, while town refuse is probably one of the lowest on the scale of combustibles; yet if the town refuse can be delivered and consumed, as in many cases it can, at a cost to the town less than that previously incurred in disposing of it, or even at a slightly higher cost, it evidently becomes more efficient in the commercial sense than the best coal, or other combustible which has to be paid for. The limit is reached, of course, when the extra cost of dealing with the refuse, including interest on special refuse plant, exceeds the cost of the coal for which it is substituted. Again, after the gases formed by combustion in your furnaces have done all they can in raising steam, there is still a good deal of energy remaining in them; and after the steam raised in the boiler has done all it can in driving the engines, there is still a considerable quantity of untransformed energy remaining in it. Every heat unit that can be extracted from either the gases or the steam after they have passed through their respective apparatus, is so much added to the commercial efficiency, provided that the cost of working the energy saving plant, and the interest on the capital outly, does not exceed the value of the units recovered. So, again, high speed engines which can be coupled directly to dynamos are necessarily more efficient, the combined plant, than slow speed with belt or rope driving. As they also take less floor space, their use may have an important bearing on the commercial efficiency where the land upon which the station stands is valuable, as in the centre of large towns; yet, if the use of these engines demands the presence and the time of highly skilled attendants, the commercial efficiency may possibly be lowered, rather than raised by their use. But perhaps the apparatus upon which the engineer is most tempted to proceed to extremes, in his striving after efficiency of transformation, is the dynamo and the motor. Electrical engineering is in a more advanced state, notwithstanding its so recent development, than any other branch of engineering in the sense that electrical engineers have more complete command of their work than any others. The electrical engineer who understands his work can design a dynamo or a motor for any efficiency he pleases within certain limits. It is no more trouble for him to design for 95 per cent. than for 85 per cent. His troubles commence, of course, when the cost is gone into, and it is then that he is often tempted to increase his transformation efficiency by certain measures, which in very many instances seriously affect the commercial efficiency. To take one frequent case that is often met with—transformation efficiency requires that the space occupied by air insulation and active conductors between the iron core of the armature of a dynamo or motor and the iron faces of the field poles should be as small as possible, and so the engineer is tempted to make his insulation thin radially, and the clearance between the external periphery of his armature and the polar faces very small. Sometimes Providence is kind, and the machine works all right for some time, but more frequently some trifling expansion, due to the passage of an increased current, or to some other cause, takes place, and the conductors rub on the polar face, and the machine has to stop for the time. The designer would say, of course, that the increased current, or the increased expansion from, say, another source of heat, ought not to have taken place. Experience, unfortunately, proves that it always does, or nearly always. Or if the machine escapes this fate, it will, if the insulation has been cut fine, probably fall a victim to the property the electric current has of throwing a spark across between two conductors through all kinds of intervening material when temporarily possessed of several times its normal E.M.F., as when induction takes place.

What then should be the course of the engineer who wishes his plant to be efficient commercially, as well as in the transformation sense? The answer, in the writer's opinion, is, CALCULATE! CALCULATE! CALCULATE! Calculate each item in the cycle of transformations from every point of view. Watch the loss in each transformation, and watch the cost of reducing it. One golden rule may be taken. *Nothing is so commercially efficient as continuous running.* Whether you are furnishing lights for streets, shops, &c., current for hauling tramcars, for pumping, or cutting coal, or whether you are running a cotton mill, driving a steamer across the ocean, the one thing that you can always be quite certain will pay, is continuous running; and while every possible improvement, every possible source of economy should be carefully considered and carefully tested, nothing should be adopted which admits of even the remote probability of stoppage. A striking instance in point comes from America. An electrical engineer in the States was asked to advise a man who had 100 sewing machines working as to driving them by electric motors. The question was, should one 10-H.P. motor be put in to drive the lot, 10 motors of 1-H.P. to drive groups of 10, or a motor to each machine. After the question had been explained to him, the proprietor himself decided for a motor to each machine. As he put it—if one motor of 100 goes wrong, it means one girl idle; if the one motor which drives the lot goes wrong, it means complete stoppage. In the writer's opinion, the proprietor was quite right, provided the $\frac{1}{10}$-H.P. motors were as reliable in work as the larger ones.

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INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(*Continued from page* 305.)

Bonding.

In the early days of electric traction the earth was assumed, in accordance with telegraph practice, to be devoid of resistance, and was therefore selected to form the return circuit to the generating station. It was not long, however, before the excessive fall of pressure at the end of the line observed in working, and involving serious loss of power, was correctly attributed to the great and varying resistance possessed by the earth return. In addition to the loss of power involved, the currents which found their way back through the earth to the generating station, in seeking the path of least resistance, passed through all the metallic conduits which lay in proximity to their course, and caused most serious damage therein by setting up electrolytic action. Gaspipes, waterpipes, hydraulic mains, telephone and telegraph cable conduits were subject to most mischievous and serious deterioration, and traction companies had to make this damage good at ruinous expense. The careful investigation of the subsoil conditions led to the recognition of the following facts:—

1. That salts of ammonia, potash and soda, and carbonates of calcium and magnesium of a soluble character were always more or less present in the ground.
2. That a mere directive force in the nature of difference of pressure was sufficient to cause a current to flow.
3. That the presence of a small amount of soluble salt was sufficient to set up electrolysis, which continued as long as a current flowed.
4. That the amount of current depended upon the relative resistance of the soil and the pressure causing the current to flow.
5. That the corrosion due to electrolysis depended on the amount of current flowing from a given area and the nature of the salts present, the order of activity being chlorates, nitrates, and sulphates.
6. That there is no actual transference of iron from the anode to the cathode, this being deposited in the soil as hydroxide of iron.

From the above it was apparent that with continuous currents electrolytic action must always occur wherever a sensible difference of potential existed in the return circuit, whether that was wholly or partially composed of the earth, or so long as any of the currents found their way back to the generating station through the earth. With alternating currents the whole of these difficulties would disappear, but so long as continuous currents are used for electric traction purposes, the question of the return circuit must remain of primary importance.

Were it not for the question of cost, the difficulty involved in setting up electrolysis in surrounding metallic conduits could be met by placing them in metallic connection with the rails, so as to keep them at a uniform potential, but this would seriously interfere with the telephone and telegraph services using earth returns, by inducing heavy currents in their cables.

An ideal return circuit would evidently be an insulated copper wire of no less capacity than the feeder, with which connection could be made at every instant as freely as with the feeder, but this again is out of the question on account of the cost.

On the whole, the only reasonable alternative seems to be the utilising of the rails as the return circuit, insulating them as far as possible and improving their joint connections so that the conductivity should be uniform, or, in other words, that the joints should be abolished electrically and the drop throughout the return circuit should not exceed the restricted limits of loss due to the specific resistance of the rails. This involves the whole question of bonding and bonds, the latter being daily more and more recognised as among the most indispensable accessories of electric traction.

The specific resistance of steel rails of the ordinary composition, *i.e.*, with the high percentage of carbon now usual for railway and tramway purposes, at the ordinary atmospheric temperatures, is from 10 to 11 times as great as that of copper; but the cross section of the rails in common use for tramway purposes is from 200 to 300 times the area of the feeders, so that the conductive capacity of the rails, irrespective of the joints and insulation, as compared with the feeders, is from 20 to 30 times as great as would be theoretically necessary. It is evident that with bonds joining their ends giving approximately a conductivity equivalent to that of the rails themselves, the drop in potential due to leakage at the points of contact between rails and their supports and the rails and the earth could be reduced to a negligible amount in excess of the loss due to the specific resistance of the steel composing them. In other words, a return circuit of a uniform specific resistance equivalent to that of the rails between joints, would present such an easy channel for the return current that practically none would find its way to the generating station through earth, and the electrolytic action set up in the neighbouring pipes and mains by stray currents would be insignificant, while the drop in potential or the loss of power in the circuit through leakage, would approximate to the irreducible minimum involved in the molecular changes set up in the material of the rails, by the passage of the current. The question, therefore, of the more or less loss of power in a circuit and the production or non-production of damage to the pipes and mains existing in the neighbouring subsoil, resolves itself into the question of the effective electrical bonding of the rails.

The conductivity of a joint evidently depends upon both bonds and fishplates. That the latter, even when the rails have been in use for some time, have an appreciable effect on conductivity has been conclusively shown by Mr. H. F. Parshall in a recent paper before the Institution of Electrical Engineers. Both by laboratory tests and tests on rails in actual use with bonds and without bonds, Mr. Parshall shows that the resistance at the joint with the fishplates removed was more than double that of the combined fishplate and bond, and that the conductivity which the fishplate contributed to the joint did not sensibly deteriorate with age, the contact between rail and fishplate being preserved fairly well, even when not fully tight through the bright patches always existing on both surfaces. On the whole, the resistance at a joint increases inversely with the tightness of the fishplates and the cleanness of the contact between them and the rails, and that independently of the character of the additional bond used for the joint. Mr. Parshall expresses the resistance of the joint in terms of the equivalent rail length added to the general resistance of the return circuit by the joint,

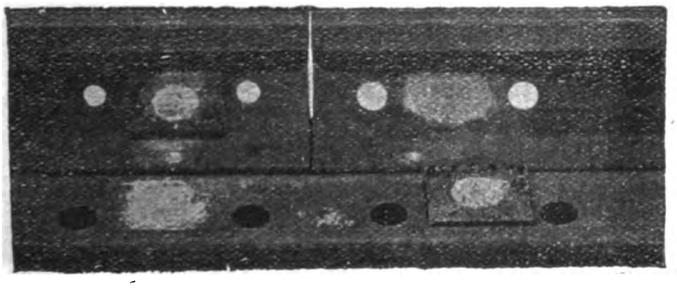

Fig. 79A.

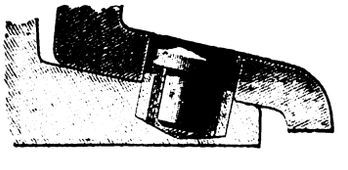

Fig. 79B.

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and this seems to be a particularly happy way of expressing the matter.

There are three ways in which the ends of rails may be bonded electrically:—

1. By utilising their usual fastenings.
2. By adding bonds independent of these fastenings.
3. By dispensing with the usual fastenings and substituting a special joint or doing away with the joints altogether.

The first method involved the utilising of the ordinary fishplates with the addition of a plastic metallic composition to form a bond between them and the rails.

The only form of bond of this character which is in use is known as the Edison-Brown plastic rail bond (fig. 79A). In this bond the contact between the rail and the fishplate is established by a special metallic plastic composition inserted between the web and the fishplate, after contact spots about 2 inches in diameter have been cleared of scale and rust and treated with a solid alloy which instantly silvers the surfaces and prevents rusting. The plastic composition is held in a 1½-inch hole in an elastic cork case treated on the surface with a sticky compound, and these cases are placed in position as near the end of the rail as possible. The conductivity of the completed joint is practically equal to that of the fishplate. Some plastic bonds which have been in use for five years have shown no sensible deterioration, the explanation being that, when correctly applied, these bonds never rust.

The plastic bond is also applied (fig. 79B) in a somewhat different manner, when used for rebonding old T and girder rails, with fishplates having angle projections over the rail foot. At the end of each rail a hole is drilled diagonally through the angle plates, and into, but not through, the base of the rail. These holes may be of any suitable diameter from ⅝ inch upwards. The drill used for boring these holes is made with a specially obtuse angle, so that as it penetrates the lower surface of the plate, it carries down a burr into the surface of the rail. A part of this burr is forced between the rusted surfaces between the fishplate and the rail, and forms a telescope hole perfectly smooth on the inside. To avoid the surface being lubricated with a non-conducting substance, a solution of soda and water is used instead of oil in drilling, and the drill chips are removed with a permanent magnet. The holes are then amalgamated with the solid alloy, and partly filled with the plastic compound. An amalgamated copper plug of T shape is driven into the hole dipping into the plastic alloy, and is locked in place by a burr made with a blunt chisel. Mr. Parshall's experiments before alluded to, with 1½-inch plastic bonds and 83-lb. rails, demonstrated that the resistance of the joint expressed in inches of rail, which, with one plate only bonded, and no contact between rail and plate, except through the bonds, amounted to 24 inches of rail; by double bonding could be reduced to 14 inches, and by allowing free contact between rail and plates, to 9 inches only, the bonds being apparently responsible individually for $\frac{5}{24}$ths of the total resistance each, the contacts between fishplate and rail collectively to about the same amount as one bond, the balance being divided between the four bolts and the resistance induced by the "gathering" of the current at the bond terminals and in the neighbourhood of other points of contact between the rails and the fishplates, and amounting to about $\frac{9}{24}$ths or $\frac{3}{8}$ths of the total joint resistance. To make these plastic bonds as efficient as possible, it appears to be necessary to connect both fishplates with the rails, and to keep the fishplates in as close contact with rails as possible, or, in other words, to screw up the bolts as tightly as possible, and use some form of lock-nut that is not liable to working loose under service conditions.

The category of added bonds, independent of ordinary fastenings, comprises what might be called bonds proper, and here the ingenuity of inventors has been lavishly expended in scheming devices of infinite variety of form to meet the requirements of the case. They, however, all belong to two groups, viz:—

(A) Long and uncovered bonds;
(B) Short and covered bonds;

Group A being bonds external to the fishplates, and Group B bonds that are placed between the fishplates and the rails. These groups are each of them sub-divided into four classes according to the character of the contact established between the rails and the bonds, viz.:—*a*, mechanical contact; *b*, soldered contact; *c*, welded contact; *d*, amalgamated contact. The phenomenon termed "gathering of current," which occurs in the neighbourhood of the joints in a conducting circuit, seems to be analogous to the retardation induced in the flow of water through pipes by bends or contracted orifices, and is no doubt produced by the same causes, viz., the increased friction or resistance due to the contraction of the effective sectional area of the channel through which the flow is taking place. Successful bonding, therefore, means the limitation of "current gathering" at rail ends to the irreducible minimum involved in the flow of a current across the physical boundary or gap existing between one conductor and another. In the case of mechanical contact this gap is filled by a film of air occluded between the contiguous surfaces of rail and bond. In the case of soldered and welded contacts the gap is filled by the film of soldering or welding material, and in the case of amalgamated contact by a film of amalgam, and in all three of these latter cases by some portions of occluded air films in addition. The resistance of the gap may be further increased by the presence of a film of dirt or oxide on the surfaces. The following conditions have obviously to be observed in all bonds to ensure successful results:—

1. The sectional area of the bonds and of the rails they unite must be sensibly in the relative proportion of the conductive capacity of the metals composing them, *i.e.*, the effective areas of the channels offered to the flow of the current by rail and the bond respectively must be practically equal.

2. The contact surfaces must be as few as possible, and their areas as restricted as possible, subject to their being proportioned to the lesser conductive capacity of the two metals; *i.e.*, in the case of steel and copper, the area of the contact surface must be in proportion to the conductive capacity of the steel and not the copper, or from 10 and 11 times as great as would be necessary between copper and copper.

3. The gap between the contact surfaces must be as restricted as possible; *i.e.*, the surfaces must be brought as close together as possible.

4. The contact surfaces must be absolutely cleared of all dirt and oxides before the contacts are made, and kept clear thereafter.

If the above first condition is complied with, it is obvious that the bonds comprised in Group A must all be more costly than those comprised in Group B, which will inevitably replace them sooner or later, irrespective of the question of the relative merits of the designs.

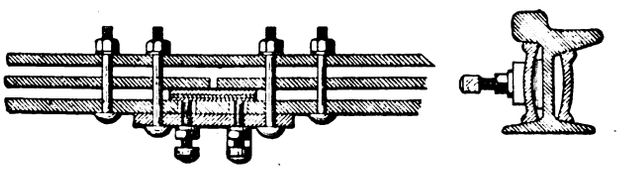

Fig. 80.—Ajax Bond.

In a similar way the constructive difficulties involved in the use of bonds composed of metals whose conductive capacity is inferior to copper must as inevitably be replaced by bonds made of the latter metal, if for no other reason than their relatively more bulky and unwieldy dimensions.

Condition 2 disqualifies all compound bonds, *i.e.*, those composed of more than one metal or of more than one piece on the score of the multiplication of contact surfaces and of the gaps between them. Condition 3 demands that the contact between the bond and the rail should be brought about by the application of considerable force in such a way that its effect shall persist, after the force is withdrawn, unaltered. Condition 4, in addition to the careful cleansing of the contact surfaces previous to bonding, also demands that they shall be treated as for Condition 3, so that the film of air imprisoned may be reduced to a minimum, and with it the chance of the future formation of a film of oxide between them similarly reduced.

This much being premised, it becomes possible to critically examine the details of the various leading bonds in use and determine their merits and defects.

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Class *d*, or "amalgamated contact bonds," contains very few examples, the "Ajax bond" (fig. 80), belonging to Group B, being about the only one now used. It consists of a strip of copper placed under the fishplates and pressed against the rail ends by set screws working through the fishplates, the contact surfaces being amalgamated. The defects of this bond are:—(1) Complexity of parts and multiplication of gaps; (2) impossibility of maintaining gaps at a constant minimum interval; (3) disturbance of contacts when contraction or expansion of rails takes place, and consequent increase of resistance; (4) cost.

Class *b*, or "welded contact bonds," also contains very few known examples. The "Payne welded bond" (fig. 81) also

Fig. 81.—Payne Welded Bond.

belonging to Group B, consists of a corrugated strip of copper with flat terminals welded in any position on to the rail ends. The objections to this form of bond are:—(1) impossibility of obtaining a really perfect weld under the conditions of track-laid bonding; (2) the unavoidably increased resistance introduced by the residual film of spelter remaining between the welded surfaces; (3) increased cost involved in welding.

Of Class *c*, the only "soldered contact bond" which is at all used is the "Syracuse bond" (fig. 82). This is used

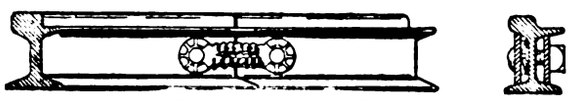

Fig. 82.—Syracuse Bond.

in forms belonging to both the long and short groups. This bond consists of broad flat terminals connected to wires by soldering, which are themselves soldered to the webs of the rails. The objections to this form of bond are due to its compound character and to the multiplicity of the gaps between its various parts; and also the relatively high cost of its application owing to the process of soldering involved.

(*To be continued.*)

CORRESPONDENCE.

The Glasgow Contract.

Such of your readers as are engaged in supplying local authorities with tenders for electrical or steam plant, will, I am sure, be ready to extend their sympathy to Messrs. E. P. Allis & Co. in this their hour of affliction. Although it has fallen to the lot of some of us to miss contracts at or near the bottom prices, our sorrow on these occasions has been tempered by considerations similar to those which consoled the fox when he failed to get the once coveted, but now despised, grapes. Whether our philosophy would have supported us if we had only just missed booking a top price, and such a top price as that before us, I hesitate to consider.

Permit me to suggest, for the comfort of Messrs. Allis, that, now they have come to do business in England, they must endeavour to realise that the municipal system, with all its virtues, is attended with certain inconveniences under which we all suffer. These inconveniences are known to the corporations as well as to engineers, but both are powerless to remove them.

There is not an engineer in England that has not had his brains picked and the details of his schemes published, not of malice or chicane, but of necessity, and he, recognising this fact, endeavours to possess his soul in patience.

Personally, I think Messrs. Allis made a tactical mistake in addressing their letter to the *Manchester Courier*, for Lancashire is a county of mechanics, who are just as cocksure that everything they turn out is the best that money can buy as are our American friends; and, further, they have learned by experience to render so much respect to the firm of Hick, Hargreaves & Co., and to have such confidence in all the products of Soho Foundry, that no amount of assertion would make them believe that any engine built therein could be either "inefficient, unreliable, or antiquated."

John S. Raworth.

August 30th, 1899.

THE CHARGING SYSTEM OF FIRING.

This method of firing was recently advocated in the columns of the *Practical Engineer*, and we have inquired further into the system, which we have always advocated as suited to forced draught working on the contention that fire thickness, draught, and fuel dimensions are more or less interdependent. The charging system cannot well be carried out when the rate of combustion exceeds 10 to 12 lbs. per square foot. At such rates it can be managed without difficulty, but even then some selection is required in the coal, which is best when it consists of a mixture of slack and moderately round coal. When this mixture is properly charged right along the centre of the grate, the rounder pieces tend to roll down the heap and towards the sides of the grate. The sides of the fire are thus more open than the middle, and the draught penetrates more freely, and when charging is properly done there is a belt of flame on each side of the fuel heap which curls round the furnace, and meets at the crown of the furnace. A fair natural draught of about ½ inch water gauge is necessary. As the whole heap cakes through, it is finally burned into holes, which need to be filled up, and when burned sufficiently low, the mass can be approximately levelled and recharged. With such a mass of fuel on the grate, and a reserve of draught, there is great command over the working of the boiler, and steam can be made readily. We believe that with forced draught this system has not been attempted, but we see no reason to doubt that a good stoker, who should be allowed to try the system for a time to acquire the practice necessary to a new system, would, with forced draught, secure similar results upon a heavier rate of fuel consumption. It must be clearly understood that there is no spreading of the coal upon the bars; only so much goes to the sides as rolls there by gravity, and an experienced man is able to so charge a furnace as to heap up the centre of the ridge to within a short distance of the furnace crown. It might be thought that in this system there would be a large volume of smoke produced, but this is not so. Such smoke as is produced comes off from the surface, and the whole volume of gases from the mass requires a long time to evolve, and, as it does come off, it does not come into contact with the furnace crowns, but finds itself in the narrow space between the fuel mound and the arch of flame which rises up from the sides of the grate.

In charging a fire on this system, the stoker commences against the bridge and fills up this end first, the mound sloping gradually towards the firedoor. A longitudinal section of the fire would show a line parallel some distance with the furnace crown and then sloping downwards to the dead plate in a curve, convex upwards. Similarly, a cross section would show an approximately parabolic, or haycock, form. Such a form enables the condition of the whole length of furnace to be seen from the furnace door, and is also favourable to the proper admixture of any necessary fresh or auxiliary air, the admission of which may be in smaller volume and of greater duration than when small charges of fuel are made upon a bright thin fire. In such case the hydro-carbon gases are at once liberated in great volume, and a short period of very copious air admission is necessary. As said above, with ordinary chimney draught the system cannot very well be used with a rate of combustion above 10 or 12 lbs. per square foot of grate per hour.

Mr. Ingham, a Manchester engineer of great experience in steam boiler work, rightly says, however, that with forced draught almost everything can be done, but he lays stress on

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some amount of selection being necessary as regards the coal—that it should have a proportion of round coal which will roll to the sides as charged and secure the action aimed at—the flame belts round the furnace plates.

The principle underlying the method is the preservation in the furnace of a large mass of fuel ready to be quickly put into a condition of more rapid combustion as soon as a demand is made for more steam. But the method demands what is technically known as boiler room, and as we have already pointed out, where double the fire-grate area could be arranged with a given heating surface, it would appear desirable to do this or to secure the same end by means of fan-assisted draught. The tendency of late has been to claim unduly high possibilities for steam boilers. It is likely that more moderate figures will be worked to in the future.

Probably some of the excessive smoke of electric light stations is due to the too heavy work demanded from steam boilers. Where anything over 20 lbs. of coal per square foot of grate area per hour is to be consumed a fan draught will be required, and with a fan draught and bituminous coal there must be provision to bring the fan pressure to the auxiliary air ducts, for the blast pressure will prevent any fresh air being admitted at the furnace doors, and such auxiliary air must be forced into the furnace.

LONG DISTANCE TRANSMISSIONS FOR ELECTRIC RAILWAYS.*

There seems to be no doubt that in the near future long distance transmissions by means of polyphase currents will form an important feature of electric railway practice. A number of instances of this practice have already been mentioned in the *Review*, and a new road has just been projected in the Kootenay country of British Columbia which will be operated by means of a power plant which contains a number of most interesting and unique features. It should also be added that this is but one of a considerable number of polyphase transmissions in the Pacific North-west, where there has lately been remarkable activity in the projection and construction of long-distance transmissions operated by water-power. While for the purpose of supplying power for general purposes, and especially to mining machinery, the induction motor has now become a worthy rival of direct current machinery, street railways will undoubtedly continue to be operated from sub-stations containing rotary transformers for the production of 500-volt direct currents.

The West Kootenay Power and Light Company, whose plant is described in detail in the *Journal of Electricity* of May, 1899, contains an unusual number of useful and instructive features. This plant is essentially a power plant, only a small percentage of its output being applied to lighting purposes, and so various are the uses to which this power has been applied and with such eminently satisfactory results that a considerable extension of the service is to be made, including an electric railway, which is to be installed at once.

The engineering features of this plant are most interesting. The power house is situated on the Kootenay River, which forms a connecting link between Kootenay Lake and Columbia River, and the Bonnington Falls, from which the power is supplied, are situated near the lower end of this river. At low water these falls, both upper and lower, are capable of delivering 267,000 H.P., but the lower falls, a part of which the West Kootenay Company has utilised, have an available head of 40 feet at low water, and are capable of delivering 100,000 H.P.

The company constructed a canal cut out of hard rock, 650 feet in length, and 26 feet wide, the lower end of which widens out into a forebay 54 feet wide. The forebay is shut in by a dam of solid concrete, 82 feet high and 26 feet wide at the bottom, tapering to 6 feet wide on top. Across the head-race, 250 feet from the concrete dam, is a wooden dam sloping at an angle of 42°, constructed of sills and timbers securely fastened between the two high b'uffs. This dam is 44 feet high, and has five sluiceways across the bottom, the object of which is to control the supply of water to the forebay at all times.

The back of the dam really forms one side of the power house, and of the tail-race, which runs at right angles to it, being a pit 20 feet wide by 30 feet deep, and extending nearly the length of the power house, which is 66 feet. The dam is provided with two feeders of 9 feet each, and one of 10 feet, the upper ends of which are closed with wooden gates. Two outside frames extend upward of 30 feet, and the racks for raising and lowering the gates are bolted to the wall of each pit. The gates are each provided with a small iron flood-gate, and the main gates are raised and lowered by means of head-gate irons bolted to the top of the dam. The winch controlling these is operated by one man. Three steel penstocks run through the dam into the hydraulic room of the station, each penstock carrying a standpipe nearly as high as the top of the dam. To the lower end of each penstock is bolted a housing which contains a pair of 39-inch horizontal cylinder gate turbines, the housing being supported on I-beams laid on the retaining walls of the tail-race. The draft tubes 22 feet long and 10 feet in diameter are bolted to the bottom of the housings. The generators are coupled direct to the turbine shafts, and three exciters are driven by three independent 12-inch horizontal gate turbines contained in cast-iron flumes connected to the housings of the large wheels, from which they derive their water supply.

The dynamo room contains two 750-KW. generators and one of 1,500-KW., all of the standard General Electric revolving field type. These run at a speed of 180 revolutions per minute, have 40 poles and deliver three-phase currents at 1,100 volts.

The transformer room is a separate compartment at one end of the dynamo room, and contains the necessary capacity of air-blast transformers; they are 12 in number, each of a capacity of 250 KW. These deliver at a pressure of 20,100 volts to the line. The pole line is a double line extending to Rossland, a distance of 31 miles, the profile of which varies in height by over 2,200 feet, and a step-down transformer station is situated at the latter town. A branch is taken off the main line at a point three miles from Rossland which runs to Trail, B.C., a distance of four miles. At this town is situated the great smelter of the Canadian Pacific Railroad, and a transformer station at this point provides three-phase currents at 550 volts for the operation of various parts of the smelter. At this point an electric tramway is to be immediately built, the operation of the plant in all kinds of weather having been so successful as to encourage the company to extend its operation to railway work.

* *Street Railway Review.*

BUSINESS NOTICES, &c.

Bankruptcy Proceedings.—The creditors of Lawrence John Lawrence, electrical engineer, 5, Stafford Street, Old Bond Street, W., met on Thursday at the London Bankruptcy Court. The debtor commenced business about four years ago without capital. Six months later he was joined in partnership by Mr. W. H. Butcher, who introduced £200 capital, and the style of the business was altered to Lawrence & Butcher. That partnership was continued for about a year when it was dissolved by mutual consent, Mr. Butcher taking £120 in cash and the debtor retaining the stock and book debts. All the partnership liabilities were settled and the dissolution was duly gazetted. The debtor continued the business by himself up to last Christmas. In December, negotiations were entered into for the formation of the business into a limited company with a capital of £2,000, but nothing came of them, and the matter is at present the subject of litigation. Accounts filed under the failure show unsecured debts £334 8s. 7d., and assets, doubtful book debts, £50. The reasons given for the failure are bad debts, illness, loss in business, and insufficiency of capital. No offer being submitted the creditors left the matter in the hands of the Official Receiver to be wound up in the usual course of bankruptcy. The public examination is appointed for September 19th. Appended is a list of the principal creditors, viz.:—Unsecured.—General Electric Company, Limited, £81 12s. 8d.; W. McGeoch & Co., £42 8s. 11d.; Paterson & Cooper, £38 3s. 8d.; John Russell & Co., Limited, £20 2s. 3d.; H. M. Salmony & Co., Limited, £33 17s. 7d.; and various sums under £20. Partly secured.—H. J. Lawrence (security valued at £70), £100. Preferential creditor for rent, £37 10s.

A receiving order has been made in the case of H. W. Thane, electrical and general engineer, The Hill, Northfleet, Kent, on debtor's own petition. The first meeting is to be held at 115, High Street, Rochester, on September 6th, and the public examination will take place at Court House, Eastgate, Rochester, on September 4th.

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Electrical Wares Exported.

Week ending Aug 30th, 1898		Week ending Aug. 29th, 1899.	
Aden. Teleg. cable	Value £33,600	Adelaide	Value £103
Amsterdam	900	„ Teleg. mat.	70
Auckland	40	Alexandria. Teleg. mat. ..	60
Barcelona	18	„ Teleg. wire ..	28
Bombay	83	Amsterdam	160
Boulogne	93	Bangkok	17
Cape Town	156	Boca. Teleg. mat.	270
Colombo	24	Bombay	72
Durban	181	Boulogne	40
„ Teleg mat.	166	Buenos Ayres	18
Flushing	70	„ Teleg. mat. ..	375
Fremantle	1,089	Calcutta	498
Graymouth	89	Cape Town	151
Hamburg	100	Channel Islands	553
Hobart	15	East London	284
Malta	66	Fremantle	90
Melbourne	57	Flushing	20
Penang	17	Gothenburg. Teleg. wire ..	36
Port Elizabeth	514	Hamburg. Teleg. mat. ..	100
Port Said	25	Hong Kong	69
Rangoon	50	Iquique	85
Shanghai	57	Lyttelton	35
Sydney	671	Melbourne	75
Trieste. Teleg. cable	654	„ Teleg. mat.	880
Yokohama	29	New York	29
		Port Elizabeth	19
		Rotterdam	11
		Shanghai	40
		Singapore	1,896
		St. Petersburg. Teleg. wire ..	59
		Stockholm. Teleg. wire ..	19
		Sydney	218
		„ Teleg. mat.	775
		„ Teleg. wire	872
		Toronto	120
		Wellington	21
		Wiborg	45
		Yokohama	978
Total ..	£38,708	Total ..	£9,141

Book Received.—"The Electrical Engineer's Central Station Directory." Third edition. Biggs & Son, London. 3s. 6d.

Catalogue.—The new complete catalogue just issued by Messrs. Veritys, Limited, belongs to that class of trade publications which one keeps along with directories and the other works essential in a commercial establishment, so as to be always ready to hand for reference. The catalogue being a complete collection of all the classes of electrical machinery and wares in which Messrs. Veritys do business is necessarily bulky, but it is so neat and unobtrusive in its binding, &c., that it will be quite in keeping with the most elaborately furnished offices. It is complete in nine sections, which we mention in outline: (*p*) plant and machinery; (*m*) motors and motor driving (from which we published a selection of illustrations showing motor applications some weeks ago); (*w*) wires, cables, and wiremen's sundries; (*a*) switchboards and accessories; (*b*) bells and telephones; (*s*) surgical and medical appliances; (*e*) electric light fittings; (*d*) ship, mine and dock fittings; (*g*) reflectors, glass and silk shades. In addition to a host of illustrative and descriptive matter, we notice several interesting features, viz.—Estimates for complete private plants; comparative costs of gas and electric light; hints on house wiring and joint making with wiring rules and tables; metric measurement tables; electric bell and telephone connection diagrams. The electrolier, standard and statuette fittings section has a special glazed paper which shows the illustrations up to best advantage. Some of the designs are very pleasing.

The Chitty Dynamo and Motor Company, Limited.—The senior Official Receiver, Mr. G. S. Barnes, has issued a summary of the statement of affairs on the date of the winding up (June 26th, 1899) as submitted by the directors, together with his observations thereupon. The gross liabilities are put at £32,556, expected to rank £32,342. The amount estimated as available to meet unsecured creditors (subject to cost of liquidation) is £20,912 13s. 9d., and there is thus an estimated deficiency of assets to meet the liabilities of the company, of £11,429 10s. 10d. There is no unpaid capital liable to be called up to meet the above deficiency. The capital issued is £33,030, and adding to this the deficiency above stated, there is a total deficiency of £44,459 10s. 10d. The chief cause of the failure appears to be the insufficiency of working capital. The company went to allotment on December 18th, 1897, upon a total cash subscription of £5,540. The purchase price was originally fixed at £56,000 without any valuation by Mr. Chitty and his solicitor (£11,000 cash and £45,000 in shares), but in consequence of insufficiency of cash capital, these terms were modified, and it was arranged that Mr. Chitty should be paid £28,000 (£1,500 cash and £26,500 shares), and the remaining £28,000 to be payable in proportion to a further issue of capital. Mr. Chitty was to be appointed for five years as managing director at £1,000 a year, but for the first year only £500 was paid, the deficiency to be made up in the following year by cash or shares. The expenses of carrying on the business have been £1,955 plus directors' fees, £160, salary to managing director (cash and shares) £1,530, ditto claimed to end of agreement £3,4:9, depreciation in plant, &c., £897, depreciation in letters patent £36,000. The gross receipts have been £19 15s. 9d. A dynamo motor has been supplied at £40 14s., but £10 odd has to be spent upon this before it will be in working order and payment obtained. Mr. Chitty and the other directors have valued the letters patent at £20,000, but, says the receiver, it is doubtful whether any such amount will be realised unless some scheme is formulated for working the patents. The liquidation of the company has been left in the hands of the Official Receiver with a committee of inspection.

Directory.—The "Universal Directory of Railway Officials," for 1899, has now been published from the offices of the *Railway Engineer*, 8, Catherine Street, Strand. This directory contains very useful information regarding railway officials all the world over. It is divided into sections dealing with England and Wales, Europe, Asia, Africa, Australasia, North America, South America, but there is also an alphabetical index for ready reference comprising every name included in the other sections.

Dobson & Curtis v. Weldon.—At Dublin Courts (Chancery Division) last week, this action was brought by Messrs. Dobson & Curtis, Limited, electrical engineers, Stephen's Green, Dublin, against Mr. Joseph V. Weldon, Rathgar Road, for £47 11s. 11d. for goods supplied and work done.—Defendant's counsel applied that the action be remitted to the Recorder of Dublin sitting at Kilmainham, and the Court made the order.

Electrical Progress in Germany.—From the official statistics just issued by the German Electrical Bureau in Berlin for the year March 1st, 1898, and March 1st, 1899, we learn that the increase of electrical works, &c., in the German Empire during that period has been unprecedented. For whereas in the preceding period the number was 96, it was at the end of last year 105, and it is calculated that in the current year or so the number will be increased by no less than 123 new works more. In these figures are not included installations for the working of tram and railways, or private concerns. All these works have been started since 1880, indeed, the Great Berlin Electrical Works are only 15 years old. These figures speak eloquently enough, but the figures compared with the gas statistics are still more pointed. For whereas the first gasworks in Germany were started in 1825, there are now only 816 such works, *i.e.*, in the period of 75 years the gasworks only outnumber the electrical by about 300, whilst the latter have only a history of 20 years. Indeed, it is estimated that in another four years the number of both will be equal. As regards agency of working it may be of interest to mention that three-fifths of the electrical works are driven by steam engines, and one-tenth by water turbines. The largest electrical concern in Germany is the Rheinfeld Transmission Works in Baden, capable of developing 12,000 KW., the central station in Hamburg coming next with 7,000 KW. The Berlin Electricity Works have three stations, developing respectively 1,700, 5,500, and 5,000 KW., whilst the works at Frankfort-on-the-Main produce 4,200 KW. All other works develop no less than 4,000 KW. Coming to the lighting statistics we learn that whereas in 1894 all glow lamps in Germany only numbered 500,000, they now number 2,000,000 in round figures, whilst the number of arc lamps have increased in that period from 12,500 to 41,500. The motors in working at present represent nearly 70,000 HP. As regards the future progress of electricity in Germany there is still a wide field of operation open, as although all the seven cities with a population over 350,000 have now electrical works, and all those with a population under half a million will be similarly provided at the end of the year, and only eight towns with a population below 100,000 will then still be without such, there remains nearly 3,000 towns with a population below 50,000 which possess no electrical works.

The Institution of Junior Engineers.—The summer meeting of this Institution has just taken place, the rendezvous being Portsmouth, with excursions to Southampton. There was a larger attendance than usual, being about 12 per cent. of the total membership. The party reached Portsmouth on Friday, August 11th. Among the works of interest visited was the Portsmouth Corporation Electricity Works, and it was very evident that the undertaking, under the superintendence of Mr. E. Price, was in a healthy condition. New plant was being laid down to meet the increasing demand for current. The accounts for the year ended March 31st last, showed a credit balance on revenue of £9,650. The total maximum supply demanded was 1,132 KW.; there were 261 public lamps, and the total quantity sold had been 1,224,949 units. The Southampton electricity works were also visited. The Summer Dinner was held at Portsmouth, Mr. B. H. Joy presiding.

Liquidations, Dissolutions, &c.—The Porcelain Electrical Fittings Company is to be wound up voluntarily, Mr. T. W. Hayes, Cheapside, Hanley, Staffs., being appointed liquidator.

Mr. A. Shuttleworth was in July appointed liquidator for the winding-up of Browett, Lindley & Co., Limited, now reconstructed.

Creditors of Galloways, Limited (the old company now liquidating for reconstruction), must send particulars of debts, &c., to Mr. J. W. Pollitt, 7, Pall Mall, Manchester, the liquidator, by October 7th.

Messrs. H. G. Massingham and G. N. C. Mann (Massingham and Mann, electrical engineers, Torquay) have dissolved partnership. Mr. Massingham attends to debts.

The *London Gazette* records that on August 10th a committee of inspection was appointed to act with the official receiver and liquidator of the Chitty Dynamo and Motor Company. Messrs. E. E. Barrow, A. C. Bean, and D. J. Edmonds, were appointed on the committee.

Rope v. Central London Railway.—At the Sheriff's Court on the 24th ult., Mr. Under-Sheriff Burchell and a special jury, had under consideration an action for compensation brought against defendants by Messrs. John, James, and Walter Frederick Rope, refreshment contractors, carrying on business in the Bayswater Road. The claimants, as we gather from a report in the *City Press*, had cause to make serious complaints as early as 1896, shortly after the new line was begun, about the effect of the works upon their premises and since then the damage and inconvenience had been considerable. The tunnel ran beneath the pavement, and

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the oscillation caused by the work was felt continuously day and night. The property had suffered to a considerable extent, and damages were consequently sought. On behalf of the railway company several expert mining engineers were called, and expressed an emphatic opinion that the damage complained of by the claimants could not possibly have resulted from the work in operation in connection with the construction of the line. They attributed the cracks in the walls, and other damage to the age of the building, the clay surrounding the foundations, and certain recent structural alterations. The jury found that the damage had not been caused by the railway works, and gave a verdict for the defendants.

Tower Wagons.—The well-known Heathman ladders have been in use for some time at Dublin, Swansea, Prescot, and Newcastle-under-Lyme, and Messrs. Heathman & Co. are now building tower wagons for Carlisle and Sunderland. They are considered to be specially suitable for electric trolley wire construction and repair work.

Trade Announcements. — Mr. Felix Chapman, of Birmingham, has been appointed sole agent for that city and district for the British Electric Works Company's parts and fittings.

Messrs. Donnison, Burton & Co., electrical engineers of Llandudno, have opened a branch at Bangor.

Mr. Walter Gray, electrician, has just opened premises at 342, Fulham Road, S.W., as St. Mark's Metal Company.

Messrs. Sax, Slatter & Co., Limited, have removed from Foresters' Hall, Clerkenwell, E.C., to 1, Basil Street, Sloane Street, S.W.

Messrs. Laing, Wharton & Down, Limited, announce that in consequence of the rapid development of their export business, and the necessity for dealing with it in a systematic way, they have arranged with Messrs. Fry & Co., Limited, 18, Billiter Buildings, London, E.C., to attend to this department, as their special knowledge of this kind of business will enable them to deal with it to the best advantage. All correspondence relative to export business, addressed to Messrs. Fry & Co., Limited, will have prompt attention.

ELECTRIC LIGHTING NOTES.

Aberdeen.—Tenders for electrical supplies for the current year have been opened in committee and remitted to Mr. Bell, the electrical engineer, for tabulation and report.

Asylum Lighting.—The plans for the proposed electric light installation at Rainhill Asylum have been approved by the Lancashire Asylums Board. Subject to the Secretary of State's approval, £24,000 has been granted for the work.

Aycliffe.—Messrs. Cox-Walker, of Darlington, have reported to the Parish Council on the water-power available for electric lighting, and a resident, Dr. Lambert, has offered to present a dynamo to the village.

Ayr.—A letter from Mr. Hammond was before the Town Council last week in the minutes of the Lighting Committee with reference to the decision of that body to accept the proposal to exchange one of the present low speed plants for a high speed plant. Mr. Hammond asked Messrs. Siemens to quote their lowest price for the 200-kw. set and their tender was £2,880 (for a Siemens-Belliss steam alternator similar to the two recently supplied to the Ayr Corporation). Mr. Hammond asked the E.C.C. and Messrs. Fowlers to quote for a 200-kw. set, to comply with the high speed plant specification. Messrs. J. Fowler & Co. quoted £2,765 and the E.C.C. £2,575. The committee had advised the Council to settle with Messrs. Siemens on the terms quoted less £100.

Bath.—The "noisy" arc lamps led to another animated discussion at last week's meeting of the Electric Lighting Committee, a further report from Mr. Hammond as to the working of the lamps being read. It was again contended that the lamps worked without undue noise when the pressure of supply was fairly constant. Mr. Hammond recapitulated at length the steps which had been taken during the past month to place the lamps in satisfactory working order, pointing out that since the introduction of the choking coils there had been considerable improvement, the sound emitted being within the limits allowed for lamps working with alternating current. A report as to the week's test ended with the following paragraph:—"Taking the test as a whole, I am of the opinion that the carbons used by the works are quite good enough, and that the regulation of the pressure on the Brush machines should be controlled with much greater accuracy than at present." At the close of his report Mr. Hammond urged that the variation of the generating pressure was a matter over which the contractor had no control, and they could not be held responsible for any unsatisfactory results in the working of the lamps arising from the excessive variations which had been proved to take place. Under all the circumstances, he did not feel warranted in refusing any longer to grant a certificate to the contractors for the retention money, and in future he should recommend any members of the Committee who encountered unduly noisy lamps to make certain whether they were being run under proper conditions before placing the blame on the contractors or on the consulting engineer. Mr. Hammond said it also appeared, upon investigation, that it was the custom of Mr. Metzger to run the arc lamps in the small hours of the night with the Brush machines taken over from the old company, in connection with which the methods for regulating pressure were most primitive.

The chairman, Alderman Taylor, remarked that if they were compelled to believe all this report contained, it would place them in a very serious position indeed with their own engineer.

Mr. Metzger, the engineer at the works, replied in detail to the communication from Mr. Hammond. He said it was known to Mr. Hammond and the Electrical Construction Company that it was always intended to run the arc lamps off the Brush plant, but to satisfy the contractors they were run off their own machines at all tests, and at some risk to the new plant. The results always proved, in spite of what Mr. Clayden might report to the contrary, that the different machines made no difference to the humming of the lamps. Mr. Todd, Mr. Hammond's own representative, reported, as the result of special experiments on May 11th, that "a variation on the primary volts to the extent of 50 from the normal either way did not affect the noise given out by the lamps to any practical degree. As regards variation of speed, I am not of opinion that this makes any appreciable difference in the lamps beyond the fact that at the lower speed, and consequently lower periodicity, the test-room lamp seemed quieter." Mr. Hammond, writing in reference to this report of Mr. Todd, said: "For my own part, I believe the noise is due to the vibration of the working parts, and especially the core, and I cannot understand why they do not tackle the problem from this standpoint." Dealing with the report of Mr. Clayden, Mr. Metzger said it was a pity that Mr. Hammond did not observe the working of the lamps personally rather than rely altogether upon the opinions expressed by his subordinates. In his (Mr. Metzger's) opinion, the choking coils had effected a great improvement in the working of the lamps, and it only remained to be seen whether such improvement was permanent.

Mr. Shum moved a resolution to the effect that, while they could not adopt or agree with Mr. Hammond's report, they recommend the Council to pay the bill.

Mr. Shum's resolution was carried.

Mr. John then moved an additional resolution to the effect that the committee, having heard the reply of Mr. Metzger, express their entire satisfaction with their engineer's method of running the plant and general management of the station.

This was seconded by the chairman and carried unanimously.

Belfast.—The question of improving the lighting of the upper portion of North Street has been before the Police Committee, but, pending the report of the sub-committee as to the desirability of adopting electricity, action in the matter was deferred.

Brighouse.—The Council's electricity department for the year ended March 31st last, showed a loss of £205 18s. 3d. The price is to be increased from the same date 2d. per unit for lighting purposes, viz., from 5d. to 7d. per Board of Trade unit.

Bristol.—An architect is preparing plans, &c., for the further extension of the electricity works. Mr. Bell, the assistant engineer, has resigned his post, and the question of a new appointment rests with the Electrical Finance Sub-committee.

Cleethorpes.—The District Council has decided to engage Mr. A. S. Barnard as electrical expert, and the Hull Corporation is being asked to give its consent to the arrangement. The tramway company has informed the Council that plans and specifications for the power station are nearly ready.

Cobham.—The Epsom Rural District Council has been notified by the Cobham Gas Company of its intention to apply for a provisional order for electric lighting at Cobham. The Cobham Parish Council asks the Epsom body to strongly oppose the application. It is stated that the gas undertaking has been bought up by a syndicate, which intends to keep out a private electric lighting company if possible.

Coventry.—The quarterly report of the Electric Light Department, presented to the City Council on Tuesday, showed satisfactory progress. The amount of current supplied was 18,925 units, as compared with 14,178 in the corresponding quarter last year; rentals, £429 12s. 7d., as against £328 1s.; number of consumers, 147, an increase of 30.

The City Council has completed negotiations with the National Electric Free Wiring Company, for introducing its system of free house wiring.

Dover.—The Town Council will arrange for electrical illumination of the Granville Gardens and the Monument during British Association week.

Dyce.—Ratepayers were called together last week to pass a resolution forming Dyce into a special lighting district. Messrs. P. C. Middleton & Co., electrical engineers, have submitted a proposal to the Council, under which they would pay £50 per annum for spare water-power at the water works and supply electric lamps of 16 c.p. for public lighting at 25s. 6d. per annum, and for private lighting at 16s. to 25s. per light.

Epsom.—The Board of Trade has approved of the electricity supply scheme.

Fenton.—The Royal assent had been given to the Fenton Council's electric lighting order.

Godstone.—At a recent meeting of the District Council a letter was read from Edmundson's Electricity Corporation, Limited, in reference to their application for a provisional order for electric lighting in the parish of Warlingham. It was proposed to put a generating station down for the supply of both Caterham and Warlingham.

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Fulham.—Messrs. Willans & Robinson, who are one of the sub-contractors under the General Electric Company, Limited, for the electrical contract for the Fulham Vestry, have offered resistance to the labour clause, which was made one of the conditions in their contract. The course matters have taken may be gathered from the following report, which we have reproduced from our exchange, the *Contract Journal*:—

"A special meeting of the Electric Lighting and Dust Destructor Committee of the Fulham Vestry has been held to consider communications from their consulting engineer, the General Electric Company, Limited, and their sub-contractors for engines, Messrs. Willans & Robinson, with regard to trade union rate of wages. The following letter was submitted from Mr. Medhurst, the engineer, who attended:—

Westminster Chambers, 13, Victoria Street, S W.,
August 14th, 1899.

W. J. H. Denselow, Esq.,

Dear Sir,—I enclose herewith copy of letter received from the General Electric Company, Limited, from which you will see that Messrs. Willans & Robinson, the sub-contractors for some of the smaller engines in your electric lighting station, refuse to be bound by the terms of the contract in respect to the payment of trades union rate of wages. You will see from the General Electric Company's letter that Messrs. Willans & Robinson have prepared a full statement of the wages, &c., that they pay their workmen, and that these they are prepared to pay for work undertaken for your Vestry. I shall be glad if you will arrange for a committee meeting at an early date for the purpose of discussing this question.

Yours faithfully,
F. H. Medhurst.

"The General Electric Company wrote as follows:—

Peel Works, Adelphi, Salford,
August 9th, 1899.

To F. H. Medhurst, Esq.

Dear Sir,—We regret to inform you that Messrs. Willans & Robinson refuse to be bound to pay the union rate of wages, and we give you below extract from their letter: "We have no reason to fear a comparison of the rates we pay with those paid by any other firm in our district, but we must decline, and always have declined, to accept union rates, or anyone else's as a standard binding upon us. Under these circumstances, unless you get the clause withdrawn, we must ask you to place the order elsewhere. We enclose list showing the rate of wages paid here, which was prepared for the information of firms tendering to the Battersea Vestry, whose order for the engines, you may remember, has been placed with us. We are willing to accept any clause which falls in reasonably with the payment of these rates. We are, of course, very sorry that this opportunity for working with you should fall through, but the acceptance of this clause would be contrary to the principles to which we have definitely decided to adhere." Will you, therefore, please instruct us if you still wish us to place the order with Messrs. Willans & Robinson, whose rate of wages (copy of which we enclose) appear to favourably compare with the rates paid in their district, or whether we are to place the order elsewhere, in accordance with the rider embodied in Clause 39 (sub-letting, &c.). We may say that we have already prepared drawing of our dynamo coupled to Willans engine, but we are delaying sending this in for your approval until we learn your decision. Unless you decide that the clause can be altered or ignored in this particular instance, we should propose to supply Musgrave engines. Your kind and immediate attention will much oblige.

Yours faithfully (for the General Electric Company, Limited),
(Signed) Tom Hawkins.

"A list of rate of wages paid was subjoined. It was decided that the Committee saw no reason why Messrs. Musgrave & Co. should not have the contract for the exciter engines. This was agreed to."

Gloucester.—The applications which have already been received for the electric light are stated to be very satisfactory, and show that the installation will result in a clear profit.

Haslingdon.—The site originally proposed for electricity works is not considered suitable, and the Sub-committee has been recommended to look for a better one.

Hornchurch.—The Cottage Homes Visiting Committee of the Shoreditch Board of Guardians have considered the question of lighting the Cottage Homes at Hornchurch by electricity, at an estimated cost of £4,000. The Guardians generally are favourable to the scheme.

Ilford.—A Local Government Board inquiry has been held here *re* the Council's proposed loan of £4,400 for a site for electricity supply and tramway works.

Kensal Town.—The Kensal Town members of the Chelsea Vestry will bring before a special Vestry meeting, arranged for September 26th, a proposal to apply for a provisional order for electrically lighting their portion of the parish.

Larne.—The District Council has passed a resolution to the effect that a committee be appointed to consider the entire question of the lighting of the urban district, with power to obtain legal advice, and to consult experts.

London, E.C.—An explosion occurred in a Bartholomew Close electric light main box on Tuesday afternoon.

Lowestoft.—The Town Council last week further discussed the question of electric trams. It was proposed that "in consequence of the decision of Her Majesty's Light Railway Commissioners with regard to the non-construction of the light railway from Gorleston to Lowestoft, the Council is now released from its engagement to support the East Anglian Light Railway Company," and that it was advisable to take a municipal electrical scheme in hand, the Drake & Gorham Company to be informed accordingly. This was not carried, as the Mayor moved and it was resolved—

That in view of the guarantee by the Drake & Gorham Electric Power and Traction Company, Limited, to proceed in the next Session of Parliament to obtain powers under the Tramways Act to construct as a tramway the portions of the proposed light railway, for which they failed to obtain the sanction of the Light Railway Commissioners, and to substitute for the proposed route of Railway No. 6, an alternative route to be agreed to by the Council, this Council will continue its support to the scheme of the said company on certain conditions.

It was stated by the clerk "that the purport of the amendment was that the Corporation would postpone their application for powers until they saw how the company fared with their application."

Middlesbrough.—The Corporation has accepted tenders for building the works for the electricity station.

Newark.—Mr. Vesey Brown has been engaged to advise the Council on an electricity supply scheme for the town.

Newcastle-on-Tyne.—The Sanitary Committee of the Corporation has decided to appoint a Committee to consider the advisability of using the city refuse for the generation of steam. It has been thought that steam thus raised might be employed for generating electricity for the Tramways Committee's purposes.

Oldham.—The Borough Council has considered and approved the minutes of the Electric Lighting Committee, referred back by the previous meeting. The committee proposed to expend about £4,000 on a boiler house at Rhodes Bank, in order to meet the increasing calls for electric light, and to prepare for the demands which will be made upon them when the local tramways are municipalised, and converted from horse and steam to electric traction.

Perth.—Tenders for the electric light installation plant have been received from over 50 firms. They were to be considered on Tuesday.

Pontypool.—The Urban District Council is to approach the Electric Light and Power Company with the view of opening negotiations for the purchase of the company's works.

St. Helens.—A Local Government Board inquiry was held on the 29th ult. *re* the Corporation's proposed loan of £3,600 for electric lighting extensions. The town clerk gave particulars of previous loans raised for electric lighting, and said that in 1897 the Corporation purchased the local tramways and resolved to build a station for generating electricity on the continuous current system, both for lighting and traction purposes. A considerable demand for motors had sprung upon the town, and the Corporation now proposed to lay new continuous current mains and relay the old alternating current cables in the districts of Parr and Sutton, two new areas to be opened. The current to the new areas would be supplied on the alternating system from the Warrington Road works. The change of current would mean that the people now using electricity would have to change their lamps, and the Corporation proposed to bear the cost of such changes, as the consumers could not be expected to bear the expense. The town clerk added that the demand for electric lighting was steadily growing. Up to March in 1897 the number of 8-c p. lights in use was 2,570; in 1898, 4,752; in 1899, and from March last to June last the number had increased to 6,714. The price for electricity up to June last was 6d. per unit, but it was now 4½d. per unit, while for power it was 3d. for three hours and 2d. afterwards. Besides the total amount of money borrowed under the Local Government Board authorities £25,000 had been obtained for tramways equipment and other purposes by permission of the Board of Trade. Mr. Highfield, the borough electrical engineer, then gave details of the scheme, and said that it would not be necessary to take up all the cables from the streets where they were already laid. They would take out only the high tension feeders. The plant for the new districts would be capable of supplying 3,500 lamps of 8 c p. The Corporation had demands for 1,200 lamps. The inquiry then terminated.

St. Paul's Cathedral Lighting.—It is stated that a contract has been given to a West-end firm for the electric lighting work at the Cathedral, and a start has been made with fitting up the necessary tubes for carrying the wires.

Shoreditch.—The proposal of the Committee to spend £4,000 on the electric lighting of the Cottage Homes will not be acted upon by the Guardians until the report has been circulated among the members.

Southampton.—The borough engineer is to prepare plans for the Works Committee of the City Council of the proposed positions of the electric light and tramway pillars on the Shirley route.

Staines.—The General Purposes and Drainage Committee has had an interview with Mr. Offor, of the Electrical Power Distribution Company, Limited, with reference to the company's proposed application for a provisional order for the district. Mr. Offor will submit terms upon which an order could be worked.

Stirling.—The Burgh Buildings, King Street, are to be lighted electrically. The master of works is to submit a specification and estimate of the cost.

Sunderland.—On Tuesday a Local Government Board inquiry was held as to the proposed loan of £40,000 applied for by the Corporation for the extension of the electric lighting station and plant. The Corporation have already spent £71,000 over electrical plant, and a profit has been realised. In view of the electric tram scheme more plant is needed.

Swansea.—It is stated that the tenders received for electric lighting plant, &c., are higher than was anticipated, and they have been referred to the engineer to report upon.

Wales.—The Urban Council of Bala has rescinded a resolution to erect gas lamps in certain parts of the town, and will re-consider the whole question of lighting, electricity having been mentioned in connection with the matter.

Walker.—Application was made at the meeting of a committee of the Newcastle Corporation last week by the Walker authorities for the erection of a power station to generate electricity. The matter will be brought up at the next meeting.

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West Ham.—In connection with our account of the electricity works last week, we omitted to mention that the installation of the electric light in all the public offices, amounting to nearly 1,000 lamps, was carried out by Mr. H. J. Rogers, A.I.E.E., of Watford.

Wigan.—The Corporation has applied to the Local Government Board for sanction to borrow £90,000 for electric lighting purposes. The erection of a dynamo house and other premises will be at once proceeded with.

Woodhall Spa.—There is a good deal of talk about an electric lighting scheme which is expected to take shape directly. Our local correspondent says that an engineer has been asked to send in an approximate price for putting down a lighting plant at the sewage works and carrying current into the town by overhead wires.

Wrexham.—The Local Government Board has requested the Council to furnish certain details regarding the electric lighting work, for which it wishes to borrow £2,000.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Barcelona.—The chairman of the Barcelona Tramways Company, on Wednesday, told the shareholders that electric traction was inaugurated on their system in January last with the running of only nine electric cars. At the present time they had 78 electric cars and 42 mule cars at work, but the number of the former is being added to.

Bradford.—The City Council is to make application to the Light Railway Commissioners for an order authorising the Council to undertake to construct and work a light railway between Bradford and Leeds.

Returns showing the working of the electric tramways for the fortnight ending August 20th, show that on the Bolton section 5,467 miles were run, and the receipts amounted to £299 19s. 9d., which is equal to 13·16d. per car mile. The total receipts since April 1st, 1899, amount to £2,619 19s. 6d., or 12·49d. per car mile. On the Horton section during the past fortnight, 10,090 miles were run, and the receipts were £668 9s. 1d., which is equal to 15·89d. per car mile. The total receipts since April 1st, 1899, amount to £5,602 2s. 6d., which is equal to 14·25d. per car mile.

Dublin.—The Dublin United Tramways Company has written to the town clerk with reference to the committee's "strong conviction" that it is necessary "to provide for each car a driver or motorman, a conductor to start and stop the car, and a collector of fares." The company says that, since the opening of the electric tramways, more than two years ago, only one accident occurred, due to the falling of wires, which was attended with the slightest injury to any person, viz., the recent falling of the wires under the railway bridge in Amiens Street, where, owing to the bridge being so low, the overhead construction was of a difficult and complicated character. Since the accident occurred the committee have approved of a method of improving the construction of the overhead wires under this bridge which will prevent the possibility of such an accident occurring again. The board therefore see no necessity for employing a third man to manage the trolley rope on each of their cars, which is not required anywhere in the world where electric traction on the overhead system is in operation. It is added:—"The trolley rope is not an essential feature in this system of electric traction, and it is in contemplation to discard its use altogether, as a new type of trolley head is being introduced, which will not be liable to catch in the overhead wires."

A trolley pole broke on one of the electric cars last week, but no one was injured.

The Rathmines section of the Dublin electric tram system (between Terenure and Nelson's Pillar) was inaugurated on 28th ult.

Dundee.—The Tramway Committee last week had before it the tenders for the overhead line equipment of the Perth Road and Lochee Road routes, and these were remitted to the convener and the engineer to report as to the most advantageous tender.

Eccles.—Last week a meeting was held at Eccles of representatives from the Little Lever, Radcliffe, Barton Rural, Farnworth, Worsley, Whitefield, Urmston, and Little Hulton District Councils and the Eccles Town Council to consider a scheme for the construction of electric tramways to connect the above districts with the Salford Docks. The length of the proposed line is about 12 miles, and it will pass through districts with an estimated population of 250,000 and a rateable value of £500,000. The conference was private, but it is stated that a decision was come to to recommend the various authorities represented to agree to the construction of tramways through their districts, the trams to be electrically equipped and worked by a private company. It was decided to seek the necessary powers under the Tramways Act. The conference then adjourned for a month to enable the representatives to lay their views before their respective Councils.

Glasgow.—The Corporation Electricity Department has decided to construct a motor car for conveying members of the Committee and leading officials on their visits to the various power stations. The car will accommodate four persons and obviate the use of cabs.

Greenock.—The Police Board last week considered motions regarding the municipalisation or leasing of the tramways system, and resolved that: "If suitable terms can be arranged, the Board make immediate arrangements for leasing the whole line of tramways within the burgh as an electrical system."

Hastings.—Those who have so far successfully advocated the introduction of tramways into the borough are doing their best to educate public opinion as to the advantages of an electric tram service, by public meetings and the distribution of literature.

Italy.—The authorities of the Late Mediterranea Railways have placed a contract with the Thomson-Houston Company for the conversion of the railways between Naples and Castellammare, Rome, and Frascati, and Milan, and Gallarate into electrical lines.

Leeds.—There was a short stoppage of the electric car service on the 27th ult. through a defect in the Sheepscar feeder.

Limerick.—A private meeting of the Borough Council was held last week to consider a proposal to introduce electric trams into the city at a cost of £67,000. Messrs. Fitt, solicitor, and Fuller, C.E., attended on behalf of the promoters, and explained the scheme at length. The application was adjourned for further evidence.

Liverpool.—The Tramways Committee has decided, upon the advice of the city engineer, the city electrical engineer, and the general manager, to recommend the Council to apply for Parliamentary powers authorising them to construct various lines of electric tramway in order to complete the system for the whole city. A special Council meeting will consider the recommendation. The city engineer is to arrange with Messrs. Blackwell & Co. for the execution of the overhead work in Stanley Road between the Rotunda Theatre and the Bootle boundary at their present schedule of prices, while with regard to the other routes and extensions the engineers were authorised to obtain tenders.

The laying of the lines for the north extension to Walton of the electric tramways has been carried out so expeditiously that within a week the whole of the street works will have been completed up to Spellow Lane. It is said that early in October the line may be equipped with cars. The laying of the metals from the Rotunda Theatre to Bootle is being pushed forward, and the street works have been carried out up to Commercial Road. It is anticipated that in a fortnight's time the lines will have been laid up to the Bootle boundary, and the Aintree and Fazakerley route will next be proceeded with.

The cart owners are protesting against the rapidity with which the Corporation is pushing forward its electric tram scheme, because of its effect upon the ordinary street traffic.

London.—A correspondent of the *Daily Chronicle* advocates electric traction as a remedy for the overcrowding in London, and he urges the County Council to push forward with its scheme with all possible speed and establish a record for good and quick work. Fixed stopping places are recommended. Our contemporaries might do worse during the silly season than open their columns to a discussion showing the advantages accruing from the adoption of electricity on tramways. These benefits are matter of ancient history to the electrical engineer, but the average Londoner knows little thereof, and he would be more enlightened by such a correspondence than by the trashy rubbish on impossible subjects which has been appearing of late.

Mirfield.—The District Council has resolved to invite the Huddersfield Corporation to extend the proposed electric trams to Mirfield.

Mumbles.—The British Electric Traction Company have, it is announced, just taken possession of the Mumbles Railway and Pier.

Newcastle.—The city engineer has submitted his observations upon the recommendations of Prof. Kennedy and Mr. Hopkinson *re* electric tramways. They are as follows, says the *Newcastle Leader*:—

Both of these gentlemen (Prof. Kennedy and Mr. Hopkinson) agreed that the use of conduit and overhead together is quite practicable; but neither of them is enthusiastic in advising its adoption, and both of them seem to me to have rather a leaning towards the surface contact system, which they both consider to promise well in the future. Kennedy puts the cost of the surface contact system at about the same as trolley; Hopkinson does not give any estimate.

Hopkinson does not advise the combination of the trolley and conduit, and suggests the installing of the trolley throughout, but regarding it as only temporary in the central streets where it may be replaced in future by the perfected surface contact system. I accept Kennedy and Hopkinson as authorities, and adopt their electrical conclusions as accurate. Mr. Hopkinson's proposal to instal the overhead trolley temporarily in the central streets seems to me, however, a doubtful policy. I was inclined at first to agree with it, but on second thoughts it does not settle anything, and leaves the old difficulty untouched. If, on the other hand, the surface contact (or the conduit system) is installed at once in the central streets, it settles the disputed matters once and for all. There may be some future expense in following up the improvement of the system, but, if the experts are right, it will only be in matters of detail that changes will have to be made.

Considering all things then, I am of opinion that the least risky plan will be to put down the surface contact system at once in the central streets at least, to be worked in conjunction with the trolley outside, and to discard the conduit, which is apparently not favoured by the experts, though Kennedy's report to the London County Council is much more favourable to it.

The City Engineer will probably live to rescind his present decision. The New Tramways Committee, it will be remembered, recommends the adoption of the trolley for the centre of the city, and the matter comes before the Council on September 6th.

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Rothesay.—The Council has considered the agreement between a committee and the British Electric Traction Company, who propose to purchase the present tramways and run them electrically. There were two clauses submitted. The Council generally adopted the proposal, but one clause was altered so that granite setts will be laid between the rails, and for 18 inches on each side of the rails, the remaining part to be tar macadam.

Sheffield.—On Friday last week Sir Francis Marindin, chief inspector of the railway department of the Board of Trade, inspected the track of the new electric tramways, with satisfactory results.

On Tuesday, Mr. A. P. Trotter, electrical adviser to the Board of Trade, inspected the new electric tramway power station.

South Shields.—Public meetings are being held here to stir up a movement in favour of municipal electric trams.

Walsall.—It is feared, says a local correspondent, that the notice which has been, or is to be given by the Town Council to the South Staffordshire Tramways Company of their intention, six months hence, to determine the agreement dated February 11th, 1892, as to the use of electricity on the lines, and also of the intention of the Council to purchase so much of the tramways as was authorised by the Walsall and District Tramway Order, 1882, may lead to some inconvenience by dislocation of the traffic.

Southampton.—A deputation recently waited upon the secretary to the Board of Trade (Sir Courtenay Boyle) relative to the proposed reconstruction of the permanent way and to the necessity of obtaining increased borrowing powers for the tramways undertaking. The Council last week resolved that, having regard to the satisfactory interview with Sir C. Boyle, "The Tramways Committee do exercise the power given them by the Council on July 26th, 1899, to accept tenders for the reconstruction of the tramways between Portswood Terminus and the Docks, and that it be an instruction to the Finance Committee to provide for the payments from time to time to be made to the contractors in respect of these works from a Special Suspense Account to be created upon the best terms that the Committee may be able to obtain." The provisional order, it seemed from the discussion, was not obtained when it ought to have been, but it was considered that it would not prejudice the Council in the eyes of the Board of Trade when applying for the order if they did not delay the works.

TELEGRAPH AND TELEPHONE NOTES.

A Cape-Australia Cable.—In the following extract from an Australian paper it will be seen that the Eastern group of cable companies do not yet despair of maintaining their hold on telegraph traffic from Australia. They have, it is true, abandoned the absurd claims they advanced for subsidies, guarantees, and a monopoly of the right to land cables at all the numerous places where their existing cables already land. They also volunteer a reduction on the present charge for telegrams to Australia (a reduction which may cause a delay in the reform of the rates to India). The return they ask for this self-effacement is apparently insignificant, but we hope that the experience which the Colonies have had in the past of the dealings with these companies will not fail to show them that the closest scrutiny should be made, and the greatest publicity possible should be given to the terms of the "privilege" asked for. We should not be in the least surprised to find that the nature of this "privilege" will be such as to amount, indirectly or directly, to a joint-purse agreement with the Colonies of West and South Australia at least, as these Colonies are the proprietors of the trunk landlines, the "harassing and annoying delays" on which have driven their old allies, the submarine cable companies, to project the laying of a cable, which will be in direct competition with these inefficient Government landlines, unless some agreement is come to between the companies and the Governments. The extract is as follows:—"The Eastern Extension Company has forwarded to its representative here, by cable, the following outline of a new scheme for an alternative cable *vid* the Cape:—'As public opinion in Victoria apparently favours an alternative cable *vid* the Cape, rather than by the Pacific route, and according to the Chancellor of the Exchequer's admission, the company's Cape proposal was also preferred by the Imperial Government, but fell through because Australia refused to assist it, we are willing to meet the difficulty by making the following liberal concessions, namely: We will entirely waive the renewal of subsidy and guarantee against competition, and, in addition, to providing a cable from the Cape all the way to Glenelg, *vid* Perth, will agree to at once reduce the tariff to 4s. per word, and make further reductions on a sliding scale as the traffic increases. In return for the above the company would only require the same privilege in the Colonies as they have hitherto enjoyed in Great Britain, of directly delivering and collecting national telegrams to and from the public. The length of proposed line would be about 7,700 knots, including connections, thus: Natal to Mauritius, 1,818 knots; Mauritius to Rodrigues Island, 406 knots; Rodrigues Island to Cocos Island, 2,218 knots; and Cocos Island to Perth, 1,862 knots. From Perth the cable would be submarine to Glenelg, South Australia, which would remove the harassing and annoying delays which are experienced with the landlines.' The cost of the line is estimated at £1,500,000. Sir George Turner, when seen in reference to the proposal, said he could not state his views until he had consulted the Postmaster-General; and it was quite possible the matter would have to be referred to a conference of the Australian Premiers."

Glasgow Corporation and the Telephone Service.—The Corporation had another debate last week with reference to the rights of the Postmaster-General to open the public streets and give the National Telephone Company a right of way. There were also some hard things said about the anomalous state of affairs caused by the Government Telephone Act. The Statute Labour Committee's report was before the meeting, and it was stated with reference to the recent decision of the Railway Commissioners against the Corporation in their refusing to allow the Post Office authorities to open the streets for post office purposes, that the sub-committee had had a meeting, and had resolved to appeal against that decision to the Inner House of the Court of Session. The committee had taken the opinion of counsel. It would cost a little money, but after they had gone so far, the committee felt bound, on behalf of the Corporations generally throughout the country, to fight the issue to the bitter end. This course was agreed to.

The Pacific Cable.—A Reuter dispatch from Wellington (August 29th) says that the New Zealand House of Representatives, in committee, has adopted resolutions authorising the Government to contribute towards the cost of the construction and maintenance of the proposed Pacific cable.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa...	April 4th, 1898 ...	...
Latakia-Cyprus	June 20th, 1899 ...	...
Para-Maranham	April 10th, 1899 ...	August 25th, 1899
Accra-Grand Bassam... ...	August 1st, 1899 ...	...
Corea-Japan	August 7th, 1899 ...	...
Iquique-Valparaiso	August 15th, 1899...	August 25th, 1899
Serena-Valparaiso	August 18th, 1899...	August 25th, 1899
Nagasaki-Fusan	July 22nd, 1899 ...	August 20th, 1899
Jamaica-Colon	June 30th, 1899 ...	...
Jamaica-Porto Rico (Ponce)	August 15th, 1899...	...
Cape Haitien-Puerto Plata ...	August 21st, 1899...	...
Cape Haitien-Mole St. Nicolas	August 21st, 1899...	...
Landlines.		
Communication between Saloniks and Monastir ...	March 23rd, 1899 ...	...
Communication between Bolama-Bissao	July 28th, 1899 ...	...
Puerto Plata-St. Domingo ...	August 23rd, 1899 ...	...
Lines from Haiti to Gonaives, Gros Morne, Port de Paix Plaisance, and Cape Haitien Port au Prince to Miribalais and Jacmel	August 18th, 1899...	...

Wireless Telegraphy.—A New York telegram from Laffan's Agency to the *Times* says:—"Encouraging experiments in wireless telegraphy, in which kites were used, have been made between Harvard College and Milton, Massachusetts. The distance was 12 miles, and there were considerable difficulties, owing to the electric power houses, electric trolleys, &c., on the route. In spite of this, however, it was possible to telegraph at the rate of 10 words a minute, and it is thought that greater success will be achieved when the disturbing elements have been overcome. The process employed was practically the same as Signor Marconi's, but wires hanging from the kites were substituted for poles. It is claimed that these have an advantage over poles, as being more easily adapted for any height or distance."

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking Town.—October 24th. The District Council wants tenders for boilers, pipe work, two 100-kw. steam dynamos switchboard, motor and trailer cars, trucks and electrical equipment overhead equipment, underground feeders, conduits, road work, &c. for the Barking and Beckton light railways. See "Official Notices" this week.

Barnsley.—September 16th. Tenders are wanted for electric light wiring and fittings at the Harvey Institute, Eldon Street, for about 700 lights. See "Official Notices" August 18th.

Barnsley.—Tenders are to be invited for wiring the Public Hall for electric lighting.

Belfast.—September 31st. The Electric Committee wants tenders for c.i. floor plates and w.i. rails for the electric light department. Specifications from the city electrical engineer on payment of one guinea, returnable as usual.

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Bermondsey.—September 13th. The Vestry wants tenders for electric lighting work at the Town Hall. See "Official Notices" this week.

Carlisle.—September 11th. The Corporation wants tenders for extension to steam, drain, and feed pipes, feed pump, and extension of economiser at the electricity works. See "Official Notices" August 18th.

Carlisle.—September 18th. The Corporation wants tenders for extension of switchboard for dynamos 5 and 6, and for traction work. See "Official Notices" this week.

East Ham.—September 9th. The Urban District Council wants tenders for combined electric light and traction plant, engines, generators, overhead line equipment, cars, switchboard, arc lamps, &c., water-tube boilers, condensers, and other steam plant, electric light cable. Mr. W. C. Ullmann, The Limes, White Post Lane, East Ham, is the Council's electrical engineer. See "Official Notices" August 4th.

Germany.—September 20th. Tenders are being invited until September 20th by the Cotton Wool Exchange authorities in Bremen for a complete installation of electric lighting in the new Exchange. Tenders are to be sent to Das Banbureau für die Bremer Baumvoll börse la Dechanatstrasse, Bremen, whence particulars may be obtained.

Hackney.—September 12th. The Vestry wants tenders for four sets of direct current steam dynamos (either high or low speed). See "Official Notices" August 11th.

Heckmondwike.—September 20th. The District Council wants tenders for the supply of water-tube boilers, economiser, pipe work, steam dynamos and motor boosters, accumulators, switchboard work, travelling crane, mains, arc lamps and posts, and station lighting. See "Official Notices" August 25th.

Ilfracombe.—September 25th. The District Council wants tenders for boiler plant, engine plant, dynamos, condensers, switchboard, mains, lamp-posts, accumulators, meters, crane, buildings, &c. See "Official Notices" August 18th.

Luton.—September 22nd. The Council wants tenders for boilers, superheaters, engines, dynamos, switchboard, steam and other piping, batteries, street conduits, boxes, feeders, arc lamps and posts, and various other plant and machinery for the electric lighting installation. See "Official Notices" August 25th.

Malmo.—September 1st. The Gas Works' directors want tenders for the erection of electricity works for the city. Particulars on application to the clerk of the Gas Works (deposit 12s).

Middleton.—September 20th. The Corporation wants tenders for Lancashire boilers, superheaters, economisers, steam pumps, condensers, steam dynamos, balancer and boosters, switchboard, accumulators, cables, crane, &c., for electricity works. See "Official Notices" this week.

Moscow.—*Commercial Intelligence* says that electrical engineers and contractors will shortly be invited to compete for the electric railway for Moscow. The contract will probably require an expenditure of about 20,000,000 roubles.

Oldham.—The Electric Light Committee invites tenders for rolled steel girders, concreting, and other works required in the foundations for "Kleins Tower Water Cooler" at the electric light station, Gas Street, Oldham.

Poplar.—September 6th. The Guardians want tenders for high speed engine and dynamo, electric motors, Lancashire boilers, economiser, and other plant, as briefly particularised in our "Official Notices" August 18th. Mr. Warden-Stevens, the consulting engineer, asks us to notify that Section L., Steam Jet Plant, relates to ejector condensers, jet pumps, and injectors; and Section M., Auxiliary Pumping Plant, to air compressors, centrifugal pumps, and three-throw pumps.

Portugal.—September 6th. Tenders are being invited by the municipal authorities of Cascaes, Portugal, for the concession for the electric lighting of the town.

St. Annes-on-the-Sea.—September 11th. The Council wants tenders for high speed engines, continuous current dynamos, and balancing booster, for electric lighting. See "Official Notices" August 18th.

Salford.—September 12th. The Tramways Committee is inviting tenders for 100 tramcars. See "Official Notices" this week.

Sunderland.—The Corporation wants tenders for four 270-kw. three-crank direct current steam dynamos, and two surface condensers and cooling tower. See "Official Notices" August 18th.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

Tiflis.—The Town Council is inviting tenders for a tramways concession, one of the conditions being that the present horse traction shall be replaced by electric traction, the new lines to be also worked by electric power. The Managing Department of the Town Council, Tiflis, Transcaucasus, is open to receive offers until the beginning of October.

CLOSED.

Blackpool.—The Electric Lighting and Tramways Committee have decided to recommend the Council to accept the tender of the British Thomson-Houston Company, Limited, for the 10 car equipments, for which tenders were recently asked.

Cape Town.—Both electric light and electric traction are making headway at Cape Town. At the last meeting of the Municipal Council of the city tenders were under consideration for machinery for the extension of the Dorp Street generating station. The tenders recommended for acceptance were those of Messrs. Sissons & Co. for the supply of two engines, each of 500 I.H.P., for £2,200; Messrs. Clayton & Shuttleworth, four boilers of the locomotive multitubular type for the sum of £2,390; Messrs. Bailey & Co., a pump, £225; and the South African General Electricity Company two dynamos, each capable of an output of 350 kw. as a continuous load, £3,150. It seemed, however, that the South African General Electricity Company had requested a definite reply to their offer in a fixed time, and as the Council could not give this the tender was withdrawn. The Public Works Committee were empowered to accept the next lowest tender. With regard to the electrical tramways, formal consent was given to an extension by the Metropolitan Tramway Company of the lines to Tamboer's Kloof.

Halifax.—The contract for electric lighting work at the Municipal Technical School has been given to Messrs. Laing, Wharton and Down at £405. There were altogether 16 tenders ranging from £361 to £628.

Ingleton.—Ingleton Electric Light Company have let the contracts for the construction of a weir, pipe track, launder and turbine house works, and the electrical machinery contracts are to be let in a few days.

NOTES.

The Glasgow Corporation Contract.—We were credibly informed that the Allis Company tendered for the alternative two-crank engine for the Glasgow tramways, and before our article on page 343 went to press we inquired telephonically at Mr. Blackwell's office whether this was correct. Unfortunately he was away in Glasgow, the gentleman who looks after the Allis engine matters was out, and nobody in the office could give us one word of information. Since we went to press a telegram from the North informs us that the American makers tendered for the three-crank. That portion of the article, therefore, alluding to what we understood to be the American tender need not be seriously considered, nor our remarks on Mr. Parshall's apparent requirements, which are now shown to be unwarranted.

On Monday the Tramway Committee met the representatives of the four offerers, to each of whom eight questions were put. The matter was afterwards discussed for some hours. Bailie Thomson moved that the contract for the four main engines be given to Messrs. John Musgrave & Sons, Limited, Bolton, on condition that they be completed within a stipulated time. Their estimate is £95,516.—Bailie Steele moved that the contract for two of the engines be given to that firm and two to the Edward P. Allis Company, the American firm, whose tender to construct the four engines for £114,000 was originally accepted by the committee. On a division Bailie Thomson's motion was carried, but as Mr. Musgrave could not agree to the stipulation laid down, the meeting adjourned without coming to any definite conclusion. Another meeting of the Tramway Committee was called for the following afternoon to reconsider the matter.

Personal.—Mr. A. F. Malyon Eatrill has resigned his position as engineer-in-charge at West Ham electricity works, he having obtained an appointment with the Electrical Power Distribution Company.

(*Continued on page* 366.)

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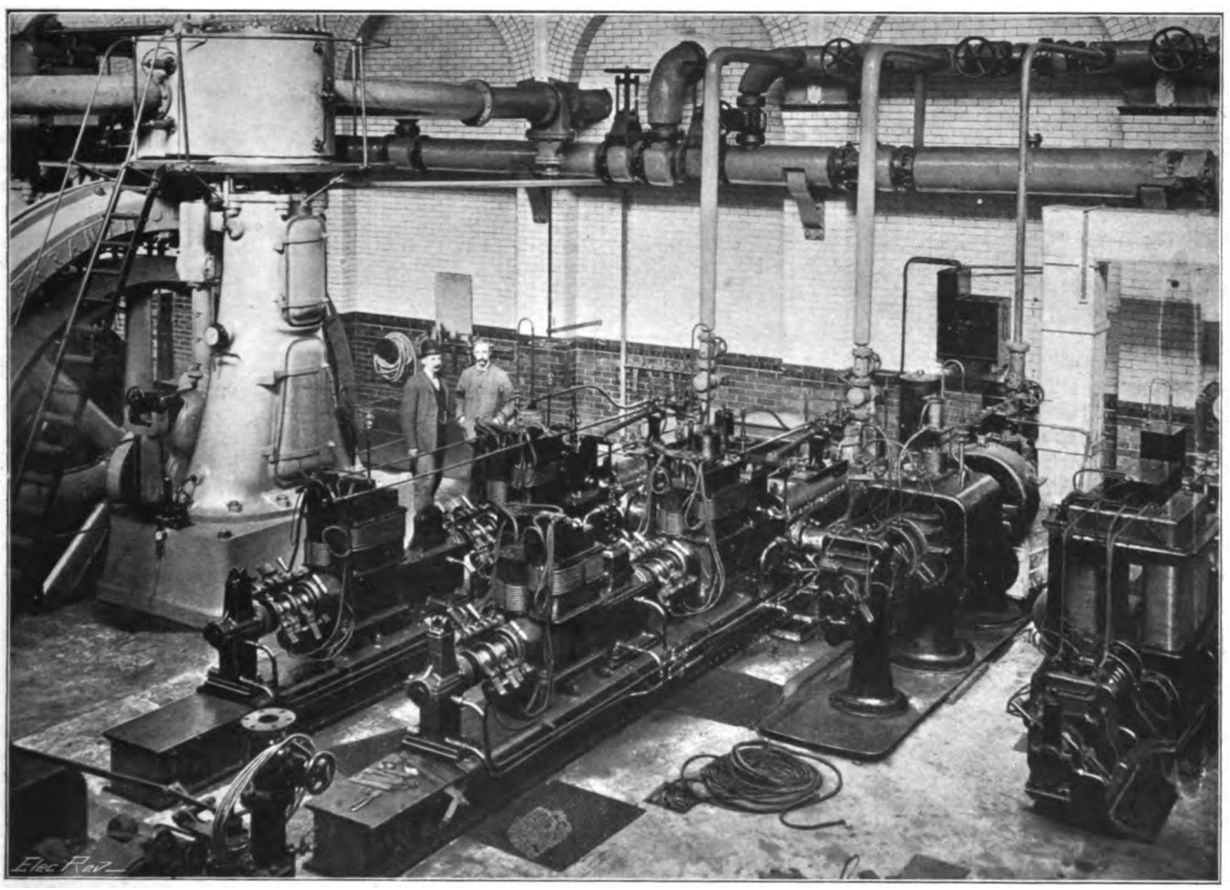
THE CONVERSION OF BLACKPOOL TRAMWAYS.

It is not without a feeling of regret that we write the above words. The Blackpool Conduit Tramway was one of our venerated standards of reference; being one of the earliest attempts at carrying out a system of electrical tramway traction on a practical scale, and certainly the very first successful conduit system, it constituted the outward visible sign of our country's claim to be considered as pioneers of electric traction.

The line was constructed to the designs and under the supervision of Mr. Holroyd Smith, who merits all honour for his courage and originality. It was opened in 1884, has run ever since, and might still have been in operation had it not been for the adverse conditions under which it laboured. What modern engineer would so much as attempt to build and work a conduit which was exposed to sand-drifts and to flooding with sea water? Small wonder that a time came when it was seen to be imperatively necessary to reconstruct the line, and place the conductors out of harm's way. We cannot but agree as to the wisdom of this course, however much we regret the necessity.

It should not be forgotten that in spite of, or, rather, as the result of, the many attempts which have been made of recent years to evolve a perfect conduit, the general form and equipment of the Holroyd Smith conduit have been retained by the best designers, even to the porcelain insulator and the cotter to grip the conductor—modified in construction, no doubt, but in essence the same. The earth return, however, has been avoided by the use of conductors of opposite polarity in the conduit.

The original tramway was laid down by the Corporation and leased for seven years to a company; the Corporation then—in 1892—purchased the plant, &c., for the sum of £15,587 inclusive. Part of the conduit was relaid, and further expenditure of the same kind incurred in 1893-4, but on account of the frequent failures and unsatisfactory working, the whole of the conduit along the Promenade was relaid on a new principle in the winters of 1894—6, at a cost of over £8,000. Still the trouble increased, and after a report from Mr. Quin, who took charge in 1897, a deputation from the Council visited various places on the Continent to examine the systems in use. Their conclusions, which were embodied in a report issued in March, 1898, and were strongly in favour of an overhead system, were adopted by the Council.



Turbo-Generators in the Electricity Works.

The system now in operation employs the overhead wire and side trolley, with the usual rail return. It is remarkable on the score of the short length of the bracket arms, and the great length of the trolley poles; these peculiarities were due to the desire of the Corporation to avoid disfigurement of the promenade along the sea-front, which is traversed by the cars, and the justice of their choice is evidenced by the artistic and inoffensive nature of the construction seen in the accompanying photograph of the promenade. By this means the local opposition to overhead construction was overcome, thanks to the untiring efforts of Mr. Quin, the Corporation electrical engineer, to solve the problem.

The motive power is derived from the municipal electricity works, the lighting and traction having been combined since

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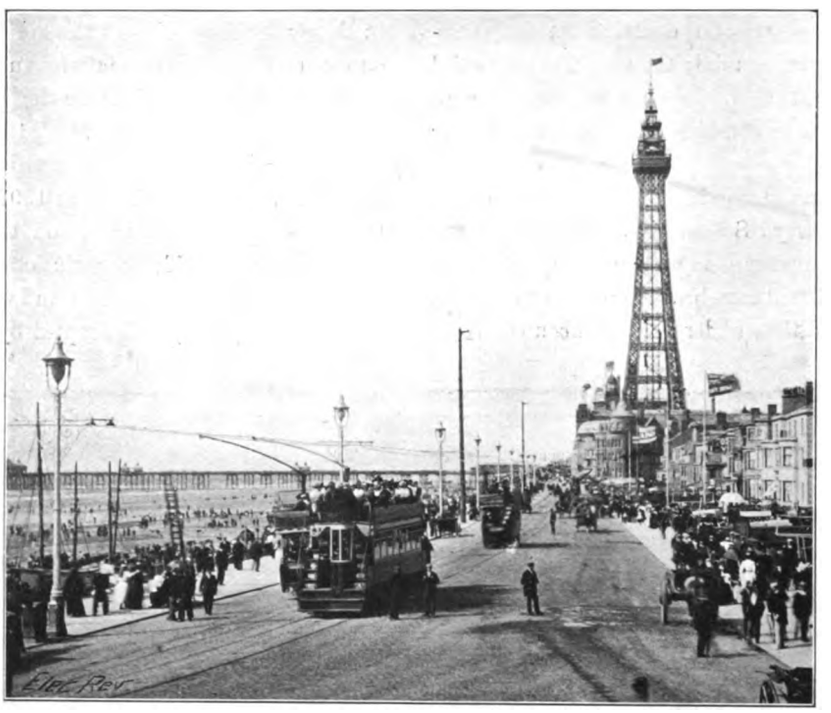
1894; there are two Parsons turbo-generators in the station, of 400 H.P. altogether, which are seen in our view of the engine room. The turbines are compound, and are coupled to generators of the two-pole Parsons type, running at 250 volts, each engine driving two dynamos coupled to the same shaft and joined in series.

The whole of the feeders were made and laid by the British Insulated Wire Company, Limited. There are three feeders of 0·3 square inch cross section, running from the works to the first feeder pillar on each section of the line, and 0·2 square inch from there to the next pillar. Each feeder pillar serves ¼ mile of double wire on each side, and is fitted with four of Mr. Quin's patent maximum and minimum automatic cut-outs, of which we give an illustration.

The cut-outs are provided with a shunt and series coil in opposition, the shunt coil being excited by current brought through a pilot wire from the end of the section, so that if by any chance the trolley wire should be broken, the magnetising current is cut off from the shunt coil, and the switch released, so that current is cut off from the fractured wire before it has time to reach the ground. Should a short circuit come on the line, the current through the series coil causes the pull of the shunt coil to be neutralised, and in this way also the switch is released. These switches have now been in use at Blackpool some time, and have never failed to protect the line when called upon to act.



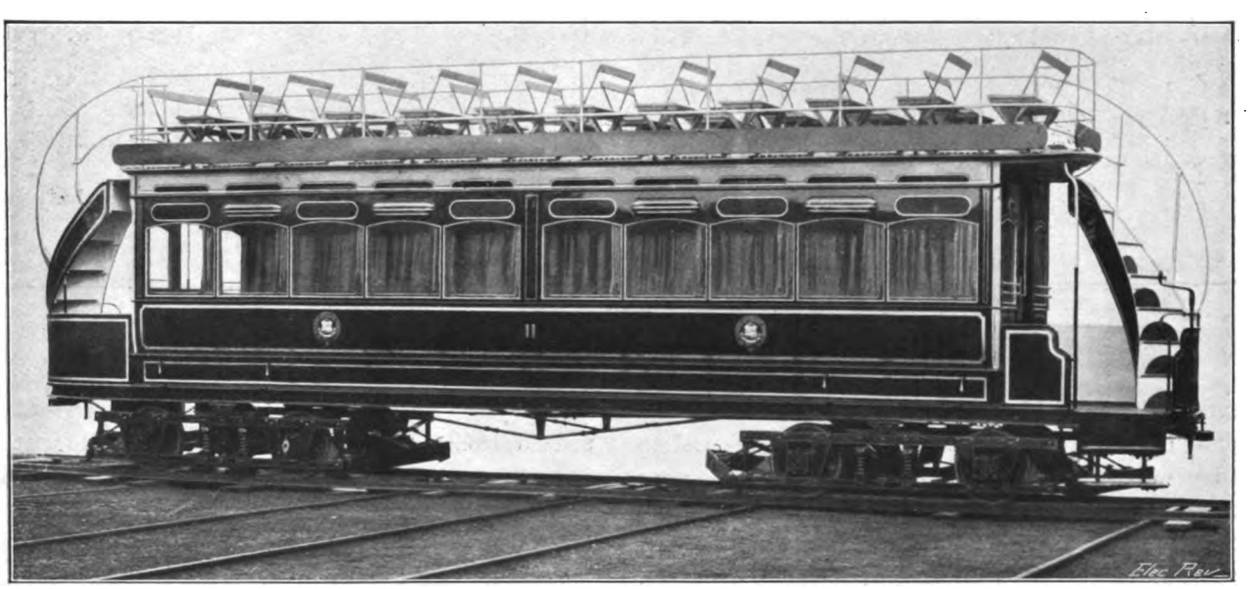
Promenade, looking Northwards.

The special cast-steel points and crossings and the spring points were supplied by Messrs. Askham Bros. & Wilson, Limited, who also supplied the material for the original conduit and for those laid down by the Corporation.

The contract for the poles and overhead line equipment was let to Messrs. Lowdon Bros. & Co., of Dundee, Edinburgh, and Glasgow, who commenced the work in December of last year. The poles, of which there are 152, are of mild steel and butt welded. They are each in one length of 28 feet. The pole at the foot is 8 inches outside diameter, and is half parallel and half taper, tapering from 8 inches to 5 inches at the point; the metal is of a uniform thickness of $\frac{7}{16}$ inch.

Before erection the pole is slipped through a plinth, which is of cast-iron, with ornamentations, and the Blackpool coat-of-arms, and was designed by Messrs. MacFarlane, of Glasgow. The pole is stepped into a cast-iron plate, with a socket and set screws, at a depth of 5 feet 6 inches from the surface.

The cross arms are Mannesman steel tubes 2 inches outside diameter and ½ inch thick. Instead of being screwed into clamps and bolted round the pole, the cross arm is slipped through a hole in the pole, which makes a much neater and stronger arrangement than the clamps. The cross arms are supported by wrought-iron ornamental scroll work. For about two-thirds of the route the poles are on the pavement at distances varying from about 9 to 18 feet from the track.



Bogie Car.

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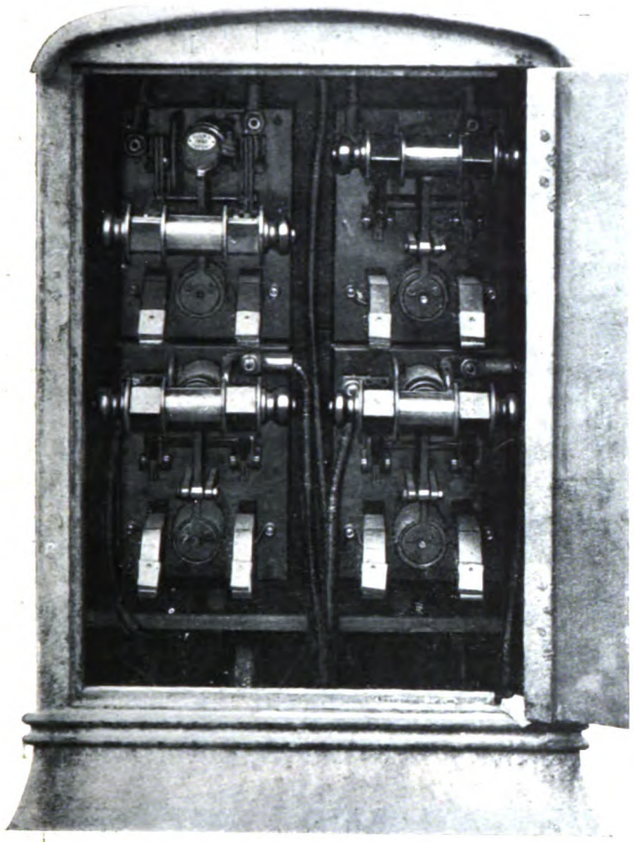
The remainder of the route is on the centre pole system. The maximum span is 40 yards. The trolley wire is



Feeder Pillar with "Quin" Automatic Cut-outs.

000 gauge, and on testing was found to have a tensile strength of 28 tons per square inch.

The clamps and insulators are the standard West End pattern, and the line is doubly insulated, having, in addition to the usual insulation, a rubber sleeve slipped on to the cross arm, over which the hanger is clamped.

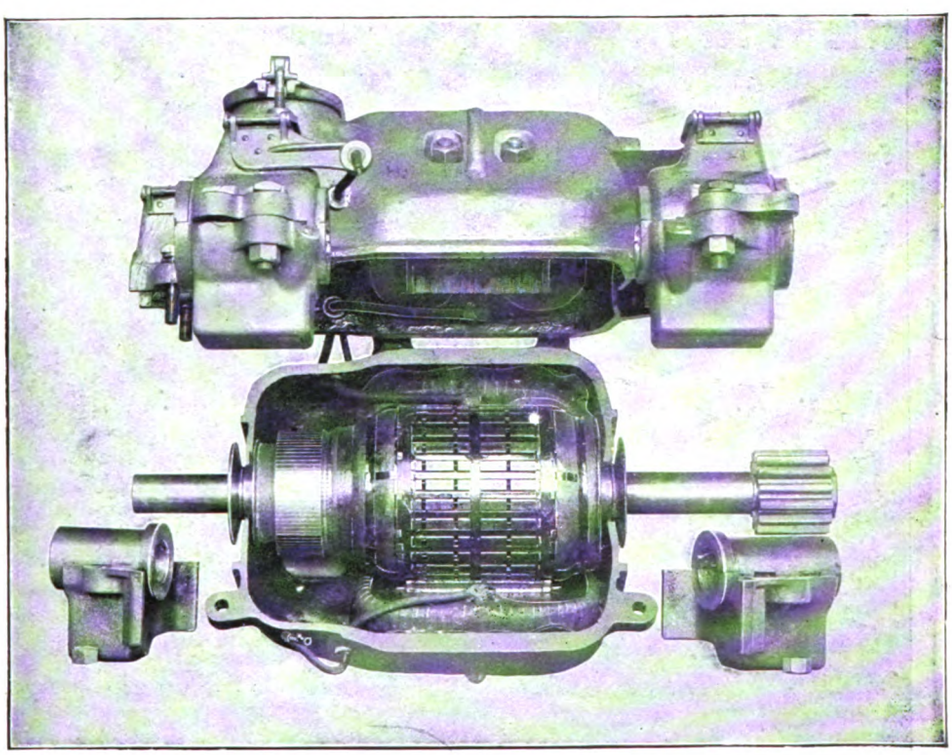
A unique feature of the system is the extremely long trolley arm, which is 20 feet in length from the trolley wheel to the standard. The trolley arm is a single steel tube, tapering from 2 inches diameter at the butt to $1\frac{1}{8}$ inches at the point. The trolleys are "Little and Ireland's" patent, with internal concentric springs, so fitted as to give an equal pressure on the trolley head when the trolley arm is moved through a vertical angle of about 20°. Of course such a long trolley arm necessitates an exceptionally powerful set of springs in the trolley standard. The springs, of which there are two pairs, are spiral, and are concealed inside the standard. They are wound to form two double sets, the smaller set being slipped into the core of the larger. These actuate a copper plunger, making contact with a hard copper spring, which again is connected to the controller. Thus the whole trolley arm is perfectly free to swivel, and the tension on the springs may be adjusted by means of a screw attached to the plunger. At some parts of the route the trolley has to swing from behind the car, right out to an angle of 45°. Owing to this it was found necessary to design a special trolley head, which would be durable and would also swivel easily. The new form of head is mounted with ball bearings, both on the turntable and the trolley wheel. The trolley wheel is a light steel casting with a gun-metal liner, a brush being used to conduct the current from the wheel to the trolley lead. The insulation of the trolley arm is also of special design. A thin steel tube is used as a former, and is coated inside and out with mica. This tube is inserted between the trolley head and the trolley arm, and forms a strong and efficient insulation.

The cars are of various ages and various types, some being 14 years old, others about two years old. Six cars have double trucks, four have single trucks, and six have no trucks at all, the car body being carried on axle brackets, as in the old horse cars; on all these cars are trolleys having 20-feet arms.

We illustrate on the previous page one of the bogie cars supplied to the Blackpool Corporation by the Lancaster Railway Carriage and Wagon Company, Limited, before the overhead system was adopted.

The trucks are equipped with G.E.-52 motors, and K.-10 series-parallel controllers with emergency brakes are used, all supplied by the British Thomson-Houston Company, Limited.

The two latest cars which Messrs. Milnes & Co., Limited, supplied to the Corporation are especially interesting, in that they have the largest carrying capacity of any electric tramcars at present running in England, viz., 36 inside and 50 on the roof, making a total of 86 passengers. The inside seats are longitudinal, of pitch pine and sequoia wood slats, supported on turned ash legs, and the roof seats are of the garden type, with reversible backs; they are also provided with Challenger's rainproof fittings. Another interesting feature in connection with these cars is the special design of the platforms; the latter are provided with double staircases and the steps are suspended the full width of car to facilitate loading and unloading, by which means the enormous crowds of passengers are dealt with with the shortest possible delay. The centre part of the platform is framed up on one side, with glass in the upper part to form a protection for the driver.



G.E.-52 Motor with Lower Frame Dropped.

The car body is mounted upon two bogie trucks of the double bar frame type, of Messrs. Milnes' design and manufacture. The car body rests on rollers, and there are vertical rollers mounted on cast-iron sliding pedestals, resting on compound $\frac{3}{4}$ inch steel spiral springs, with bottom cups and blocks

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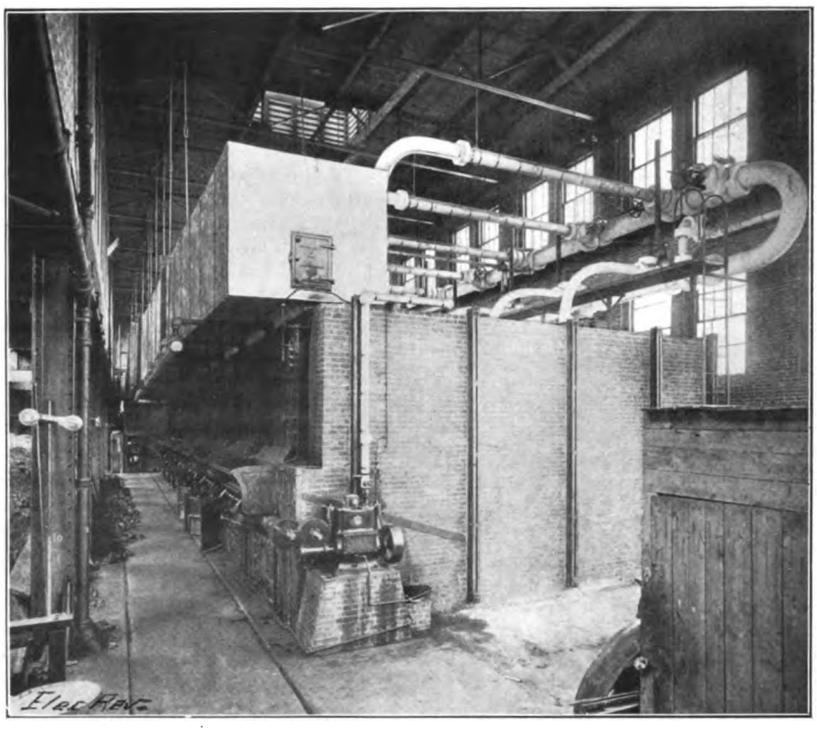
secured to the bottom framing of the truck, arranged so as to take the end and side thrust of the car; the truck is also fitted with centre radial pivots and side plates to ensure easy riding. The wheels are of chilled cast-iron. The trucks are fitted with patent roller bearing axle boxes.

The general dimensions of the car are as follows:—Length outside body, 26 feet; extreme length over platform steps, 37 feet 10 inches; extreme width, 7 feet; height inside at centre, 6 feet 9 inches.

The main body panels are of teak. There is a partition framing in the centre of the saloon of figured oak, panelled with ash. With the ends of the saloon framed and panelled with similar woods, and bevelled edge mirrors fixed along the sides and at ends above the windows, the spacious saloon looks very effective.

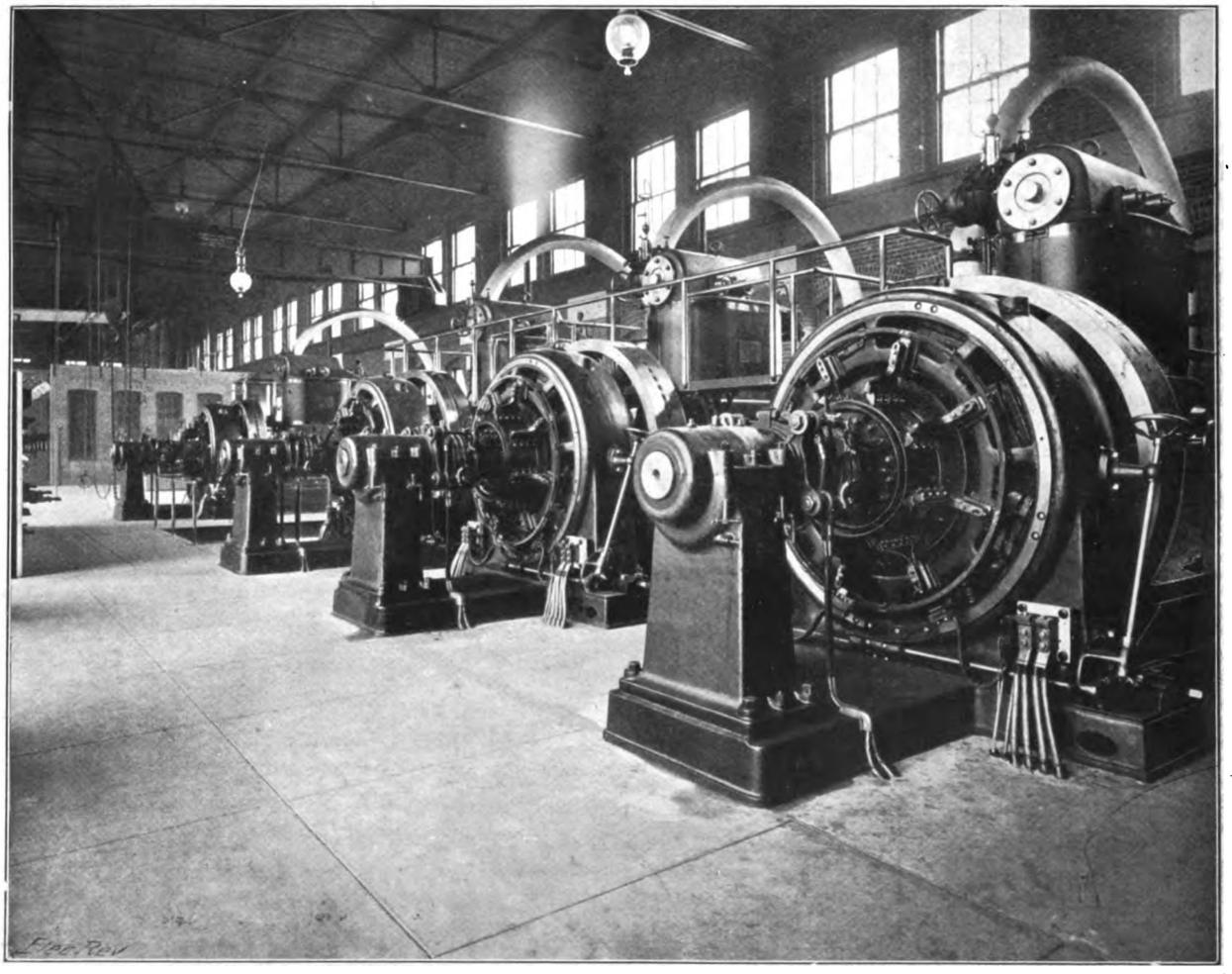
There is a lamp fixed over the canopy at each end of the car, fitted with plate glass at the bottom and bull's-eye 12 inches diameter at the front, provided with interchangeable coloured slides. A hole is made in the canopy for the lamps to fit in so as to throw a light on the platform.



Electrical Equipment of a Great Railway Terminus.—Boilers. (See page 363.)

The present equipment replaces all the conduit system, and extends from Cocker Street (north end of the Promenade) to Victoria Pier (at the south end) and also along Station Road and Lytham Road. Our illustration gives a very good idea of the appearance of the Promenade with the overhead system of construction.

As a general rule, the length of the bracket arm from the post is 4 feet 6 inches, increasing at parts to 6 feet. At one portion of the line there is a distance from the nearest tramway rail to a line plumb down from the overhead line of 15 feet 6 inches, and yet cars have run over that portion of the line with the trolley (at night) at a speed of 25 miles an hour. Of course, considerable difficulties have arisen from time to time. The first trouble was with the insu-



Electrical Equipment of a Great Railway Terminus.—Generating Plant. (See page 363.)

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lation of the trolley standards; that has now been got over. The next one was with the trolley heads; in order to get over this, Mr. Quin has had to design a new head, but as this is not yet working, we can give no details of its construction. The leakage of current with the conduit system was at times abnormal; in fact, a heavy shower of rain on many occasions multiplied the output by eight. When it went beyond this it pulled the dynamos up. A shower of rain has now no appreciable effect. As regards the financial side of the question, it seems highly probable, if things go on as they are going, that the year's profits will be able to pay, with the increase over last year, from one-third to half the cost of adopting the overhead system. At present the receipts are some £3,500 greater than they were this time last year, this being due to a quicker and more reliable service. No change whatever has been made in the generating plant except to couple the tandem dynamos in series instead of parallel, the pressure of the old conduit system being 250 volts, of the overhead 500. Short extensions are to be carried out directly after the present season, and further large extensions after the next season, specifications for which work will be issued shortly. The generating plant in the works, other than tramway plant, consists of Ferranti, Leeds and London, E.C.C., and Parsons turbo-alternators; the total normal working capacity is 1,350 KW., of which 550 KW. are given by Parsons alternators. The whole of these machines are run in parallel, and although there were some initial difficulties, these have been overcome, and it is now possible to run any two of them, or any combination of them, in parallel, and leave them on their governors.

We have to thank Mr. Quin for his kind assistance in preparing this description, and for several excellent photographs; as well as the various contractors who carried out the work.

THE ELECTRICAL EQUIPMENT OF A GREAT RAILWAY TERMINUS.

THE equipment of the Great South Terminus of the Boston Terminal Company, U.S.A., possesses many features which will be of interest to electrical engineers on this side of the Atlantic. We are also inclined to think that the up-to-date equipment at Boston furnishes a valuable object lesson to the great trunk lines of this country, which are of recent years showing signs of useful advance in the application of electricity to lighting and power purposes—more particularly the former.

The Boston Terminal Station differs from the great railway stations to be found on this side, inasmuch as it is the terminus of a number of the great railway services of the States, viz., the Boston and Albany Railroad, the New England Railroad, the Boston and Providence Railroad, the Old Colony Railroad, the New York, New Haven and Hartford Railroad. The vast local and through traffics which have to be dealt with on these several lines made it necessary that the terminal station should be of dimensions which render it the largest of its kind in the world.

Among the many uses to which electricity is put here may be mentioned arc and incandescent lighting, electric driving, electric elevating, ventilating, and electro-pneumatic switching and signalling. By the kind assistance of Mr. George B. Francis, the resident engineer, we have been enabled to compile from various sources the following notes regarding the installation.

When the engineers took the construction of the station in hand in 1896, it was decided, says Mr. Francis in a paper read this year, to so build it, that the new motive powers, electricity and compressed air, one or both, could be used therein; that a large increase in suburban trains, due to smaller train units and more frequent service, could be had; and that every effort possible should be made to remove the handling of baggage from the passenger platforms.

As to the lay-out of the numerous tracks and buildings we are not much concerned in this article, but with respect to the immense switching system which must be maintained at so large a terminus, we observe that Mr. Francis says: "If the coming motive power is electricity, through a third rail," this will not conflict with the present switching arrangements.

Not the least of the station problems most vital to the successful operation of the station is the track arrangement necessary just outside of the station for the safe and expeditious handling of the trains. An actual count at the old stations indicates about 4,000 movements in 18 hours each day through the switches. By the simple arrangement adopted the station may be operated as a unit, incoming trains on one side, and out-going trains on the other side, or in four sections, one for each of the four main lines.

The switching and signalling system includes a very complete installation of Westinghouse electro-pneumatic interlocking apparatus for handling all the trains using the station to and from the main train shed, and for the frequent trains which are to use the tracks in the suburban loop. The switches and signals, according to a recent description prepared by Mr. Henry J. Conant, the Boston agent for the contractors, are both operated by compressed air furnished from the power house, and the operating mechanism is controlled electrically from interlocking machines in the towers. We hope to refer at greater length to this signalling system at a later period. We may here incidentally remind our readers of the recent announcement of an experimental trial of the Westinghouse electro-pneumatic system on the Great Eastern Railway near Bethnal Green junction.

In June, 1897, a contract was made for the general mechanical and electrical equipment of the station, divided into the following heads:—Interlocking plant and signals, boiler plant, engine plant, ice plant, lighting (arc and incandescent), heating, cold water and refrigeration, ventilation, hot water for cleaning, air for brake testing, elevators, steam heat for cars, protection for roof conductors, fire protection and pumping plant.

At the station there are 235 arc lights, enclosed pattern; about 6,000 incandescent lights, 1,200 of which are in the main waiting room; 25 electric elevators, 10 steam boilers, four electric generators, nine compressors, 45 electric motors, 20 heating and ventilating fans, 25 steam engines, and one travelling crane.

The power plant from which current, &c., for the various purposes is derived, is laid out in what may be termed "tandem" fashion, beginning at the northern end, with the ice and refrigerating plant, the ammonia and air compressors coming next, the engine and dynamo room next, *en suite*, with the stack, economisers, central heating plant and the boiler room, while beyond all, to the south, is the Pintsch gas plant.

The boiler house equipment, as shown in one of our illustrations, comprises 10 boilers, horizontal return tubular type, 72 inches in diameter and 18 feet long. They are made from an extra quality of steel specially rolled, and are designed for a working pressure of 150 lbs. per square inch. The furnaces are provided with an equipment of Roney mechanical stokers, and are adapted to burning widely different qualities of fuel, including "front ends" from locomotives, and either high or low grade coals, with the greatest possible economy and without smoke. The waste gases are passed through a pair of improved circulating economisers, with dampers and by-pass so arranged that they may be operated singly, in parallel, or in series with each other, as the conditions of service may allow, thereby permitting the greatest possible saving to be made at all times. Draught is furnished by a pair of large, slow-running fans, either of which is of sufficient capacity for the entire plant. The products of combustion, cooled by the economisers to a point at which natural draught could not be employed (except by the use of a chimney so large that its cost would be prohibitive), are discharged at a point a few feet only above the roof of the boiler house through a short and inconspicuous stack. Provision has been made for a substantial increase in boiler capacity whenever required, and consideration has also been had to the future installation of coal handling machinery so far as expedient to do so.

The engine house plant was recently described in the *Electrical World and Engineer* by Mr. H. W. Weller, to whose account we are indebted for some of the following notes:—

There are four units, each consisting of a 375-H.P. Westinghouse compound engine, with cylinders 18 inches and 30 inches in diameter by 16 inches stroke, running at 250 revo-

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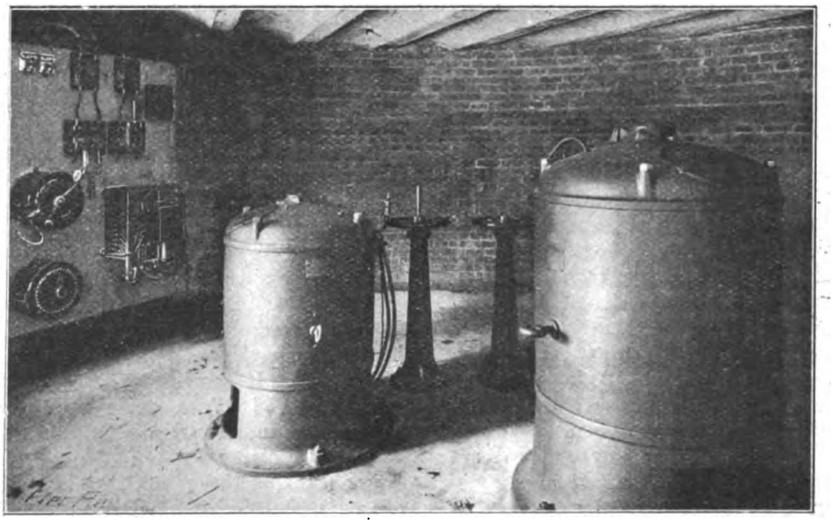
lutions per minute, with steam at 125 lbs. per square inch. Each engine, as will be seen from our illustrations, is coupled to a Westinghouse 8-pole direct current 220-volt compound wound generator. These generators are fitted on the commutator end with four collector rings tapped at quarter-phase intervals into the armature winding, the brushes bearing upon them being connected to two balance coils through which the neutral wire of the three-wire system is brought in to the machine winding. The machines are built with the fields split vertically, so that they may be moved laterally away from the armature, and on account of the three-wire feature the series coils of the compound winding are divided, there being two series coils on each pole, one connected in the positive end and the other in the negative end of the machine circuits.



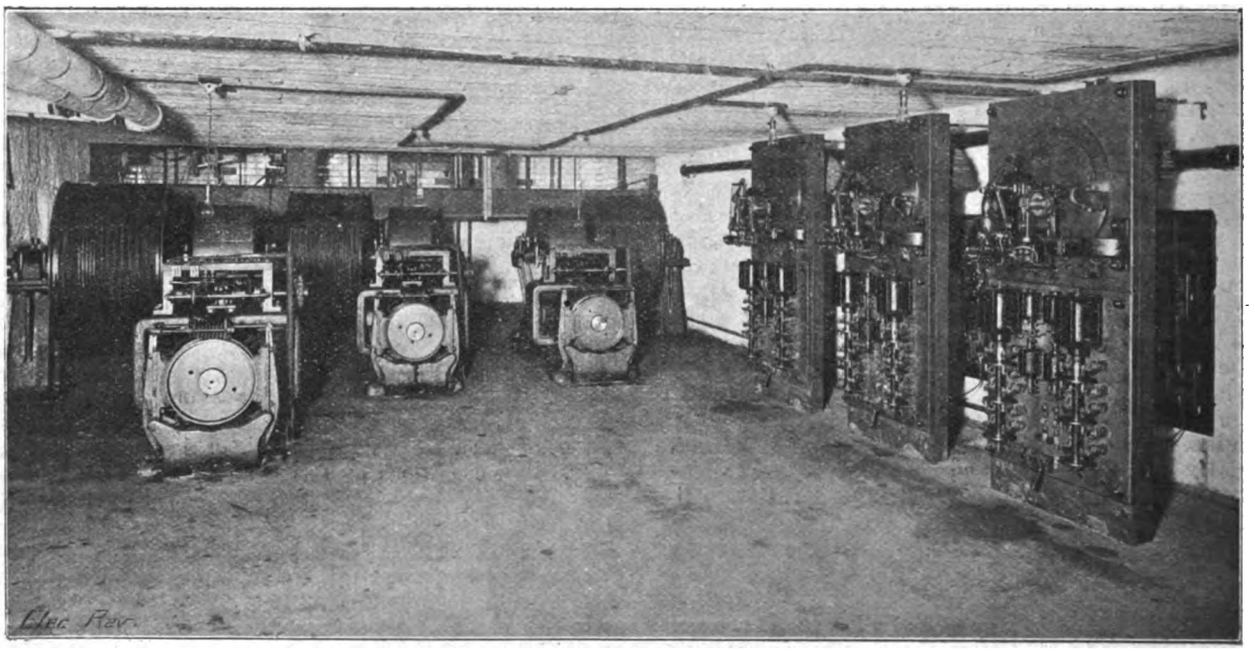
Sump, Showing Vertical Motors.

The engines are connected to the steam mains by bends, and an 8-inch pipe connects each to the exhaust. The engines are run non-condensing, and the exhaust is taken into the central heating plant for general purposes, but otherwise they are run condensing. Proper iron platforms and stairways are constructed round the engines to facilitate the work of the attendants, the platforms of the three engines nearest the boiler room being connected together for convenience. Space is provided for two more similar units if the additional power is required in the future.

28 inches by 24-inch stroke. The exhaust from the engines is brought to it by a 16-inch steel main on the west side of the basement, the main exhaust passing to the central heating plant through an 18-inch steel pipe. Arrangement is made for a free exhaust into the atmosphere if necessary.

The switchboard for the electrical instruments is of polished white marble securely bolted to an iron framework on the west side of the engine room. It consists of 13 panels. The station panel has mounted upon it two Weston standard voltmeters with illuminated dials, showing the E.M.F. on the two sets of bus bars. One Weston station voltmeter with an illuminated dial is carried on a swinging bracket, and can be thrown on any generator by the use of a plug switch. There is also a circular-pattern Weston ammeter, showing the unbalanced load on the neutral or balance wire of the system. A set of annunciators is installed, connected with the various centres of distribution for the lights, showing which centre is calling for current.

There are four pairs of machine panels, one for each generator, one of each pair being connected to either side of the system. The positive contains the field rheostat, a circular Weston ammeter, a magnetic cut-out switch or circuit breaker, which opens the positive line and also the positive equaliser; also a main



Elevator Machinery.

A handsome gauge-board of polished white marble, supported on iron standards, is placed on the east side of the engine room, containing five polished brass gauges, showing, respectively, the boiler pressure, air-interlocking, vacuum, back pressure, and air-brake testing pressure.

In the basement of the engine room are installed the four balance coils for the generators and also the condenser. This is a jet condenser and pump made by the Deane Steam Pump Company, of Holyoke, Mass., with cylinders 18 inches and

switch controlling both the positive and negative side of the machine, and the positive and negative equaliser. This switch is double-throw, and can connect the machine to either set of bus bars. The two sets of bus bars are provided in order that two different potentials can be carried at the same time, and so that machines can be run in multiple or separately on different services. On the negative panel of each pair is another magnetic circuit breaker, which opens the negative side of the line and the negative equaliser.

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There are also four feeder panels containing the various double-throw pole switches for throwing each feeder circuit to either of the two sets of bus bars. These panels also contain the various circular-pattern voltmeters operated by pressure wires from the several centres of distribution, showing the power-house attendant at all times the actual E.M.F. at the various distribution boards.

A polished white marble gangeboard is installed in the office of the superintendent of the power plant, containing five Bristol recording gauges for the steam, compressed air for interlocking, compressed air for air-brake testing, E.M.F. on the high potential, and the E.M.F. on the low potential bus bars.

There are 16 two-wire feeders on the 220-volt circuits, running from the main switchboard at the power house, 12 of these leading to the various centres of distribution, and used for lighting purposes only, the other four sets of feeders being for motor service. There is also the balance or neutral wire of 400,000 C.M., running from the balance coils in the basement, making a complete loop around the station buildings, and taking in all the centres of distribution. The arc and incandescent lamps are connected across from either wire of the 220-volt feeders to the balance or neutral wire, giving them an E.M.F. of 110 volts.

The 12 lighting circuits are divided as follows:—No. 1, the public incandescent lights, such as waiting rooms, lavatories, &c.; No. 2, the basement lights, fan rooms, cellars, &c.; No. 3, the restaurants and other tenants; No. 4, the inward baggage rooms; No. 5, the outward baggage rooms; No. 6, public arc lights, including the train shed; No. 7, suburban platforms in subway; No. 8, office lighting; No. 9, suburban tunnels, both incoming and outgoing; No. 10, the express companies' buildings; No. 11, power house, gas plant, &c.; No. 12, interlocking towers and sump lighting.

At the above centres of distribution are located slate switchboards, provided with the necessary triple-pole switches, which control the various lighting circuits of that centre. A pilot lamp indicates the presence of the current, and a push button signals to the power house when current is required.

There are over 6,000 110-volt incandescent lamps installed. They are Sawyer-Man high efficiency 3·1-watt lamps, and have a regulation within 2 per cent. There are also upwards of 250 enclosed long-burning arc lamps, supplied by the Jandus Electric Company, which consume about 5 amperes at 110 volts. These are used for lighting the train shed, baggage rooms, entrance, and for lighting outside the station under the sidewalk awnings.

The motors are fed from the 220-volt circuit, and the following distribution of the circuits has been arranged:—One operating all the elevators and baggage lifts, except the elevator for the ice plant; one operating the basement fan motors for warm-air heating, another for the ventilating motors and attic fans, and the remaining one for the sump motors and the ice plant.

The various feeders are carried along the roof and sides of the tunnels used for the heating mains, and along the basements of the baggage and waiting rooms, being supported on porcelain insulators, and suitable racks where necessary. The main waiting room is lighted in a very pleasing and artistic manner, harmonising with the architectural features. There are 33 15-light clusters enclosed in opalescent globes, at the intersections of the deep ceiling beams, and 48 10-light clusters, besides 228 side bracket lights, or over 1,200 lights in this waiting room. The fixtures throughout are specially designed and very handsome, those in the grand dining room being of bronze.

In connection with the heating and ventilation arrangements, there are six blower fans or blast wheels for forcing external air through the heaters situated in the various basements. These fans are operated by means of belt from six standard Westinghouse multipolar motors ranging from 5 to 30 H.P. each. Eleven special slow speed vertical motors, varying from 1 to 8 H.P. are direct connected to the same number of attic fans in the roof to insure perfect ventilation. An electric elevator is employed for taking ice from the tank room to the ice house. This is of the Morse belted pattern, operated by a Westinghouse multipolar motor.

There are seven electric passenger and 12 electric baggage elevators, all of which were furnished and installed by the Sprague Electric Company of New York. The elevator machines are seen in one of the pictures. The passenger elevators are located in the head house, and serve the general offices, restaurants, &c. Four of these have a car rise of 70 to 80 feet, and their individual capacity is 4,000 lbs. at a speed of 200 feet per minute, or 250 feet with an average load. The motors are rated at 20 H.P. at a speed of 470 revolutions per minute, but they are readily capable of 50 H.P. for a short time. There are two elevators with a capacity of 2,000 lbs. each at a speed of 100 feet per minute, the car rise being 11 feet and 32 feet respectively. The other passenger elevator has a car rise of 18 feet and a capacity of 2,500 lbs. at 150 feet per minute.

The 12 baggage elevators, or lifts, have an average car rise of 16½ feet, and a capacity of 3,000 lbs. at 15 feet per minute. These were specially designed for the duty required, and the limited space available. They are placed in pockets or pans built of steel plates, formed in the top platform level, and just large enough to receive the hoisting machines and drums. These are built up on 12-inch channel irons, framed into the platform structure at one of the short ends of the well. The motor used is rated at 12 H.P. at 750 revolutions per minute. Steel worms on either end of the motor shaft mesh into bronze gear wheels. The shafts of the worm wheels are direct connected by flanged couplings to the two drum shafts extending along either side of the well. On each shaft are two chain drums, upon which are wound the chains fastened to each corner of the elevator platform. The worm wheels are cut right and left to take up all of the end thrust. Automatic "limits" are geared to one of the gear shafts, and two-foot pushes are provided at each end of the platform, one for the "up" motion, and the other for the "down."

At each gate at top and bottom are placed push buttons for bringing the car to that landing, providing it is not already in service, and the gates are all closed. Automatic locks and safety switches break the circuit, and prevent the movement of the car until everything is secure at the landing. The gates are also automatically locked, except when the car is at that landing, in which case they are automatically released.

Of the above lifts, four are located in the baggage rooms on either side of the train shed, five between the train tracks at the onter end of the shed, and the other three between the tracks at the head house end of the train shed.

The suburban loops and a large portion of the basements are below tide water, so that the disposal of water from the large extent of waterproofed structure involved somewhat unusual considerations. Mr. Conant, in the paper already referred to, says that a large sump well was built near the power house, in which electrically-driven centrifugal pumps were installed (see illustration) to pump away any possible seepage, storm water, and melting snows, which, owing to the grades of the suburban track, will necessarily be carried to the lower levels. The electrical pumping apparatus is controlled automatically by the level of the water in the sump, and a large reserve pump is provided to handle unusual quantities of water. Electric alarms are also provided to notify attendants to start the large pump whenever the water might reach a predetermined danger level.

The entire equipment mentioned in this article was, we understand, carried out by Messrs. Westinghouse, Church, Kerr & Co.

We have to express our indebtedness to Mr. Francis, the resident engineer, for the photographs accompanying this article, and to the papers by Messrs. Francis and Conant, as well as to the *Electrical World and Engineer*, for the material from which this description has been compiled.

Warning.—We are asked to publish a warning to electrical business people in London so that they may be on their guard against a certain probable visitor. The man in question has already entered several electrical establishments to talk business under the pretence that he has orders to place, and after being taken out to dine in the usual way has told a very plausible story and secured a small loan. Needless to say he has never reappeared to repay his indebtedness.

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NOTES.

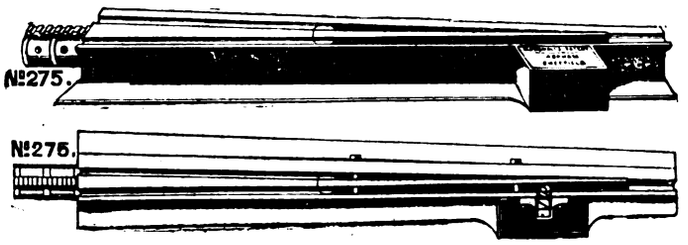
(*Continued from page* 358.)

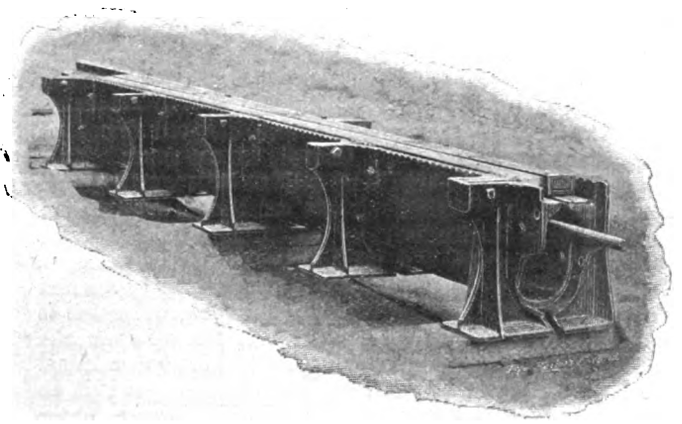
Re "Cassier's Magazine" Electric Railway Number.—Messrs. Laing, Wharton & Down, Limited, send us the following:—

Doubtless many of your readers will read or look through this production, and we, therefore, take the liberty of correcting two errors that are very potent and annoying to us. On both pages, 296 and 325, the overhead equipment is ascribed to Messrs. Greenwood and Batley, who will at once inform you that this is not a fact. We carried out this work under our chief engineer, Mr. Justus Eck, direct for the Leeds Corporation, and if you will refer to your back numbers, we think you will find this mentioned therein. The fullest detail, if our memory serves us right, was given in the *Railway World* of September, 1897, and this remains unqueried to this day.

We take the liberty of calling your attention to this matter, as the *Magazine*, having no correspondence columns, is not well able to make corrections, and we feel that the subsequent number will not have the same circulation and attention as the current one.

Blackpool Tramways.—We give below an illustration of the spring points referred to in our article on the above tramways, as well as of the "Mapple" patent conduit which was supplied by Messrs. Askham Bros. & Wilson for the Station Road section. This conduit is made in sections, each complete in itself, and is so arranged that the steel





channel rail which forms one side of the slot can be raised on hinges. In this way access is readily obtained to the interior of the conduit, and to the insulators, which are bolted to the other (fixed) channel rail. The conduit consists entirely of iron, and is 16 inches deep by 10 inches wide. It is claimed that, amongst other advantages, the ease of repair without interruption to traffic forms a most valuable feature of the system.

More English Orders for America.—A daily paper reproduces the following comments from the *New York World*, in which it refers to and endorses Lord Kitchener's speech at the opening of the Atbara Bridge:—

We are in a position to state that a representative of one of London's greatest industrial and financial concerns is returning to England to-morrow, after having placed an order here for several million dollars' worth of machinery. He confesses that this was of such delicate construction that no shop in England is capable of producing it. A part of his order was for 36 locomotives, and he predicts that he will make frequent trips on similar errands to the United States.

Automobiles at the British Association.—Arrangements for the automobile exhibition in connection with the Dover meeting of the British Association are in an advanced state, and prospectuses regarding space for exhibits, prizes, and general details, have been circulated. The exhibition, organised with the co-operation of the Automobile Club of Great Britain, and under the controlling influence of the Mayor, Sir W. H. Crundall, J.P., who is chairman of the Managing Committee, will be held for three days, from Tuesday, September 19th, to 21st, towards the close of the Association meeting. There are to be certain competitions as to running, control, economy of fuel consumption, design, &c., the Judging Committee for this purpose being as follows:—Mr. W. Worby Beaumont, Prof. C. Vernon Boys, Mr. H. Graham Harris, Major Holden, Sir W. H. Preece, Mr. Boverton Redwood, Prof. Hele Shaw, and Mr. James Swinburne. All communications should be addressed to Mr. F. E. Beeton, the secretary, at Park Street, Dover.

Partnership.—We are informed that the partnership hitherto subsisting between Mr. Reginald Wilson and Mr. W. H. Story, under the name of "Wilson & Story," and carrying on business at 66, Victoria Street, S.W., has been dissolved. In future the business will be continued by Mr. Wilson alone, at the same address, under the style of "Reginald Page Wilson."

British Association.—Among the arrangements for the British Association meeting at Dover is a lecture on the 18th inst., by Dr. Fleming, on the "Centenary of the Electrical Current." It is stated that the lecture has been fixed for this day so as to be coincident with the congress of electricians at Como. It will deal with wireless telegraphy, and be illustrated by experiments.

Effects of Lightning.—The United States Weather Bureau has just issued a statement (which is abstracted in the *Western Electrician*) of damage to property and loss of life by lightning in the United States during the last nine years, from which it appears that 312 persons are killed annually by lightning stroke in that country, taking a fair average. In this respect the worst year was 1895, when 426 Americans were destroyed in this way; in 1898 the mortality was 367. In nine years, from 1890 to 1898, inclusive, five individuals in every million of the population of the United States were killed by lightning. The danger from this cause seems to be least in large cities and in thickly populated districts. Agricultural labourers furnish the most victims. Ohio is the greatest sufferer, the death rate by lightning in that State being 24 in every 100,000 persons of the farming class. The greatest proportion of fatal strokes is found in the Missouri Valley, on the Great Plains, and in the Rocky Mountain region. In 1898 no fewer than 1,866 buildings were damaged or destroyed by lightning involving a loss of $1,446,880. During the same year lightning killed 964 cattle, 306 horses, 30 mules, 116 pigs and 426 sheep, representing a total value of $48,257. All of this destruction of farm animals was accomplished by only 710 "strokes." Much of this damage might be avoided by grounding wires at suitable intervals along lines of barb wire fences, which are sometimes deathtraps to stock, the fatal shocks being inflicted often through the medium of the wires at a considerable distance from the point hit. So far as human beings are concerned, practically all of the deaths occur during the five months from April to September, the highest record being in June and July.

Personal.—Dr. J. T. Bottomley, F.R.S., has resigned all his appointments at the University of Glasgow, and now intends to devote his whole attention to consulting work in electrical engineering. While we regret that the University will no longer have the benefit of Dr. Bottomley's teaching, we feel that in his new sphere of action his scientific attainments will have greater scope, and we wish him a long and successful career as a consulting engineer.

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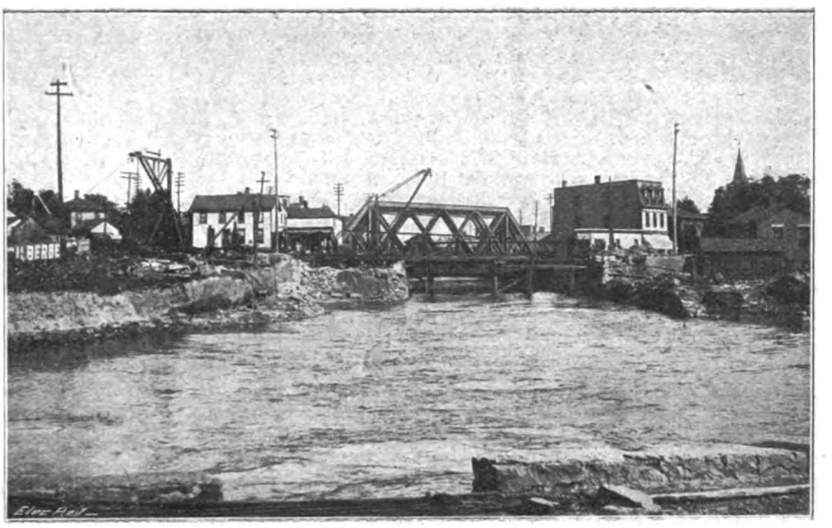
Niagara Falls.—The Niagara Falls Hydraulic Power and Manufacturing Company is displaying the usual energy this summer in the deepening and widening of the surface canal that carries water from the upper Niagara River to the forebay on the edge of the bluff of the lower river, from which forebay the turbines in the power house at the water's edge in the gorge are supplied. The length of the canal is about 4,400 feet. The entrance is about 250 feet wide, but in a few hundred feet of length this narrows down to 70 feet. For a portion of the width of the canal the channel is 8 feet deep, and for the remainder it is 14 feet deep. Drill boats and dredges are now at work adding to its water-carrying capacity, but probably the most notable improvement now being made is in and about the basin of the waterway. This basin is located 300 feet back from the edge of the bank, and is connected to the forebay by two canal feeders. In the past this basin has been of comparatively limited dimensions, but now the line of the banks is being broken away and the basin has been turned into quite a bay fronting on the various mills that stand between the basin and the edge of the bank. This work of enlarging the canal basin is still under way, the picture well portraying the improvement. At the point where Main Street crosses the canal a new bridge with a span of 100 feet in the clear is being put in, and the canal widened from 70 to 100 feet at that point. A close inspection to the left of the bridge will show the old and new walls of the canal. The canal basin has been deepened, and when all the work has been finished for the summer the capacity of the waterway will have been materially enlarged. All this work is under the personal supervision of Wallace C. Johnson, M.Am.Soc.C.E., who is chief engineer of the Niagara Falls Hydraulic Power and Manufacturing Company.



A New Method of Forced Draught.—This system was described in a paper before the Institute of Naval Architects at Newcastle by Mr. Nelson Foley. It consists in forcing the air into a box placed across the furnace front and into which the ends of the bars are fixed. The bars are hollow and are perforated with numerous small holes along both sides. The forced air escapes at these holes to the fire, and has also an inducing action upon the air in the ash-pit, which is also forced into the fire by this means. The bars can be made in lengths of 4 feet, and it is said they keep cool and clinker does not adhere. Tests have been made showing as much as 72 lbs. of coal consumed per square foot of grate. The jet holes are $\frac{5}{32}$ to $\frac{3}{16}$ inch diameter, and are pitched $\frac{1}{4}$ of an inch apart. The length of grate was only 2 feet 7½ inches. The intensity of the draught was never over 8½ inches, while with 1¾ inches draught the combustion was 29 lbs. per square foot of grate. With 1¼ inches of draught as much as 41 lbs. of combustion was secured, while 40 lbs. was allowed with 1·73 inches of draught. There is not information sufficient to explain the differences of results.

The Thermo-chemical Theory of the Carbon Cell.—More than 10 years ago Donato Tommasi described an electric element in which the electrodes were of carbon, one being coated with lead peroxide, and immersed in a solution of sodium chloride, and he regarded the action as due to the oxidation of the uncoated carbon and the reduction of the peroxide. Reed (Electrical Review, 1896) considered the current to be due to the action of the sodium chloride on the lead peroxide, but this view is untenable, as in that case the coated carbon should be the negative electrode, whereas the reverse obtains. Further, the E.M.F. calculated, according to the author's view of the action, is equal to that actually found for the element. For further details consult the *Bulletin de la Société Chemique de Paris* (III.), Vol. 17, pages 963-964.

The Scourge of Scholarship.—The Vice-Chancellor of Cambridge University, Dr. Alexander Hill, has been condemning the system of granting scholarships. It is time the system was condemned. Under it he finds that boys are overworked, and there is cramming. The early developed brain was selected by the scholarship system. Boys were not properly to be regarded as sheep, which are raised to become mutton at two years, irrespective of the fact that at five years they would be really inferior. But the five years of the sheep is never attained. The sheep has materialised, as intended, at two years. Boys, however, are raised and ripened at 19 years, and this is wrong, for it does them so much harm, that at 49, when they should be at their best, they are done for. Such was the very correct drift of the arguments advanced by the Vice-Chancellor. He advocated a proper regard for athletics as a counterpoise to too much study. Unfortunately, however, no substitute was proposed for the scholarship test, which, we grant, is pernicious enough, and so hard and fast drawn in its rules that we hear boys deplore the date of their birth. Had they been so much younger or so much older they could have got such and such a scholarship. Then a boy whose school career may have been of the best has some trivial complaint on examination day, and he may thereby be thrown out and miss his chance of a university career, which he cannot afford unless with the help of the scholarship. It is a fact that a very considerable proportion of university students who work would not be there but for the pecuniary aid of some exhibition or scholarship. Such pecuniary aid is essential if the universities are to be run on their present lines and retain such workers. At the same time, might not the governors of all public schools devise some better means of awarding scholarships than they now possess, taking into account not simply proficiency at an examination of a few hours, but general conduct during, perhaps, several years, and general capacity? At present, with the narrow system of awarding scholarships, breadth of education is shut out. There is no chance for the all-round boy. The classic who cannot get beyond simple addition in mathematics is able to appear a genius as a scholarship man. The mathematician who only knows various alphabets and letter forms so that he may use the letters in cabalistic formulæ also appears to be possessed of genius until he tries to read or write decent English. The boy, good all round, well read, well balanced, and healthy, has no chance for the best rewards, and it is certain that for good or evil many of the best are thus shut out of the universities, which are too expensive for any not really well-to-do people to afford unaided.

Sheffield Trams.—On Monday next, September 4th, the municipal electric tram system will be publicly inaugurated by the Lord Mayor. There will be special cars run over the section from the Nether Edge to Tinsley for the convenience of the party, and tea will follow at the Town Hall. The public service will commence on Tuesday.

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NEW COMPANIES REGISTERED.

Electric Lighting and Traction Company of Australia, Limited (63,334).—This company was registered on August 17th, with a capital of £20,000 in £5 shares, to carry on in Australasia or elsewhere the business of electrical and mechanical engineers, electricians, suppliers of electricity for light, heat, motive power and otherwise, tramway and railway proprietors, contractors, carriers of passengers and goods, &c. The first subscribers (each with one share) are:—R. P. Sellon, 49, Queen Victoria Street, E.C., electrical engineer; W. E. Lane, 14, Durley Road, N., electrical engineer; R. A. Dawbarn, "Wierton," Sidcup, electrical engineer; F. M. Hodson, 14, Harpenden Road, West Norwood, accountant; J. McLachlan, 33, Agamemnon Road, West Hampstead, N.W., assistant secretary; J. Renwick, 29, Hillside Road, Stamford Hill, N., accountant; and G. J. Tindall, 1, Wellington Chambers, York Street, Westminster, articled clerk. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification, £250; remuneration, £1,000 per annum, divisible. Registered office, 49, Queen Victoria Street, E.C.

Southport Boating Company, Limited (63,307).—This company was registered on August 15th, with a capital of £1,800 in £6 shares, to adopt an agreement with the Mayor, Aldermen and Burgesses of the borough of Southport, and to build or acquire, repair, sell, let on hire, and otherwise deal in pleasure and racing boats, launches, &c., and to carry on the business of electricians, engineers, suppliers of electricity, and manufacturers of apparatus for the generation, distribution, and employment of electricity. The first subscribers (each with one share) are:—Henry Wright (Stem), 79, Snellfield Road, Southport, fisherman; Thomas Blundell, 116, Shellfield Road, Southport, salesman; William Wright (Jenneys), 40, Shellfield Road, Southport, fisherman; William Wright (Roberts), 12, Shellfield Road, Southport, cabinet maker; Miles Blundell, 121, Shellfield Road, Southport, fisherman; Richard Wright, Bank Nook, Southport, fisherman; and John Blundell, 55a, Shellfield Road, Southport, tailor. The number of directors is not to be less than four nor more than nine; the first are William Wright (Roberts), Miles Blundell, William Wright (Jenneys), and Henry Wright (Stem); William Wright (Roberts) is the first managing director.

Portuguese Tramways Construction Company, Limited (63,337).—This company was registered on August 17th, with a capital of £1,000 in £1 shares, to construct or acquire and maintain any tramways, railways, &c., and to carry on the business of carriers of passengers and goods, suppliers of electricity, electrical and mechanical engineers, &c. The first subscribers (each with one share) are:—J. Jewell, 13, Richmond Crescent, N., clerk; F. Davies, Hillwood, Westcliffe-on-Sea, clerk; A. W. Rogers, 8, Denning Road, Hampstead, N.W., clerk; S. M. Nelson, 20, Sheepcote Road, Harrow, clerk; H. A. Milner, 84, Effingham Road, Hornsey, N., clerk; W. MacGillivray, 368, Green Lanes, N., clerk; and T. A. Barson, 1, Inglewood Road, West Hampstead, clerk. The number of directors is not to be less than three nor more than seven; the first are to be appointed by the subscribers; remuneration, £300 per annum, divisible.

Barnsley and District Motor Car Company, Limited (63,352).—This company was registered on August 18th, with a capital of £5,000 in £100 shares, to build or acquire and work by means of electricity, steam, oil, or other motive power any locomotive and other engines, motor cars, carriages, omnibuses and other vehicles, and to carry on the business of carriers of passengers and goods, electricians, engineers, manufacturers of and dealers in electric, magnetic, galvanic and similar apparatus, &c. The first subscribers (each with one share) are:—Charles Wray, Fair Field House, Barnsley, butcher; E. J. B. Ridcal, Barnsley, solicitor; C. H. Charlesworth, Barnsley, provision merchant; John Harvey, Barnsley, hotel proprietor; William Wray, 14, Cheapside, Barnsley, pork butcher; John Cooke, Beech Grove, Barnsley, butcher; and Joseph Hewitt, Marrow House, near Barnsley, solicitor. Table A mainly applies.

Davy Improved Arc Lamp Syndicate, Limited (63,358).—This company was registered on August 19th, with a capital of £2,100 in £1 shares, to adopt an agreement with W. J. Davy and to carry on the business of electrical engineers, arc lamp manufacturers, electric light makers, &c. The first subscribers (each with one share) are:—J. W. Lee, Budleigh, Salterton, Devon, colonel; C. Bhould, Finsbury House, E.C., clerk; L. H. Wilkins, Finsbury House, E.C., accountant; F. R. Redgrave, 41, Burnley Road, Stockwell, S.W., accountant; J. Cassidy, 95, Holbeen House, Chelsea, clerk; J. J. Bye, 126, Laburnum Street, Kingsland Road, N., clerk; and J. Gordon, 80, Birchanger Road, South Norwood, clerk. The number of directors is not to be less than two nor more than nine; the subscribers are to appoint the first; qualification, 200 shares; remuneration as fixed by the company.

Electrical Wool Pulling Syndicate, Limited (63,360).—This company was registered on August 19th, with a capital of £15,000 in £1 shares, to acquire certain patents for improvements in methods of and apparatus for removing wool or other hair from skins. The first subscribers (each with one share) are:—Seth L. Johnson, 10, Billingsley Terrace, Bradford, manager; W. R. Jones, Boldshay Street, Bradford, wool puller; S. Brooksbank, 63, Bramsley Road, Frizinghall, salesman; E. Johnson, 107, New Cross Street, West Bowling, Bradford, accountant's clerk; H. Goodwin, 7, Grantham Terrace, Bradford, wholesale paper hanging dealer; J. Clayton, 310, Wakefield Road, Bradford, wool and waste merchant; and Mrs. Ellen Johnson, 10, Billingsley Terrace, Bradford. The number of directors is not to be less than two nor more than five; the first are to be appointed by the subscribers; qualification, £250; remuneration as fixed by the company.

Street Lighting Company, Limited (63,388).—This company was registered on August 23rd, with a capital of £30,000 in £1 shares, to adopt an agreement with the Liverpool Meter Company, Limited, and its liquidators, and to carry on the business of mechanical and electrical engineers, ironfounders, brassfounders, millwrights, metal workers, suppliers of gas and electricity, metallurgists, and manufacturing chemists. The first subscribers (each with one share) are:—D. de Ybarrondo, 8, Tower Chambers, Liverpool, merchant; A. S. Hannay, 24, Hacking Hey, Liverpool, cotton broker; J. T. Binning, Phœnix Chambers, Liverpool, underwriter; T. E. Hassell, Queen Insurance Buildings, Dale Street, Liverpool, sharebroker; G. H. Brown, Exchange Court, Liverpool, cotton broker; R. H. Smith, Manchester Buildings, Liverpool, produce broker; F. M. Radcliffe, 9, Cook Street, Liverpool, solicitor. The number of directors is not to be less than three nor more than four; the first are Domingo de Ybarrondo, Anthony S. Hannay and Arthur H. Holme; qualification, £500; remuneration, £100 each per annum (200 for the chairman) and a share in the profits.

Julius Sax & Co., Limited (63,371).—This company was registered on August 21st, with a capital of £18,000 in £1 shares (12,000 preference), to acquire the electrical business of a company of the same name (incorporated in 1892), to enter into an agreement with H. M. Salmony, and to carry on the business of electric light and power contractors, electricians, electrical and mechanical engineers, &c. The subscribers are:—G. Arbuthnot, 52, Eaton Place, S.W., gentleman, 5,000 preference shares; L. G. F. Oppenheim, 40, Great Cumberland Place, W., gentleman, 5,000 preference shares; H. M. Salmony, 119, Coldharbour Lane, Camberwell, S.E., electrical engineer, one ordinary share; A. Bannister, 48, Ambler Road, N., gentleman, one ordinary share; L. Moss, 22, Austin Friars, E.C., gentleman, one ordinary share; L. Wolff, 22, Austin Friars, E.C., gentleman, one ordinary share; T. E. Cowan, 18, Austin Friars, E.C., solicitor, one ordinary share. The number of directors is not to be less than three nor more than five; the first are the first three subscribers; qualification, £1,000.

Dick, Kerr & Co., Limited (63,407).—This company was registered on August 24th, with a capital of £350,000 in £5 shares (30,000 5 per cent. cumulative preference), to adopt an agreement with Dick, Kerr & Co., Limited (incorporated in 1890), and to carry on the business of manufacturers of and dealers in railway and tramway appliances, rolling stock, engines and machinery of every description, iron and steel founders, electricians, engineers, contractors for public and other works, &c. The first subscribers (each with one share) are:—C. T. Cayley, Constitutional Club, S.W., engineer: J. Kerr, 110, Cannon Street, E.C., contractor; J. Gane, 66, Coleman Street, E.C., chartered accountant; G. Flett, 110, Cannon Street, E.C., contractor; H. T. Crewe, 78, Queen Victoria Street, E.C., engineer; H. Brown, 2, Bond Court, Walbrook, E.C., solicitor; and G. W. Carr, 110, Cannon Street, E.C., secretary. The number of directors is not to be less than two nor more than seven; the first are Claud T. Cayley, David C. Ellis, John Kerr, and G. Flett: qualification, £500; remuneration, £150 each per annum and an extra £150 for the chairman. Registered office, 110, Cannon Street, E.C.

Gramophone Company, Limited (63,411).—This company was registered on August 25th, with a capital of £150,000 in £1 shares, to acquire and take over as a going concern the business carried on at 31, Maiden Lane, W.C., and elsewhere, as "The Gramophone Company," to adopt an agreement with Edmund T. L. Williams and William B. Owen, to manufacture and deal in gramophones, phonographs, mutoscopes, biographs, mutographs, and electrical and scientific apparatus of all kinds, and to carry on the business of a telephone, telegraph, and general electric supply company. The first subscribers (each with one share) are:—E. T. L. Williams, 1, Clements Inn, W.C., solicitor; W. B. Owen, Albany Lodge, Esher, merchant; Miss J. M. T. Lewis, 49, West Cromwell Road, S.W.; P. H. Bohanna, 34, Hambalt Road, Clapham, agent; T. D. Addis, 98, Petherton Road, Highbury New Park, N., clerk; G. F. Long, Heath Lodge, Fernham Road, Thornton Heath, accountant; and B. G. Royal, 41, Gower Street, W., engineer. The number of directors is not to be less than three nor more than eight; the first Edmund T. L. Williams, William B. Owen, and Emile Berliner (permanent directors; special qualification, 10,000 shares); qualification of ordinary directors, 1,000 shares; remuneration, £300 per annum, and a share in the profits, divisible (maximum £1,000).

"Perfect" Arc Lamp and Accessories Company, Limited (63,414).—This company was registered on August 25th, with a capital of £10,000 in £1 shares, to enter into an agreement with F. R. Hill & A. V. Gifkins, to manufacture and sell in Great Britain only, the "H. & G." high tension switch, to deal in the "Perfect Arc Lamp," to manufacture, sell, and deal in incandescent lamps, engines, dynamos, motors and electric fittings and supplies, and to carry on the business of electrical and mechanical engineers, electricians, &c. The first subscribers (each with one share) are:—H. Bourne, Lancaster Lodge, Wandsworth Common, S.W., gentleman; H. A. Caspard, 147, Lower Addiscombe Road, Croydon, clerk; T. G. Wallace, 58, Winchester Street, Pimlico, electrician; G.

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Hobley, 41, Chetwynd Road, Highgate Road, N.W., clerk; F. E. Janes, The Lawns, Sevenoaks, solicitor; C. S. Lickfold, 1, Draper's Gardens, E.C., gentleman; and J. M. Lickfold, 51, Doughty Street, W.C., secretary. The number of directors is not to be less than two nor more than five; the first are F. R. Hill, H. Bourne, A. W. Scrivener, and W. N. Stewart; qualification, £500; remuneration, £200 each per annum. Registered office, 32, York Street, Westminster.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electrical Construction Company, Limited (39,292).—This company's annual return was filed on August 11th, when 112,100 ordinary and 25,000 preference shares were taken up out of a capital of £400,000 in 150,000 ordinary and 50,000 preference shares of £2 each. 2,100 ordinary and 11,855 shares have been paid for in full, and the remaining 110,000 ordinary and 13,145 preference are considered as fully paid.

F. H. Royce & Co., Limited (41,362).—This company's annual return was filed on July 14th, when 6,000 preference, 21,480 ordinary and 500 deferred shares were taken up out of a capital of £60,500 in 6,000 preference shares of £5 each, 30,000 ordinary shares of £1 each and 500 deferred shares of £1 each. £1 5s. has been called up on each of the £5 shares, and the full amount on 9,466 £1 shares, resulting in the receipt of £16,966. The remaining 12,514 £1 shares are considered as fully paid.

British Thomson-Houston Company, Limited (47,982).—This company's annual return was filed on August 4th, when 24,000 shares were taken up out of a capital of £400,000 in 40,000 £10 shares; £165,310 has been paid on 16,531 shares, and 7,469 are considered as fully paid.

Crompton & Co., Limited (27,200).—This company's annual return was filed on August 2nd, when 32,098 shares were taken up out of a capital of £162,000 in 54,000 £3 shares. £3 has been called up on 30,098 and £90,044 has been received, leaving £250 still due. 2,000 shares are considered as fully paid.

D. P. Battery Company, Limited (44,084).—This company's annual return was filed on July 26th, when the entire capital of £10,000 in £1 shares was taken up. £1 has been called up on each of 8 shares, and 17s. on 9,992, resulting in the receipt of £8,501 4s.

Coventry Gas Fittings, Electrical and Engineering Company, Limited (22,431).—This company's annual return was filed on July 26th, when the entire capital of £15,000 in £1 shares was taken up. 14,500 shares have been paid for in full, and the remaining 500 are considered as fully paid.

West African Telegraph Company, Limited (21,626). This company's annual return was filed on July 26th, when 23,109 shares were taken up out of a capital of £400,000 in £10 shares. £231,090 has been received.

CITY NOTES.

The Chloride Electrical Storage Syndicate, Limited.

The ordinary general meeting of this syndicate was held at Clifton Junction, near Manchester, on Tuesday, 29th ult., Dr. F. H. Bowman presiding.

In moving the adoption of the report and accounts, the Chairman said the shareholders would notice that the course of the company during the past year had been one of steady progress. The storage battery continued to give the greatest satisfaction, and orders had begun to pour in. Nothing could hinder electrical storage from being required all over the country. There were already signs that it would be used for electrical traction on all tramcar routes in the centre of cities. He had no hesitation in saying that the company's battery was by far the best in the market, and the only one that could be called commercially successful at the present time. From the balance-sheet the shareholders would see that after providing for debenture interest they had a sum of £16,390, which the directors considered very satisfactory, taking into consideration the rise in the price of zinc and lead, of which large quantities were used in the works. After writing off £5,160 from the various accounts, there remained at the disposal of the company £11,229. Dividends had absorbed £3,703 of this, and the directors proposed to carry forward £7,526, and to declare a further dividend out of that money at the rate of 7 per cent. Further capital would be required owing to the great extension of the business, and it was proposed to raise that by a further issue of debentures. Although he would have liked to report greater success, still the balance-sheet was one with which they had every reason to be satisfied.

Dr. Hopkinson seconded the resolution to adopt the report and accounts, and the resolution was declared to have been carried unanimously.

A Shareholder thought that more particulars of the accounts should be shown, but accepted the explanation of the chairman that this would not be desirable in view of competition.

Mr. Harvey was re-elected as a director, and Messrs. Parkinson, Mather & Co. were re-elected auditors of the company.

In returning thanks for a resolution that the usual remuneration be given to the directors, the Chairman said that the directors had been very ably assisted by Mr. Grindle, the manager, and by all the officials of the company. In the past the directors had declared an interim dividend, and although they had power to do that under the articles of association, he would prefer that the shareholders should confirm the course they had taken.

Mr. Priestly seconded a resolution to this effect.

Mr. Harvey said that before the resolution was put he would like to remark that, considering the present price of materials and what could now be got for batteries as compared with the figures in the early days of the company, he thought there had been exceedingly good management. The company had now a very large amount of orders in hand, sufficient, at the present rate of output, to last for a very considerable time to come, and it would be therefore necessary to still further increase the works.

The resolution as to the dividend was then put to the meeting and carried.

Votes thanking the directors, manager, and staff were responded to by the Chairman, on behalf of the board, and by Mr. Grindle on behalf of himself and staff.

The Brush Electrical Engineering Company, Limited.

The directors' report to be submitted to the tenth annual general meeting to be held at Cannon Street Hotel, E.C., on Friday, September 8th, 1899, at two o'clock p.m., reads as follows:—

"The directors herewith submit the balance-sheet and profit and loss account for the year ended June 30th, 1899. The profit and loss account shows an available gross profit of £57,259 11s. 9d. After deducting maintenance, general charges, interest on debenture stock, and interim dividend on preference shares for the half-year ended December 31st last, there remains a balance of net profit of £26,480 7s. 3d. The directors recommend that this sum be applied as follows:—

	£	s.	d.
To dividend at the rate of 6 per cent. on preference shares for half-year ended June 30th, making 6 per cent. paid for the year	5,400	0	0
„ dividend at the rate of 5 per cent. on ordinary shares for the year	9,000	0	0
„ bonus payable to employés under profit-sharing scheme	1,980	0	0
„ depreciation reserve fund	5,000	0	0
„ balance carried forward	5,100	7	3
	£26,480	7	3

Capital expenditure to the extent of £55,956 2s. 6d. has been incurred during the year on extensions of buildings and plant at Loughborough, to enable the company to meet the growing demand for electric traction and power distribution undertakings in Great Britain and the Colonies. The provision referred to in last year's report with reference to the Workmen's Compensation Act has proved to be more than sufficient to meet the requirements of the case; and the directors propose that the company should continue to effect its own insurance in respect of the Act. The policy of developing the company's facilities for dealing with electric traction contracts has borne good fruit during the past year; and the works are well filled with orders for steam engines, electrical machinery, and rolling stock. The result of the year's trading enables a further distribution to be made to the company's employés under the profit-sharing scheme, with the results of which the directors continue to be satisfied. The directors have decided to make the company's financial year coincide in future with the calendar year. A balance-sheet and report will accordingly be issued for the six months ending December 31st next, and thereafter for each whole year ending December 31st. Mr. J. B. Braithwaite, jun., and Mr. B. H. Van Tromp are the directors who retire by rotation, and, being eligible, offer themselves for re-election. The auditors, Messrs. Cooper Brothers & Co., also retire and offer themselves for re-election.

Prospectus.

The prospectus of the Electric Lighting and Traction Company of Australia, Limited, was before the public at the earlier part of the week, the list closing on Tuesday last. The Electric and General Investment Company offered, on behalf of the Brush Electrical Engineering Company, 20,000 6 per cent. preference shares of £5 each, at a premium of 10s., and 20,741 ordinary shares (£5) at par. In addition 1,400 ordinary shares are issued in part payment of purchase money, 7,859 ordinary shares being reserved to shareholders in the existing Melbourne companies, and these will also be issued as fully paid in part payment of the purchase price. The company, which has a nominal capital of £300,000, will carry on electricity supply business for lighting, traction, and other purposes in the Australian Colonies, which are believed to offer a large field for electrical development, and for the investment of capital therein. The undertakings of the New Australian Electric Company, Limited, and of

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the A. U. Alcock Electric Light and Motive Power Company (both already supplying electricity in Melbourne and suburbs, and holding electric lighting orders in certain districts). Extended orders for additional works in the same districts are being applied for. The maximum charge per unit is 9d., but the companies are charging 7d., with discounts down to 5d. The population of the several districts is 216,000, and the price of gas is 5s. per 1,000. During the past four years the two companies have shown an average combined net annual profit of £8,831, exclusive of charges for interest and depreciation. The amalgamation of the two concerns can hardly fail to effect economies, as the two generating plants will be now brought into one set of buildings. The Melbourne City Council is purchasing the rights, plant, &c., of the two companies in the city district, paying therefor £40,000 in cash, but the companies will continue the supply of current until the municipal station is completed. It is not anticipated that the withdrawal of the city supply will reduce revenue, as the suburbs are to be energetically worked. The company will not confine itself to electric lighting, but is already proceeding with electric traction negotiations. There will be a local advisory board of directors at Melbourne, the home board consisting of Messrs. J. B. Braithwaite, jun., J. F. Albright, A. U. Alcock, M. F. Armstrong, and R. P. Sellon. Mr. F. W. Clements, M.I.E.E., is the engineer. Messrs. Kincaid, Waller & Manville being consulting engineers. The registered office is 49, Queen Victoria Street. The purchase price of the two undertakings is fixed at £179,105, and the way this is made up is shown in the prospectus, as are also particulars of contracts entered into, &c. We have often thought that our Australian Colonies offered a splendid field for electrical development and for the profitable employment of English capital. We shall probably see a good deal of this within the next few years.

Manchester Electrical Works.

THE *Financial Times* says that the following circular letter has been issued to the shareholders of the Manchester Electrical Works, Limited, by the secretary:—

"Dear Sir (or Madam),—I am instructed by the directors to send out the following letter as a reply to many inquiries received from shareholders.

"Since the circular of December 2nd, issued by the directors, the sum of £900, less charges, being the purchase price of the works by Mr. Thomas, as approved at the general meeting of September 5th, 1898, has been paid. A proportion of this has been absorbed by payment of rent, legal and other charges, rates, taxes, &c. No fees have been paid to the directors, and there are no charges for office expenditure. The balance of cash is at the bank. Securities were taken by the directors in connection with Mr. Rawson's liability to the company. These securities will require careful realisation, and it is hoped that the directors will be left a free hand in the matter, as they are acting in the interests of the shareholders only. Negotiations are pending for the sale of the company's rights in the Woodhouse & Rawson electric filaments, which are acknowledged to be the best in the market.

"The directors do not consider that any benefit would be derived from calling a meeting until they can report more definitely on the company's position. They will, however, not fail to keep the shareholders informed of any alteration which may occur."

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending August 26th, 1899, were £2,090 6s. 11d.; receipts for week ending August 26th, 1898, £1,212 8s. 6d.; aggregate for half-year to date, £11,990 18s. 8d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending August 25th, 1899, were £3,692 18s. 8d.; corresponding period 1898, £3,171 0s. 8d.; increase, £521 17s. 7d.

The City and South London Railway Company.—The receipts for the week ending August 27th, 1899, were £895; week ending August 28th, 1898, £866; increase, £29. Total receipts for half-year, 1899, £8,641; total receipts corresponding period, 1898, £8,695, decrease, £54. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending August 26th, 1899, were £346 16s. 6d.; week ending August 26th, 1898, £278 1s. 6d.; increase, £68 15s. Total receipts to date, 1899, £6,488 0s. 9d.; corresponding period, 1898, £5,357 9s. 9d.; increase, £1,130 11s. Miles of track open, 1899, 3; 1898, 3. Car miles run, 1899, 4,966; 1898, 4,339. Number of cars, 1899, 12; 1898, 10.

The Dublin United Tramways Company.—The receipts for the week ending Friday, August 25th, 1899, were as follows:—D. U. T. Co., horse cars, £2,525 8s. 9d.; ditto, electric cars, £1,469 12s.; D. S. D. Co., electric cars, £1 699 8s. 8d.; total, £5,693 19s. 5d. corresponding week last year—D. U. T. Co., horse cars, £3 020 14s. 11d.; ditto, electric cars, £523 5s. 4d.; D. S. D. Co., electric cars, £1,240 1s. 10d.; total, £4,784 2s 1d.; increase, £849 17s. 4d. Aggregate to date, £88 023 9s. 7d.; aggregate to date last year, £86,586 7s. 5d.; increase to date, £1,437 2s. 2d. Worked:—The mileage open is 18 miles electrically, 26 miles by horses, as against 12 miles electrically, and 30 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways. — The receipts for two weeks ending August 20th, 1899, were £1,671; Miles of track open, 12. Car miles run, 28,124. Number of cars, 21. The receipts for two weeks ending August 24th, 1898, were £648. Miles of track open, 8. Car miles run, 7,443. Number of cars, 10. Increase, £1,028. Total receipts to date, August 20th, 1899, from August 24th, 1898, £20,384. Total receipts to date, August 24th, 1898, from June 30th, 1898, £3,241. Increase, £18,143.

The Liverpool Overhead Railway Company.—The receipts for the week ending August 27th, 1899, amounted to £1,899; corresponding week last year £1,661; increase, £238.

The South Staffordshire Tramways Company.—The receipts for week ending August 18th, 1899, were £703 2s. 6d.; aggregate receipts for 34 weeks, £22,874 6s. 6d.; week ending August 19th, 1898, £700 8s. 2d.; aggregate receipts for 34 weeks, £21,289 5s. 6d.

STOCKS AND SHARES.

Wednesday Evening.

THE Transvaal trouble hangs like a sable cloud over the Stock Exchange, retarding enterprise in almost every direction, and causing grave anxiety in all the markets. Despite the huge amount of public money that awaits investment, the owners of the cash decline to use it freely in the Stock Exchange, owing to the political uncertainties of the moment. The electric lighting and kindred departments of the House would be among the first to benefit by a return of public confidence, but, as it is, there is so little business doing, that a change of price of any kind in a quotation is considered noteworthy. As one of the jobbers in the electrical supply section said to us the other day, "We tick the prices on the lists day after day just as a matter of form, and not because there is any need to do it." City of London, however, are 10s. better; Charing Cross and the other two West End companies sharing the same honourable distinction. Firmness is the prevailing feature, the tone throughout the list being very good. Citys still enjoy the attraction of being a good medium for speculation, and the account was arranged on Tuesday at an average rate of 5 to 7 per cent. for carrying over the shares. City of London 5 per cent. Debenture stock is being asked for, and the price has risen two points.

The telegraph market has naturally been agitated by the fears of a Transvaal rupture, to which reference has already been made. Prices of the Eastern Companies keep steady, but the dealers are naturally shy of making close prices, and suspended animation is the order of the market. Eastern Extension shares are stolidly unmoved at the effort which the company is making to improve its Australian business. The American Cable Company's stocks show very little alteration one way or the other. A temporary lull in the "Yankee boom" has resulted in a corresponding quietness of Anglo-American issues, speculators being anxious for a little more light upon their path before adopting aggressive tactics again. West Indian shares maintain their firm front, even in face of the news that is daily received as to the prospects of another hurricane in these islands.

Telephone descriptions are tame and featureless. Nationals at 5⅜, ex dividend, have ceased to attract attention, and the market is waiting for a new move on the part of the company or the Government before tinkering with the price. We might, by the way, suggest to the Stock Exchange managers that while the alterations to the House are in progress some better arrangement with regard to the telephonic service would be worth introducing. At present the Stock Exchange labours under an arrangement which, to the members, combines the maximum of inconvenience with the minimum of proper management.

Brush Electrics have lost part of the ground they gained last week, and the price has fallen to 2 middle. A few sales were made by people who had long given up hopes of ever seeing a rise in the shares, and who took advantage of the late advance to clear out of their holdings. There is a tendency to buy the senior securities of Electrical Supply and Traction Company, but this is retarded by the uneasy feeling that prevails amongst the investment markets generally. Crompton's Debentures have secured a point rise, and an advance of 2 was scored by Aluminium 4½ per cent. Debenture stock. Callender Cable shares retain their rise of last week, and a small premium is already established upon the new Preference shares offered by Henley's.

New issues are nearly as rare as snakes in Iceland, but the Electric Lighting and Traction Company of Australia has been boldly bidding for popular favour. We fancy its reception must have proved a little disappointing to its promoters, and no market for the shares has been made in the Stock Exchange. The company certainly appears to have some chance of success, but to face the music in the dog-days is a trying experience for any new concern, especially when the object is of a speculative character, and one which it requires some faith and enterprise to take up heartily.

The electric railway market presents no special mark of interest. Waterloo and City Ordinary has fallen 1, but the main spirit of the market in the Stock Exchange is out of town, and dealing is more or less a matter of negotiation. Central London shares were carried over at 10½, the rate of contango being 5 to 6 per cent.

Shareholders in the Manchester Electrical Works, Limited, are not likely to be particularly pleased with the circular just issued by the directors in response to a number of questions which have been addressed both to the company and the Stock Exchange. It would appear that the purchase price of the works has now been paid to the company, but we are not told how much of this now remains. The references to Mr. Rawson's liability to the company are vague, and we think a little more frankness would have been appreciated by the patient shareholders.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, August 23rd.	Closing Quotation, August 30th.	Business done during week ended August 30th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	101	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	63 — 66	63 — 66	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	115 —116	115 —116	116	115
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	1½— 15	14½— 15	14 15/16	14¾
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	...	...
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,382,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105¼	104½
234,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9⅜	9½
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,981	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107½	103 —107½	...	...
60,710£	Direct United States Cable	20	3 %	3½ %	3½ %	11⅜— 12¼	11⅜— 12¼	12¼	12
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½ %	7 %	7 %	153 —158	153 —158	156	154
1,795,000	Do. 8½ % Pref. Stock	100	...	...	...	99 —102	99 —102	100½	99⅞
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	116 —121	116 —121	117⅛	116⅛
250,009	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14½— 15	14½— 15	14½	...
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	115 —120	115 —120	116	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	102	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	4 %	...	...	102 —105%	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5⅛ %	10⅜— 11¼xd	10⅜— 11¼	11	10 13/16
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15 — 15½xd	15 — 15½	15 5/16	15
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	30¼	...
89,500	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	109 —112	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5⅛ %	6 %	6 %	5¼— 5⅛xd	5¼— 5½	5 7/16	5 5/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14 xd	13 — 14	13 5/16	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14 xd	13 — 14	13⅜	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5⅛xd	5¼— 5½	5 7/16	5⅜
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	100½	100¼
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,389	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	4⅜— 5¼	5	...
151,788£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	100 —103	...	...
80,008	West Coast of America, Nos. 1—80,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	101 —104	101 —104	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	...	...
88,321	West India and Panama Telegraph	10	1 %	8/9 %	...	1⅜— 1⅝	1⅜— 1⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10¼— 10⅝	10¼— 10⅝	10⅝	10 3/16
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9⅛	8½— 9⅛	8½	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	103 —106	103 —106	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	100 —105	...	...

ELECTRICITY SUPPLY COMPANIES.

80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11 xd	10½ — 11½	11	10⅞
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½xd	6 — 6½	6⅜	...
24,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8½	8½	8 1/16
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	113 —115	113 —115	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11 — 12	11½ — 12½	12 3/16	11 15/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½xd	12½ — 13½	13⅛	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	123 —128	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 11½	11 — 11½	11 1/16	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13½— 14½	13½— 14½	...	...
220,000	Do. 4½ % Deb. Stock, Prov. Certs (£30% to be paid) Rd.	...	...	...	...	81 — 83	81 — 84	83	82¾
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5 — 5½xd	5 — 5½	...	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	8 — 9 xd	8 — 9	8¾	8⅜
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	3 13/16	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 7	6⅝	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	105 —107	106	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	15 — 16	15½	15
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14½— 15½	14½— 15½xd	15⅛	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	16 — 17	16½ — 17½	17¼	16¾
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3⅞— 4⅛	3⅞— 4⅛	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	15 — 16	15½—16½	16	15¾

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid. § Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked † are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Aug. 23rd.	Closing Quotation Aug. 30th.	Business done during week ended Aug. 30th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3 — 3½xd	3 — 3½	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	97 —102	...	...
30,000	British Electric Traction	10	...	...	6 %	17½— 18½	17½— 18½	...	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13¾— 14¼	13¾— 14¼	14	13⅞
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	...	...	...	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	...	11 — 22	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	...	6½— 6¾	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	2 — 2½	1⅞— 2⅛	2⅛	2
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2⅜	2¼
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13½— 14½	13½— 14½	14¼	14
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10⅜	10¼— 10⅜	10⅜	10 7/16
178,303	Do. do. do. £8 paid	10	...	...	...	8¼— 8¾	8¼— 8¾	...	...
61,033	Do. do. Pref. half-shares £3 paid ...	...	...	...	...	2¾— 3¼	2¾— 3¼	...	...
71,447	Do. do. Def. do. £5 paid ...	...	...	...	...	5¼— 5⅝	5¼— 5⅝	...	...
630,000*l*	City and South London Railway	Stock	1 2/16 %	1⅞ %	2⅛ %	65 — 67 xd	65 — 67	66½	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6¼— 6¾	6¼— 6¾	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	99 —102	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½ %	6 %	6 %	1⅜— 2¼xd	2 — 2½	2⅛	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½ %	6 %	6 %	4 — 5 xd	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2 3/16	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	102 —105	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ⅞	⅝— ⅞	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	12	11¾
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	25 — 26	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	20 — 22	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	22	21
800,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	103½	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3½ %	3½ %	7⅝— 7⅞	7⅝— 7¾	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13¼— 13¾	13 — 13¼	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	38 — 42	38 — 42	39½	38
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9¾	9¼— 9¾	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅞— 6¼	5⅞— 6¼	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	102 —105 xd	101 —104	103¼	103

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8¼—9¼.
British Aluminium, Ordinary, 9¼—10; 7 % Pref., 10—11.
House-to-House, 4½ % Debentures of £100, 103—106.
National Electric Free Wiring, 10s. paid, 5/16—7/16.
Smithfield Market Electric, 2—4.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13—14; 1st Preference Cumulative 6%, £5 (fully paid), 7⅞—8¼. Debentures, 101—104. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 19.

* From Birmingham Share List.

Bank rate of discount 3 per cent. (February 2nd, 1899).

MARKET QUOTATIONS, Wednesday, August 30th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a " Nitric .. .. .. per cwt.	22/-	22/-	..
a " Oxalic .. .. .. per cwt.	32/-	32/-	..
a " Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. per cwt.	25/-	25/-	..
a Ammonia, Muriate (crystal) .. per ton	£25	£25	..
a " " .. .. per ton	£28	£28	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a " (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25	£25	..
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a " White Sugar .. .. per ton	£31	£31	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3½d.	3½d.	..
a " Caustic (75/80 %) .. per ton	£24	£24	..
a " Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a " Recovered .. .. per ton	£5 10	£5 10	..
a " Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a " Crystals .. .. .. per ton	£3	£3	..
a " Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£224	£224	..
b " Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 3" to 12") basis per lb.	8½d.	8½d.	..
c " Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c " Wire, basis .. .. per lb.	8½d.	..	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f " Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£89	..
g " Wire (basis price) .. per lb.	10½d.	10½d.	..
g " Sheet .. .. .. per ton	£88	£88	..
g " Rod .. .. .. per ton	£88	£89	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6'-	6/-	..
h India-rubber, Para fine .. .. per lb.	4/8	4/8	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i " Pig (Cleveland warrants) per ton	64/9	65/-	3d. dec.
i " Forgings, according to size per ton	From £11	From £11	..
i " Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8 .. per ton	£12 17 6	£13 15	17/6 dec
g Lead, English Ingot .. .. per ton	£14 18 9	£14 10	8,9 inc.
g " Sheet .. .. per ton	£15 7 6	£15 7 6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 12	£8 7	5s. inc.
d Mica (in original cases), small per lb.	1½d. to 6d.	1½d. to 6d.	..
d " " " medium per lb.	1/9 to 2/6	1/9 to 2/6	..
d " " " large per lb.	8/6 to 7/-	8/6 to 7/-	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd strip & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£146 10	£146 10	..
g " foil .. .. per lb.	1/6	1/6	..
n " wire Nos. 1 to 16 .. .. per lb.	1/10	1/10	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb	7½d.	7½d.	..
j " Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j " Hemp, 8 ply 10 lbs. .. per lb.	3½d.	3½d.	..
j " " Russian, 10 lbs. per lb.	4½d.	4½d.	..
j " Jute, 180 lbs. rove .. per ton	£13 10	£13 10	..
j " Manila, 24 thread .. per ton	£35	£35	..
k Zinc, Sheet (Vielle Montague bnd.) p.s.	£27 10	£28	10s. dec.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakespeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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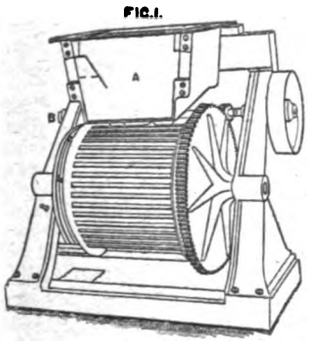
SOME FORMS OF MAGNETIC SEPARATORS, AND THEIR APPLICATION TO DIFFERENT ORES.*

By H. C. McNEILL, Assoc R.S.M.

The first application of magnetism as an agent for the separation of a magnetic from non-magnetic substances was probably the permanent hand magnet used in the machine shop for separating iron or steel turnings, &c., from brass or gun-metal sweepings. Similarly, foreign oats and grain are freed from bits of iron wire, pieces of cutter blades, nails, needles, &c. The railway companies and other large employers of horse labour have found it necessary to subject all the materials utilised for horse food, such as maize and oats, to rigorous mechanical and magnetic cleansing, for which purpose a permanently magnetised steel plate about 4 feet long, 6 inches wide, and ½ inch thick, with the long edges horizontal, is placed transversely, and inclined at an angle of about 35° to a continuous stream of grain fed from a hopper. An automatic scraper, in the form of a belt revolving round pulleys at each end of the magnet, and provided with a brush of leather, removes any accumulation every two minutes. This is pushed to the end of the magnet, and drops into a separate compartment; the grain which passes on is jigged on a three-bottomed perforated tray, by which means not only is the corn or maize separated, but the oats are freed from mixture of smaller seeds, bits of stone, and dust.

With the introduction and wider application of electro-magnetism, not only have machines been devised whereby naturally magnetic iron ores are freed from admixtures of other minerals, but by a preliminary roasting, *i.e.*, the artificial production of magnetic oxide of iron, other ores may be rendered suitable for a magnetic separation treatment. Mr. R. E. Commans mentions† that Sella, in Piedmont,

FIG. 1.



in 1855, was the first to use an electro-magnetic separator, but to free the magnets the current had to be broken; also that in 1881 Heberle, at the Friedrichssegen Mine on the Lahn, introduced a continuous current machine for separating blende from spathic iron ore after a preliminary roasting. In addition to the separator which bears his name, and which is dealt with in this paper, Mr. Heberle also designed that part of the dressing floors at the Gellivare Company's Works at Lulea, where the apatite, after being separated from the magnetic iron ore with which it occurs, has to be freed from a small percentage of hæmatite before being converted into soluble phosphate.

Other workers, both in Europe and America, including Wenström, Ball and Norton, Chase, Conkling, Hoffman, Kessler, Buchanan, King, Edison, and Wetherill, have all designed machines suitable to treat certain classes of ore which have come under their particular observation, and have successfully dealt with the problems presented by local conditions and peculiarities.

In the summer of 1898 the author had the opportunity of seeing some of the principal magnetic concentration plants in Sweden, and the present paper is mainly confined to these. He is indebted to the various managers of works, engineers, and others for the information freely accorded in every case.

The endeavour has been to present an outline of the machines and ore treatment processes. The sketches are entirely diagrammatic, and have been prepared from the author's hand sketches.

The machines will be described, in each case with the accessory ore treatment processes, in the following order:—

1. The Wenström machine.
2. The Monarch machine.
3. The Dalvik-Grödal machine.
4. The two types of Heberle machine.
5. The Wetherill machine.

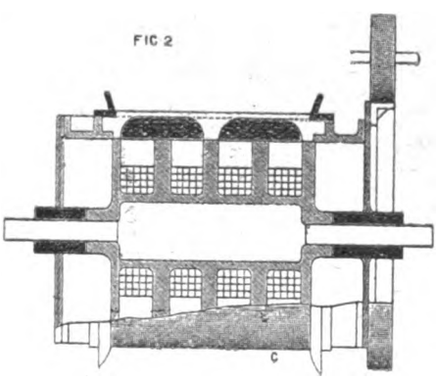
1. The Wenström Machine.

This is probably the simplest, and, for the particular purposes which it is intended to fulfil, the most efficient separator at present in use. Unlike most other designs, it is capable of treating ore of fairly large size, and it is not necessary that the stuff treated should be previously dried; its chief use is in such cases where the magnetite iron ore contains inclusions of rock, or where, as in open-cast workings, portions of the containing walls of the ore body get mixed with the ore in blasting and like operations. As a general rule, it is found to be more economical to pass the whole of this material collected together over a Wenström machine, after the "best" of a blast has been dealt with, than to attempt further hand selection in the quarry or underground. In addition, there are other uses to which this separator may be put, such as the treatment of cupola residues and foundry loam and sand; also the recovery of cast-iron shot entangled in blast furnace slag, &c.

Fig. 1 gives a general view of this machine. The material to be treated is fed through a hopper, A, and on to a jigging tray, which receives its motion from a cam arrangement placed on the shaft, B. This tray is inclined, and at each recoil a line of ore is left on the drum. Figs. 2 and 3 show part sections of the drum in directions at right angles to one another.

C is the armature barrel, consisting of a series of soft iron bars, each separated from the other by a bar of wood. D is a stationary field magnet, placed eccentrically with regard to the armature barrel. Non-magnetic end plates, carefully fitted with "jointing," so as to be water-tight, bind up the whole into the form of a drum. The bars of soft iron are internally shaped, so that each successive bar

FIG 2



becomes oppositely magnetised, a combination of greater power being thus exerted on a piece of ore large enough to bridge the distance between two adjacent bars.

The magnetic portion of the ore adheres to and is carried round on the drum until beyond the influence of the magnetic field, when it drops away down a shoot at E, whilst the non-magnetic portion passes down in front of the drum into a shoot at F.

A machine with a drum of 2 feet 2½ inches diameter and 2 feet length, revolving at 30 revolutions per minute, will treat about 5 tons of mixed material per hour. Such a machine is capable of dealing with ore of any size up to pieces that will pass through a screen of 4-inch mesh, and requires a current of 15 amperes, the tension at the dynamo terminals being 110 volts. Although the machine may be and is used on ore which is quite wet, the greatest efficiency is obtained when the material to be treated is dry, and in some cases, as

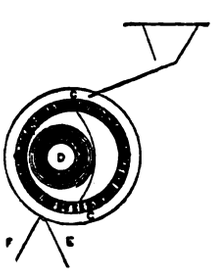


FIG. 3.

at Dannemora (Sweden), care is taken to treat only that ore which is fairly dry, without incurring the expense of artificial drying, whilst in other instances (Grängesberg and Grangen) the ore is treated directly after being washed, and whilst quite wet.

This separator requires but little care and attention when working, whilst the cost of maintenance is practically *nil*.

Generally the most efficient plants are also the simplest. The process usually consists of either a rough preliminary sizing by means of revolving or flat screens, with or without washing, followed by treatment on the separator, or the uncleaned ore may be passed on to the magnetic machine direct, and subsequently screened into different market sizes. At Dannemora the latter method is adopted, and I am indebted to Captain Hammershal for placing at my disposal the particulars given in the following short description of the plant used there.

The ore on arrival at surface is first subjected to a rough hand selection on sorting-floors conveniently arranged near the shaft. Between 50 per cent. and 60 per cent. of the total quantity of ore raised is rich enough to be taken direct to the furnaces. The remainder, which is of any size up to 2 inches diameter, is trammed from the sorting floors to the separation plant, or to the ore heaps,

* Read before the Iron and Steel Institute at Manchester, August, 1899.

† *Proceedings of the Institution of Civil Engineers*, Vol. cxvi., 1893, p. 63.

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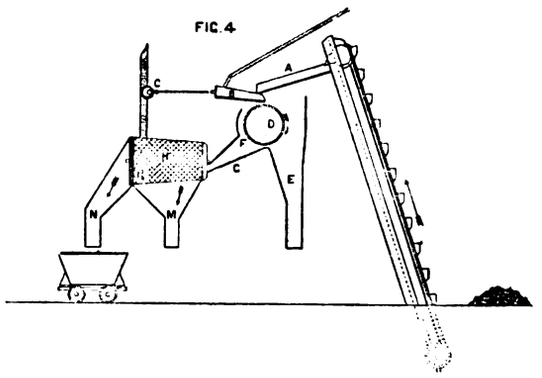
for future treatment by the separator. Fig. 4 represents the plant in use.

By means of the elevator shown, the ore is lifted and dropped on to the inclined shoot, A, and so on to the reciprocating table, B, which delivers it to the Wenström separator, D.

The tray, B, receives its motion by means of the small eccentric, C. The unmagnetic, and in this case worthless, portion falls at once down the shoot, E. The magnetic portion is carried round on the drum of the separator in the manner already described, and passes down shoot, G, into the revolving trommel or screen, H.

This trommel is of ½-inch steel plate, provided with ⅞-inch punched holes pitched 1⅜ inches apart, so that every body under ⅞ inch diameter passes through and down the shoot, M, the stuff above ⅞-inch, which

FIG. 4.

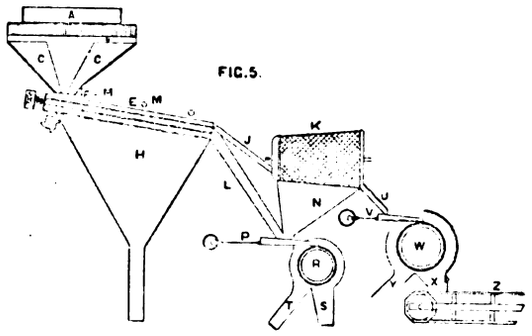


does not pass through the holes of the trommel, being delivered down the shoot, N, two marketable products being thus obtained.

An example where preliminary sizing and washing before separation is found to be advantageous is at Grängesberg (Sweden), and no doubt many of the members of this Institute will remember seeing the actual plant at work.

The mill is built at the foot of an embankment, so that the material to be treated is wheeled either in railway trucks or mine waggons directly into the top storey. During the winter, from obvious reasons, it is found impossible to run the mill; during this time large reserves of ore are accumulated. The railway trucks, when used, are so constructed that the whole sides are capable of being dropped, and rest horizontally on the top of grizzlies which extend from end to end of the truck. In figs. 5 and 6

FIG. 5.



the truck is represented at A and the grizzlies at B. The ore is shovelled by four to six men out of the truck on both sides, and that which is too large to pass through is hand-picked into the waggons, D, by men and boys standing on the platforms shown. The grizzlies are made of bars of iron, rectangular in section, and placed 5 inches apart, so that all the material under that size falls down the shoots, C C, and on to a three-bottomed perforated recoil table M. If small stuff has to be treated, it is dumped directly down the central shoot (fig. 6) from the mine waggons, which are run into the mill on the narrow-gauge rails shown and without being passed over the grizzlies. The three bottoms of the table are placed exactly above one another, and about 3½ to 4 inches apart, and are all actuated by means of the cam-shaft, cam, and springs. The top tray is provided with holes 1¼ inches diameter and 2 inches pitch; the middle tray has holes ⅞ inch diameter, and the bottom one ¼ inch diameter. The ore is distributed in an even layer by means of the hinged iron plate F, assisted by the vibrations given to the table, by which means it is gradually worked down the tray, and at the same is subjected to a thorough washing, the water for the latter purpose being supplied by the 3-inch perforated pipes, M M. The result is that all fine particles of ore are washed through the three trays down the shoot, H, and are carried off with the water by launders out of the mill, where boys are engaged in digging small channels, whereby the water very quickly drains away, leaving a coarse powder which is sufficiently rich to be marketable. The stuff under 1¼ inches and over ⅞ inch diameter passes through the holes in the top tray, and is caught by the middle tray; that which is less than ⅞ inch and more than ¼ inch diameter passes through the middle tray, and is caught by the third tray. Both sizes fall into the same shoot, L, and are treated on the smaller Wenström machine, B. The material between 1¼ inches and 5 inches, after being thoroughly washed, is delivered from the topmost tray into a shoot, J, and then into a revolving trommel K, also provided with 1¼-inches holes, and the ore which passes through these holes is taken by shoot N to join the products from the middle and lowest tray, and is treated by the separator, B. Stuff between 1¼ inches and 5 inches is delivered from the end of the trommel, K, on to the feed-plate of the larger separator, W. The material which comes away from the "worthless" shoot, X, is deposited on to a slowly-moving broad metallic belt, Z. Here any pieces of valuable ore are hand-picked off by boys and dropped into a shoot placed on either side of the belt, the worthless portion being left on the belt, and travels into a separate compartment. The use of the

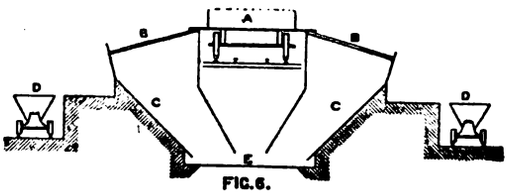


FIG. 6.

belt may be explained by the fact that the weight of some of the larger pieces of ore is greater than the magnetic force exerted by the machine, in which case they would fall off and get mixed with the worthless portion; also that it is more economical to adopt these means instead of hand-spalling and selecting the material to be treated according to more or less exact size. In addition, a lump of the stuff may be partly magnetite and partly unmagnetic, in which case, if the latter happened to come into contact with the drum first, it would not adhere.

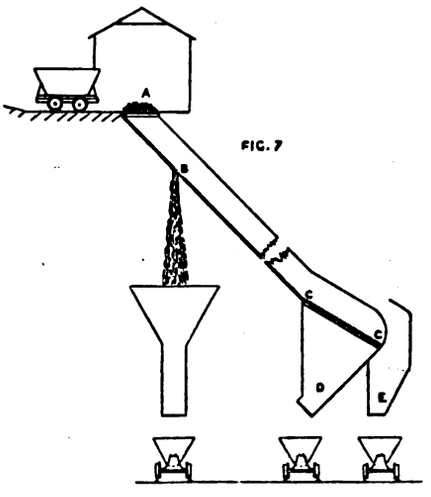
Three commercial products are obtained:—

(1) Ore between 1¼ inches and 5 inches diameter.
(2) Ore between 1¼ inches and ¼ inch diameter.
(3) Ore anything up to ¼ inch diameter.

The Grängesberg plant was designed to meet the particular requirements at the mine; the ore contains a considerable amount of specular iron, which somewhat easily crumbles, also hæmatite, and differs from that of Dannemora where the ore is compact and very hard, and there is little or no tendency to crumble, hence probably the difference in the methods of treatment and the primary washing, in order to save and eliminate the fine material.

At both Dannemora and Grängesberg the uncleaned ore averages 38 per cent. to 42 per cent., and the concentrates 58 per cent. to 62 per cent. metallic iron.

FIG. 7.



The rejected portion of the material consists of quartz, pegmatite (from inclusions and veins running through the magnetite ore bodies), schistose material, &c.

In both the preceding cases the operations of sizing or screening the ore are carried out mechanically either immediately before or after separation, but it may happen that the deposit is so situated as to render it necessary that the ore should be brought down to a convenient mill site, in which case the apparent disadvantages of position may be made use of in many ways. A case in point is at the Slotterberg Mine at Grangen. It appears that a considerable amount of work was done many years ago some 300 to 400 feet up the side of the hill, where large dumps were left by the old workers; in those days there were no magnetic separators, and only the very best picked ore was used; it is now found to be worth while to treat these old heaps. The stuff consists of anything between a powder and 6 inches diameter, and the whole of it, just as it comes to hand, is treated by screening, washing, sizing, &c., whilst on its way to the foot of the hill.

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The first operation which the stuff undergoes is shown in fig. 7 at A, where the ore is dumped on to a screen at that point, and is spread out by boys with rakes, and as much of the finer material which adheres to the larger pieces sent through the screen; the latter, which has an area of one square yard, passes everything under 2½ inches diameter, the larger pieces remaining on the screen being hand-picked; after passing through the screen the ore falls down the wooden shoot, which is some 18 inches square in section and lined with iron plates, the whole roughly secured to trestles against the side of the hill, at about an angle of 45°. At B is a rectangular opening in the bottom of the shoot, 2 inches wide, which allows a quantity of the finer material to drop through, but which is skipped by larger pieces as they roll down. Arrived at the bottom of the shoot, the pieces of ore being thus fairly cleaned, fall on to another screen, C C, with which the shoot terminates, where a further separation of the smaller material takes place. This screen is 10 feet in length, and the bars are placed longitudinally and ½ inch apart; the material under ½-inch diameter passes through and is caught in the shoot D, the finer stuff so eliminated, together with that which drops through

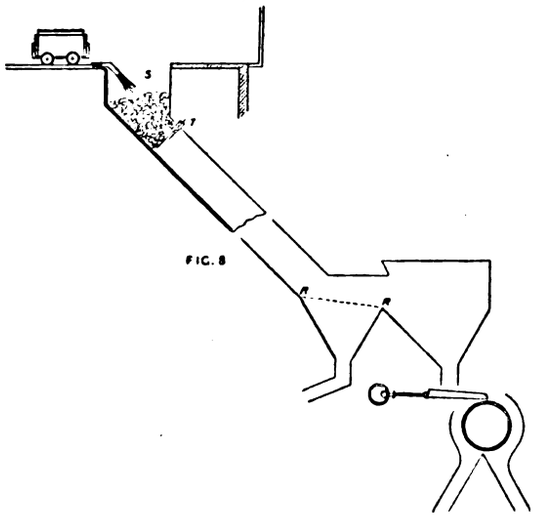
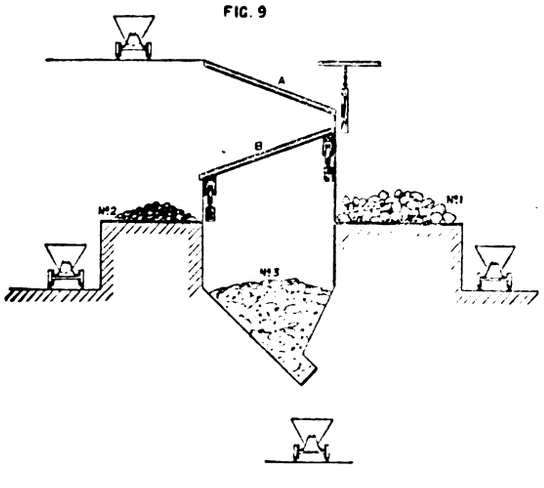


FIG. 8

at B, is dumped near at hand as worthless; and the remainder, of size between 2½ inches and ½-inch, falls into shoot E; from this point it gravitates down an inclined tramway until it arrives at the top of another shoot or launder also placed against the side of the hill, and terminating in the separator plant (see fig. 8).

The product from shoot E is tipped from the waggon into a square chamber at the top of the launder, and is kept in place by a shutter or plate T by means of which the feed of ore down the launder may be regulated, after being washed by water from the hose pipe shown. The height of the ore chamber, S, is 60 feet above the separator, and on its way down the material is well washed. At B B is a fine screen through which passes the finer material still left, together with the water, the residue of washed ore passing on to the Wenström machine.

FIG. 9



In addition to the old dumps mentioned, good ore has recently been discovered near the base of the hill, which is possibly a continuation of the deposit worked, as already stated, higher up. The ore thus obtained is first screened close to where it is mined. Fig. 9 is a sketch of the plant used for this purpose. A is an inclined screen made of old railway metals with an effective opening of 5 inches between each; pieces above this size roll off the screen and form No. 1. Pieces under 5 inches pass through and are caught on screen B, also made of old rails, but placed 2½ inches apart, so that the material of size between 5 inches and 2½ inches falls to the sorting floor and forms No. 2. The ore under 2½ inches that passes through screen B forming No. 3.

No. 1 is hand-spalled, selected, and divided into

(*a*) Almost pure magnetite.
(*b*) Material containing 60 per cent. to 70 per cent. magnetite.
(*c*) Gangue with 12 per cent. to 15 per cent. magnetite.

(*a*) and (*b*) are sent direct to the furnace.
(*c*) is dumped as worthless.
No. 2 is similarly treated.
No. 3, after a further screening, is passed on to the separator.

The top screen may be extended to any length according to the amount of ore to be treated. The under screen, B, is usually a short piece mounted, as shown in fig. 9, on wheels, so that it may be moved under any part of the upper screen that it may be convenient to use. It is also a good plan to divide up the shed into compartments, so that when sufficient ore has been put through to be easily "looked over" by one man, the operation may go forward in another compartment; by these means also the workmen on the lower platform are protected from the falling ore.

(*To be continued.*)

THE STRESSES IN STEAM ENGINES, WITH SPECIAL REFERENCE TO ELECTRIC TRACTION.

One of the claims continually made for American engines is that they are so very heavy and substantial. Generally speaking, the American stationary engine appeals to the writer as being a well-designed, plain, substantial machine, but not in any respect superior in design to the ordinary English engine. How is it, then, that so much is heard about the great weight and substance of American engines, contrary to fact? Simply because everything American has been enormously strengthened during the past few years. A few years ago American machinery was usually held up as the embodiment of scamped material. Americans, not less offensive in their way, jeered at what they were pleased to term the sacrifice of material to British ignorance. However, time has wrought changes. Americans to-day claim that they sacrifice as much material as the most benighted Britisher, and having brought themselves to such an extreme will insist on counting it to themselves for righteousness, and the contrast with their former methods is so great that they really bring themselves to believe that such strength and substance were never before seen. Such, in brief, is the true history of the American belief of to-day, a belief which has no foundation so far as regards any superior design of the American engine. But they have succeeded in frightening some of our ignorant local politicians into the belief that the American traction experience, embodying as it does a long series of disasters and breakdowns of previously too light engines, has evolved a type of engine with which no English engine can compete. It is all a myth. Traction work requires strength, but not more strength than the ordinary good English modern high pressure practice allows. Let us examine the stresses in any engine under maximum load variation. We will assume the fly-wheel to be placed between the crank and its work in contradistinction to the faulty American practice of placing the fly-wheel on the opposite side from the generator.

Assume the engine to be a single crank engine under a full steady load. On each dead point of the crank full steam is admitted to the cylinder. At that point of the revolution there is absolutely no work passing from the crank-pin to the generator. Yet the generator is running under full current without a flicker of the meters. This work can have only one source, and that source is the fly-wheel. There is no other visible or conceivable source of energy. Obviously, therefore, there are two more or less short arcs of revolution during which the engine performs no work. If just before the dead point steam were shut off, the engine would do no work during the next half revolution; all work would come from the fly-wheel. When, after such a half revolution of no work, the crank arrives at its opposite dead point, it may or may not receive a full load of steam pressure. If it receive none, the engine will make another idle half revolution. If, however, steam be admitted, a working half revolution will be made and energy will pass into or past the fly-wheel, but is it not perfectly clear that so far as the stress in the crank and shaft is concerned there is no difference whether the previous stroke has been an idle or a working stroke? Every revolution sees the engine exposed alternately to full load and no load, and no matter how much the load on the generator may vary there can be no excess of stress brought upon the engine beyond the ordinary maximum stress of full boiler pressure, and an engine built for a given boiler pressure can never be put to stresses greater than those due to a steady load at this given boiler pressure carried to the latest point of cut-off. Under certain circumstances, the current output may be so very heavy as to bring an engine to rest in a very short time. In such a case of a load suddenly applied to swallow up the energy stored in a fly-wheel in the course of a very few revolutions, there may be very heavy stresses set up between the fly-wheel and the generator, and these stresses ought to be provided for. Unfortunately for the claims made as to traction stresses being so very severe, it is practically noticeable that American practice, as exemplified in many of the examples sent over to this country, takes so little account of these enormous stresses

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as to place the crank-pin between the fly-wheel and the generator, and therefore exposed to all the variations of stress that ever occur.

When the load on an engine with correctly placed fly-wheel is varied from *nil* to maximum, the effect is simply to cause the fly-wheel to vary from, let us say, 101 to 99 revolutions on a normal 100 revolutions. This shows that the maximum possible load variation of this particular engine is such as to absorb in half a revolution 2 per cent. of the fly-wheel store of energy, and the governor varies its position to give full or minimum steam for the next half revolution. But, as an engine sets out its own duty one half a revolution at a time, it is obviously impossible for any load variation to throw upon any part of the engine a stress greater than that which takes place at every half revolution under a maximum steady load. Compared with marine work with a huge screw propeller flung alternately high in air and deep into water, the resistances due to the revolution of an armature in a medium resembling a fluid with a variable viscosity are mere trivialities. The sudden accession of resistance in the field of revolution cannot be compared with the material inertia of a mass of salt water. Catch phrases are very apt hooks on which to snare the unthinking, but it does not require much thought to perceive that the stresses in steam engines arise from boiler pressure, and that no matter how the load may vary it cannot induce the governor to do more than simply admit steam when the piston arrives at the end of the stroke. How such a process can cause huge stresses, beyond those ordinarily provided for, it passes common sense to perceive! Certainly it is possible that the many failures of high speed electric light engines have had their influence in giving to all electrical work a terrifying aspect. But it has been already pointed out in these columns that the one cause of the failure of so many high speed single acting engines has been the intolerable weakness of their crankshafts, such engines often demanding shafts fully sixfold the torsional strength of the shaft of a double acting engine of equal speed and power. As pointed out in the Electrical Review of last week, English practice in electric lighting has long been superior to the prevailing American practice, and there is no reason whatever for doubting the possibility of vastly improving on American traction practice. There is more of it in America it is true, but English practice already passes American in its general features and careful execution, and America has no monopoly of suitable engines. Abnormal stress is a bogey that has been made very useful, but it is high time that clear and truthful conceptions should be gained on so important a subject.

To give fixity of ideas, let an engine of 160 H.P. be assumed at 240 revolutions per minute, with a fly-wheel equivalent to a rim of 4,000 lbs., at a velocity of 80 feet per second. Then, in each stroke of the engine, there is developed 11,000 foot-pounds of work. The stored energy in the fly-wheel represents 400,000 foot-pounds, of which 3 per cent. approximately represents the regular addition of energy per stroke, and should measure the variation of velocity in one stroke under maximum load variation. The engine would then run about 4½ seconds under full load, and no steam.

The speed variation of an engine under maximum load variation is thus strictly a function of the fly-wheel. The sudden addition of load early in a stroke will at once check the fly-wheel velocity, and bring into action the inertia governor and thereby prolong the steam admission. It would approximate a late steam admission. At worst a load variation can only endure one stroke before it is met by the countervailing action of the governors, and in the above engine this is one-eighth part of a second. The speed variation between full and no load is a function of the internal energy of the governor itself—its general sensitiveness. This is simply determined by natural laws. These laws are well known, they are not the monopoly of any climate, or any maker, or any nationality, though it would appear as though there had been an attempt to corner them to uphold untenable claims. The easiest engines to govern are those of highest rotative speed, and as high rotative speed is more particularly English practice, the claims made elsewhere may well be doubted, unless sustained by physical laws. In the Glasgow engines, so much to the fore at the moment, the rim velocity per second is probably about 75 feet per second at most, referred to the whole wheel. The stored energy is thus barely 20 million foot lbs. At 5,000 H.P., the work per half revolution will be fully 1 million foot lbs., and the ratio to the fly-wheel energy will vary according to the relative positions chosen for the cranks.

Finally, one point more as to the enormous stresses due to traction. The effect of a suddenly applied load of 100 H.P. is at most equal to a steady stress of 200 H.P., and for this the shaft between generator and fly-wheel must be designed. A traction generator has no mechanical or material inertia to overcome when a sudden accession of load is put upon it, and this fact limits the maximum possible stress in the shaft to double the ordinary. Now, all crankshafts are designed in view of the fact that they receive a torsion from the crank which varies in a single crank engine from *nil* to a maximum of considerably above the mean torsion. After all, therefore, the difference of shaft diameter in any engine, before and after the fly-wheel, is not necessarily enormous. Allowing as much as 50 per cent. excess stress, a 24-inch shaft would become 27 inches beyond the fly-wheel, a 12-inch hole being assumed through the whole, or

$$D = \sqrt[3]{[1.5\,(d^3 - d_1^3)] + d_1^3}.$$

The dimensions given for the Glasgow engines are open to severe criticism, as is also the design of the shaft as a tapering structure.

Award.—The Cape Asbestos Company, Limited, has been awarded a gold medal and diploma of merit at the Greater Britain Exhibition, West Australian Section, Earl's Court, for their exhibits in blue asbestos removable coverings for boilers, steam pipes, &c.

THE INSTALLATION OF STEAM BOILERS.

VI.

For many years the furnaces of a Lancashire boiler were probably its weakest part. They were lap riveted both longitudinally and circumferentially, and each ring of the furnace tube was often very far from truly circular. The introduction of the butt joint for the longitudinal seams was a great improvement, but even with this improvement furnace tubes were not strong against collapse. It was found, in course of time, that short tubes were much less liable to collapse than were long tubes. Even the ordinary ring seams were a source of strength. Tubes were then stiffened by the use of rings of ⊥ iron (fig. 15) used as joint rings

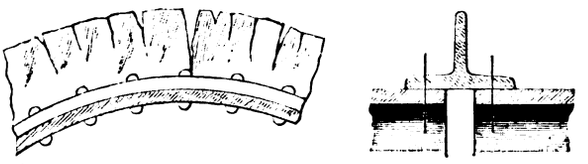

Fig. 15.

between adjacent rings of plate. The fault of the tee iron is that the part riveted to the plates becomes hotter than the web which projects into the water, and, in expanding while the web remains cooler, it causes the web to split. This fault was remedied in the Bowling hoop (fig. 16), which was

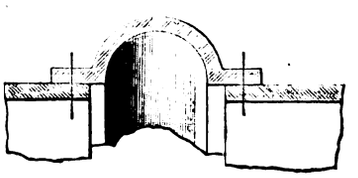

Fig. 16.

also supposed to act after the manner of a concertina and give elasticity endwise. It did not do so, but nevertheless, the Bowling hoop was an improvement, and gave anti-collapsive resistance. In the case of old boilers, it became customary to rivet rings of angle iron round the furnaces for purposes of strength. At first they were closely attached to the plates, but troubles of overheating arose, and rings became split, just as in the case of the T rings of fig. 15. The best system of attaching these stiffening rings is that of fig. 17. The ring was attached by wedges around the

Fig. 17.

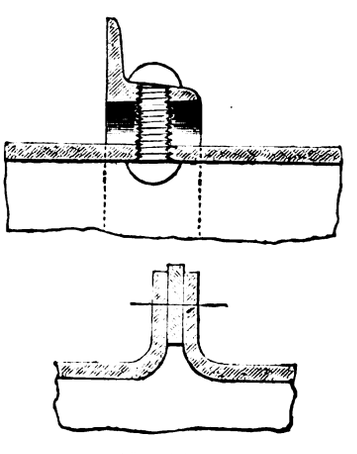

Fig. 18.

furnace tube, and holes were drilled through both ring and plate. These holes were tapped and a screwed bolt was tightly screwed into the two and riveted over on the water side. The whole of the ring was thus of one temperature, the space between the ring and furnace plate being an inch. But nearly all new boilers, 20 years ago, were already con-

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structed with the Adamson flanged seam. In all other seams and rings there are rivet heads exposed in the furnace, edges of plates were also exposed, and in process of time such edges often became split and burned. They began to leak, and required frequent attention and repair. The flanged seam of Adamson, fig. 18, cured all these faults and had little to condemn it, has held its own to the present day, and appears likely to do so, for it seems to give to a furnace tube all necessary strength against the highest pressures, and it is the favourite seam in competition with the corrugated and the ribbed plates of more recent introduction. In the flanged seam there is neither head of rivet nor edge of plate in the furnace, and the flanging together with the flat ring between the flanges gives great rigidity, and also there is some longitudinal elasticity secured, which, however, is very trifling. In the most approved modern construction the rings of tube are first welded up solid and truly circular. They are then heated and flanged, a process which puts to proof the soundness or otherwise of the welding. They are then turned on the edge and face and put together by machine riveting with a turned joint ring. So constructed a furnace tube is a good and true mechanical piece of work. It deviates a mere fraction from strict circularity, and is as strong as any part of a boiler. The rings of plate which come next to the boiler end plates are often made stouter than the remainder, the better to withstand the severer stress which comes upon them at the attachment flange of the end plates. The ring next the back end plate is usually about 6 inches smaller in diameter than the rest of the tube, to which it is joined by a tapering length. In this way the back end plate is permitted to be attached by an inside flange to the shell and still preserve sufficient elasticity. The gusset attachments are also enabled to be sufficient and proportionate, and finally space is left between the two tubes to admit of a man passing between them into the lower part of the boiler. We need scarcely discuss the attachment of cross water pipes in the tubes. These are sometimes flanged and riveted, and sometimes are welded in. In either case recent practice has come more and more into line with our frequent condemnation of these useless encumbrances. Experiment has shown that they do not add to efficiency, and they do not aid circulation either, nor can it well be urged that they add to the strength of a furnace tube, of which the weakest part, namely, the furnace, is the one part, in which not even the advocates of tubes will advise them to be fixed. Further, they tend greatly to cause smoke, and check proper combustion, and they make a boiler very sooty on the one hand, while, on the other, they prevent proper access for the sweep and for the inspector, as well as increasing many times the need for inspection.

These pipes are often specified owing to some lingering belief in their efficacy, but it is difficult to discover how any engineer of experience should continue to prescribe these simply weight-producing impedimenta. Even boiler makers, who profit, we may presume, by the sale of such tubes, have begun to look askance at them, and to shirk putting them in even where originally specified. Our drawing of the boiler end plate shows how the furnace tubes are arranged upon these end plates in relation to the centre lines of the boiler. We have already pointed out that the space left between the connecting rivets of the tubes to the end plates and the lowest rivets of the angle iron attachments of the gusset stays must be 10 inches, a figure that seems to give fair results and one that has been attained by a long series of practical experiments. A suitable diameter for the furnaces of a Lancashire boiler seems to be two-fifths of the shell diameter. This allows fair room for cleaning between shell and furnaces and keeps the flanged seams clear of the shell sides. In order that the flanged seams of the two furnace tubes may not touch, it is arranged that the front end ring of one tube is 6 inches longer than that of the other tube, and conversely at the back end the final rings differ in length by 6 inches. The corresponding seams of the two tubes are thus 6 inches apart throughout. As regards strength against collapse the Board of Trade rule for Adamson flanged seams is

$$\text{Working pressure} = \frac{8{,}800 \times T}{3 \times D} \times \left(5 - \frac{L + 12}{67{\cdot}5 \times T}\right),$$

where T is the thickness in inches, L is the pitch centre to centre of the flanged seams, and D is the external diameter of the furnace. This rule supposes steel of an ultimate tensile strength of 26 to 30 tons. For a 40-inch diameter furnace ½ inch thick and 23 inches pitch the rule gives a working pressure of 132·5 lbs. per square inch. Lloyd's rule is much simpler, the working pressure being $\frac{1{,}000 \times (T - 2)}{D}$, where D is the external diameter in inches, and T is the thickness in sixteenths of an inch.

The furnace just named would show 150 lbs. working pressure by Lloyd's rule. The variety of satisfactory furnaces is so great, including the plain corrugated, Purves' ribbed plates, Morrison's suspension ribs, that a full discussion of the subject would occupy too much space. The different rules may be found in works on boilers or in the abstracts of Board of Trade and Lloyd's rules which are given in Kempe's Year Book. We need not discuss furnaces with plain joints. No modern boiler is now made for good work with anything less strong than the Adamson flanged seam. We may add, however, that the resistance to collapse increases with increase of tensile strength of the steel used, and this fact is something of a temptation to secure strength too dearly. The Leeds Forge Company advise, we believe, that steel for furnaces ought not to exceed 27 tons tenacity, though others have admitted 28 and 30 tons. The Germans who made the Fox furnace, in Germany, stated at one time that no trouble had arisen from 16,000 furnaces made from steel of 23 to 26 tons, but the 500 they had made from steel of high tensile strength had given more trouble than the previous 16,000 furnaces.

Experience generally points to the superiority of milder steel for furnaces. There is practically no cracking or splitting of any kind with this material. We need hardly say that, as with boiler shells, no fittings must be attached by bolts to the furnaces. Practically, the only things to be attached are the small angle iron lugs which carry the fire-bar bearers. These lugs should be attached by two rivets each, and it is an argument in favour of bars made in two lengths, that the weight of the grate and fire can thereby be distributed better than where long bars, supported only at the two ends, are used. In this case, however, the weight can be carried at the back end of the bridge casting, and we think that, with short bars partially carried at the centre, the supporting lugs may with advantage be tied across the furnace to each other by a flat stay to resist any possible spreading pressure due to the weight. So far we have spoken only of plain Lancashire boilers with circular flues throughout. For high pressures we consider the circular flue essential. Any departure from circularity can only be counteracted by the use of water pipes as struts to resist the inevitable collapse which would otherwise occur. Lancashire boilers are, however, sometimes made in which the back ends of the furnace tubes are replaced by numerous small tubes. While in themselves safe, they prevent entrance to the flues through the furnace, and they do not form so reliable a stay between the end plates as do the plain tubes, and they are less to be commended for bituminous fuel than for coke or other smokeless fuel, for which they should be efficient in adding to the heating surface. With these tubes it also becomes necessary to afford a stay or suspension to the furnace tubes from the shell in order to prevent too severe a stress on the ends of the small tubes and probable leakage. Some of the small tubes should also be nutted stay tubes, and the longitudinal bolt stays, usually omitted now from Lancashire boilers, should be retained as a safeguard. Numerous modifications of the Lancashire boiler have from time to time been made and patented, but it is safe to say that very few possess serious merit, many are absolutely dangerous, others are unscientific, and practically all cease to possess such merits as may be apparent at a low pressure when put to the stress of modern high pressures, which demand first either perfection of form or simplicity of staying such forms as are not self-supporting.

Gas.—There was a failure in the gas supply at Helensburgh, near Glasgow, at a busy hour on Saturday night, the place being plunged into darkness owing to water getting into a valve at the gasworks.

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INTERNATIONAL CONGRESS OF TELEGRAPHISTS.

RESULT OF PROFESSIONAL COMPETITION.

THE jury have at length published their report on this competition, and we are able to give the details for the first time in English. For the Hughes apparatus the test was the transmission of 1,000 words in French, Italian, English, and German. The languages were equally divided. In addition, 200 groups of figures, not exceeding six figures to the group, and 100 words taken from a commercial dictionary, were sent. The times, &c., of the first nine competitors were as follows :—

HUGHES.

No.	Competitors.	Time employed in transmission.	Surplus of time resulting from errors.	Total time.	Prize obtained.
		M. S.	M. S.	M. S.	
1.	Grueber, Joseph (Munich)	32 38	Zero.	32 38	First.
2.	Cappanera, Giuseppe (Rome)	33 45	0 15	34 0	Second.
3.	Blein, Francois (Lyons) ...	34 29	0 15	34 44	Third.
4.	Käess, Otto (Munich) ...	34 20	1 0	35 20	Fourth.
5.	Michel, Fritz (Berne) ...	35 19	1 15	36 34	Fifth.
6.	Di Palma, Enrico (Naples)	36 24	0 15	36 39	Sixth.
7.	Ristori, Federico (Rome)...	36 35	0 45	37 20	Hon. mention.
8.	Mantone, Pasquale (Bari)	36 38	0 45	37 23	" "
9.	Geronimi, Luigi E. (Milan)	35 52	2 15	38 7	" "

The Morse test was divided into two parts, viz., transmission and reception. For the receiving test, 650 words were sent by means of a Wheatstone automatic transmitter working with a single current to a Morse receiver so arranged that the reception could be by sound or slip. For the sending test a like number of words were sent by the competitor. For each error not corrected, 20 seconds were added to the total time. The times, &c., of the first nine competitors were as follows :—

MORSE.

No.	Competitors.	Time employed in transmission.	Surplus of time resulting from errors.	Time employed in reception.	Surplus of time resulting from errors.	Total time.	Prize obtained.
		M. S.	M. S.	M. S.	M. S.	M. S	
1	Geronimi, Luigi E. (Milan)	20 10	zero	20 52	1 40	42 42	First.
2	Mantone, Pasquale (Bari)	21 16	0 40	24 5	4 40	50 41	Second.
3	Franchetti, Attilio (Florence)	20 42	zero	24 0	6 0	50 42	Third.
4	Meliarca, Ottavio (Palermo)...	22 47	1 20	25 18	3 20	52 45	Fourth.
5	Job, Ernani (Bellinzona)	21 33	zero	20 55	11 0	53 28	Fifth.
6	Balsamo, Pasquale (Adriatic Railway)	22 27	zero	24 0	9 0	55 27	Sixth.
7	Gentile, Ernesto (Cap. Engineers)	23 55	0 20	22 45	9 20	56 20	Hon. mention.
8	Vetrano, Guiseppe (Messina)	27 33	4 20	21 27	3 20	56 40	"
9	Perego, Arturo (Mediterranean Railway)	23 21	0 20	24 25	10 0	58 6	"

The prizes were in two series of equal value, one series for either system. The following is a list of the series :—

1. A gold medal given by the Minister of Posts and Telegraphs, an artistic object given by the Organising Committee, and a diploma.
2. A silver medal given by the Minister of Posts and Telegraphs, an *objet d'art* given by the Organising Committee, and a diploma.
3. A silver medal given by the Minister of Posts and Telegraphs of Italy, an *objet d'art* given by the Organising Committee, and a diploma.
4. A silver gilt medal given by the Committee of Organisation, and a diploma.
5. A bronze medal given by the Organising Committee, and a diploma.
6. A bronze medal, and a diploma.
7, 8, and 9. Honourable mentions.

SOME NOTES ON THE ELECTRICAL MACHINERY AT THE COMO EXHIBITION.

BY KENELM EDGCUMBE, Assoc.M.INST.C.E.

(*Concluded from page* 310.)

COMING now to the electrolytic apparatus itself, the latest type is shown in fig. 12. As will be seen, each of the two gases is collected in a separate chamber. Fig. 13 shows a

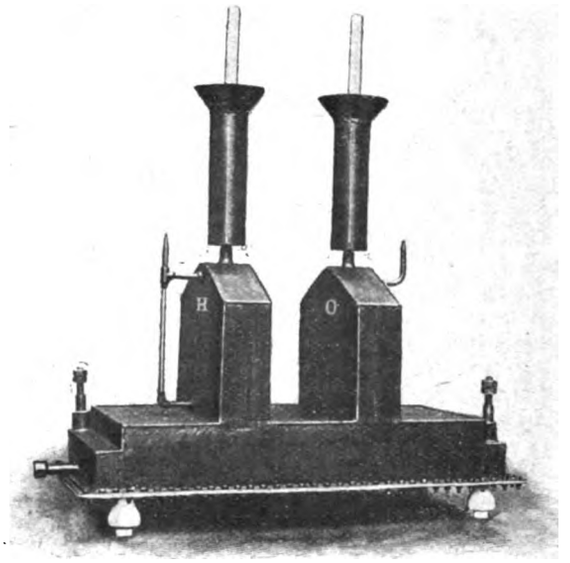

FIG. 12.

section through one of these, though of a slightly modified type. The electrodes consist of plates of sheet-iron, the anodes and cathodes alternating with one another and being connected in parallel. The distance from one plate to the next ranges from 10 to 12 mm. As will be seen from fig. 13, each electrode is in a separate compartment, also formed of sheet-iron, and perforated with 1 mm. holes to allow of the free passage of the electrolyte. These partitions are shown at E. All the compartments containing anodes communicate with the reservoir, G, by means of the small holes, F. From here the oxygen is led off through a tube (the junction being water sealed) to the gasometer. The hydrogen is in the same way led from the cathode compartments to its gasometer. *b* shows the positive terminal, the current entering the chamber at B. As will be seen, the whole apparatus rests on wooden blocks in the vessel, A, and in this respect differs from that shown in fig. 12, which is entirely self-contained. The chief feature about this apparatus is the use of metallic diaphragms. The advantages gained are, firstly, longer life, and secondly, greatly reduced resistance, owing to the large holes employed. The diaphragms, of course, do not form part of the electric circuit, as, in order to do so, they would require an additional voltage equal to that necessary for the electrolysis of water. In spite of

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the large holes which are employed in the diaphragms, the separation of the gases is found to be very perfect, the hydrogen containing about 1 per cent. of oxygen, and the oxygen from 2 to 3 per cent. of hydrogen. The electrolyte employed is a solution of caustic soda of 25° Beaumé. The voltage required in all cases is only 2·2 at 77° F., or 1·8 volts at 165° F. The apparatus shown in fig. 12 takes 400 amperes at a current density of ·13 ampere per square inch. The total weight is 200 lbs., and the output per 24 hours amounts

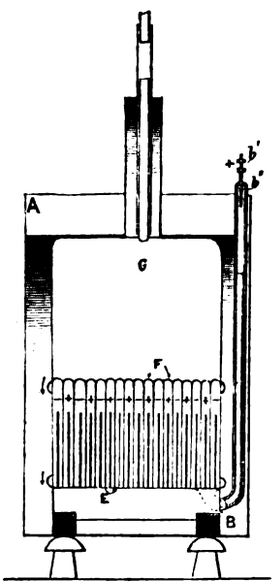

Fig. 13.

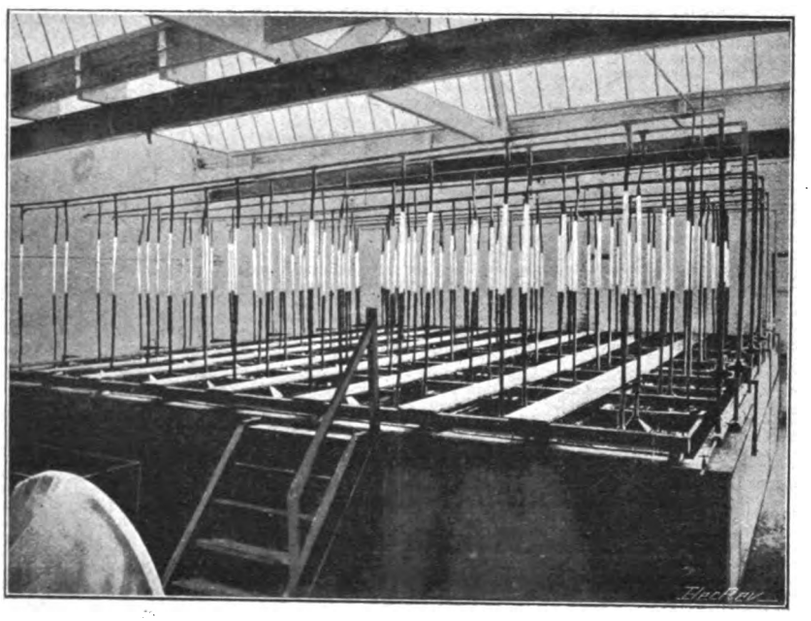

Fig. 14.

to 59 cubic feet of oxygen, and 118 cubic feet of hydrogen. The energy required is thus 400 × 2·2 × 24 = 21·12 units, or ·358 unit per cubic foot of oxygen.

Fig. 14 shows a large plant belonging to the Soc. Anon. Oxhydrique, of Brussels. This company retails the compressed gases at the following prices:—Oxygen, 8 francs per cubic metre, and hydrogen at 3 francs per cubic metre. In Italy, also, the War Department have lately laid down an electrolytic plant for the production of hydrogen for filling military balloons.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

16,461. "Improvements in or connected with overhead collectors for electric railway vehicles." H. H. Hall and R. J. Urquhart. Dated August 14th.

16,492. "Improvements in or relating to apparatus for the suspension of wire cables and the like." E. Bennett. Dated August 14th.

16,494. "Improvements in or relating to automatic cut-off devices principally designed for controlling the flow of fluids and electric currents." H. L. Groome. Dated August 14th. (Complete.)

16,548. "Improvements in rails for electric trams, railways, and for other similar suitable purposes." W. Buck, T. L. Patchett, and B. W. Shaw. Dated August 15th.

16,555. "Improvements in the reduction of aluminium by electrolysis." F. A. Gooch. Dated August 15th. (Complete.)

16,569. "Improvements in accumulator electrodes." R. A. Katz. Dated August 15th.

16,584. "An electric light or lamp." H. L. Arnold and J. W. Graydon. Dated August 15th.

16,600. "Improvements in the manufacture of earthenware troughs for carrying electric cables and analogous purposes." G. H. Nisbett. Dated August 16th.

16,627. "Improvements in electric arc lamps." J. Lesthevenon. Dated August 16th. (Complete.)

16,628. "Improvements in arc lamps." J. D. F. Andrews. Dated August 16th.

16,629. "Improvements in electric signs or signals." J. D. F. Andrews. Dated August 16th.

16,636. "Improvements in electrical accumulator batteries." Dated August 16th. (Complete.)

16,648. "Improvements in holders for the shades of incandescent electric lamps." R. J. Liebisch. Dated August 16th.

16,650. "Improvements in conduits suitable for electric mains." S. Petersen. Dated August 16th.

16,690. "A new or improved composition for use as an electrolyte in batteries or cells." J. Byrant. Dated August 17th.

16,739. "Improved contact system for electrical railways." W. Grunow, jun. Dated August 17th (Complete.)

16,743. "Improvements in holders for incandescent electric lamps and shades." R. J. Liebisch. Dated August 17th.

16,749. "Improvements in incandescent electric lamps." J. R. Schauer. Dated August 17th.

16,796. "Improvements in or relating to conduits for underground electric cables, telephone, or telegraph wires, or for conveying fluids." G. H. Cullen. Dated August 18th.

16,830. "Electrically-controlled design reading apparatus." B. J. B. Mills. (L. David and T. David, France.) Dated August 18th.

16,824. "Improvements in apparatus for electro-chemical and electro-thermic melting operations especially for the production of calcium carbide." E. Grauer. Dated August 18th.

16,835. "Electric loopup." G. Tarry. Dated August 19th.

16,854. "Improvements in connection fittings for various electrical purposes." R. F. Hall. Dated August 19th.

16,859. "Safety guard for trolley rope on electric trams or other motors." J. Costigan. Dated August 19th.

16,878. "Telephonic apparatus for transmitting and receiving messages simultaneously to and from several distant stations." Siemens, Bros. & Co., Limited. (Siemens & Halske, Actien Gesellschaft, Germany.) Dated August 19th. (Complete.)

16,879. "Method for dividing an alternating current into two currents whose phases are shifted relatively to each other through a determined angle." Siemens Bros. & Co., Limited (Siemens & Halske, Actien Gesellschaft, Germany.) Dated August 19th. (Complete.)

16,889. "Improvements in electrical transformers." A. F. Berry. Dated August 19th.

16,898. "Improvements in pneumatic controlling mechanism for electric railway cars." S. H. Short. Dated August 19th. (Complete.)

ELECTRICAL PATENTS OF 1885 EXPIRING IN SEPTEMBER, 1899.

We are informed by W. P. Thompson & Co., that about 60 applications for electrical patents were filed in September, 1885, of these some were never completed, and of those that were only one has been maintained to run its full term, viz., 14 years, and being of considerable interest we give a short abstract of it below:—

10,451. "Improvements in the manufacture of metal pans, cylinders, boilers, containers, or receptacles." F. E. Elmore. Dated September 3rd, 1885. Boiling pans, pans, cylinders, hollow-ware, &c., are produced by the electro-deposition of a metal, generally copper, upon suitable moulds, as described in specifications Nos. 1,737, 4,499, and 8,707, A.D. 1885. The mould is prepared by coating it first with a film of adhesive and then a film of non-adhesive copper; it is then mounted on the shaft and immersed in the bath. The mould is then connected with the negative pole of a dynamo or other source of electricity, the positive pole being connected to strips of copper, or of carbon, lead, or other insoluble substance; the strips follow the form of the mould as nearly as possible, and are all placed at the same direction from the shaft. The shaft is rotated during the deposition by toothed or belt gearing, the surface of the metal being at the same time acted upon by a burnisher. 2 claims.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

15,169. "A method of measuring electrical power and appliances for that purpose." M. S. Field. Dated June 24th, 1897. Relates to energy meters and electro-meters. Power supplied by an alternating current to any circuit is

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measured by the reading of two instruments indicating $(1\ c\ v)^2$, and $(c\ v)^2$ respectively, where c and v are simultaneous, instantaneous values of the current and pressure. In a modification, the second instrument indicates $(v\ c)^2$; in three other modifications the instruments indicate v^2, c^2, and either $(c\ v)^2$ $(c\ v)^2$ or $(v\ c)^2$ from differences of which the power v c may be obtained. A single differential instrument may be used, indicating power directly. The supply mains are connected by the primary of a transformer, and one main continues a low fixed resistance. The transformer has two equal low-pressure secondaries connected through the two circuits of a differential current meter to the ends of the resistance. For the first modified method, the resistance is in two equal halves and the transformer has a single secondary, or is replaced by a single coil, a part of which serves as a secondary. With a single resistance, secondary, and instrument a switch may be used to reverse connections so that the two quantities may be observed successively. With two instruments a switch may be used to change the connections so that they indicate current and pressure separately; from these and the power readings the apparent power supplied, and phase difference may be obtained. Power supplied in any three-wire system is obtained by making separate measurements between each outside main and the third one, or a single instrument may be used. The instruments are preferably hot-wire or electrostatic. The movable part is connected to the central main, and carries plates within two pairs of fixed cells, which are connected separately to the terminals of fixed resistances in the outer mains. Such an instrument may be used on a two-wire system. A differential instrument may be made with two hot wires or other devices acting oppositely through two pulleys and cords on one indicator. Two distinct instruments may be mounted in one case, with pointers indicating on one scale. To fix the pointers while their positions are observed, two strips of peper are pressed against them by shafts which are cranked and connected by a link to a handle.

15,237. "Improvements in electrical switch apparatus for the points and crossings of electrical railways or tramways with underground conductors." Siemens Bros. & Co., Limited. (Siemens & Halske.) Dated June 25th, 1897. Relates to switches for the rails and conductors of electric railways and tramways on the conduit system. Conductors, permanent way. The point of the rail is pivoted, and the point of the conductor is pivoted so that it has a greater angular throw as the two are connected so as to move simultaneously by the insulating piece. The end of the conductor point is insulated by a part, and short lengths of the conductors alongside are also insulated, the lengths of the portions being greater than a part, so that any sparking may occur at the part rather than at the point of the conductor. The electric connections on a cross-over road cause a change of polarity as the car passes over the points. 3 claims.

15,169. "Improvements in arc lamps." P. Duffee. Dated June 24th, 1897. Relates to arc lamps.—A ratchet escapement lamp is constructed. The upper carbon of which is carried by an insulated holder on a frame which slides in tubes and may be provided with anti-friction rollers. Connection with it is effected by a flexible conductor. The lighter, lower carbon holder is attached to a rod, within the tube, and connected through the frame. The holders are hung by a chain or cord from a pulley attached to a toothed wheel, and supported in fixed bearings. A frame, movable about the same axis, carries a pinion in gear with the wheel and attached to a ratchet wheel with deep teeth. This is normally held in engagement with a stop by a link connecting the frame with a weighted or spring actuated lever. A curved iron plate forming part of the lever enters a shunt solenoid which turns the frame and the wheel when the ratchet is in engagement with the stop and the terminal difference of potentials sufficient, thus bringing the carbons together until the ratchet leaves the stop. The ratchet may be attached to a heavy fly-wheel to check its rotation when released. 2 claims.

15,329. "Improvements in apparatus for operating two or more electric current switches simultaneously or periodically." C. D. Lucas. Dated June 26th, 1897. Relates to operating mechanism for resistance and other electric switches when employed for making and breaking signal or other electric currents in predetermined order, such as those applied to illuminated signs and other signalling and switching devices. A section of the apparatus is shown in which a row of switches is provided with levers. Each lever is provided with a guide swell, an oblique recess and a groove in the end. The levers are operated to close or open the switches by the motion of the levers, which are connected by a link and have controlling springs. The levers have operating studs or rods for engaging with the levers. A selecting device, consisting of a slotted rotating disc is operated by a ratchet mechanism or hand lever. Lifting rods are provided with projections which pass through or are depressed by the disc. The other ends of the lever allow the levers to be in their operative position or to be raised to the inoperative position. The mechanism may be operated by a motor or by hand, and indicators may be employed with the switches. 4 claims.

15,399. "Improvements in or relating to carbons for electric welding, brazing, and the like purposes." G. W. de Tunzelmann. Dated June 28th, 1897. A metallic oxide or oxides, such as the oxides of iron, copper, lead, or manganese, are incorporated or mixed with the carbon to form the electrodes or carbons for use for electric welding, brazing, and like purposes. The object is to reduce the excess of free carbon in the arc, and also to produce an arc in which the heat is more equally diffused owing to the presence of a metallic vapour. 1 claim.

15,411. "Improved electric igniter for gas engines." R. Bosch. Dated June 28th, 1897. Relates to a dynamo for generating an electric current for igniting in gas engines. The armature is stationary, and its insulated terminal can be rigidly attached to the conducting-wire or to a terminal on the framing. Magnets with or without sole-plates embrace the armature, and between them soft-iron strips are mounted and oscillate being attached to the end discs on the shaft. 2 claims.

15,419. "Improvements in or connected with electrical distribution fuseboards." Veritys, Limited, and M. B. Cotterell. Dated June 29th, 1897. A main lead is connected to several screw terminals so that the fuses are in each branch. Each fuse is held by means of C springs and clamping nuts. Projections and recesses may be employed on the springs and nuts to produce a locking action. The fuses are supported on porcelain troughs separated by glass washers, and carried by rods threaded through holes in the blocks and washers. The rods are coned at one end, and have extra locking-nuts to hold the bars rigidly in place across the iron case. 5 claims.

15,472. "Improvements in electric furnaces and processes of treating ores." G. B. Burton. Dated June 29th, 1897. Electric furnaces.—Ores are dried, roasted, and smelted in furnaces in which the heat is produced by passage of electric current either through a metal or other conducting coil, or a carbon rod, covered by the ore, or through a body of ore placed between two electrodes. Reducing agents may be mixed with the ore. The furnace may also be used for making calcium carbide. Alternating current is preferably used, and is regulated to increase the heat in successive stages of the treatment. In the furnace a glazed fireclay body contains a perforated hollow helix on a pipe which is rotatable by gearing to stir the ore. A coil of pipe may replace the pipe and helix. The pipe, &c., may be made of a copper-antimony alloy. Electric current is passed through the pipe and helix by terminals and clamps. Air may be introduced through the pipe by a lower valve, and gases are delivered through an upper valve, or through a valve and a tube made in sections. This contains baffles to stop articles deposited by the gas, and may be provided with magnets to stop magnetic particles; it ends in liquid in a tank. Liquid products are discharged at a tapping hole in the base, which rests on radially removable supports. When the current is to be passed through the ore itself, the tube is divided, each part carrying a perforated disc electrode in place of the helix, the upper part of the tube, with its electrode, is vertically adjustable. 25 claims.

15,486. "Improvements in apparatus or means for charging accumulators." H. S. Cox. (The Cox Thermo-Electric Company.) Dated June 29th, 1897. In order to charge accumulators from a generator of low voltage, the cells are arranged singly or in groups which are successively charged. The cells are arranged in groups which are connected by conductors alternately to contacts insulated from one another but cross-connected by conductors. Rubbing on these contacts are bushes mounted on the rotary shaft. Current is supplied to the bushes from the generator. The shaft is rotated by clockwork or other mechanism; each group of cells is thus charged for a certain time. The pairs of contacts may be arranged otherwise than in a ring, the bushes being successively moved over them. 5 claims.

15,490. "Improvements in electric heaters." G. B. Fraley. Dated June 29th, 1897. Current is passed through a series of carbon blocks, or a continuous carbonised conductor, enclosed by firebrick blocks. In the stove described, a hollow firebrick block in a casing has channels of U-form in its sloping front, containing balls or other blocks of carbon; the channels are open to some extent, before and behind the balls. The channels terminate in metal tubes which contain weights to press the balls together, and are connected with electric supply conductors. Both light and heat are produced by this apparatus, some combustion taking place; the ashes fall inside the block. When the weights have fallen so that pins on them rest on the bottom of slots in the tubes, more conducting blocks are introduced, after removing covers and the weights. The casing front is closed by doors containing mica sheets. Carbonised paper or like conductor is enclosed in grooves between blocks, and connected to terminals; the blocks are bolted together. Metal sheet conductors may be enclosed similarly between blocks, near the face of these, and are provided with rearward extensions to hold them in place. Or conductors may be formed by painting mixtures of powdered carbon and saccharine material into grooves in the blocks. Such apparatus is applicable for broiling or cooking. 17 claims.

15,491. "Improvements in electric heating apparatus." G. B. Fraley. Dated June 29th, 1897. Current is passed through a resisting wire coiled on asbestos or other non-conductor surrounding a mica-covered cylindrical core. The wire is also covered with a thick layer of a mixture of talc, silicate of soda, and carbonate of soda or other insulating material not shown. The core may be of copper slit longitudinally and perforated to pass a limited air current. Reflectors or baffles are fixed within or near its ends. The core is supported by a cap adapted to screw into a metal sleeve in a porcelain or other holder. The upper end of the wire is connected electrically to the core, cap, the sleeve, and a terminal; the lower end is connected to a central screw on a porcelain disc, this making contact with a plate and second terminal in the holder. For alternating currents the core is provided with slits extending partly along it from opposite ends alternately, so that the heating currents may be induced in it, or the core may be a conducting plate rolled up into several layers with intervening insulation, the inner and outer ends of the plate being connected electrically by rivets. In this form the core is carried in clamps near its ends. One clamp is insulated, and the ends of the wire are connected with the clamps. Additional layers of wire may be used, separated by asbestos. 15 claims.

15,503. "Improvements in electric arc lamps." O. Imray. (The Pennsylvania Salt Manufacturing Company.) Dated June 29th, 1897. Relates to a clutch-lamp provided with improved feeding mechanism. The upper carbon carrier passes between V-shaped jaws carried by levers which are pivoted on a disc, and are supported by links on the core of a solenoid. When the core falls sufficiently the disc rests on stops, and the jaws release the rod. The upper carbon passes through a lid having a flange resting on the inner globe, the dimensions being such as to permit some lateral play of the cover with the carbon. The inner globe may be held by a ring bearing on a shoulder in it, and screwing on a screw surrounding the lower carbon-holder. This is attached to the frame of the lamp by insulated screws; the carbon is held by a pivoted shutter and clamping-screw. The outer globe is secured in a cup which is supported by a nut and bolt on a part of the frame. The bolt has a cross-head which may be turned and lowered through slots in the part when the outer globe is to be lowered. When in place the nut serves to raise the outer globe into contact with a cover on the lamp frame. A pin and collar limit the motion of the bolt and nut. 6 claims.

15,510. "Improvements in secondary or storage batteries or accumulators and in the manufacture of the same." J. P. Clare, G. E. Hatch, and J. H. Taylor. Dated June 29th, 1897. In making the electrodes, active material is first formed on the metal plate itself by electrolytic action, and then active material or material to be rendered active, in a granular or pulverulent condition, is packed round the plate, and the electrolytic action is continued until the two masses are firmly united together. The plates and the active material are contained in a casing formed of large porous terra-cotta plates made up of separate sections fitted together and having recesses, pits, grooves, or cells, on their inner surfaces to hold the active material, and grooves near their edges for the insertion of thick rubber to make a water-tight joint. The terra-cotta sections are made of different sizes, so that when built up into plates, the horizontal joints in one plate are not opposite those in adjacent plates. The terra-cotta plates have ribs on their outer surfaces, and those in adjacent plates are preferably at right angles to each other. A number of elements so prepared are held between plates of hard rubber by rubber bands. 6 claims.

15,607. "A method of effecting multiplex telegraphic and telephonic communication, and apparatus for that purpose." J. Imray. (La Societe Anonyme pour la Transmission de la Force par l'Electricite.) Dated June 30th, 1897. Relates to a system of multiplex telephony and telegraphy, in which two lines connecting two central stations are provided with synchronously driven distributors, and the various subscribers are connected to single or grouped sectors on the distributors. When telephony and telegraphy are carried on simultaneously, two sets of distributors are employed, the telephone signals being sent on the metallic circuit, and the telegraph signals being sent on the metallic circuit as the line with an earth return. The signals are kept separate by resonators and condensers. The distributors are driven by motors or clockwork, separate sectors being employed for sending the synchronising currents; or the metallic circuit may be used with an earth return, in multiplex telephony, for the motor synchronising circuits, double primaries of transformers being connected in each of the leads. In this case the secondaries are in loops at each end with the distributors and the subscribers. Several arrangements of these circuits are described; in one of them the main line alternating current bell call circuit is arranged as a shunt to the motor circuit. In another form the double wound armature of a continuous current generator for the telephone currents is arranged with one winding in each of the metallic lines. The armatures of the distributor motors are preferably screened with copper end discs and connecting bolts. A telephone relay is described, in which the coil is enclosed in a magnetic shell, the armature carrying a microphone in circuit with a local battery and receiver. 4 claims.

15,560. "Improvements in electrical switches." J. W. Swan. Dated June 30th, 1897. In order to prevent arcing, an insulating wall is arranged between the terminals. Walls or projections are fitted on the base, and separate the terminals. The circuit is completed between the terminals by the bridge, to which a quick break is given by the spring, the handle being formed to give the required play. In a modified form, the wall is circular, one fixed terminal being within and the other without. The bridge is formed with one arm shorter than the other. 2 claims.

1898.

468. "Improvements relating to enclosed motors or dynamos." P. Rosling and H. W. Appleby. Dated January 7th, 1898. A dynamo armature shaft is mounted between the armature and case enclosing the dynamo and the vanes of a fan by which air is drawn into the enclosed casing from the outside atmosphere through a suitable opening which may be provided with a filter of cotton wool applied in a manner so as to extract from the air any moisture, grit, &c., that might be detrimental to the commutator, &c. 1 claim.

532. "Improvements connected with electric lamps and switches." W. M. Walters. Dated January 10th, 1898. The object of the inventions is to provide appliances whereby the illuminations in a room may be regulated. For this purpose a small incandescent lamp is carried in the box provided with the usual contact pieces. The switch lever is so arranged that when the main lamp or lamps is or are switched off the small lamp is switched into the circuit in place of the main lamp. 2 claims.

3,539. "Improvements in and relating to electric heaters." E. F. Porter. Dated April 12th, 1898. Relates to electric heaters, especially to the kind described in specification No. 5,595 of 1891. Consists in making the fan blades themselves of a material which will act as a resistance, and passing the current through conductors on the blades. 9 claims.

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THE

ELECTRICAL REVIEW.

VOL. XLV. SEPTEMBER 8, 1899. No. 1,137.

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1899

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THE DISTRIBUTION OF ELECTRICITY AND HOME INDUSTRIES.

IT was once remarked by a very eminent man in this country that the distribution of electricity might prevent, to some extent, the aggregation of workpeople which we witness to-day in the great factories and workshops. Although it might appear an ideal state of existence to go back to the time when the weaving and kindred industries were carried out in the homes of the people, there is little doubt that the question of production might be very seriously influenced. There is a good deal of work which is capable of being carried on in the homes of the people, and if a power of any description, that was easily regulated and controlled, were available, it could hardly be doubted that there might be considerable extension of home work. Undoubtedly, small industries have been affected by the introduction of electric power, and an investigation into the uses of electricity in many of our large towns, even with the limited work that is being done, would be distinctly interesting. We are looking forward to the day when the complete schemes of the great power companies will enable electricity for power purposes to be obtained in places that are removed from the great industrial centres, but which, nevertheless, carry on small home industries. In these days, when the attention of most people has been directed to the distribution of large powers over long distances, it is not surprising that most interesting examples of transmitting electricity over small areas have escaped attention. One of the most interesting examples of power transmission is one in the district of Saint Etienne, where a most material effect has been produced upon an industry that has been for the most part carried on by the workpeople in their own homes. The ribbon industry of the district of Saint Etienne is one of the most ancient in France, and it will afford some idea of the importance of the industry when it is mentioned that in the district surrounding Saint Etienne there are probably 30,000 looms, there being 15,000 in Saint Etienne alone. Before the introduction of electricity, these looms were chiefly driven by hand, the weavers employing occasionally skilled assistants, or, in many cases, using the skill of members of their families. Some years ago an interprising electric company founded electricity works in the district, which were originally situated at Saint Victor sur Loire, some eight or nine miles from Saint Etienne. The original plant consisted of three turbines of 300 H.P. each, a stand-by being provided in the shape of two 300-H.P. engines, which were utilised in the event of a water-power failure. Some time after this company started operations it was incorporated with a rival concern, and at the present moment the company is supplying power over a district of some 24 miles in extent, power being chiefly employed for the purposes of driving weavers' looms. The system of generating and distribution is the three-phase, and current is conveyed throughout the district by 68 miles of wire. Spread over the district are 30 sub-stations, in which transformers are placed to reduce the voltage of the current, which is delivered at 5,200 volts, to a pressure of 190 volts for motive power and 110 volts for

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lighting purposes. The total power of the plant employed by the company at the various generating stations amounts to 2,000 H.P. Throughout the district there are 8,000 lamps in use, and 2,500 looms are now being operated by means of electric motors. On an average a ribbon loom requires ¼ H.P., and the charge to each consumer for the power necessary to drive a loom is £4 1s. 6d. per annum, or 8s. per month. From all accounts it is apparent that the ribbon industry has been materially affected by the introduction of electric power, and the output of individual looms has been greatly increased since the introduction of the electricity works.

MOSAICS.

Sir William Preece, as President of Congress of the Sanitary Institute, last week delivered an address at Southampton to upwards of 1,700 delegates, on the advantages of pure air, pure water, pure food, pure dwellings, and pure bodies. Following the precedent of another President, he made frequent use of Biblical allusions; the address was, in fact, an appreciation of the skill of Moses as a sanitary engineer. Moses, according to Sir William Preece, was the greatest sanitary engineer the world has known, for in the regulation of the food supply of the Israelites was displayed, in the opinion of Sir William, that profound knowledge of the hygienic requirements of Eastern nations which has determined the healthy and cleanly lives of the Jews at the present day. To Sir William, the book of Leviticus is a treatise on hygiene, and the Jews the cleanest race on earth. The pity is that they don't all look it.

It must be confessed that there are many reasons for objecting to Biblical allusions when they form the basis of a presidential address to a non-religious society like the Sanitary Institute. Unless very carefully handled, such allusions may easily be misunderstood; they are nearly always in questionable taste, and they are nearly always fallacious. The fallacy of upholding Moses as the founder of cleanliness, is obvious; for the grown-up daughter of Pharoah was taking her customary morning bath before Moses was out of his little bulrushes. Indeed, it was on her way to the bathing machines that she discovered the baby; a proof that not only bathing, but "mixed bathing," was common in the earliest dynasties of the Egyptians. Later on in life, it must be admitted, Moses showed some proclivities towards hydrostatics, and evinced some marvellous knowledge in matters of commissariat. Unfortunately it is futile for a modern sanitary engineer to follow the methods of the great Levite, for he was favoured in his foraging by phenomena peculiar to the exigencies as they appeared—phenomena which in the World's history are never likely to recur. The modern engineer is, so to speak, not to the manna born.

There is comfort in the thought that, of all the Institutes, one is sanitary; but to the casual observer it must seem something of a mystery that this one Institute should choose its president from the ranks of electrical engineering. It is really wonderful to contemplate how much the world appreciates the intelligence of the modern electrician. Search the universe up and down, from Glasgow to Cape Town, from New York to Southampton, and you will find that where experts, diplomatists, presidents, and company-promoters are wanted, the electrician is always there. It is not too much to say that if the General Staff of France became disrespected to-morrow, if Kruger ceased from Krugering, if the Czar abdicated and went to Paris, a telegram addressed to the Electrical Engineers would ensure that every gap in the political fence should be filled, and that the world should still go on, talking.

In the case of the Sanitary Institute, however, it must be admitted that they showed a good deal of wisdom in going far afield for fresh ideas. It is a question of healthy homes, healthy workshops, healthy workhouses, healthy churches, healthy prisons, healthy post-offices; and it is improbable that any one man should have experience of all of these at once. As an electrician, Sir William Preece was able to call attention to the advantages of electrical methods of ventilation and illumination, and he did well to emphasise the merits of dust-destructors. We may smile at his wanderings in the wilderness of Shur, but there is no doubt he imparted some freshness to the bitter waters of the usually dull proceedings; and in addition he gave the Sanitary Congress some good practical advice in directing their attention to the housing of the poor.

THE DIFFERENCES OF EXPERTS.

The Newcastle Corporation, which has been for something over two years violently agitated on the subject of overhead tramways, and its Tramways Committee has arrived at last at a sensible decision. The main question before the Council for some time past has been whether it was advisable to adopt a overhead or a conduit system in the central streets; but on the advice of one of its experts, it has decided to equip the central portion of the town temporarily with overhead wires. The Committee has arrived at this decision in a somewhat curious manner. It has had abundant expert testimony on the subject. Prof. Kennedy was commissioned to provide a report, Mr. Charles Hopkinson was asked to give an opinion, and Mr. Laws, the borough engineer, was likewise requested to give his opinion. In a multitude of counsellors there is wisdom, but there is also considerable difference of opinion. Prof. Kennedy, in his report, follows fairly closely the views which he put forward in his report to the London County Council. He points out that there is no difficulty in obtaining successful results from a combined system of overhead and conduit, and he takes a favourable view of the surface contact system, and declares that it would not cost more per mile than a really well-arranged overhead system. On this point we imagine there will be considerable divergence of views. Apart from the question of whether it is possible at the present moment to obtain a surface contact system which may be expected to meet the very trying conditions of street life, it is doubtful whether a contact system could be equipped for anything like the sum that is necessary to put up the best overhead system in existence. From an intimate knowledge of all the contact systems which have been brought to the notice of tramway authorities, we do not think that any municipality would be justified in spending a single penny on them. Clearly and emphatically, we state that such systems have not gone beyond the experimental stage, and if a municipality adopts surface contacts, it ought clearly to recognise that it is doing nothing else but carrying out what might prove to be very expensive experiments. The advice of Mr. Charles Hopkinson to the Newcastle Corporation is entirely contrary to, and probably more precise than, that of Prof. Kennedy. He states, on the subject of contact systems, that "The greatest working difficulties would arise after a period of use." He truly points out that the system had not been in commercial use for a long enough time to demonstrate that the possibilities of breakdown were overcome; and where such systems were in use the climatic conditions were less severe than in Newcastle. It is quite possible that a surface contact system may be evolved in the next year or two which will justify its adoption, but at the present moment we should counsel hesitation on the part of the municipality to adopt what at the best must be an expensive system. It is satisfactory to find that Mr. Charles Hopkinson's advice to erect the overhead trolley system in the central portion of the town has been accepted; at the same time we should just like to point out that the difficulties of a municipality when considering electric tramway matters are very materially added to if they seek too much advice. In this particular case both Prof. Kennedy's and Mr. Hopkinson's reports were submitted to Mr. Laws, the city engineer, and the consequence is that he agrees with neither. Indeed, Mr. Laws goes so far as to state that the best plan will be to put down a surface contact system at once in the central streets. With such marked differences of opinion before it, it is satisfactory to find that the Newcastle Committee can arrive at what must be held to be a reasonable decision.

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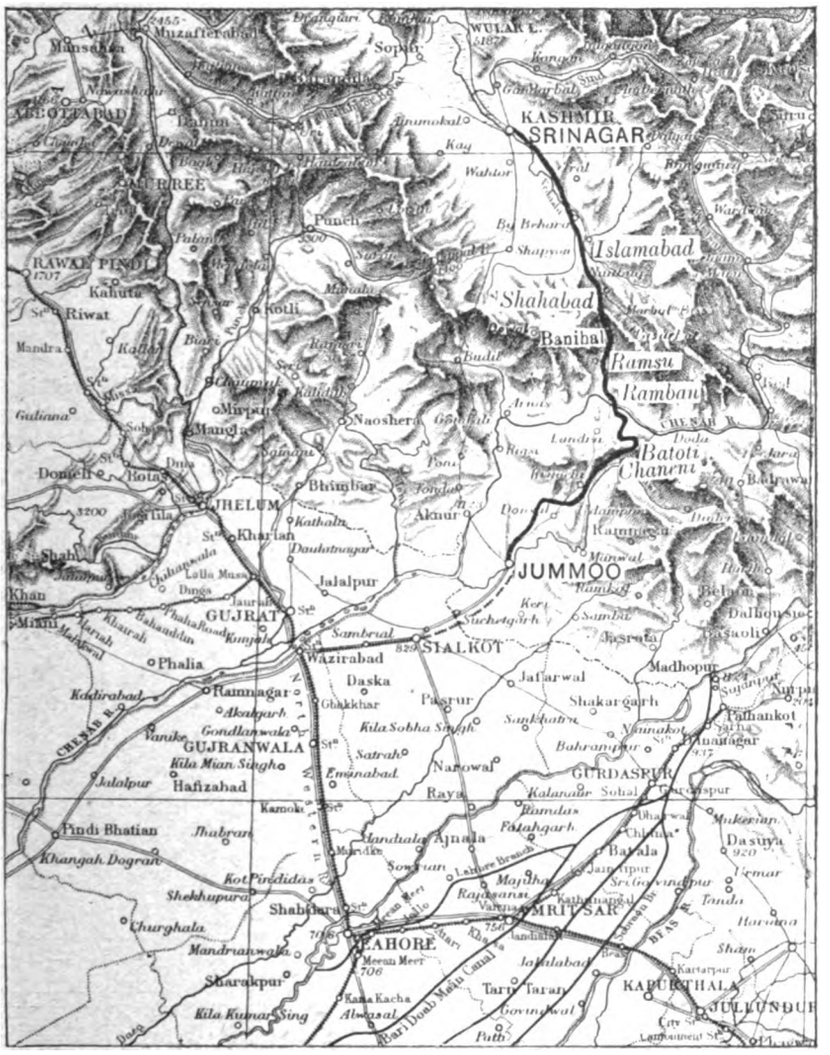
KASHMIR ELECTRIC RAILWAY SCHEME.

Speaking politically, the area covered by the title Kashmir extends to about 300 miles east of Rawal Pindi, and to about the same distance north of Lahore, the western and southern frontiers being distant from these places about 30 and 70 miles respectively. What, however, is historically and geographically known as Kashmir is a valley some 70 miles by 20, having a general level of 5,000 feet above the sea, lying north-west and south-east, and surrounded on all sides by mountains, some of which attain an altitude of 16,000 and 17,000 feet.

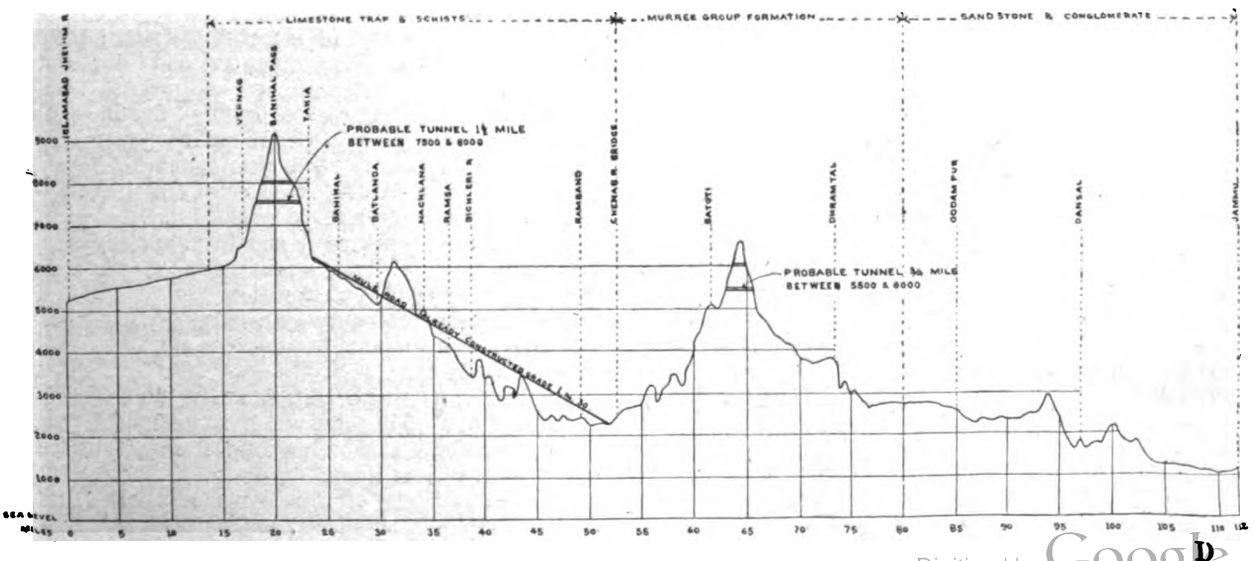


The Valley of Kashmir is watered by the Jhelum, which, rising in the south-east, flows into the extensive Wular Lake, and then making an abrupt turn to the west, flows down into the plains of India through a series of gorges. The capital, Srinagar (pronounced Shrinugger), is situated on the Jhelum, almost in the centre of the valley.

Srinagar is accessible from the south by the gorges of the Jhelum, and by a limited number of passes which cross the main mass of the Himalaya mountains. A cart road has been constructed along the Jhelum route, the distance between Srinagar and Rawal Pindi being 198 miles. Before this road was made available for wheeled traffic, the bulk of communication was carried on across the Pir Panjal and the Banihal Passes, the former being 11,400 feet, and the latter 9,700 feet at summit.

Notwithstanding the formidable natural obstacles in the way of railway communication between the Valley of Kashmir and the outer world, various projects have from time to time been brought forward with this end in view. In 1886 General de Bourbel directed an investigation into the possibilities of establishing a railway, the routes considered being (1) from Rawal Pindi, on the North-Western Railway, up the Jhelum Valley, *viâ* Abbottabad, with an alternative route starting from Mandra, 20 miles lower down the line; (2) *viâ* the Pir Panjal Pass, and (3) *viâ* the Banihal Pass. In 1890 the Jhelum Valley route was surveyed, and estimates prepared, but the cost was considered to be too great, and the scheme was abandoned. At the same time General de Bourbel reported in favour of the Banihal route. The matter was, however, not considered again seriously until recently, when Mr. M. Nethersole, State engineer to the Kashmir Durbar, brought forward a proposition for working the line by electricity, with proposals as to the route to be adopted differing considerably from those hitherto suggested. The Indian Government has considered Mr. Nethersole's report, and has given formal sanction for the commencement of the necessary survey.

The accompanying map indicates the general alignment of the proposed railway, and the section is that along the existing mule track. The line, which will probably be of 2 feet 6 inches gauge, starts from Jummu, the second capital town of the State, which is already connected by rail with the North-Western system. Jummu is situated nearly at the junction of the rivers Tawi and Chenab, at an elevation of 1,000 feet above sea level, and it is at this point that the boldness of Mr. Nethersole's plan becomes apparent, for he



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proposes to leave the valley of the Chenab and strike up the northern slopes of the Tawi valley, passing through Udhampur and crossing the Bototi Pass at an elevation of 6,000 feet, and descending again to meet the Chenab at Ramband.

There appears to be abundant reason why this plan should in the end prove less costly and more satisfactory than that originally suggested by General de Bourbel, who contemplated working up to Ramband by the east bank of the Chenab. The distance from Jummu to the summit of the Bototi is estimated at about 65 miles, with grades averaging 1 in 30, but rising to as much as 1 in 20 for part of the way. The descent to Ramband would be made by a grade of 1 in 30 extending for about 25 miles.

Ramband will in all probability be selected as the point where the larger part of the power required for working the line will be generated. The report gives particulars of as many as 11 places within reach of different points of the proposed route where water-power is available. Of these, Ramband is considered to be the most favourably situated. It is actually on the line; it is about midway between Jummu and Srinagar, and there is a practically unlimited amount of water-power, the minimum discharge of the Chenab at Ramband being estimated at 6,000 cubic feet per second, with an average fall of 20 feet per mile.

On leaving Ramband the line follows the existing mule road up the steep ascent of the Bichlari valley for a distance of 27 miles at a grade of 1 in 30. On nearing the top the grade will be increased to 1 in 20 for about 10 miles, and the actual summit pierced by a tunnel of 1½ miles in length, at a height of 8,000 above the level of the sea. Within a short distance of the tunnel the head waters of the Jhelum are met with, and it is estimated that 1,000 H.P. is available at this spot. The importance of having water-power at this elevation will be appreciated when the question of the transmission for working the heavy grades at each end of the tunnel is gone into.

After quitting the northern exit of the tunnel the line descends to Islamabad in the Valley of Kashmir by a rapid fall of about 2,500 feet in 10 miles. The remaining section of the route is practically level, the distance into Srinagar being 45 miles, making in all a length of 180 miles from Jummu.

In forming an estimate of the amount of power that will be required, Mr. Nethersole has calculated that the probable traffic could be dealt with by 10 trains of 100 tons each per day, and that it would be necessary to provide turbines of not less than 5,000 H.P. This estimate of power, as is carefully stated in the report, is based on very rough approximations, and will have to be checked, and revised if need be, when the whole question of the electrical equipment is gone into in detail.

An average speed of 12 miles an hour over the whole line is recommended. This involves large variations of speed according to the grade upon which the train may happen to be running. Thus on a grade of 1 in 20 the estimated speed is 8 miles an hour, while on a level it exceeds 20 miles an hour. These conditions of working raise some interesting points in connection with the design of the controlling system, especially if polyphase motors are to be used, which is almost a foregone conclusion.

The financial probabilities of the scheme are promising. Taking the working expenses at 60 per cent. of the gross revenue—a high figure where the power is obtained entirely from water—it is estimated that the net revenue will represent 8·8 per cent. on the maximum and 13·2 per cent. on the minimum capital cost.

The scheme, as it is presented in the report, is altogether a remarkable one, and we congratulate Mr. Nethersole on having convinced the Government of India of its soundness. There are no doubt technical difficulties, but they are of the same order as others which have been met with and successfully overcome. To the professional mind the scale on which electrical traction will be employed lends a peculiar interest to the undertaking, while the political and commercial results of the new railway must attract public attention to it in no ordinary degree.

THE GENERATION OF POWER FOR ELECTRIC TRACTION.

By J. GRAY SCOTT.

(*Concluded from page* 220.)

In dealing with the subject of the generation of power, no treatise would be complete without reference to the machinery installed at the generating station.

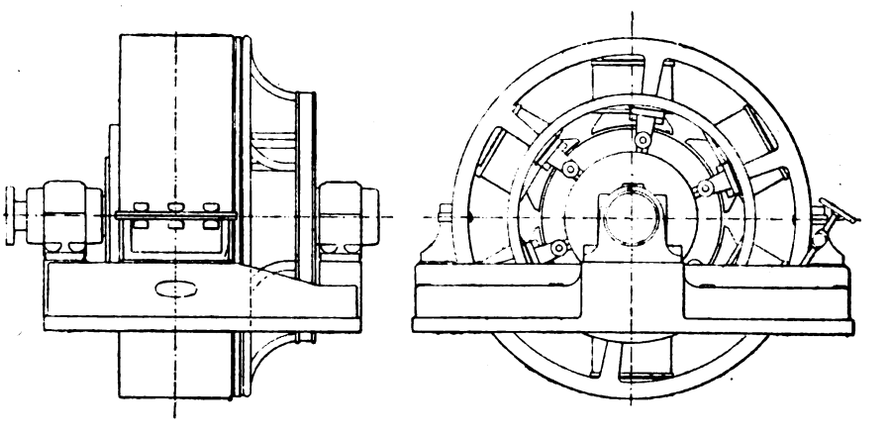
The engines at Bradford are of the well-known Willans central valve type working triple expansion at a pressure of 180 lbs. per square inch.

The I.H.P. of each engine is 600, at or about 300 revolutions per minute.

The satisfactory working of these engines, even under the stringent conditions associated with traction work, goes to prove the high state of efficiency both as regards working and governing which has now been attained, and it is more than probable, that with the development of traction work, high speed engines will continue to be very largely employed.

These engines are too well-known to require description.

The dynamos to which they are coupled offer considerable interest however, being at the time of their installation the largest continuous current generators manufactured in this country; the newer type has not, so far as the author is aware, been previously described.



The general appearance of these machines may be seen from the side and end elevations reproduced herewith.

The field-magnet yoke is nearly 8 feet in diameter, and the machine stands some 6 feet 6 inches from the floor level.

The yoke ring and poles are of cast-steel.

The armature, which is slotted, has a six circuit single winding and is nearly 48 inches in diameter; the commutator is about 36 inches diameter and has some 324 segments.

There are six sets of carbon brushes—five in each set, the connecting cables being carried round the outer ring of the circular brush rocker to which also the brackets carrying the brush spindles are fixed—but insulated therefrom.

The brush gear carriage is mounted on the periphery of the field-magnet yoke ring, and the necessary adjustment may be made by the hand wheel shown on the lower right hand extremity of the end elevation.

The machine is on a separate bedplate from that of the engine, and the armature has bearings of the swivelling and self-lubricating type.

The output for which each generator is designed is 750 amperes at 500—550 volts, which it need hardly be said is easily obtainable—moreover, a considerable overload has been sustained at various times.

The weight of one of these dynamos is over 21 tons, that of the armature being about 7 tons.

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The magnet coils are compound wound, the shunt winding alone being used when the machine is employed for lighting —the series coils being requisitioned only for traction supply.

The six coils of the shunt winding are connected in series and have a total resistance of about 41 ohms.

The resistance of the armature (from brush to brush) is less than $\frac{1}{100}$th of an ohm.

In tests of two machines by Hopkinson's method the following figures were obtained :—

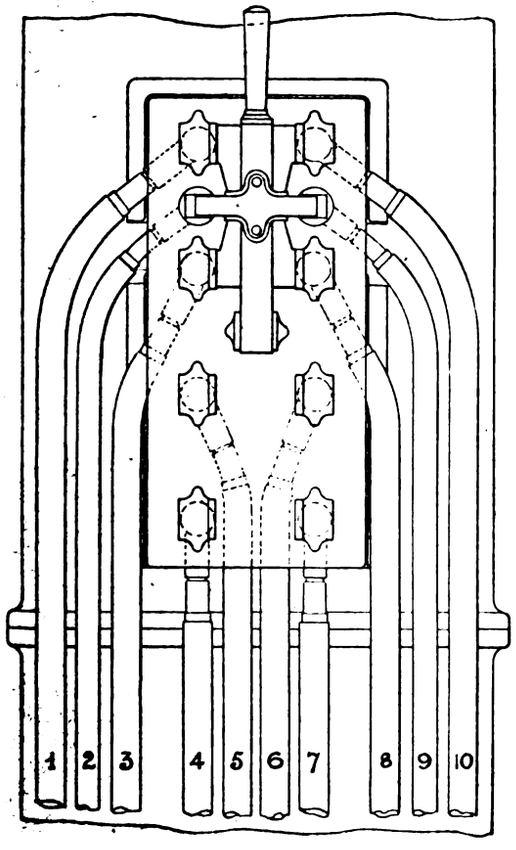
At quarter load, 90 5 per cent.
At half load, 94·25 per cent.
At full load, 95·5 per cent.

Presuming the machines to be of equal efficiency, we get a commercial efficiency of each machine of

97·7 per cent. at full load.
97 per cent. at half load.
95·1 per cent. at quarter load.

In a previous section the author pointed out the importance and convenience of interchangeability of the generators in a combined lighting and traction station.

In order to effect this as may be desired each machine has fitted a change over switch as shown in the following drawings :—



The switch is of course double-pole, the two pairs of inner contacts being connected to positive and negative dynamo terminals respectively ; of the outer contacts, the upper pair are connected with the positive and negative bus bars respectively of the traction switchboard, while the lower pair are connected with the positive and negative bus bars respectively of the lighting switchboard.

In the position shown, the switch would connect the generator with the traction system, the series coils being now in circuit and the equaliser switch closed.

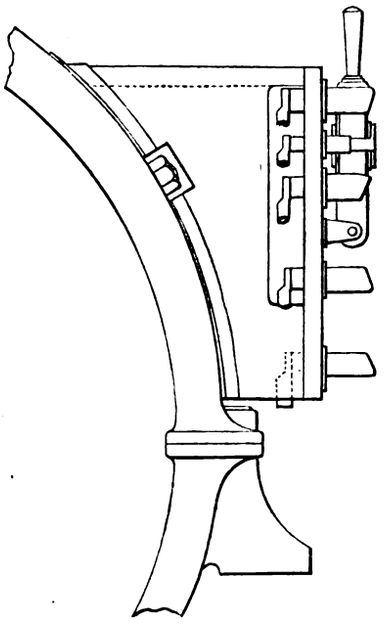
This switch is intermediate between the two upper pairs of main contacts, and its function is simply to connect together the positive brushes of those machines running in parallel on the traction system, and thus obviate the possibility of reversal due to the series winding.

Connection is sometimes made from each of these switches to what is called the equalising bar on the switchboard, but more often is simply connected to a cable in close proximity to the various machines and which equally well performs his function.

Referring to the cables which may be seen passing downwards from this switch it might be well to indicate their connections passing from left to right as numbered.

No. 1 connects the top left-hand contact to the positive bus bar on the traction board, through the series coils on the field magnets.

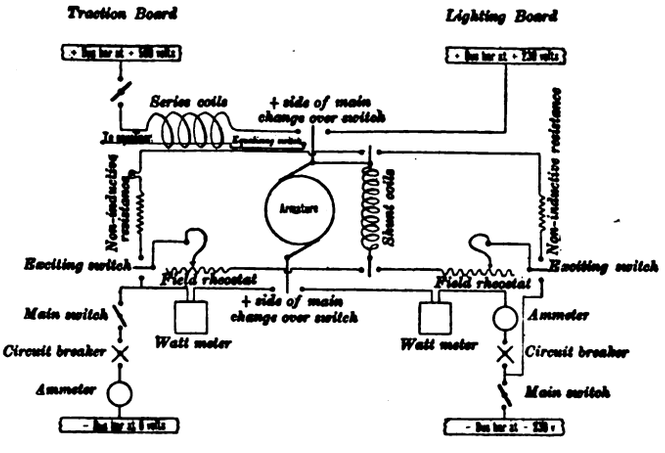
No. 2 connects the equaliser switch to positive brush for equalising when two or more machines are running in parallel.



Nos. 3 and 5 connect the two intermediate left-hand contacts to positive pole of dynamo.

Nos. 4 and 7 connect the two lower contacts to positive and negative bus bars respectively on the lighting switchboard.

Nos. 6 and 8 connect the two intermediate right-hand contacts to negative pole of dynamo.



No. 9 connects equaliser switch to equaliser bar or cable.

No. 10 connects top right-hand contact to negative bus bar on the traction board.

The accompanying diagram clearly sets forth the suitable connections for the interchange.

In conclusion, the author has to express his appreciation of the facilities afforded by his late chief, Mr. Gibbings, of Bradford, in the preparation of the foregoing matter.

The thanks of the author are also tendered very sincerely to those of the staff at Bradford who were good enough to render him assistance, and also to Messrs. R. W. Blackwell and Co. and Messrs. Siemens Bros. & Co., for kindly supplying blocks and drawings.

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INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(*Continued from page* 351.)

Mechanical contact bonds constitute, on the contrary, a very numerous class, which falls naturally into two divisions (multiple and simple bonds), the first sub-divided into polymetallic and monometallic, and the second into composite and uniform, in accordance with the character and condition of the metal or metals used in their construction.

The "American solid bond" and the "American flexible bond" are multiple polymetallic bonds, where ordinary steel wire and stranded steel wire respectively constitute the bond (figs. 83 and 84), connection being made with the rail web

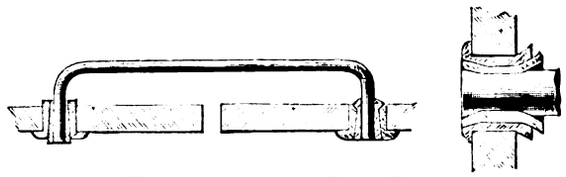

Fig. 83.—American Solid Bond.

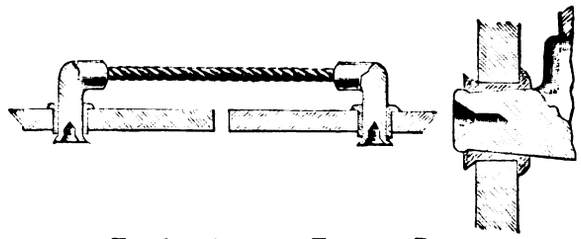

Fig. 84.—American Flexible Bond.

in the first case through tapered copper bushings and sleeves, contact being ensured by driving home the bushings, while in the second the stranded wires are gathered into the thimble ends of conical copper bushings, which are expanded by driving a conical wedge home in the opposite end, when they are passed through the sleeves lining the holes in the rail webs. The defects of these are practically the same as the preceding ones, multiplicity of gaps, deficient capacity, and excessive length.

In the "Grauten bond" ordinary steel wire again composes the bulk of the bond, held in clips with grooved heads riveted through the web, as shown in fig. 85. These clips are

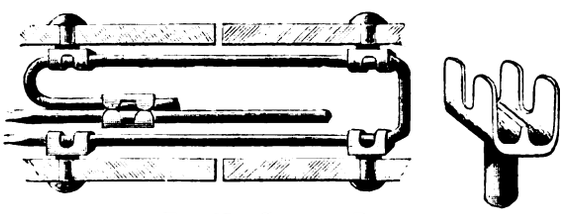

Fig. 85.—Grauten Bond.

of a composition rich in copper. The objections to this bond are also deficient capacity, excessive length, and multiplicity of gaps.

The "Stern & Silverman bond" substitutes a copper wire for the bond proper. This is held in a steel chuck screwed, split, and tapering at one end, on which a binding nut is passed. The chucks are screwed into the web, the copper wire passed through and secured by the binding nut, screwed over the tapering end. The objections to this bond are multiplicity of gaps and deficiency in closeness of contact, the contact between the chucks and the web being necessarily loose and subject to ready oxidation, and that between the copper bond and the chucks being almost as bad. The length is also objectionable on the ground of cost. (Fig. 86).

The "Bryan bond" is another multiple polymetallic bond belonging to Group A. Here the wires composing the bond are clipped between two corrugated washers, one of steel and the other of copper, contact depending on the screw pressure of the bolt passing through these and the rail webs and on con-

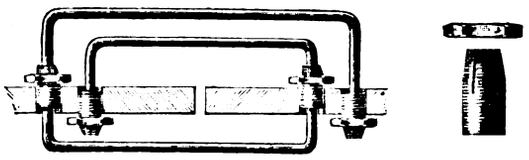

Fig. 86.—Stern and Silverman Bond.

dition of the surfaces. In practice, the closeness of contact cannot be secured, nor can oxidation be prevented in the excessive number of gaps.

Among multiple monometallic bonds, of which steel is the metal used, may be mentioned the "West-End bond" and the "Ohio Brass Company bond," in which steel wire composes the bond proper, the connections being made with the rail webs through tapered steel bushings and caps respectively, which are driven forcibly home. Their defects depend upon deficient conductive capacity and excessive length of the wire and multiplicity of gaps. The principal multiple monometallic bonds in which copper is the metal used are the "Johnson" and the "Columbia" bonds. The first (fig. 87) consists of five parts, a long copper rod, ends bent

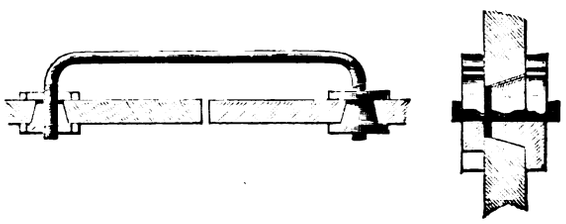

Fig. 87.—Johnson Bond.

at right angles and screwed, two conical tapered nuts, and two flat nuts. The latter are first screwed on the ends, which are then passed through the tapered web holes, and the conical nuts are then screwed home, making the contacts and fixing the bond. The objections are: multiplicity of gaps, impossibility of producing really tight contacts, and therefore of protecting contact surfaces from oxidation.

The Columbia bond has tapered conical heads with filleted base (fig. 88). Two tapered thimbles are inserted in the web

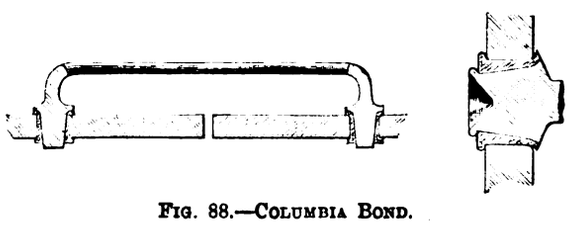

Fig. 88.—Columbia Bond.

holes, the conical heads are passed through these, and tight contact is ensured by setting up the conical head with a plug-headed hammer, or a screw press. The defects of this bond arise from the multiplicity of gaps, and the impossibility of ensuring a uniformly tight non-oxidisable contact throughout the contact surfaces by setting up from one end as described. Mr. Parshall's experiments previously referred to show how considerably the resistance in this bond can vary, the condition of holes and bond remaining constant, owing, presumably, to slight differences in the tightness of the contact surfaces, one being as low as 7·2 microhms, another as high as 9·5 microhms (per two terminals in series), a difference of 32 per cent., the holes being clean and bonds untouched in both cases.

The second or "simple" division of mechanical contact bonds remains to be considered, and this contains some of the most promising forms, as well as some that leave much to be desired. In the "composite" sub-division, one belongs to

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Group A (the "Harrington diagonal bond"), and three to Group B (the "Forest City," the "Atkinson and Harrington ball bonds"). The Harrington diagonal bond consists of four copper wires rolled into tapering conical terminals ($\frac{3}{4}$ inch maximum diameter) which are inserted in diagonal holes in the rail foot. This is a composite bond, owing to the difference in conductivity in the rolled ends and the drawn wires, producing an increase in resistance analogous to the introduction of a gap between the rolled and drawn portions. The tapering ends cannot be driven so as not to work loose and do away with closeness of contact and protection from oxidation of the contact surfaces. Its length makes it also a very costly bond.

The Forest City (fig. 89) and Atkinson bonds closely

Fig. 89.—Forest City Bond.

resemble each other in appearance and method of application. They consist of strands of flattened copper wire uniting solid terminals, the first being cast and the second pressed on to the flattened copper strands. They are both composite bonds owing to the difference in conductivity of the copper in the wire strands and in the cast and laminated terminals respectively. This difference with its attendant increased resistance at the junctures of the different forms of copper is liable to be considerably augmented in the case of the cast terminals by these being very liable to contain blow-holes which greatly decrease the conductivity. Both bonds are fastened by the application of pressure through a press (bond welder) or a screw and ratchet clamp. Their defects are those inherent in bonds, the metal composing which is of composite character.

The Harrington ball bond differs from the "Forest City" bond only in having the terminals cylindrically perforated, and in being fixed by expanding them by driving a steel ball into the cylindrical perforation. Its defects arise wholly from the composite character of the metal of which it is composed and the increased resistance produced thereby.

(*To be continued.*)

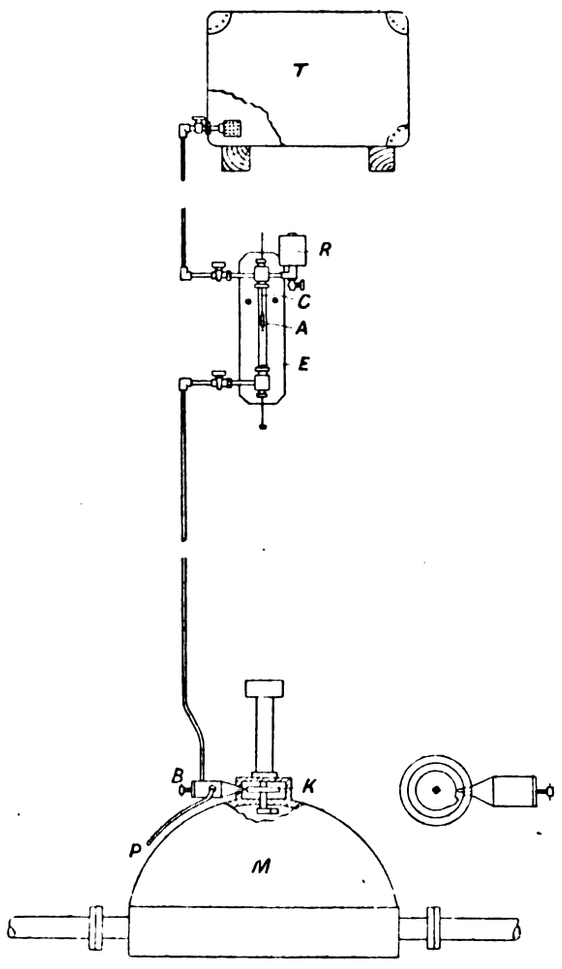
THE PURIFICATION OF FEED WATER.

By T. W. BLOXAM.

When considering the cost of maintenance of steam boilers —which constitutes a large percentage of the works' costs— the most important item, and the one where economy can be most easily effected, is that of labour for cleaning. This can be largely reduced by removing from the feed water the impurities which produce hard scale. The varying amount of attention paid to this point by steam users, drawing their supply of water from the same source, shows a lack of appreciation of its importance by many; for we find some spending several hundreds of pounds on a water-softening appliance, whilst others consider the occasional surfeiting of the boilers with anti-incrustation fluid of unknown composition all that is necessary. In most large installations a water softener is installed, but the cost of maintenance considerably reduces the economies it effects, and for every one of these there are 10 where soda solution or boiler compositions, costing several shillings per gallon, are either thrown into the feed tank without any regard to the varying composition and quantity required under different conditions, or else are not used at all. Where an excessive quantity is used expensive materials are wasted, and fittings injured by corrosion.

In some cases a small pump, actuated by the feed pump, is used to add the required proportion of reagent, but this method has not proved satisfactory owing to the difficulty of keeping the small valves in order and the plunger tight.

A considerable improvement on the pump is a simple piece of apparatus manufactured by Messrs. Kennedy, of Kilmarnock, and shown in the accompanying sketch.



It consists of a mushroom valve, B, which is periodically opened by a cam or tappit on the feed pump or water meter, allowing the reagent in the tank T to flow by gravity into the suction pipe of the pump, the quantity admitted being regulated by the float A, enclosed in a glass tube which it fits loosely.

The action is as follows:—When the valve B opens, the liquid in the tank flows through the controller carrying the float A with it until it reaches its seat, E, stopping the flow. When the valve B again closes, the float A returns to the adjustable stop C, and is ready for the next delivery.

By raising or lowering the stop C, the quantity delivered can be regulated to any proportion, which is maintained in spite of the rate of delivery of feed water varying. The movements of the float A indicate whether the apparatus is working properly or not.

The simplicity and small cost of this arrangement should recommend it to users of water softening reagents.

THE GLASGOW ELECTRICAL TRAMWAYS CONTRACT.

To repair an error is always difficult, yet we hope that Glasgow will find means to come to a satisfactory conclusion on the engine business. What is done cannot be undone. It is recorded that when a child had been receiving religious instruction she was so impressed as to inquire whether, having gone upstairs and come down again, it lay within the capacity of omnipotence to make it so that she had not been upstairs. So with Glasgow.

However, they have attempted a solution by awarding two

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engines to the Allis Company at £28,000 each, and two to Musgrave's at £24,000, the extra £4,000 amounting practically to a bonus for about three months better despatch. This at least was the committee's resolve to recommend to the Council, although Bailie Thomson wished to award all four engines to Musgrave's, whose price was £95,516, against the Allis Company's price for £114,564. This motion was carried, subject to delivery, but Mr. Musgrave could not agree to the delivery terms. What surprises us is that some firm of marine engineers could not see their way to tender for these engines in the time required. What we consider should have been done was to have carried out the promise to have given freedom to contractors, and, at most, to have specified speed, diameter of cylinders, and stroke. Then, and then only, would there have been any semblance of equality. The position was a difficult one, but maintenance for 12 months would have been a safeguard against insufficient strengths.

Writing to the *Engineer*, Mr. H. Austen disallows the Allis Company's right to complain as they are doing, seeing that they put in at the top price, and under the rule practically controlling public tenders, had no chance of success at the price. They were properly disqualified by price, and ought to keep quiet, for they had no right whatever to expect to take the order from other firms who could and would supply fully equal engines at a less price. As regards the question of time for delivery, it is very largely the fault of such municipalities as Glasgow and others uninformed and hesitating, that electrical work has been kept back so much in England, and it is only right that manufacturing engineers should be allowed longer time. They would not have needed such time if the natural growth of the electrical industry had been allowed free play. Municipalities accept goods from abroad made under free labour conditions—in America there is no Truck Act—and entirely unhampered by specification, whereas an English firm is asked to rigidly observe an often impossible specification, and to pay certain wages called "standard," as to which there is no limit of meaning. This demand for a standard wage is simply a means of offence. It enables any Common Councilman to render himself obnoxious to the contractor, and it should be abolished. There is no justification for this clause in any contract on which foreigners have been also allowed to bid.

Turning now to the electrical equipment, we have a different story to tell. The specifications for this portion of the plant strike us as being excellent in every way, and just what was required. They are perfectly fair to any manufacturer who is able to turn out high-class and absolutely modern machinery of large size, and at the same time the buyer is fully protected.

We think with regard to the generators and rotaries that no English firm has any idea as to what must be done in order to build machines of this size to fulfil guarantees such as in the present case—as to delivery they would certainly be out of it.

Moreover, after carefully studying the specifications, in order to see as well as we can what was passing in Mr. Parshall's mind, we have no doubt but that Glasgow has done the best thing in retaining him as electrical expert, even when taking into consideration all that has been said on the engine side of the question, for we do not think that any English engineer has had sufficient experience to do what Mr. Parshall has done. The system is undoubtedly right, his ideas are very clear, and it is easy to see that he knows exactly what he is about.

Our further impressions on technical grounds may be gathered from the following notes on the Glasgow tramway specifications for (1) generators, (2) transformers, and (3) rotaries.

1. With regard to the specification for three-phase generators, we are unable to see that a better or fairer specification could be drawn up. It asks for nothing out of the common, and could be tendered for by half-a-dozen first-class firms.* The temperature rise is fairly liberal, but is it the common figure obtained with all such large units? The same remark applies to the fall of pressure allowed and to the efficiencies at various loads. Machines built on the lines indicated (which, as stated before, are practically the constructional lines adopted by first-class firms on the Continent and in the States) would come out reasonably light and cheap, while amply good enough electrically, and the buyer would have thoroughly reliable machinery.

The tests specified are reasonable, but perhaps would add somewhat considerably to the contractor's price on account of the size of the units. They are, however, none too stringent. With regard to delivery, the times allowed are very short, and no firm could deliver anywhere near the time stated unless they had already made similar machines, that is, unless they had the whole design and patterns complete.

As to whether any English firm could supply these machines, we are decidedly of opinion that there is not a firm in the country who could do so. Nothing of this size has been attempted up to the present by any firm here (alternators of the "ironless core" type are completely shut out, as being impossible), and they would not have the experience. That is to say, English firms could not guarantee the performance, owing to the want of experience in three-phase machinery of such an output and speed, and they could not deliver in anything like the time, as no English works are equipped to take this size and class of work.

2. *Transformers.*—Here, again, it is difficult to see where the specification could be improved on. The figures allowed for heating, drop, &c., are standard with any good maker of transformers, English or foreign, and are by no means outside commercial limits.

Any English firm having experience in transformer building could give the necessary guarantees easily but we do not think the delivery could be made so quickly as asked for.

The question here—England *v.* Abroad—would turn solely, we imagine, on the price and delivery.

The tests are reasonable and sufficient. The moderate heating asked for could not be attained without oil-cooling or air-blast, unless the transformers were made very heavy and expensive.

Nothing is said about protecting the high pressure terminals or their position.

3. *Rotaries.*—Nothing out of the way is asked for, and the guarantees, tests, &c., are by no means too stringent.

Efficiency and heating figures are quite normal.

Overload capacity (with fixed brushes) is rather high. The speed is left to the maker.

There is only one point about this specification that would appear to be rather vague, as follows:—The generators, transformers, and rotaries are all specified for on the basis that the load is *non-inductive*. In order that this may be so, it is clear that the rotaries are intended to be *over-excited* in order to get rid of the lag. The amount of over-excitation will naturally affect the clause dealing with parallel running. We think further details might have been given in order that tenderers could see exactly how the machines will be used. The compounding question is also affected by this over-exciting and parallel running. For instance, suppose a big load is put on—the series coils strengthen the field, and hence diminish the lag. This might affect the parallel running if the engines varied much more than the specified amount in the angular speed during a revolution.

These points, however, are perhaps covered by the "choking-coil" clause, which practically gives a free hand to the contractor as to what special devices he may employ in order to get the desired result.

Electrical Extraction of Iron from Ore.—The *Financial News* says that it is reported from Vienna that the Prague Iron Industry Company has commenced a series of experiments with a view to testing the commercial practicability of a new process which has just been discovered for the extraction of iron from its ores by means of electricity. "The idea of replacing the blast furnace by some form of electric furnace is not a new one, as is shown by the trials made in this direction in Germany in recent years, but it is considered that past failures do not preclude the possibility of the new process being tested at Prague proving a financial success and of great benefit to the iron trade in general."

* Other than English.

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THE REPORT OF THE PACIFIC CABLE COMMITTEE.

(*Concluded from page* 268.)

According to the estimates made by Sir Sandford Fleming, founded on a very moderate treatment of the continuously-increasing receipts accruing to the existing companies for the 20 years preceding the date of his calculations, we find that he has taken 1898 as the first full year that the cable could be in operation, and that the gross earnings, reckoned at the low rate of 2s. per word for the Pacific cable, would amount to £110,000; for the year 1899, £126,500; and for the year 1900, £143,000. If from these estimated yearly earnings we deduct in each case the fixed charge for interest and working expenses of £75,000, we would have a surplus in 1898 of £35,000, in 1899 of £51,500, in 1900 of £68,000, showing a total surplus of £154,000 for the first three years the cable would be in operation. After these first three years, during which the cost of maintenance would fall on the contractors, this item would be a charge against surplus earnings. Sir Sandford Fleming has taken the annual cost of repairs and maintenance, interest, and working expenses, at £125,000, and allowing for this he finds that the total surplus in 10 years would amount to £742,000 on the assumption that the volume of traffic would increase at the normal rate. The low rate of interest payable on capital, owing to the guarantee of the British Government, is an important feature in these estimates. Apart from the figures given above, Sir Sandford Fleming directs attention to an advantage frequently overlooked, and to which the Committee make no reference in their report, viz., that the reduction of rates from 4s. 9d. to 3s. per word will, within the first year after the Pacific cable brings such reduction about, effect a gross saving in Australasia and the mother country of £190,000, a saving which will be repeated annually, and will be continually augmented by the growth of business. The indirect advantage to Canada will be great, and as the Pacific cable is now receiving the support of the Home Government, and absolute cash returns do not count for everything in the matter, we may well consider the indirect gain to the Dominion as not the least of the prospective profits. Miss Flora Shaw has pointed out that "Canada commands the commercial high road of two hemispheres," and the establishment of the Pacific cable is a necessary adjunct to this highway, all the more advantageous that, in itself, it will be self-supporting, if not a source of profit.

In their report the Committee are careful to state that they have been "actuated by extreme caution," and although we think that as regards the probable revenue the report is too conservative, still we are glad to see that here, as in other divisions of the report, the Committee have refused to accept, blindfold, the opinions and figures advanced by the representatives of the Eastern Extension Telegraph Company and other declared opponents to the Pacific cable, and this even, although the officials of the English Post Office have, in almost every instance, been more or less in agreement with those who have vainly sought to quash the project. In his report to the Canadian House of Commons, Sir Sandford Fleming has written very strongly concerning what appears to him to be an extraordinary unanimity of opposition; but we do not propose here to go further into this aspect of the matter. We have been contented to deal with figures and statements as we find them given in evidence, and our readers, like Lord Selborne's Committee, may find much interest in the process by which the figures and opinions of some of the witnesses have finally been arrived at.

VI.—If the Cable were to be National Property, what would be the Proper Method of Management and Administration?

We are quite in agreement with the report of the Committee on this head—that the general direction should be under the control of a small board, on which the associated Governments would be represented. It is true that, to avoid the petty jealousies which have frequently arisen in the past amongst the Australasian Colonies, it might be necessary to have a larger board than that which would be absolutely necessary for fair representation of the various parties to the Pacific cable scheme. But as the interest is a common one, we do not anticipate that much difficulty or delay would be caused by a very full representation. We are, however, clearly of opinion that it would be a most regrettable mistake to place on such a board any of these gentlemen who have shown themselves adverse to the laying of the Pacific cable. In the establishment and management of this work neither pessimism nor incompetence should have a part. These are not the qualities which are required to establish a satisfactory position in the face of powerful opponents.

VII.—What should be the Form of Contract offered to a Contractor for its Construction?

The Committee only touches lightly on this point, which, in view of the variety of opinion expressed in the technical evidence, is of some importance. We think that, as this is a subject connected with long deep-sea cables which have not as yet come under the control and experience of the Post Office authorities, it would be best that the Board of Management should nominate three representative cable engineers, professionally independent of each other, and unconnected with any manufacturing company. The engineers thus selected to draw up and submit to the Board of Management such specifications and terms of contract as they may agree upon; this draft form of contract should then be sent to each of the manufacturing firms, who should return the draft to the Board with such notes or suggestions as they may think necessary. The final form of contract on which tenders would be invited from manufacturers could then be decided on by the Board in consultation with their engineers. By this means the Board would have the advantage of finding before it the fullest information on the subject to be decided upon, as well as the opinions of all those most competent to deal with the matter. We are perfectly aware that this is not the usual procedure, but it appears to us the method from which the best results may be derived.

We have now dealt with all the points mentioned in the instrument of appointment of the Committee, but in the course of the evidence a considerable amount of attention was drawn to the question of duplication, a question which goes hand in hand with that of the durability of cables. Lord Tweeddale raised the question as to the need of duplicating cables, and in answer to a question (No. 1,968) says that duplication is a principle on which his companies have acted, and, again, in reply to question No. 2,107 *et seq.* says that duplication is an absolute necessity for safety. Sir W. H. Preece cannot call to mind "a single instance in which reliance has been placed in a single cable." There is no doubt that there would be an additional load on the Pacific cable cost were only the above opinions correct! But elsewhere in the evidence these opinions are not supported. Lord Tweeddale himself makes reference to the company's cable from Madras to Penang, but appears to forget that this main line cable to Australia and the Far East, laid in 1870, remained unduplicated for 21 years, also that his second Penang-Singapore cable was laid 22 years after the first, further, that nine years elapsed before the laying of the second cable from Java to Port Darwin, thus duplicating the only connecting link with Australia; again, that his company did not lay a duplicate cable from Australia to New Zealand until the first one had been working for 14 years, and finally, that the solitary cable which was laid between Singapore and Banjoewangi 20 years ago, and which is the only submarine cable link now connecting Australia with Singapore and the rest of the world, is only duplicated by the use of the Dutch landlines through Java. Thus, in the history of the Eastern Extension, &c., Company alone there is to be found an object lesson on the need for immediate duplication of cables! There are numerous other similar instances which may well have escaped the attention of Sir W. H. Preece, but which should have been well within the knowledge of the representatives of the Eastern Extension, &c., Company. We could cite many instances in support of our opinion that the durability of well designed cables, laid after a careful survey has been made, is much underrated, owing to the shortness of the life of many ill-designed lines, but space will not permit us to enter on this. The Committee advise the laying of a duplicate cable, which they think would be advantageous, although not an immediate necessity.

There are many points of minor interest on which we might enlarge, but it is sufficient that the principal considera-

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tions have been laid before the readers of the Review, fairly and impartially, we believe. We cannot leave this subject without an expression of hope that the Pacific cable project, now on the verge of accomplishment, and which we have consistently and continuously advocated ever since its inception, may be successfully achieved, and we also hope that in time even those who have not strenuously opposed it, may agree with us in the opinion that the establishment of such a cable is of the greatest importance to the progress and unity of our empire.

FLY-WHEEL POWER OF MOTORS.

By E. K. SCOTT.

In driving certain types of machines individually by electric power, the question of fly-wheel effort comes prominently forward. As usually made, the fly-wheel power of small electric motors is very low, and if they are coupled up to machines which have been previously driven by a long line of shafting crowded with wheels, pulleys, belts, &c., it may be found that the change is not quite satisfactory.

A class of machines in which this is important are the "doughers" and "breakers" used in biscuit making. These machines have heavy rolls requiring to be constantly reversed, and very considerable effort is required each time the dough enters the rollers. To buy an ordinary motor and reversing switch off the shelf, as it were, and connect it up by gearing to such machinery without any thought as to the fly-wheel power, &c., is risking a failure.

Planing machines present a somewhat similar problem, and it has been found best to drive them by a motor constantly running in one direction and arranged with some amount of fly-wheel power.

Pulping machines, used in paper making, also require motors with a good deal of fly-wheel effort in order to keep up the speed when any knotty material enters the roller teeth.*

Some machines, such as shears, punching machines, stone breakers, &c., are themselves fitted with heavy fly-wheels, and as no reversal of the motor is required, they can be driven in a fairly satisfactory manner by a stock size machine dropped down alongside. On the other hand, the coupling up of a motor to a set of Callender rolls, which need extremely slow and steady variations of speed as well as reversal of the direction of rotation, requires some little thinking out.

The writer might go on giving particulars of special cases, but it will be seen from the above that although there is nothing *very* complicated about it, some little thought and judgment is required in applying electricity to driving machines.

Motors as at present made, and especially the smaller sizes, ½, 1, 1½, 2, 3, and 4 H.P., are certainly lacking in weight of the rotating parts. The tendency all along has been to cut down the size of the armature, &c., to the smallest possible dimensions. One often sees a heavy fly-wheel fitted on a machine having a ridiculously small armature. Surely it would have been better and cheaper to have put the weight into the armature, &c., right away. Any motor, whatever it is required for, is all the better for having plenty of fly-wheel effort.

This need of weight in the armatures, &c., of small motors raises anew the suggestion of using iron wire for the conductors. At the present moment the problem stands somewhat as follows:—Individual motor-driving is acknowledged to be the correct method of applying electric power to machinery; for instance, instead of one 20-H.P. motor driving a group of 10 machines, there should be 10 motors each of 2 H.P. Now, the majority of machines are comparatively slow running, and one or two trains of gear wheels are required from the motor spindle. Gearing does not work altogether satisfactorily at high speeds; besides, the less there is, the more efficient the combination. The tendency is, therefore, to follow traction practice and have slow speed motors with only a single reduction gear.

Now it happens that the most convenient way to get slow speed is to have four poles instead of two, and as the usual voltage is 220 or 440, the sizes of the armature conductors come out excessively small. A 2-H.P. 220-volt four-pole motor, for example, only requires about 8 amperes at its terminals, giving, say, 2 amperes through the armature conductors, whilst a 440-volt motor will actually have only 1 ampere flowing through the armature conductors. It will readily be seen that to wind an armature with the theoretical size wire for such trifling currents, is both difficult and expensive. As a matter of fact, No. 18 S.W.G. wire is really the smallest size which is mechanically safe, and this has an area many times larger than what is really required. Substituting iron wire at once gets over this mechanical difficulty, because, for equal conductivity, the wire is about two and a half times the diameter of copper wire.

There is another advantage in using iron wire. Small motors are principally uneconomical because the armature winding with its insulation, binding, &c., occupies such a relatively large amount of space; in other words, the air gap, and therefore the exciting walls, are excessive. Iron conductors being also magnetic get over this difficulty in a delightfully simple way, and the reduction of the air-gaps to a mere mechanical clearance carries with it the further advantage that the pole covers may be brought much nearer together without undue magnetic leakage, thus rendering a larger proportion of the armature circumference useful.

As the area of iron wire is six times the area of copper, there is, of course, more space taken up, and the total weight of the revolving mass is considerably heavier, but as has been pointed out above, this is a distinct advantage for motor work.

Fly-wheel power is what the small motor, as at present made, sadly lacks.

The question of cost comes secondary to turning out a satisfactory machine, but in this also the iron would probably score for voltages of 220 and upwards. For one thing, the cotton covering would be cheaper, and the wire much easier to handle, which, seeing that the cost of small machines mostly goes in labour, is a consideration.

Those who have not thought over the matter may be inclined to scoff at the idea of using iron wire conductors, but there is undoubtedly much to be said in favour of the change for motors of less than 3 or 4 H.P. at 220 and especially 440 volts. This latter pressure is likely to be much used in the future, but as matters stand at present it is practically impossible to build the smaller motors for this pressure.

* It is interesting to note that as the top roller takes the power, and is, at the same time, always on the rise and fall, according to the condition of the material passing through the rollers, the problem presented by the gearing is practically the same as that of a tramcar motor.

LIMITED ELECTRIC STATIONS.*

By ALTON D. ADAMS.

A central station of low first cost and high operative efficiency, to serve a limited area, is a common problem in electrical design. Hundreds and thousands of small cities and towns have nearly their entire business interests within a radius of one-half mile from a central point, and the possible demand for electric light and power is such as to warrant only a very moderate outlay. When the fact that very small central stations, in places similar to the above, run at a loss is held in mind, the necessity for careful selection of equipment is evident, and the designing engineer must decide a variety of questions with no little skill, to insure a financially successful plant.

The station under consideration would be required to operate from 18 to 24 hours per day, and this fact has an important bearing on the average efficiency of electrical equipment, when it is considered that the maximum load of lamps on a central station usually continues but two or three hours per day, and the load during the remainder of each

* *American Electrician.*

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day is but a small part of the maximum amount, since the variation of losses inside and out of the station does not necessarily rise and fall in the same ratio as the load.

There are two main classes of electric generators, either of which may be used to operate incandescent lamps, namely, those generators intended to connect directly with the lamps, through the proper conductors, and those intended to connect with transformers, but having no electrical connection with the lamps. Generators connected directly with the lamps are limited in electric pressure or volts to the voltage of the lamps, plus the small loss of pressure allowed in the connecting wires. Generators for connection to transformers are of the alternating current type, and may be of any desired voltage, as the proper voltage for lamps is supplied by a suitable transformer.

Alternating current generators with transformers have been much more frequently selected for stations like the above than have the type of generators suitable for direct connection to the lamps, for two reasons—first, because the weight of conductors to supply a given number of lamps at a fixed distance and per cent. of loss varies universely as the square of the volts or electric pressure at which the energy is supplied; and, secondly, because until several years ago the highest practical electric pressure at which lamps could regularly be had was about 110 volts. At 110 volts the weight and cost of conductors is very large compared with other parts of the equipment, even on distances so short as one-half mile; while a voltage may readily be selected for alternating current generators at 1,000 or 2,000 volts, which will reduce the weight and cost of conductors to a very low figure.

The great saving in conductors made possible by the transformer system at 1,000 volts as compared with the 110-volt system is shown by the ratio $(110)^2 \div (1{,}000)^2 = 0{\cdot}0121$ in weights of conductors for the 1,000-volt system, compared with the weights for the 110-volt system.

A third method of distribution, known as the three-wire system, by which the station voltage could be increased to from 220 to 250 volts, with 110-volt lamps, has also been possible, but being patented its use has been mostly limited to stations buying their electrical machinery of a certain company. Considering at first what are called the outside wires of the three-wire system, the weights of conductors required for it, compared with those of the 1,000-volt transformer system are shown by the ration $(1{,}000)^2 \div (250)^2 = 16$, that is, sixteen times the weight of conductors is required for the two outside wires of the three-wire system as for the 1,000-volt system; but the third or neutral wire of the three-wire system is usually made of the same size as each of the other two, so that the total weight of conductors for the system becomes $16 \times 1{\cdot}5 = 24$ times the weight necessary for the 1,000-volt system.

The 125-volt system, connecting dynamos directly with lamps, has been used in a few small stations, serving very limited areas; the 250-volt three-wire system has been very largely used by stations buying their electrical machinery from a certain company, and its use would have been much more extensive were it not for the patent limitations above named.

Reasons for the continued use of the three-wire system in many cases, and of the 125-volt system in a few stations serving a very small area, are found in the cost of transformers, which must be added to that of conductors for the 1,000-volt alternating system, and in the low all day efficiency of the transformer system.

The low all day efficiency of transformers is due to the fact that a large part of the loss in a transformer remains constant, so long as it is connected to the supply of current, no matter how small its load of lamps, or whether it is operating any lamps at all.

Now, as even quite small central stations must operate from 18 to 24 hours per day, and as most of the transformers have only a very light load or no load during most of the time, the constant transformer losses materially reduce the average efficiency. In spite of the cost of transformers and their low average efficiency under working conditions, the transformer system seemed destined to do the great bulk of incandescent lighting from small and medium central stations, had the maximum practical pressure for incandescent lamps remained at about 110 volts, but happily this is not the case.

For several years back incandescent lamps for from 220 to 240 volts pressure have been regularly on the market, and their advent, marking a new era in central station design, necessitates reconsideration of the advantages of direct and transformer systems of incandescent lighting. Allowing a moderate pressure for the loss in conductors, the new high volt lamp permits the same station pressure as the three-wire system—that is, about 250 volts—and therefore requires the same relative amount of conductors, compared with the 1,000-volt transformer systems, as is necessary for the two outside wires of the three-wire system, which amount, as computed above, is 16 times that at 1,000 volts. It is evident from the above that a fair decision between the merits of a transformer and a direct system for any given case, must rest largely on the relation between the sum of costs for conductors and transformers for an alternating system, and of conductors alone for a system of direct connection from dynamos to lamps, and also on the operative efficiencies of the two systems. The cost of conductors for the 220-volt lamp is to the cost of conductors for the 110-volt lamp on the two-wire system as $(110)^2 \div (220)^2 = \frac{1}{4}$; that is, but one-quarter of the weight in conductors is required, and as the three-wire system makes necessary a third wire, equal in weight to each of the other two, the 250-volt two-wire system requires only two-thirds the weight of conductors necessary for the three-wire system, with 110-volt lamps.

To determine, therefore, the best system under the usual circumstances, and free from chances of patent litigation, comparison should be made between the 250-volt two-wire and the 1,000-volt or 2,000-volt transformer system.

For purposes of comparison, the cost of electric generators for a given capacity may be taken as the same for either system, though the price of low pressure generators for the direct work would usually be somewhat lower than those of high pressure for use with transformers. To reach a correct decision as to the merits of heavy conductors alone on one side, and light weight conductors plus transformers on the other, each transmission system should be designed to operate at the same average efficiency during the entire daily run, or at least at some definite efficiency, so that due allowance may be made for difference in efficiencies if any exists. In places of moderate size, the average capacity of transformers which can economically be used is quite small, as individual users usually require but few lamps, and if more than two or three consumers are supplied from the same transformer, the cost of the low pressure wires to lamps becomes too great.

In a plant of moderate size, using transformers, lamps may be assumed to be divided equally between those of 40, 60 and 100 lamps capacity of 16 nominal candle-power each, and the all day efficiencies of these transformers may be fairly taken at 84, 86 and 88 per cent. respectively.

The average all day efficiencies of above transformers will therefore be $(84 + 86 + 88) \div 3 = 86$ per cent. of the energy delivered to them.

Consider now the cost of conductors on the 220-volt lamp system, and of conductors and transformers on the 1,000-volt alternating system to supply 1,000 16-c.p. lamps, taking 55 watts each and grouped at 2,500 feet from the station.

The maximum loss in conductors for the direct system at full load may be taken at 14 per cent., or the same as the average all day loss of transformers, although the maximum loss will result in a much lower average loss. With a loss of 14 per cent. in conductors and 220 volts at the lamps, the volts at the dynamos must be $220 \div 86 = 255{\cdot}8$ and the pressure expended in conductors $255{\cdot}8 - 220 = 35{\cdot}8$ volts. 1,000 55-watt lamps consume 55,000 watts, and at 220 volts the amperes must be $55{,}000 \div 220 = 250$.

The area of copper conductors to transmit 250 amperes through 5,000 feet of its length with a drop in pressure of 35·8 volts, taking 11 ohms as resistance of a mil-foot of copper, is found by the formula for circular mils as follows:—

$$C\,M = \frac{11 \times 250 \times 2{,}500 \times 2}{35{\cdot}8}$$

Therefore, circular mils = 384,070. The weight of a 384,070 circular mil conductor, insulated, and 5,000 feet long, is about $1{,}308 \times 5 = 6{,}540$ lbs., the weight being about 1,308 lbs. per 1,000 feet, and its cost, at 20 cents per lb. is $6{,}540 \times {\cdot}20 = \$1{,}308.00$.

Coming now to the alternating system with transformers,

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the average cost of small transformers may be fairly taken at $1.25 per lamp capacity, so that their total cost for 1,000 lamp capacity is 1,000 × 1.25 = $1,250.00.

As the average efficiency of transformers for all-day service is quite low—86 per cent. in this case—it is desirable to maintain a very high efficiency of conductors in the alternating system, so that the total efficiency of transmission may be as high as practicable. Were there no loss whatever in the conductors between alternating generators and transformers, the efficiency of the system would be lower than that of the direct system on the loss assumed in the direct conductors, since while this loss was taken at its maximum as equal to the average loss in transformers, its average amount will be much below the maximum, and therefore below the average loss in transformers.

It should therefore be noted that while in alternating current transmission with transformers the highest efficiency is at full load, and efficiency drops as load decreases, just as the opposite of this is true for the direct system of transmission, in which the lowest efficiency of conductors is at full load, and the efficiency rises as the load decreases.

In consideration of above facts the loss in alternating current conductors for above case may be taken at 2 per cent. for full load, and be less than this at average load.

As 1,000 55-watt lamps consume 55,000 watts when all lighted, the watts then delivered to transformers, taking their average full load efficiency at 95 per cent., will be 55,000 ÷ 95 = 57,893 watts. To transmit this power over 5,000 feet of conductors at a loss in them of 2 per cent. and 1,000 effective volts at transformer terminals requires about 2,900 lbs. of insulated conductors, which at 20 cents per lb. cost 2,900 × ·20 = $580.00. Adding the cost of transformers found above at $1,250 and the $580. just found for conductors between generators and transformers gives a total of $1,830.00, but this does not include any charge for conductors to connect transformers with the lamps on consumers' premises.

With 100-volt lamps a loss of 2 per cent. in wires to transformers, and an average length of 200 feet for these wires, the 55,000 watts consumed by all the lamps require for their transmission about 426 lbs. of insulated conductor, which, at 20 cents per lb., amounts to $85.32, making, with the $1,830 above, a total of $1,915 for the alternating current transmission system.

The cost of transmission system for the direct current in above case was found to be $1,308, so that the alternating system costs 1,915 ÷ 1,308 = 1·46 times the direct system of transmission under the fair assumptions above, for a concentrated load at one-half mile from the station. Had the direct system of transmission been designed for the same average efficiency as the alternating, its cost for conductors would have been much less than the $1,308 above found, and the increased cost of alternating system over the direct would therefore have been much greater.

Having noted, however, the increased cost of the alternating system for what may be considered ordinary design in each case, it will now be interesting to compare the efficiency of the two systems. The average efficiency of the transformers in above case is 86 per cent., and for the average loss in the two sets of alternating current conductors, with 2 per cent. loss in each at maximum load, about 2 per cent. should be allowed as average loss, making the total transmission efficiency of the system about 83 per cent. on the average.

The loss in conductors of the direct system varies directly as the load on them, and will therefore be 14 per cent. at full load, 7 per cent. at half load, and 3·5 per cent. at one-quarter load, and 1·75 per cent. at one-eighth load, of the energy transmitted at each stage of load. It is a fair assumption that full load will last during two-tenths, half load during two-tenths, quarter load during two-tenths, and eighth load during five-tenths of the time, in which case the total transmitted energy conveyed at each stage of load may be taken as follows:—At full load, 1 × ·2 = ·2; at half load, ·5 × ·2 = ·1; at one-quarter load, ·25 × ·2 = ·05; at eighth load, ·125 × ·4 = ·05; the sum of which is ·2 × ·1 + ·05 + ·05 = ·4.

The part of total energy transmitted at each stage of load will therefore be, for full load, ·2 ÷ ·4 = ·5; for half load, ·1 ÷ ·4 = ·25; for quarter load, ·05 ÷ ·4 = ·125; and for eighth load, ·05 ÷ ·4 = ·125.

Applying per cents. of loss for the several stages of load, the per cents. of total energy lost at each stage of load are: Full load, ·5 × ·14 = ·07; half load, ·25 × ·07 = ·0175; quarter load, ·125 × ·035 = ·0043; and eighth load, ·125 × ·175 = ·00218. The sum of these fractions of total energy is ·094, or 9·4 per cent., so that the average transmission efficiency of the direct system is 90 6 per cent. For above case, then, the cost of transmission devices is not only 1·46 times as great with the alternating as with the direct system, but the average transmission loss with the alternating system is 17 ÷ 9 4 = 1·8 times that with the direct.

The facts illustrated by the above figures seem ample to warrant the growing preference for direct electric distribution over moderate areas.

CORRESPONDENCE.

Renewable Lamp Company.

I have read your remarks in your issue dated August 20th, in which you state that "we are afraid we cannot congratulate the Renewable Lamp Company on the lines adopted by their advocates."

I have not the slightest knowledge of anybody who has taken it upon themselves to write letters on this question, and I must disclaim any association with them whatever, and with their discussion.

I have no intention of discussing this matter in the public press, considering that it is quite unnecessary; but for your information and for that of your readers, I may tell you that the works are being equipped in Shoreditch on a large scale, the various appointments of officials have been made, contracts are also being entered into with local authorities, railway companies, theatres, hotels and clubs, &c., and you may rest assured that the activity being thrown into this matter will make it such a live concern that there will be obviously no need for any discussion.

If you will kindly let the question rest, it is a very short time to seeing the lamp thoroughly and practically demonstrated and in general use, which is better than all anticipated discussion.

J. Atherton,
per E. T.

Prescot, Lancashire.
September 4th.

"The Value of Electrical Treatment."

My attention has been drawn to a review of the above work which has recently appeared in your columns, and I wish to protest, in the strongest manner, against the tone in which that article is written. Fair criticism must be welcome to every sensible man; but mud-throwing should not be allowed in the pages of a professional journal. Your reviewer, however, has thrown mud, by comparing me with a notorious quack and impostor.

Allow me to say that the conclusions at which I have arrived concerning the medical uses of electricity, and to which your reviewer has taken exception, are the outcome of upwards of 40 years' extensive special experience, both in hospital and private practice. They are no phantasmagoria, but have been forced upon me by what I have observed clinically over and over again, and year after year, and they may be verified by anyone who will take the trouble of working conscientiously at this subject. That portion of my work which relates to the use of electricity as a general nervine tonic, and its effects in reducing or removing the infirmities of old age, and which seems to have excited the special ire of your reviewer, has been favourably received by the greatest authorities abroad, such as Prof. E. Von Leyden, of the University of Berlin, Messrs. Trijier & Apostoli, of Paris; Prof. Domner, of the University of Lille, and many others; and has excited the greatest interest and attention in all parts of Europe and America. It is in consequence of it that I have been requested by the committee of the forthcoming International Congress of Electro-therapeutists, which will be held in

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Paris, in July, 1900, and which is being organised by the Société Française d' Electrothérapie, to give an address on the medical use of galvanism and faradism, and to open the discussion on it on that occasion. This shows as well as anything could, that those best qualified to judge, respect my teaching on that subject.

I feel convinced that my therapeutical discoveries, although they may appear startling to those unacquainted with the matter, will in 10 or 20 years' time be utilised by the entire medical profession, as a mere matter of course. An author on a special subject, who is in advance of his time, must occasionally pay the penalty for this, by receiving obloquy instead of praise; but I confess that I was not prepared, after such a long professional record as I lay claim to, for an onslaught which I consider most spiteful, if not actually libellous, and of which I trust and believe that he who has made it, will, on reflection, be heartily ashamed.

I request that you will insert this disclaimer in your next impression, and am,

Julius Altbaus, M.D.

Hof Ragatz, Switzerland,
September 2nd.

Stresses in Steam Engines for Electric Traction.

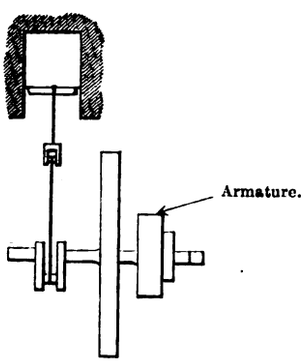
The able article on this subject in your issue of yesterday will serve as an incentive to thrash this matter out rather more fully than has, so far as I am aware, been done at present. It is, however, rather unfortunate that, after maintaining his case so well as regards the stresses on the crank-shaft on the *engine* side of the fly-wheel, you contributor should, as it were, at the last moment, rather give himself away by the manner in which he tackles the stresses arising on the *dynamo* side of the fly-wheel.

What I take exception to—and I do so very reluctantly, as I would much prefer to accept the solution of your contributor—is the statement that: "a traction generator has no mechanical or material inertia to overcome when a sudden accession of load is put upon it, and *this fact limits the maximum possible stress in the shaft to double the ordinary.*"

May I suggest to your contributor that it is *not* this fact which limits the possible stress, but, as I shall hope to show, simply and solely the question of the time-lag of the generator and the rapidity of action of the automatic cut-outs in the station.

Leaving for the moment, however, the question of the cut-outs, your contributor seems to have forgotten his remark, made earlier in his article, in which he acknowledged that there *were* "resistances due to the revolution of an armature in a medium resembling a fluid with a variable viscosity."

The point at issue is this: Is it not conceivable that the drag exercised by the field on the periphery of the armature (and which may be likened to the sudden application of an



extremely powerful brake) may, under certain conditions, attain proportions so considerable as to entirely outweigh questions of the inertia of the armature?

For clearness sake let me again repeat that I am now only considering the stresses on the shaft connecting the armature with the fly-wheel, and *not* those on the engine side of the fly-wheel.

This being so, what are the conditions? The fly-wheel and the armature are running at the normal speed; a short circuit occurs on the line; a rush of current of perhaps several thousands per cent. above the normal current (due to 500 volts acting through a trifling resistance); a sudden increase of the retarding armature torque, amounting—even assuming the field remained unaltered—to, in all probability, at least *one thousand per cent.* above the normal.

The result is equivalent to the sudden application to the armature of an immensely powerful brake, while the fly-wheel goes merrily on its way.

Your contributor, however, ignores this action. All I can say is that, though I have perhaps overstated my case as regards quantities, yet I can adduce from personal knowledge an instance where *two* traction dynamos, designed to absorb approximately 200 B.H.P. apiece, had their 5-inch shafts sheared off at the point where one would expect, from the above considerations, that such an accident would occur, and this *within three weeks* of one another.

The third was only saved, if I remember rightly, by reducing the weight of the fly-wheel by turning it down.

I am sorry that, for want of further time, I cannot now go into the question of why everything hangs on the number, arrangement, and rapidity of action of the automatic cut-outs; but the inference is a fairly obvious one, and I will close here, in the hope that I have explained my grounds for differing with your contributor's conclusions.

A. M. Taylor.

The only difference between myself and Mr. Taylor, is one of meanings. By mechanical or material inertia, I mean such inertia as, in a marine engine, is represented by the sudden putting into motion or rapid acceleration of a mass of inert water. The intensity of stress produced by such action is measured by the mass put into motion, and the time occupied in the process. The shorter the time the greater the stress, and given sufficient velocity acquired, and short enough time, a very little weight may induce enormous stresses. Now, the action of a sudden accession of current in a generator, can at its worst only represent a double stress. It is like the application of a brake to a fly-wheel, but it is not like the putting in of a claw-coupling attached to another and stationary fly-wheel. Now if we allow, and Mr. Taylor does apparently allow, this equivalent braking action, the whole question is narrowed down to the pressure that can be put upon the brake lever. I did *not* overlook this action, but merely stated that the stress due to it could not exceed double that due to the maximum current ordinarily generated. By *ordinary*, I mean the current beyond which the circuit breaker will not permit any addition.

If there were no circuit breaker, the braking action might be enormous, but I have assumed circuit breakers without which safeguard I fear stresses would be incalculable, and I should as soon make an engine without a fly-wheel as a traction system without a cut-out, and I have never seen any traction station without circuit breakers. Perhaps if Mr. Taylor will read the article again, assuming cut-outs, he will be in agreement with me. If not, will he state whether there is, or is not, reliance to be placed on circuit breakers. Does he consider these so slow in action that they permit the passage of such severe currents as to render them practically useless. Let me put Mr. Taylor's 1,000 per cent. of torque and my own coefficient of two for sudden loading into practice as follows:—

I will take it that Mr. Parshall's engine has a torque average equal to a 21·4 shaft with a 12-inch hole in it. This is smaller than Mr. Parshall's dimensions point to. Then 1,000 per cent. × 2 = 20 fold as the indicated ratio of strength in the shaft between fly-wheel and generator. The shaft for this must be 54·6 inches diameter!!! with a 12-inch hole, and Mr. Parshall's 32-inch shaft must twist off like lead. It is far too weak. Now, if Mr. Taylor's assumption is probable, as he says it is, it must be clear that Mr. Parshall places an enormous reliance on circuit breakers, so much so as to design or accept shaft diameters only half what they should be. For my own part, I have accepted the circuit breaker as being capable of preventing current in excess of a fixed maximum, and it is this fixed maximum which I would double to allow for sudden application. From his letter, I judge that Mr. Taylor has more to say, and I, for one, would be glad to have him say it. Will he tell us the rapidity of action of a circuit breaker, and

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whether it will do what I expect it to do? The whole safety of a traction station hinges on this, and without circuit breakers I fail to see what limit of sizes can be fixed on for a shaft.

Let us first agree on terms. By ordinary stress is meant the limit fixed by circuit breaker; by material inertia the energy of acceleration of a mass. My contention is, that the stress in the generator shaft is limited *within* double this ordinary, just as a beam deflects doubly as much under a suddenly applied load.

Will Mr. Taylor also state, can a short circuit produce an absolutely instantaneous sudden rush of current, or is there a certain duration of time in building up? Why are some circuit breakers fitted with a retarder to prevent them acting from mere passing flushes? These retarders are dangerous, for they prevent rapid action when this is necessary. If it is established that a circuit breaker will prevent excess of current, then there can be no abnormal or incalculable shaft stresses. If, on the other hand, they are not reliable, then Mr. Parshall's heavy shafts are mere temporary spindles.

Finally, Mr. Taylor adduces two cases from personal knowledge, where some 5-inch shafts were twisted off. Will he tell us, first, whether there were any circuit breakers; and, secondly, at what speed these shafts were running, for I find that if they were running at 180 revolutions, they correspond in strength with a solid shaft on a 4,000 H.P. generator at 90 revolutions per minute of 17 inches diameter, and a hollow shaft with a 12-inch hole of less than 19 inches diameter. It looks rather as though these 5-inch shafts were weak to begin with.

The Writer of the Article.

ECONOMY IN USE OF SUPERHEATED STEAM.

Mr. R. S. Hale is well known as a steam engineer in America, and his remarks on superheated steam in the *Engineering Magazine* are entitled to consideration. He anticipates the spread of superheating to England and America. A few years ago the practice seemed to have fairly recommenced in England, but we seem of late to have heard very little on the subject. The methods of superheating are discussed and enumerated. There are three usual methods.

(*a*) To place the superheater in the flue entirely behind the boiler. This effects a small gain and boiler efficiency, but less than can be secured from a flue feed-heater or economiser, but it cannot be very effective in adding a serious degree of superheat, for the waste gases have a temperature nothing much above that of the steam itself, unless when the boiler is forced, when a superheater may be itself effective, and also a considerable aid to the boilers.

(*b*) The superheater may have its own special furnace. Heat so applied is usefully applied, but the separate furnace is difficult of satisfactory application, and the total efficiency for the *production* of steam will be diminished.

(*c*) By placing the superheater in the path of the gases earlier than the waste flue, higher temperature is secured with efficient and considerable superheat. Nothing in the system prevents the application of the economiser at a later point, and generally the system seems to commend itself to Mr. Hale. It will be remembered that this is the system of which a good deal was said a few years ago in connection with the McPhail & Simpson superheater. But Mr. Hale appears only to know the system as applied on the Continent.

He says that carefully kept records show that the net result is equivalent to an addition of so much of the heating surface. 500 feet of superheater surface, he considers, would be equal, say, to 250 feet of more efficient water-cooled heating surface. If we recollect rightly, the experience of the McPhail system appeared to point to very effective surface if the steam was wet. A boiler could be forced until it primed, and the superheater dealt with the priming, and a water-tube boiler could thus be safely pushed to double and even treble its ordinary output, the superheater giving dry steam. Further, this position of superheater gives very even results, and it is fairly safe.

Still, an equal surface in an economiser will do more than a superheater, says Mr. Hale. Here, of course, he is speaking only of the generation of the steam, not of its possibly more efficient use. There are certain losses which are increased by the use of superheated steam, namely, those of radiation and leakage. The radiation losses increased with the superheat. This may be so, and still it is advantageous from a using point of view that steam should arrive dry at an engine. Saturated steam can never arrive dry. Superheated steam may.

Being bulky, superheated steam will suffer a greater fall of pressure than saturated steam because it must travel quicker. But is this quite true. It will travel faster with greater ease, for it will not be retarded by inert particles of water, and the velocity of a current of steam is reduced by its load of water. We quite agree, however, that steam pipes are too big in many cases. A 12-inch main is seen with 6-inch engine branches. Probably better results will be secured by reversing this, and putting 12-inch engine branches from a 6-inch main. A commonly-neglected point in steam pipe designing is that the flow of high pressure steam is very much greater than the flow of low pressure steam. The flow corresponds with the absolute pressure, but the production of a boiler is the same at all pressures. It is the same in weight but the volume differs, and no matter what the pressure the same volume of steam will flow through a given orifice. Obviously, therefore, the steam pipe of a high pressure boiler may be made much smaller than that of low pressure boilers of equal size.

Moreover, with early cut off engines the steam pipe may be correspondingly less than for long admission, provided that the sudden demand of steam at admission be provided for by the use of a receiver close up to the engine. A third loss of steam is leakage, Even when joints appear tight, there may be a good deal of steam leakage going on. Some tests of leakage have given the following figures:—

Mill	5 to 16 per cent.
Electric plant	2½ to 7 „
Steamship	1½ to 10 „
Waterworks	2½ per cent.

Suppose a plant to be worked only half of its capacity, then the leakage percentage will be doubled. As the temperature of superheating varies a good deal, so will the movement of the steam pipes be increased, and this will probably increase this percentage of leakage.

Coming to the engine, however, there is a clear net saving of 20 per cent. down to 10 per cent., and the use of mineral oils seems to have solved the problem of lubrication. Recapitulating, we find:—(1) A slight gain in the boiler; (2) an increased loss in the steam pipes; (3) a large economy in the engine.

While in favour of the form (*c*) of superheater, it is pointed out that where a long distance intervenes between the boiler and engine, the separate furnace may prove superior. Thus, if a short pipe be assumed, the following figures obtain in a typical instance:—

Gain at boiler...	2 per cent
„ „ engine	10 to 20 per cent.
Extra radiation loss	1 „ „
„ leakage „	3 „ „
Fall of pressure „	½ „ „
Net gain	7½ to 17½ „ „

Let now the length of pipes be doubled and the plant be assumed to work at only one-third its capacity.

Gain at boiler	2 per cent.
„ „ engine	10 to 20 per cent.
Extra radiation loss	6 „ „
„ leakage „	18 „ „
„ fall of pressure loss	½ „ „
Net loss, 2½ to 12½.	

In such a case, probably, superheating might pay if done near the engine. It will also pay to equip all boilers with superheaters if it is found to pay when some of them only are fitted.

Mr. Hale's remarks may be carefully considered. They point to the necessity of more careful steam pipe design. Pipe joints are one of the details of high pressure steam practice that are very unsatisfactory. A good steam pipe joint is needed. The lack of one is one of the chief obstructions to the economy of high pressure steam. Yet it seems almost as unattainable as a really strong half-inch bolt.

THE UTILISATION OF WASTE HEAT FROM FLUE GASES.

It is only comparatively recently that American practice has embraced the economiser or flue-feed heater, but having done so American engineers have gone a step further than ourselves, who have used the economiser half a century, for, to an extent unknown here, the system of fan draught has been employed for land boilers, whereas it is almost restricted to marine work in Europe. Yet it is 20 years or more since fan draught was used in a Yorkshire mill, the fans being placed at the rear of the boilers to draw away the products of combustion and discharge them to a chimney which only reached to the roof level of the factory.

The American line steamship pier at New York has its boilers fitted for fan-induced draught, and the plant is described in the *American Electrician*, which premises that with an air temperature of 60° and a chimney temperature of 500, a chimney of 100 feet will produce a sufficient draught, but that a chimney 175 feet will be required to produce the same draught with gases of 250°. This, of course, is just the reverse of a fan which is more effective with low than with high temperatures, and it is where temperatures are low, and in order that they may be low that a fan is used. A fan is more certain than a chimney, for its speed can be regulated to give a desired intensity. Unlike a chimney, and in direct opposition thereto, a fan will probably work better when the barometer is low.

An economiser is not merely an obstruction to the draught, but, by cooling the gases, reduces their draught-producing power, and a limit is put to any desired further temperature reduction. Everything points to the fan in place of the chimney. In a power plant of 1,000 H.P. at least 300 H.P. is rejected at the chimney in ordinary cases, and in good practice 1,000 H.P. at the engines must represent nearly 200 thrown into the chimney. Assume that 100 H.P. can be saved, is it not obvious that the 100 H.P. saved is very much greater

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than the power absorbed by a fan. Our contemporary sets down the ratio between fan power and chimney power as 1 : 75.

With gases entering an economiser at 526°, leaving at 269° and heating the feed water from 150° to 297°, a saving of 14·64 per cent. may be effected. Besides feed heaters, there are air heaters which will effect economy, but such things must not be carried too far. Americans in many cases seem to take it for granted that the use of an economiser necessitates a fan draught. This view has not been accepted in England where, for years, economisers have been employed with chimneys of 200 feet in power plants, giving results of 1·75 lbs. of coal per I.H.P. In America, however, many years since, Mr. Hoadley made tests where chimney gases were reduced to 162°, which represents only about 5 per cent. of heat loss. In Howden's system, the chimney gases are reduced to 574°, and the air supply is raised to 263°, but we suppose there was no economiser in this quoted case. In the particular instance under review, at the steamship pier the fan outlet has a temperature of 456°, and the air is heated to 315° when burning 41 26 lbs. of fuel per square foot of grate surface.

These results, of course, do not compare with those obtained from economisers; these sometimes reduce the gases to 350°, or even as above to below 300°, but possibly the economiser and the air heater could be both employed with advantage. Chimney draught seems never to have been applied with any satisfactory results where the air supply was heated. Something more is needed to force the air in sufficient volume to the fires. Theoretically, a saving is possible, but as air expands with heat its efficacy is spoiled, and it is only since fan draught has been employed that the regenerative system has become practically useful. In the apparatus at the steamboat pier the furnace air is simply drawn through nests of tubes around which pass the wasted gases on their way to the fan. Looked upon merely as a draught producer, the fan is a wasteful implement, unless accompanied by corresponding decrease of waste gas temperature. It should never replace an existing *sufficient* chimney, unless there is at the same time applied some means of using the waste heat. But given such means, a fan may be employed with great economy. So long as the chimney is there it need not be removed. It will always, if big enough in area, help the fan and save power in the fan engine. But if its site is wanted, the chimney may be destroyed, and it may be replaced by a simple low iron stack. It is a good plan to provide ducts, so that the fan may draw its air from the engine room to any desired extent.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending Sept 6th, 1898.		Week ending Sept. 5th, 1899.	
Adelaide	Value £2,139	Alexandria	Value £131
Alexandria	18	Amsterdam	25
Bombay	12	Antwerp	40
Bordeaux	10	Auckland	85
Boulogne	100	Bangkok	12
Buenos Ayres	870	Boulogne	63
Calcutta	531	Brisbane	157
Cape Town	957	Buenos Ayres. Teleg. mat. ..	449
Cologne	10	Calais	60
Colombo	14	Calcutta	140
Copenhagen	102	Cape Town	120
Durban	67	Chinde. Teleg. mat.	520
East London	60	Christchurch	50
Gothenburg	119	Christiania. Teleg. wire ..	47
Hong Kong	15	Colombo	53
Lisbon	14	Copenhagen. Teleg. wire ..	89
Mauritius	9	Demerara. Teleg. mat. ..	766
Melbourne	286	Durban	1,745
Naples. Teleg. mat.	100	East London	159
Paris	24	Gibraltar. Teleg. apprts. ..	36
Port Elizabeth	852	Hambro. Teleg. mat.	300
Sevastopol. Teleg. cable ..	1,200	Hong Kong	404
Shanghai	135	Labuan	39
Singapore	44	Launceston	58
Sulina. Electric detonators ..	65	Malta	68
Sydney	796	Melbourne	243
Yokohama	80	Monte Video	21
		Paris	165
		Penang. Teleg. mat.	60
		Port Said	27
		Rio Janeiro	83
		Santos	15
		Shanghai	2,062
		„ Teleg. wire (old) ..	93
		Singapore	337
		St. Petersburg	78
		„ Teleg. wire ..	89
		Stockholm	808
		„ Teleg. wire ..	46
		Sydney	1,092
		Teneriffe	12
		Tientsin	220
		Wellington	221
		Yokohama	68
		„ Elec. wire	333
		„ Elec. cable	139
Total ..	£7,775	Total ..	£11,349

Foreign Goods Transhipped.

Alexandria. Elec. supplies. Value £106

Anglo-German Competition in Russia.—The British Consul-General at St. Petersburg, in a recent report, shows that Germany is competing with us for the foreign trade of Russia with great success. He thinks the further development of this successful competition can best be met by greater activity on the part of British manufacturers, who should study previous Consular reports from Russia as to the methods to be employed; but he emphasises the importance of adopting the German system of frequently sending competent agents to Russia. The *Times* quotes the report at some length. It also mentions that a report from our Consul at Moscow says that while the machinery for cotton and flax spinning and weaving continues to be procured from England, mill engines are being got in increasing numbers from Switzerland, boilers from Poland, steam pumps and machine tools from America, and electrical machinery from Germany and Switzerland, though 10 years ago most of these went from England. In view of the ever increasing importance of Moscow, which is now the real commercial capital of Russia, he thinks British manufacturers and capitalists should give it more attention than they do at present.

Annual Outing.—The 14th annual outing of the employés of Mr. G. Stegmann took place on Saturday, 26th ult., when a most enjoyable day was spent on the river, starting from Richmond by steam launch. Lunch was served at Chertsey.

Auction Sale.—Messrs. Fuller, Horsey, Sons & Cassell, are instructed to sell by auction, at H.M. Dockyard, Chatham, on September 28th, at 11.30 o'clock, 10 electric light engines and dynamos, electric cable, gear, &c.

Bankruptcy Proceedings.—In *re* the bankruptcy petition of Henry William Thane, electrical and general engineer, 32, The Hill, Northfleet, near Gravesend. The debtor's summary of affairs show gross liabilities at £144 15s. 9d. The assets include £25 worth of stock-in-trade, and a few pounds are set down for machinery, trade fixtures, &c. There are also a few book debts, and a deficiency is shown of £101 7s. 3d. Debtor states that the cause of his failure is insufficient trade to meet expenses. Nearly the whole of the scheduled debts are with trade creditors.

The first meeting of creditors and the public examination in *re* the failure of S. F. Walker, electrical engineer, Cardiff, are to be held on September 11th and October 3rd respectively, at Cardiff.

Liquidations, Dissolutions, &c.—A meeting of the Northern Counties Electric and Motor Company will be held at Town Hall Chambers, Halifax, on October 4th, to hear an account of the winding up from the liquidator, Mr. J. Robinson.

Messrs. A. S. Jones and J. Ritchie (A. Savory Jones & Co., electrical and mechanical engineers, Oriel Road, Bootle) have dissolved partnership. Mr. Jones attends to debts.

Catalogues.—An illustrated list of electrical novelties and appliances comes to hand from the Ohio Electric Works, Cleveland, Ohio, U.S.A.

The General Electric Company sends us an illustrated list of the "Carsak" primary batteries.

From Messrs. Dick, Kerr & Co., we have received an illustrated circular describing the Solenoid blow-out series parallel controllers which are being used on a number of English electric tram lines, including Blackpool and Fleetwood, Dover, Dublin, Hartlepool, Liverpool Overhead and Waterloo and City Railways, and will be largely employed on the Bolton and Liverpool tramway systems.

Messrs. C. A. Vandervell & Co., of Thorpe Works, North Kensington, send us a set of illustrated price sheets of pocket batteries, portable lamps, cycle lamps, accumulator plates and accessories, measuring instruments, small dynamos and motors, &c.

Change of Name.—The name of the House-to-House Electric Light Supply Company has now been changed to the Brompton and Kensington Electricity Supply Company, Limited, and all communications should be addressed in that manner to Richmond Road, Earl's Court, S.W.

"Combricant."—This is the name of a new lubricant being introduced by the Lubricant Company, of Charles Road, Small Heath, Birmingham. We have received a sample tube of "Combricant," which we understand has been extensively tested on a number of public and private electricity plants with satisfactory results.

Commutator Burnisher.—The Edison & Swan Company sends us a list of its patent "Ediswan" commutator burnisher, which provides a simple means for keeping commutators in a perfectly clean condition. The trouble and inconvenience of "turning up" the uneven surface of a commutator frequently prevent this necessary duty being performed by the attendants of the machine, with the well-known deteriorating results to the commutator. This patent burnisher reduces the expenditure of labour required to a minimum, and the machines can always be run with a smooth and even-surfaced commutator, free from sparking and the consequent

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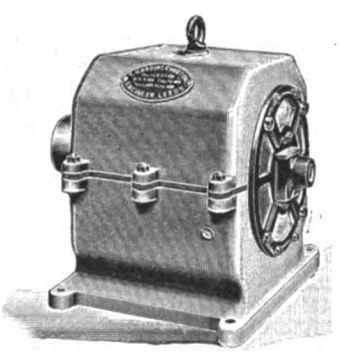
increased wear of the brushes. In operation, a strip of emery or polishing cloth, the same width as the burnisher, is cut, and one end inserted under the clip at the front end; it is then turned back under the flexible backing and applied to the commutator. The flexible backing is made in such a manner that it easily adapts itself to the curve of the commutator, but will not fall into depression on the surface. Thus the whole surface is evenly scoured with emery cloth to any degree of roughness required and afterwards polished.

Copper.—The *Financial News* says that movements of copper during August show a reversal of the conditions which obtained during July, a falling-off in the supplies and an increase in consumption resulting in the price of g.m.b.'s and standard copper going up again to £76 15s., at which it stood at the end of June, July having witnessed a decline of 10s. According to Messrs. H. R. Merton & Co.'s statistical circular, the deliveries last month were 18,595 tons, and the supplies 17,965 tons, and the stock now stands at 32,389 tons, a falling off of 630 tons. As compared with July, supplies were 2,377 tons less and deliveries 2,268 tons more.

Correction.—In our last issue we stated that Messrs. Sax, Slatter & Co., Limited, had removed to Basil Street, Sloane Street, S.W., from Foresters' Hall, Clerkenwell. As a matter of fact, the firm in April last, removed *from* Basil Street *to* Foresters' Hall, and the latter is the correct address. We are asked to correct the error as having closed their installation department which was originally carried on at Basil Street, Sloane Street, S.W. Messrs Sax, Slatter & Co., Limited have now ceased to do contracting work, and only carry on their wholesale department at Foresters' Hall, Clerkenwell.

Dynamos and Motors.—Mr. T. Harding Churton, of Leeds, is endeavouring to keep pace with the times by adopting advanced methods of manufacture for dynamos and motors. He is adopting the standardisation method for manufacturing parts, so that they may be in stock whenever required. The necessity for English firms to work on these lines has been many a time shown to be imperative, if they are to hold their own against foreign competition. His list of continuous current dynamo machines and electric motors for electric lighting and transmission work is before us. The con-



tinuous current motors detailed in this list are made to gauge, and they may be fitted with pinions for tooth gearing, or with pulleys for belt driving, or may be made for worm gear to suit requirements. The steel-armoured and enclosed motors, as shown in our illustration, are made with two and four poles, with slotted or plain armatures according to the purpose for which they are intended. They are claimed to be substantially reliably made, and motors of this type running in colliery work have run for six weeks continuously at varying loads. Others have been run for a long time, fluctuating from no load to full load without sparking. Shunt series and compound wound continuous current dynamos for 100, 140, 200, and 500 volts, are shown and briefly explained in the list, and prices are given. Among the installation contracts which have been recently carried out by Mr. Churton are the following:—An installation comprising two gas engines of 30 B.H.P., and two compound wound dynamos, switchboard, wiring, &c., and 58 arc lamps, for the Leeds Corporation. An installation comprising two dynamos, one of capacity for 1,200 lights, and the other for 150 lights, switchboard and wiring, &c., for Messrs. J. Hepworth & Son, Limited, Clothing Factory, Leeds. Electric pumping plant, consisting of 10-H.P. dynamo and motor working at 400 volts, the pump being about a mile distant from the dynamo; switchboard, insulated cables, gearing, &c.; electric lighting installation, 150-light dynamo, &c., for the Newmarket Haigh Moor Colliery Company, Oulton, near Leeds. Installation for lighting surface and pit of the Monk Bretton Colliery, near Barnsley, with about 150 lamps, dynamo, switchboard, &c. The dynamo here has worked day and night without a stop for six weeks together. A second dynamo has been recently supplied as stand-by.

Educational Notices.—The syllabus of lectures in the Engineering Department at the City of London College, Moorfields, under Prof. H. Adams, has been issued; also the complete syllabus of day and evening classes at the College. The new term commences on Monday September 25th.

The new session in Architecture, Building Construction, &c., at King's College, opens in October, and a syllabus of the day and evening classes can be obtained on application.

Explosion.—It is stated that on Monday an explosion, cause not stated, occurred in the electrical department of the Clydebank Shipyard with somewhat serious results.

Explosion at Silvertown.—On Tuesday afternoon an explosion occurred at the India-Rubber Company's Works at Silvertown, in an experimenting laboratory, and, in attempting to extinguish the flames, a man named Wood, aged 20, was severely injured by falling through a skylight. Much damage was done.

Fire.—It is stated by Reuter that on 30th ult., in the evening, a serious fire broke out in some large electrical works at La Chapelle Triage, by which the Chapelle and St. Denis railway stations are supplied. Damage was done to the extent of 1,000,000 fr. No one was injured.

Fire Resistance Materials at the Paris Exhibition.—There will be an important collective exhibit at the forthcoming Paris Exhibition, representing the fire resisting materials, system of construction, and appliances of Great Britain. The arrangement of this collective exhibit (the first of its kind) is in the hands of the British Fire Prevention Committee, to whom the Royal Commission has allotted the necessary space gratuitously, recognising the national importance of the idea, and the disinterestedness of the effort being made by the Committee to show what the country can produce in this direction. Mr. Frederick R. Farrow, F.R.I.B.A., chairman of the commercial section of the Committee has kindly undertaken the direction of this collective exhibit, and it has been decided that all applications from all British and Colonial firms to be represented in this national exhibit, must reach the offices of the Committee by October 7th. The Committee itself will exhibit a model of its testing station, specimens of reports, and the like.

Gas Motor Car.—We illustrate herewith a convenient form of gas motor car patented and manufactured by Mr. W. H. Dunkley, of Birmingham. It is intended for two adults, as a phaeton, or for two children and a governess, or one adult. It is driven by a Dunkley gas motor, which is constructed so as to be capable of taking in gas from any ordinary gas pipe, with a gas bag attached, or to work with gas that is generated and made as required, as the car goes

along. The speed is from two to twenty miles per hour; it is 5 feet long, 4 feet 6 inches high; and 2 feet 8 inches wide, permitting it to go through any ordinary doorway and stand in any ordinary room. It weighs about 4½ cwt., has two brakes, can be stopped instantly, and will turn in the narrowest streets, easily controlled by a youth or governess. Freedom from smell, vibration and noise, is claimed, and it is guaranteed fireproof. It would be interesting to hear how the car generates the gas as it goes along.

Hopkinson's Valves.—From Messrs. J. Hopkinson and Co., Limited, of Huddersfield, we have received illustrated catalogues describing the special features of their patent valves, including the patent "Ris" valve, patent isolating valves, and blow-off and scum valves. Each of the lists is well arranged and illustrated, and prices are given.

Madras Electric Tramways Company.—Some notes to hand from an Indian newspaper, state that on August 15th a meeting of shareholders in the above company was held to consider the company's position in connection with the threatened bankruptcy proceedings. Mr. Norton, the chairman, explained that the Electric Construction Company, to which the Madras Tramways Company was indebted to the extent of £65,000, had instituted proceedings in London and filed a petition for the liquidation of the Tramway Company. Mr. Norton strongly criticised the gross mismanagement of this magnificent property, for which he held the directors principally responsible, while the shareholders were extremely apathetic and allowed the directors to do practically what they liked. After a lengthy speech it was resolved that a subscription of 4 annas per

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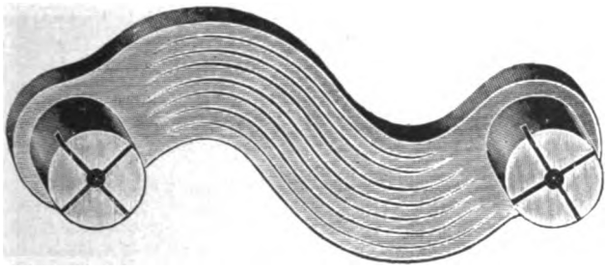
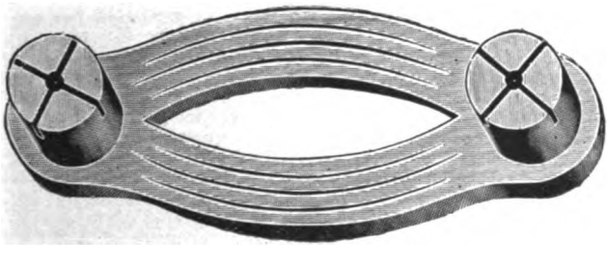
share be levied to meet the legal expenses in London, that the solicitor, Mr. Tasker, should be asked to protect the shareholders' interests in London, that the Committee be authorised to form a company for the purchase of the Madras tramways, and that an issue of 15 lakhs first mortgage debentures on the tramway be made, preference being given to the original shareholders.

New Electrolytic Works.—A Manchester paper says that land has been purchased at Cledford Bridge, Middlewich, by the Parent Electrolytic Company, and a subsidiary company has been formed to manufacture chemicals by a new electrical process.

A New Flexible Rail Bond.—To the various bonds manufactured by Messrs. Felten & Gilleaume, Mulheim-on-Rhine (Germany), and of which large quantities are already in use in the United Kingdom, another new type has been added by them, of which an illustration is given herewith. This new bond has the great advantage over other similar bonds that it is like their ordinary



"Neptune" bond, drop-forged out of one piece of copper, so that there is no weld or joint in them whatever, whereby the highest perfection obtainable is secured. The bond is designed for use in the web of the rail underneath the fishplate, and is fixed in the same method as the "Neptune" bond, viz., by expanding the head of the bond by steel drift pins. In order to provide for the vibrations of



the rails, the body of the bond has been made flexible by means of narrow strips. The sectional area of the body is equal to that of a 6/0 S.W.G. round wire, and the heads are made for ⅞ inch holes in the rails, although other dimensions can be made to order. Messrs. Felten & Gilleaume's price list for copper bonds is now being revised.

South African Electrical Notes.—The current issue of the *British and South African Export Gazette* contains the following items of electrical interest:—

The electric lighting installation ordered by the Langlaagte Exploration and Building Company, for the Mayfair township, Johannesburg, has been delivered.—The electric lighting and power plant of the Globe and Phœnix Gold Mine includes a 90 KW. generator of the four-pole type.—A 15 H.P. motor is also to be installed at an early date.—A complete electric lighting equipment is under order for the Surprise Gold Mine, Rhodesia.—An additional generator for supplying power to the slimes plant is to be erected at the New Primrose Gold Mine.—Considerable orders for telephone plant and material for the East London (Cape Colony) telephone service are in the hands of makers.—The equipment of the Kimberley electric lighting scheme, the contract for which is being carried out by Messrs. Reunert & Lenz, Johannesburg, includes four dynamos, each of 75 KW., 220 volts, and a capacity of 300 amperes. They are being manufactured by the New York General Electric Company. The cables employed will be from the works of Messrs. Johnson & Phillips, Limited.—A Fowler-Hall alternator of 180 KW. (about 240 H.P.) has been erected at the East London Electric Lighting and Tramway Works, and a second is on order. These are to be used for incandescent street and private lighting. The two tramway and arc lamp machines are also of 240 H.P. each.—An order for two dynamos, each capable of an output of 350 KW. as a continuous load, to cost £3,150, has been placed with the South African General Electric Company (Messrs. G. Findlay & Co.) by the Capetown Town Council. The dynamos, we believe, will be of American pattern.

Traction Equipment Contracts.—The London correspondent of the *Street Railway Journal* recently stated that contracts were ready for giving out for the 15-mile light railway to connect Ramsgate and Margate, in which scheme Mr. Wm. Murphy is the moving spirit. It is further stated that the entire contract for the electric equipment of the Rheims (France) Electric Tramway has been taken by the Paris house of Robert W. Blackwell & Co. The same concern has also received the contract for the additional rolling stock required by the Marseilles electric lines.

Trade Announcements.—We observe that the firm of R. W. Blackwell & Co. has now been registered as a limited company under the title of Robert W. Blackwell & Co., Limited. The registered offices are at 39, Victoria Street, Westminster, London, S.W., and the capital £200,000. This company will take over as a going concern, the business of engineers and contractors heretofore carried on by Messrs. Blackwell at 39, Victoria Street, Westminster, London, S.W.; 133, Bermondsey Street, London, S.E.; 20A, Chapel Street, Liverpool; 50, Boulevard Haussmann, Paris; and 120, Liberty Street, New York. The directors of the new company are Robert Winthrop Blackwell, Philip Dawson, and Benjamin Hunting Howell, managing directors (present partners in the firm of Robert W. Blackwell & Co.), Sir Charles E. Howard Vincent, and Francis Henry Barker.

The registered offices of La Capital Tramways Company, Limited, La Capital (Extensions) Tramways Company, Limited, and La Capital Traction and Electric Company, Buenos Ayres, Limited, have been removed to 19, Finsbury Circus, E.C.

Messrs. Wm. Whitehouse & Co., fittings manufacturers, of Birmingham, have appointed Mr. H. Adlam to represent them in London. The showroom will be at 59, Holborn Viaduct as heretofore.

Western Union Telegraphic Code and International Cable Directory.—In the High Court of Justice on Wednesday last week, Mr. Joseph moved before Mr. Justice Cozens-Hardy, sitting as vacation judge, to expunge an entry in the minute book of the International Cable Company, of New York, as registered proprietors of the copyright of the Western Union Telegraphic Code, and that the company should be condemned in costs. Counsel asked that the case might stand over for a week. The Mercantile Publishing Company were the registered proprietors of a code called the "Broomhall's Comprehensive Cypher Code," which was registered in 1895, and was assigned to the Mercantile Publishing Syndicate in January, 1896. In August, 1898, the International Directory Company, of 30, Broadway, New York, U.S.A., were registered as the proprietors of the code, and an action was brought against them in July last with the result that an injunction was granted restraining the publication or importation of this code; he suggested that the matter should stand over. Mr. Bucknill consented. His Lordship ordered that the matter stand over until the second motion day in the next sittings.

ELECTRIC LIGHTING NOTES.

Aberdeen.—Several Scotch papers record an enormous increase in the business of the electricity supply works at Aberdeen, by saying that the increase in current supplied during the past seven months was "75,527 *volts*" more than for the corresponding period last year. The total revenue for current supplied during the past year has been £4,804, a decrease of over £900 compared with the preceding year. The expenditure was £2,081, against £2,596 for 1897-98.

Beverley.—The town clerk is to continue his inquiries *re* electric lighting in other towns, and report to the next Council meeting.

Cardiff.—On a wet day last week there was a leakage of current from the mains in St. Mary Street. Several passers by are reported to have received shocks. The first to notice the occurrence was a little dog, who went up to an iron pillar in the usual way.

Carlisle.—The General Purposes Committee have had before them the tenders for the plant required for electric light extensions, and have appointed a sub-committee to confer with Prof. Kennedy *re* same.

Cheltenham.—A special Council meeting is to be held to resolve to apply for a provisional order for the extension of the electric light area at Charlton Kings, Leckhampton, Bishop's Cleeve, and other adjacent villages. A Local Government Board inquiry is to be held *re* the proposed loan of £16,600 for electric lighting.

Dolgelly.—A member of the District Council is calling attention to the desirability of having the town lighted by electricity.

Edinburgh.—A steam pipe at the Dewar Place electricity works burst on Tuesday last week. No one was injured.

Germany.—A company is in course of formation in Chemnitz to establish a large central power station to supply energy to an electric tramway between that town and Burgstadt, and for lighting purposes to a number of small towns in the district.

Glasgow.—The Watching and Lighting Committee last week considered the minutes of the sub-committee on electric lighting of streets, from which it appeared that it had been remitted to the inspector of lighting and the electrical engineer to report how to modify the cost of electric lighting. Mr. Chamen, the electrical engineer, had reported that he did not think any increase in the distance between the lamps could be safely recommended. The average distance apart, as proposed by the inspector of lighting, is 50 yards, and that is the practice usually adopted in all other important cities. For outlying districts it might be possible to increase the distance to 60, or even 70 yards; but if arc lamps were spaced thus far apart, the space between them would appear to the eye far darker than it really was. The electrical engineer also pointed out that in Princes Street, Edinburgh, the lamps are only an average distance of 45 yards apart, and are about half as powerful again as those in Glasgow. The conclusion he came to, therefore, was that he could not take the responsibility of advising that the arrangement and number of lamps be in any way reduced; and he further pointed out that the price of £14 per annum per lamp for lamps lighted the

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whole night through was the lowest in the kingdom, with the exception, perhaps, of Edinburgh, where, however, the price of £14 per lamp per annum is an all round price for lamps lighted—some all night, and some half the night. On the other hand, the capital cost and maintenance of the arc lamp pillars, lamps, and all accessories, is borne by the Electricity Department. The inspector of lighting, in his report, detailed the routes to be dealt with. The sub-committee recommended that the streets described in the report be lighted by electricity. The Watching and Lighting Committee approved the minutes.

Consumers have been circularised by the Electricity Department *re* systems of charging for current, and asking under which system they prefer to be assessed, viz:—

1. On the Maximum Demand System —For any quantity of current taken up to, but not exceeding the maximum demand for 365 hours in the 12 months, from June 1st, 1899 (being an average of one hour per day), 6d. per Board of Trade unit; all current consumed over the above-stated quantity 1½d. per Board of Trade unit. With the alternative of paying on—

2. The Fixed Charged System.—A fixed charge of 4s. per annum for each 8 c.p. (32-watt) lamp, or its equivalent, fixed in consumer's premises (or £6 5s. per kw.), this charge being spread uniformly over the 12 months from June 1st, 1899, and an additional charge for all current used as recorded on the meter of 1½d. per Board of Trade unit.

Consumers who take a supply of current for the equivalent of five hours or more per day for 365 days per annum, to be charged throughout at the rate of 1½d. per unit.

It is expected that the scheme for electrically lighting the Glasgow Harbour will be completed next month. Most of the small cranes in the Prince's and Kingston Docks will be worked by electric power.

Grays.—Mr. Preece has advised the District Council that there will be no difficulty in supplying Little Thurrock with electric light if that district obtains an order. The Council is making inquiries.

Halifax.—Tenders for masonry, joiners', plumbers', and other work in connection with the extension of the electricity works have been accepted.

Heckmondwike.—The Council has considered plans and estimates, prepared by Mr. Hawtayne, for electricity works, and the Electric Lighting Committee's recommendation to apply for a £14,000 loan to carry out the scheme, has been adopted.

Hereford.—The laying of electric light cables is nearly finished. It is thought that the works may be ready for opening at the end of October.

Hertford.—The *London Gazette* contains the usual formal notice of the intention of the Council to transfer its provisional order to the North Metropolitan Electrical Power Distribution Company, Limited.

Islington.—The Vestry is now commencing supply of current in various thoroughfares in Highbury Park at 200 volts.

Lambeth.—Work is progressing at a rapid rate at the electricity works with a view to being ready for the coming winter.

Leeds.—Since the electric lighting works of the Yorkshire House-to-House Electricity Company were taken over by the Leeds Corporation, towards the end of last year, the plant has been gradually extended to meet the growing demands. The Lighting Committee is not only adding to the machinery at present in use at the works in Whitehall Road, but is also taking steps to have extensions of a more comprehensive character carried out. Four new Lancashire boilers are nearly ready for use—these being of the type previously used. The management are also putting in, as an experiment, a boiler of the Babcock & Wilcox water-tube type. A 1,000-H.P. combined dynamo and engine is also being ordered, and two others of the same size are being constructed, one of which is to be at work before the winter. These are improvements that are to be carried out on the existing premises. With the demolition of the Britannia Mills, which has just begun during the last day or two, says the *Yorkshire Daily Post*, the Corporation will have at their disposal a valuable area for extension purposes. The Britannia Mills, which adjoin the present works and have a long frontage to Whitehall Road, cover an area of an acre and a half, or half an acre more than that on which the electric works now stand, and the space will be used to better advantage, inasmuch as the engines being of greater capacity than those on the other side, space will be economised. The cost of the old mills was included in the £217,000 purchase money that the Corporation paid to the Yorkshire House-to-House Company. For the erection of the new building and for its equipment, it is proposed to raise £150,000, and application for permission to borrow the money has been made. The engineer of the works (Mr. H. Dickinson) is just returning from the United States, where he has been making inquiries as to the different systems of generation and distribution of electric light, and Messrs. Hopkinson and Talbot are also to report as to the best plan to be followed in future work. The number of lights now connected with the mains is fully 50 per cent. more than it was at the same time last year. It should be added that the mains in the Hunslet district are just completed, and intending consumers in that part of the city may have their supply almost at once.

Liverpool.—The Electric Power and Lighting Committee recommended the Council at their meeting on Wednesday to accept a tender for the erection of an electric power station in Lister Drive for a sum of £49,783, and tender for the supply of three engines at a cost of £6,939 each, and three at £1,377 each, for the Lister Drive and Cobb's Quarry electric stations.

Llandilo.—The ratepayers are asking the Urban Council to take a house-to-house canvass *re* the electric lighting question.

An expert who recently gave an opinion *re* a scheme, calculated that the total cost of a 220-volt continuous current service would be about £2,900. Another £200 will have to be spent upon a provisional order. £500 may be saved if the Board of Trade will sanction the use of overhead mains. Within a couple of years 2,000 lamps will probably be used, giving an approximate revenue of £1,000 a year. The ratepayers' meeting sanctioned the Council to proceed with a complete system.

Norton.—The Council has informed Messrs. O'Gorman and Ockens-Hardy that it will be glad to consider any particulars they may be able to submit *re* electric light proposals for Norton.

Paisley.—The electricity works are all but completed. The total capacity of the plant is 18,000 8-c.p. lamps. Current was to be switched on on 5th inst. by the chairman of the Electric Lighting Committee.

Penarth.—It is stated that the Electrical Power Distribution Company will start immediately to construct electricity works near Lower Penarth.

Peterborough.—A request from a local company to be allowed to run an overhead wire from one depôt to another a short distance away for electric lighting has been refused by the Council.

Shoreditch.—The Lighting Committee, at a meeting of the Vestry on Tuesday, recommended the authority to purchase from Messrs. Lines for £14,500, the freehold of the wharf property facing Bath Place and Whiston Street for the purpose of a new generating station. Mr. H. E. Kershaw, in the absence of the chairman of the committee, moved the adoption of the recommendation. He stated that within 12 months the whole of the present plant and the new engines would be fully loaded, and that the Vestry would then be called upon to provide more light. The profit on the electric light undertaking during the past year exceeded that of the previous 12 months, and the authority would meet the reward of its municipal enterprise by undertaking the new scheme. There had been, the speaker said, a magnificent profit during the past year of between £3,000 and £4,000. Mr. Hall having seconded the motion, Major Wenborn proceeded to condemn the price proposed to be paid for the site as being excessive. Mr. Winkler said they were told years ago that the heat from the refuse would provide all the light required. Looking at the question now there was a great difference. There were five boilers in position, and the new scheme would involve a further expenditure of, perhaps, £30,000. He contended that the Vestry had been deceived in the matter; the destructor did not pay, and the speaker had always pointed out that it would not yield a profit. Other members having spoken, Mr. Kershaw, in reply to the discussion, said that he agreed that the price to be paid was high. *He would take that opportunity of withdrawing the statement which he made at the opening of the station—that the destructor would generate all the steam required;* but it was not possible at that time to foresee that the undertaking would grow to such a large extent. It was not true that the Vestry had been deceived as was suggested. If the destructor was allowed a fair value for the steam supplied and for the destruction of the refuse, a profit was shown on that department. On being put, the recommendation of the committee was adopted without any dissentient. It was decided to enter into a revised contract with the Brockie-Pell Arc Lamp Company, owing to the discontinuance of incandescent lamps on the street arc lamp standards, and by means of which a saving of £3 11s. per standard will be effected.

The Vestry on Tuesday approved regulations for the supply of electric current to tenements on the Moira Place and Plumber's Place areas, where workmen's dwellings have been erected by the Vestry under the Housing of the Working Classes Act. Among the regulations are the following:—

The main switches for regulating the supply will be under the control of the superintendent. The current to the rooms will be turned on each day at dusk and turned off at midnight. From October 1st to March 31st, the current will also be turned on at 5 a.m., and turned off at daylight. Tenants will be charged for the supply of electricity by an increase of the rent to the extent of 8d. per week for a two-room set, and 10d. per week for a three-room set, and such increased rent with any sums due for breakages, damages, or the like under these regulations will be recoverable as, and form part of the rent as and when the same becomes payable. One 16-c.p. lamp will be fitted in the living room, and one 8-c.p. lamp in each of the bedrooms. The Vestry will pay the cost of supplying and fixing wires and lamps and of renewing such lamps and wires except when broken or damaged by the tenant.

The Scottish Borders.—The Lighting Committee of St. Boswells have instructed Mr. Purves, Edinburgh, to make application this autumn for a provisional order for electric lighting. Mr. Purves has also suggested a scheme for Kelso, which he states to be admirably situated for the purpose, and the scheme includes the running of an electric tram from the town to the station. Hawick and Galashiels have also schemes under consideration.

Simla.—The electric lighting of Viceregal Lodge, Simla, will be thoroughly renovated next season at a cost of about 96,000 Rs. The present installation, which is 13 years old, is, according to a Delhi paper, obsolete and the plant now worn out.

Stoke-on-Trent.—The Board of Guardians has appointed Mr. G. R. Peers, of Manchester, to make an examination of the workhouse, and report to the Board upon the advisability and cost of installing electric light.

(*Continued on page* 404.)

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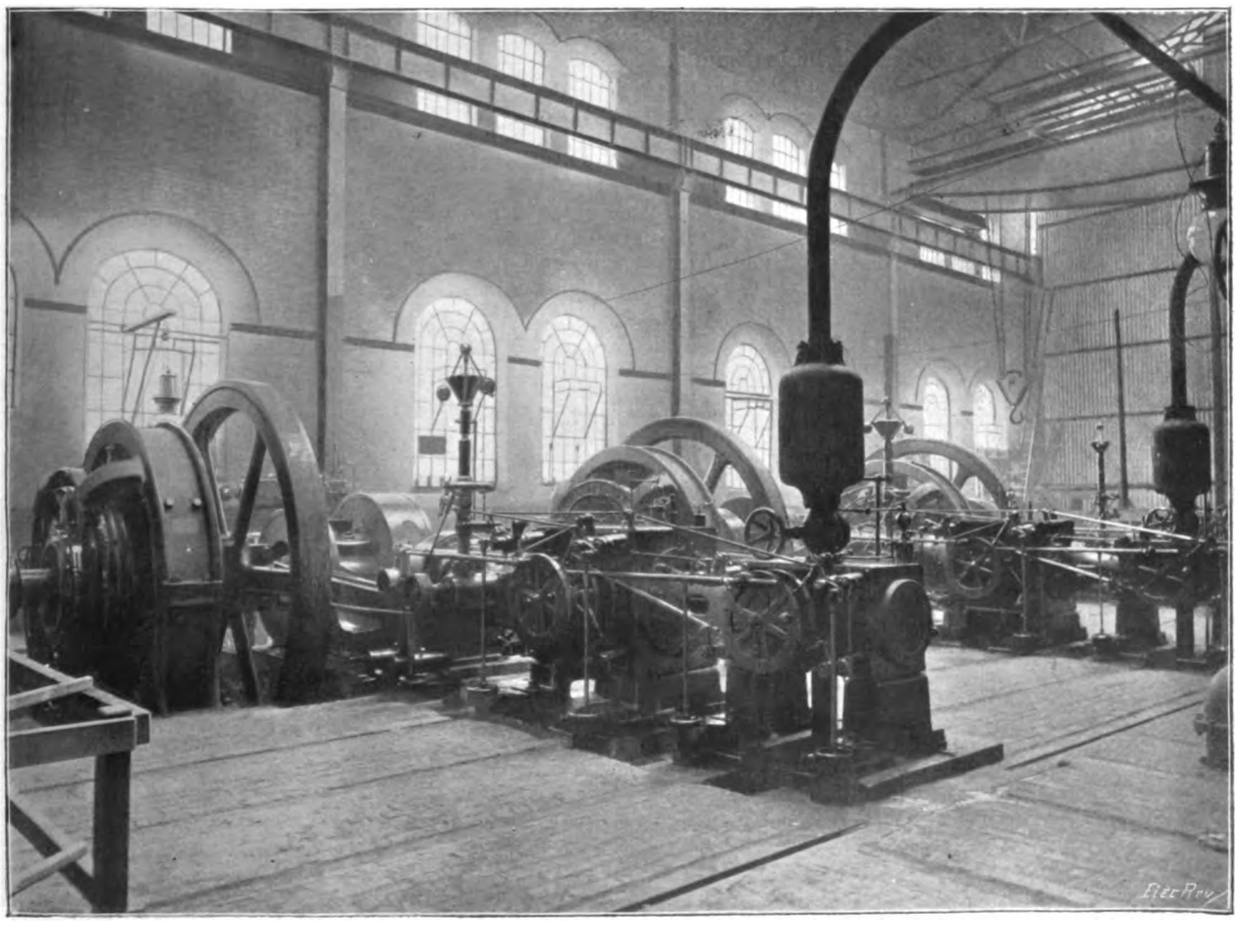
SHEFFIELD CORPORATION TRAMWAYS.

The city of Sheffield has a population of over one-third of a million, and covers an immense area, the outside measurements of the boundary being 4 miles by 12 miles; it is also very irregular, some parts of the city being a quarter of a mile higher above sea level than others. It would seem that here is a splendid field for mechanical traction, the gradients being too severe for animal haulage, except on certain routes. The old horse tramways first laid by the Corporation in 1872, and leased to a company, consisted of about 9¼ miles of double line; they remained at that figure for 24 years, when the lease expired. The Corporation then took over the working of the lines, and set to work with energy to popularise and improve the system. A deputation visited a number of British and Continental cities in September, 1896, to study the methods adopted there, with the inevitable result that electric traction on the overhead system was adopted, as being most suitable for the conditions prevailing at Sheffield. In 1897 powers were obtained for the construction of about 27 miles of double track, in addition to the 9 miles already existing, at an estimated cost of over £600,000, including electrical equipment. The work has been carried on rapidly, and the first 5 miles to be electrically equipped was inspected, on behalf of the Board of Trade, by Col. Marindin on August 25th for the Railway Department, and Mr. Trotter on August 29th for the Electrical Department. The first section of the lines, from Tinsley to Nether Edge, commenced regular running on Monday last; the Walkley section is also complete, but as

Street View.



Interior of Power House.

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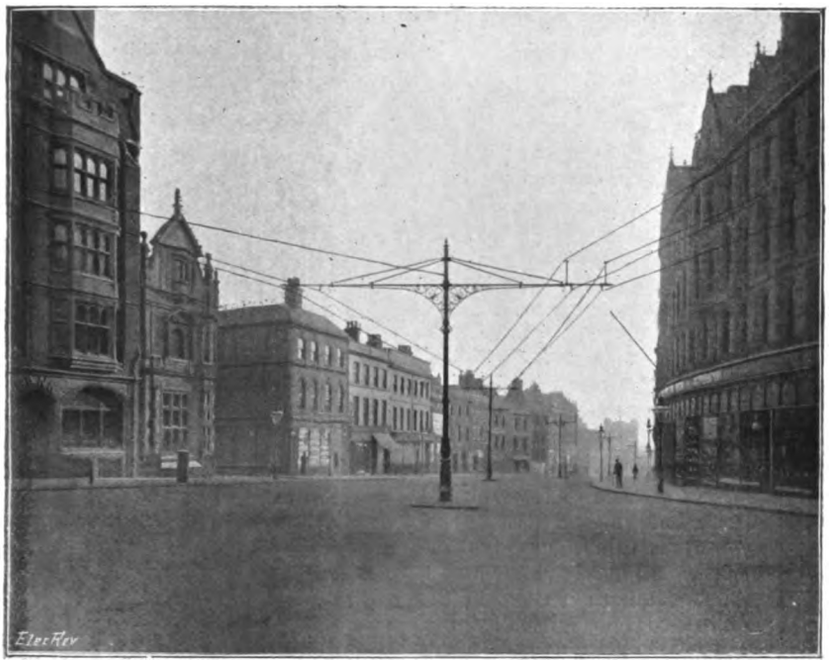
this abounds in excessively steep gradients, including some of 1 in 10, the drivers are to have a longer period of probation and training.



Street View.

The whole of the line work on the Nether Edge and Tinsley sections was done by the British Thomson-Houston Company. The equipment, including the generating plant, &c., was contracted for by the British Thomson-Houston Company, Limited. The extensions are being carried out by the Corporation staff.

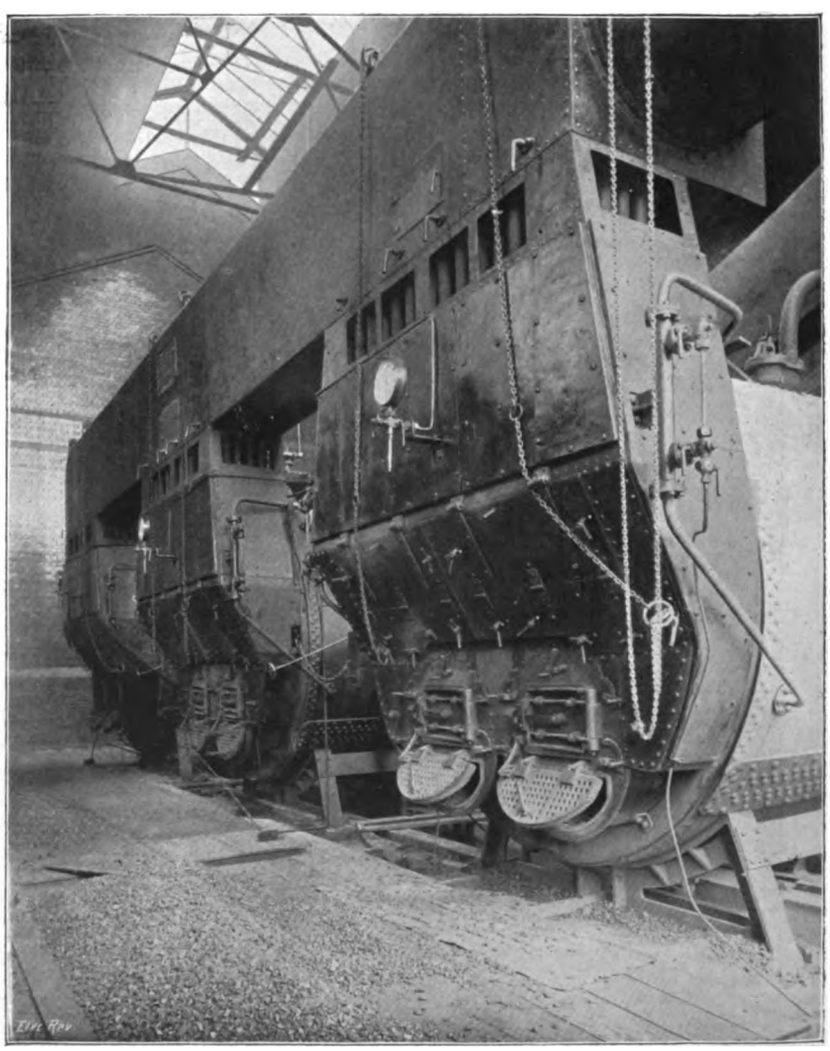
The power station consists at present of a building 110 feet wide, 90 feet long; the work of doubling the length is already in progress, and part of the additional machinery is almost ready for erection. The boiler house adjoins the engine room, and as will be seen from our illustrations, is very different from what we are accustomed to find in electricity works.

The boilers are of the marine "wet-back" multitubular type, and stand upon cast-iron chairs, without brick setting. They were built by Messrs. Vickers, Sons & Maxim at Barrow, and fitted with "Serve" tubes, "Ellis & Eaves" induced draught system and air heaters, by Messrs. John Brown & Co., Limited, Sheffield. Each boiler has two furnace tubes of the "Purves" ribbed type, somewhat resembling the Fox corrugated flues, but with ribs at intervals only; the combustion chamber, as the name "wet-back" implies, is entirely within the boiler, and the gases are returned to the fore end by "Serve" tubes of welded steel, which provide a large heating surface by means of inwardly projecting longitudinal ribs. The waste gases pass into a smoke box over the furnace doors, then through a large number of vertical tubes into the common flue above the boilers; from this they are drawn through trunks by fans and driven up the short steel chimney shaft, or at slack times they escape by natural draught. The air supply to the furnaces is admitted through traps seen in the front view of the flue, round the up-cast tubes from the smoke box; it then flows round the sides of the latter into the furnaces. The fans are two in number, direct driven by enclosed engines, which as well as the fans were made by Messrs. Thwaites Bros., Limited, Bradford.

The boilers work at a pressure of 160 lbs. per square inch, and are provided with thermometers and water gauges to show the state of the draught; they are fired by hand with small coal, and are each capable of evaporating 8,000 lbs. of water per hour. Four more boilers are on order, similar to those at present installed; they will be placed closer together—13 feet centres, instead of 17 feet 6 inches—and there will be one fan to three boilers, instead of 1 to 2, as at present. Mr. Fell also intends to instal conveyors, with automatic weighing machines, which will record the weight of coal received and the amount delivered to each stoker. A wide trench is provided under the ashpit doors, to accommodate an ash conveyor; the ashes will be dropped direct into the conveyor, and carried into a receptacle from which they can be removed at convenience.

Behind the boiler house there are coal stores, and a large tank, from which the circulation water is drawn. Water is admitted to the tank by means of a pipe from an adjoining "goit," or cut from the River Don, which flows past the site of the works, practically making it an island; the water is returned direct into the goit. The engineer's office is to be situated behind the boiler house, and over the former is a feed-water tank holding 11,000 gallons.

The steam pipes are of lap-welded steel with screwed



Marine Boilers.

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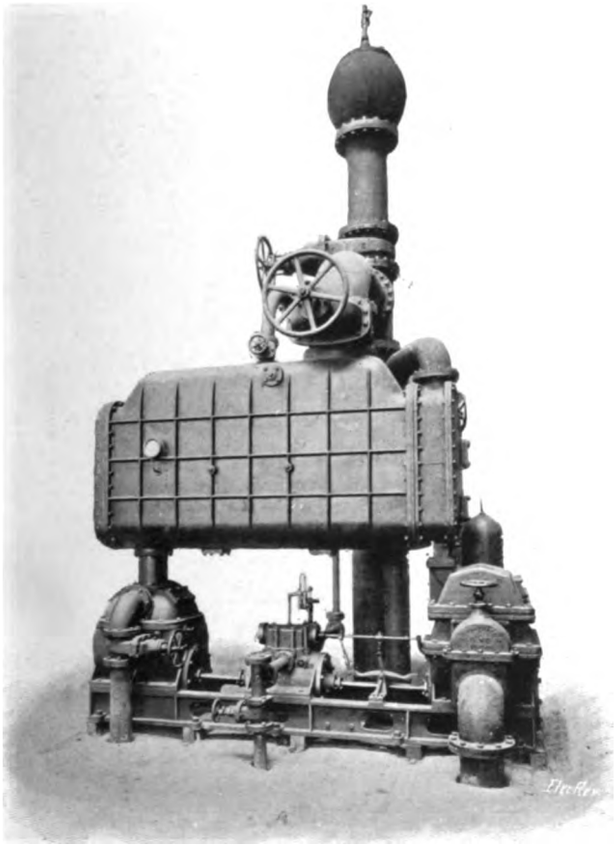
flanges; no ring main is used, the boilers being connected to a single large header running along the boiler house wall; from the header a pipe is led to each engine, passing through a separator immediately above the high pressure cylinder. The steam junction valves in the boiler house, and the feed check-valves are of Hopkinson's make; all the piping was supplied by the Best Fox Manufacturing Company, of Philadelphia.

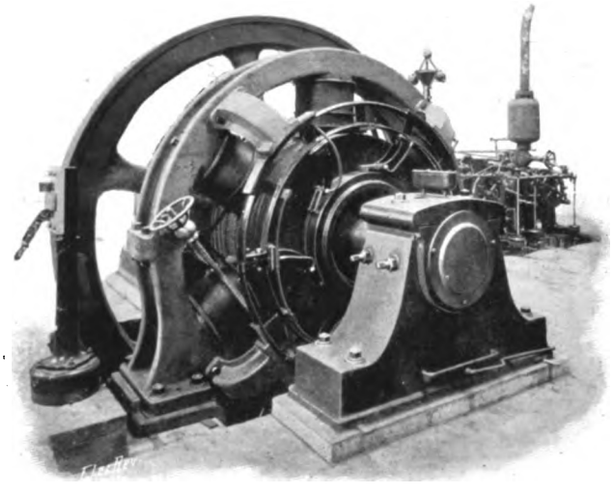
The condensing plant consists of a Wheeler "Admiralty" surface condenser having a tube surface of 1,900 square feet. The condenser is mounted directly upon Wheeler combined air and circulating pumps, as shown in our photograph, in which also the relief valve to atmosphere is seen above the condenser; the steam cylinder is 14 inches diameter, the air and water cylinders 16 inches diameter, and the stroke is 16 inches. The outfit is capable of caring for 19,000 lbs. of steam; it is fitted with Wheeler patent tubes, made of solid drawn brass, well tinned inside and outside, one end of the tube being drawn thick and having a thread chased on same, and screwed directly into the tube plate, thus making a mechanical and permanent joint, which will always be tight. The other end of the tube is secured by means of ferrule and corset lace packing which allows for the full expansion and contraction of the tubes.

Street View.



Condensing Plant.

Both the air and circulating pumps are operated by one steam cylinder. This steam cylinder is fitted with the maker's improved valve motion, which can be adjusted to run a full length of stroke under all conditions of speed, and there is no loss of motion, so that the economy in running this set is claimed to be very low. In the heater the same type of tube is used as in the condenser. The tubes are made of a large size, so that there is ample waterway and no choking of the feed-water on its way to the boiler. The area of the tubes through which the water passes is from five to six times the area of the feed pipe. Two more condensing sets similar to this are about to be erected. There is a horizontal Wheeler feed-water heater placed between the feed pumps and the boilers for utilising the heat of the exhaust steam from the auxiliary plant; the feed-water passes through tubes, the steam being outside. A pair of Edmiston feed-water filters are also provided, and are arranged so that the feed can be sent through either or both filters, or through a by-pass as desired. There are two "Manchester" vertical duplex pumps, made by Messrs. Pearn & Co., Limited, with cylinders 5½ inches diameter, rams 8½ inches, and stroke 5 inches. These, with the feed-heater and filters, are placed beneath the floor of the engine room.



B.T.H. Railway Generator.

The engines are of the "Allis" horizontal tandem compound condensing type, three in number, with cylinders 12 and 22 inches × 30 inches stroke; their normal speed is 135 revolutions per minute, with a steam pressure of 150 lbs. per square inch. Reynolds-Corliss valve gear is used, with trip admission valves, and a gravity governor resembling the familiar Porter pattern. A jockey pulley running on the governor belt is connected by a loose link with the gear, so

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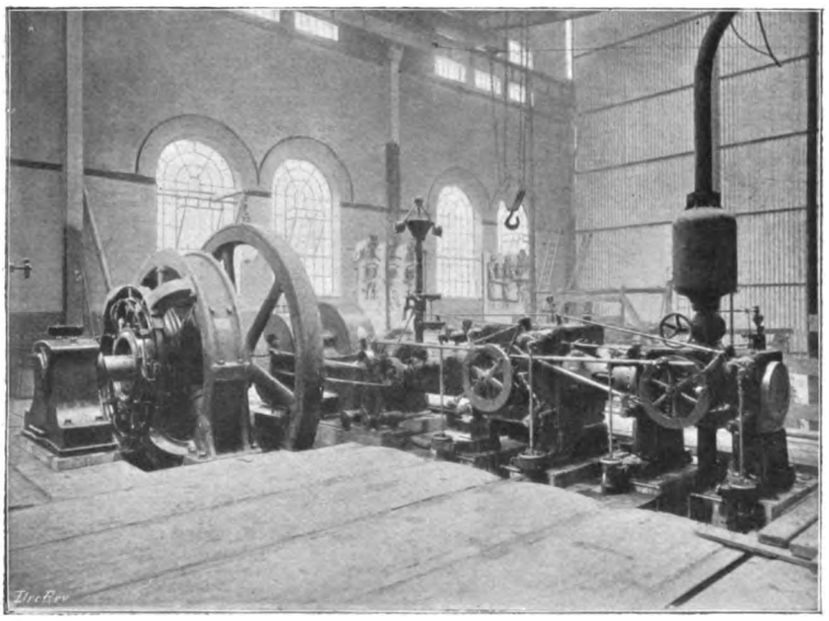
that if the belt breaks the engine is stopped at once. The fly-wheel is 12 feet in diameter and weighs 6 tons.

The dynamos are standard B.T.H. six-pole railway generators, with drum armatures about 4 feet 6 inches in diameter, 1 foot 6 inches core width, and weighing 7 tons each.



Allis Engine and B.T.H. Generator.

The normal maximum output is 225 KW. at 500 volts. The field magnets are compound wound for constant pressure (within 2 per cent.) at all loads, with constant speed and fixed position of the brushes. The dynamo is coupled direct to the engine, with the fly-wheel between, and two bearings only are used. The brasses are supported in the middle, so as to be capable of a certain amount of self-adjustment, and the journals are oiled with drip lubricators.

The normal rated output of the engines is 350 I.H.P., but they are able to drive the dynamos at 25 per cent. overload, and the latter are designed to allow of this. An equalising switch is mounted on a pillar close to each generator, for parallel running.

An overhead travelling crane, to lift 20 tons, and made by Messrs. Booth & Bros., Limited, of Rodley, traverses the engine room. The latter is 100 feet long, 50 feet wide, and 40 feet high to the spring of the roof, while an extension 84 feet in length is already partly built. When completed, the room will be a very fine structure. Foundations are being laid for four additional generating sets, two of which are nearly ready for delivery. These will consist of B.T.H. dynamos of 500-KW. output coupled to vertical engines, cross compound, with Corliss valve gear, made by Messrs. Cole, Marchant and Morley, of Bradford. The armature and fly-wheel will be placed between the high and low pressure engines, and the whole will be mounted on a single compound cast-iron bed. The engines are designed for 800 I.H.P. at 90 revolutions per minute, and we are able to take 25 per cent. continuous overload in addition, if required; the fly-wheels, 18 feet in diameter, will weigh 23 tons each. A small 25-KW. coupled set, supplied by Messrs. T. Scott Anderson & Co., Sheffield, and consisting of a Silvertown dynamo and a Clench engine with fly-wheel governor, is used to run the glow lamps in the works.

The switchboard consists of three dynamo panels, two feeder panels, and two Board of Trade panels. The instruments, with the exception of Messrs. Elliott's recording ammeters and voltmeters, are all of the Weston illuminated dial type, and the switch-gear is of the usual B.T.H. type. Two of the Weston voltmeters are mounted on a swing bracket at one end of the board, so as to be visible to the attendant from any part of the switchboard. As may be seen in our general view, a large space has been left between the generator panels and the rest of the board, to provide for four generator panels for the extensions which are in progress.

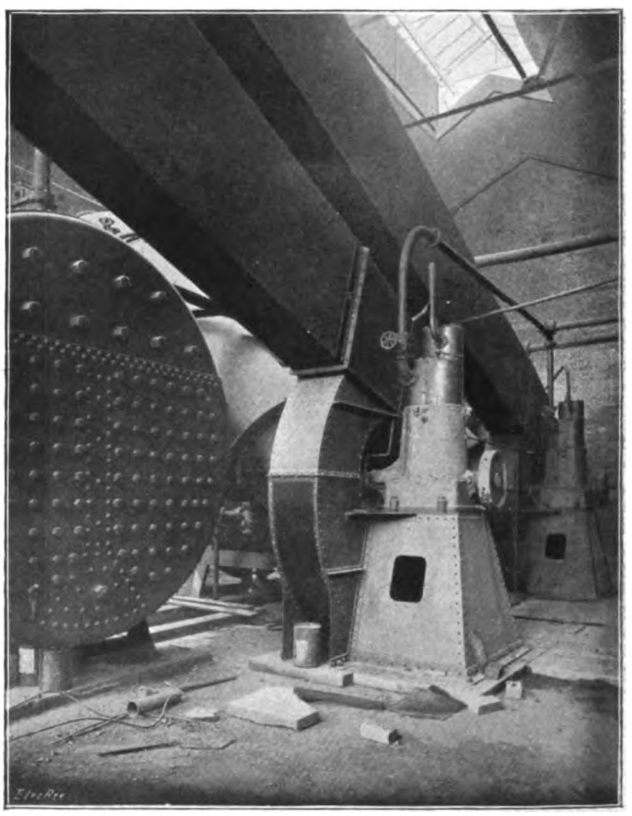
The board itself consists of white marble panels, supported in a cast-iron frame, and was supplied by the B.T.H. Company. The arc lamps in the works are run off the traction bus bars.

There are four feeders—two to Walkley, one to Nether Edge, and one to Tinsley—each to carry 300 amperes. The feeders are joined in pairs, and pass through two K type circuit breakers.

The cables are of the Callender type, insulated with jute saturated with fine bitumen, lead covered, taped and braided, with a specified insulation resistance of not less than 700 megohms per mile after 24 hours' immersion at 60° F. After laying and jointing, the cable must withstand a pressure of 1,000 volts for one hour. Messrs. Callender also supplied the cables connecting the trolley wire with the various feeder pillars, the return feeder cable, and the three-core test cable, the total length being over 13 miles.

The trolley wire feeders are 0·3 square inch in cross section; the return feeders from Tinsley and Nether Edge 0·6 square inch.

The overhead construction consists chiefly of bracket suspension, with centre and side poles; a good example of the former is seen in our photograph of South Street. There is a small amount of span wire work, which we show in a view of Fitzalan Square, as well as an interesting junction in the same neighbourhood. The line material is all of the B.T.H. standard type; the poles and brackets were made by Messrs. J. Spencer, of Wednesbury, and these, we think, show a distinct improvement in appearance over the ordinary designs.



Fans.

Some few of the poles were supplied by Messrs. MacFarlane, of Glasgow, direct to the Corporation.

The feeder pillars are of the B.T.H. type, and divide the trolley line into sections of a quarter of a mile each.

The track is laid on a 6-inch concrete foundation with rails weighing 108 lbs. per yard, made by Barrow Haematite Steel Company, Barrow-in-Furness, and bonded with Chicago

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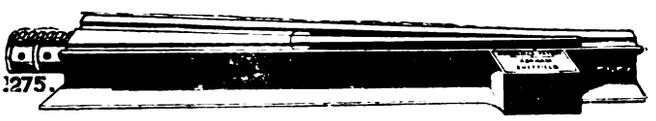
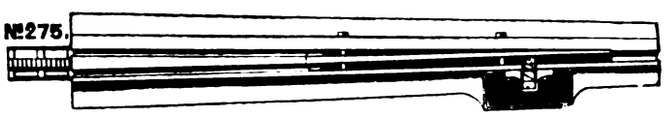
bonds. The special work at points and crossings was made in crucible cast-steel by Messrs. Askham Bros. & Wilson, Limited, of Sheffield. We show in one of our illustrations a view of an important junction, known as the Ecclesall Road junction. This was laid in about a fortnight, and leads to three important districts, Heeley, Nether Edge, and Ecclesall. All the points and crossings (36) were made in crucible cast-steel, to special angles required, by Messrs. Askham. In addition they have also supplied the drain rails, of which there are some hundreds, used upon the Sheffield tramways, also patent sole plates for junctions. The patent point and the drain



Movable Point.

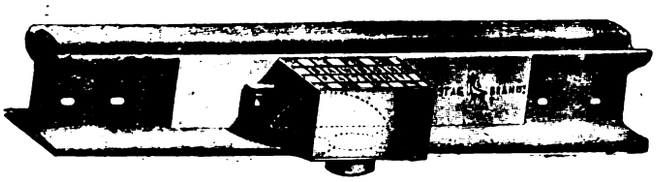


Fixed Points.

rail are shown in the small cuts. We understand that the patent points, of which some thousands have been made, have never yet failed. The loose part, or tongue, being made of forged steel, is not liable to break, and can be easily renewed. The drain rails are cast in crucible steel, and take the place of the ordinary rails for their length, about 5 feet. When connected with the sewers, the roads are drained by means of the slot cast in the groove of the rail, which allows the water to flow freely through. This arrangement is said to save their cost in six months by reduced repairs.

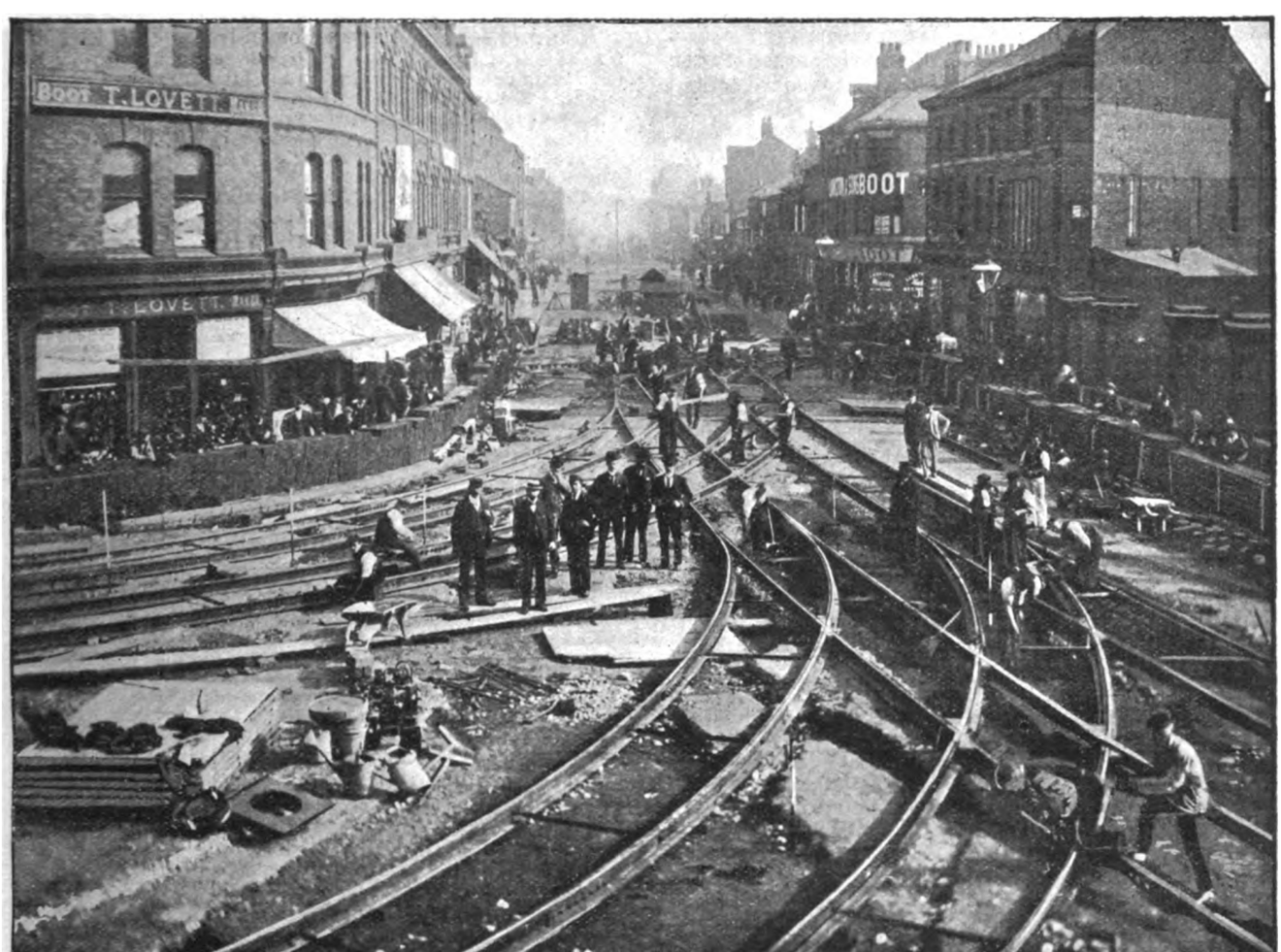
The total length of line equipped by the B.T.H. Company is 5¼ miles (double track). The rails were laid by Corporation workmen, and the overhead construction on the Walkley route was carried out in the same way. The fittings were supplied by the Electric Tramway Equipment Company, of Birmingham, and the trolley wire by Messrs. F. Smith & Co., of Halifax and Manchester. The amount of double track laid at present is about 12½ miles, most of which is ready for electrical working.

There are 52 electric cars already, and the number is to be increased to 80. Double-deck cars are employed on the Tinsley-Nether Edge route, weighing 8 tons each when empty; but the gradients on the Walkley station are so severe (some 1 in 10), that single-deck cars alone will run on that route, weighing 7 tons each, empty. Each car, in addition to the usual hand brake, has an electric brake, a slipper brake, and trailing Spencer's wedges or scotches. The electric brake consists of two discs, one keyed to the shaft with a feather, the other fixed to the frame of the truck, and fitted with a coil energised by the motors acting as generators. Hard steel wearing blocks are embedded in the discs, and show a marked improvement in the wear and in the smoothness of action of the brake.



Drain Rail.

The slipper brakes are to be used in descending steep hills, to get the car under control, while the magnetic and other brakes are used for regulating the speed. The slipper is



Special Work at Ecclesall Road Junction.

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worked by a large hand wheel outside the ordinary brake handle. The object of the trailing wedge or scotch is to hold the car fast when it is stopped while going up an ascent; the wedge blocks or scotches are dropped behind the wheels by a special handle attached to the dash on the left-hand side of the platform. The handle operates the wedge blocks behind the leading wheels. The Mossberg and the Roller Bearings Companies' bearings have been supplied to some of the cars as an experiment. The trucks are of the Peckham extra long cantilever extension type, and were supplied to the B.T.H. Company by Messrs. R. W. Blackwell & Co. The car bodies are mostly of the top-seat type, built by Messrs. Milnes & Co., Birkenhead, and are capable of seating 22 passengers inside and 29 out. The length over all is 27 feet 6 inches, width over all 7 feet. The approximate weight of the bodies is 65 cwt. each (without trucks or passengers). The single-deckers carry 28 passengers each. All the cars are fitted with G.E.-52 traction motors, of which we gave an illustration last week; the controllers are of the B.T.H. manufacture, type B 13, and there is a magnetic circuit-breaker on each car. The side trolley post is just the same as at Bristol, and is very neat. Each car carries 12 lamps, of which 10 only are alight at one time; these give an excellent illumination, amply sufficient for reading.

Two sample smoking cars are on order, upon which Mr. Fell has spent a considerable amount of time and skill. Each has a small body in the middle, seating 16 persons, and a vestibule at each end seating six persons; but in one case the vestibule is provided with open lattice sides, in the other it is fitted with sliding windows. The driver's platform is completely shut off from the vestibule by a glazed partition.

Thirty cars and trucks have recently been ordered from the Preston Railway and Tramway Carriage Works, Limited, 15 of which will have Brill trucks, and the remainder Peckham trucks. These will be fitted by the British Thomson-Houston Company, Limited, with equipments similar to those described above. The latter company has also on order 25 other equipments, 13 double-deck cars and trucks, two eight-pole 500-KW. generators, two generator panels, and one feeder panel, in addition to the original contract.

We have to acknowledge our indebtedness to Mr. Fell, the city tramways electrical engineer; to Mr. Moller, the resident engineer of the B.T.H. Company, and to other engineers engaged upon the work, for their assistance in drawing up this description and for their courtesy to our representatives on the occasion of their visit; also to the British Thomson-Houston Company, Limited, which has furnished us with numerous details of the plant.

ELECTRIC LIGHTING NOTES.

(*Continued from page* 398.)

Stowmarket.—The Council will not allow the Suffolk Electricity Company to lay wires under a certain roadway for the purpose of supplying electricity to the East Stow Rural District Council.

Todmorden.—The Council has decided to call in an expert to report on the question of erecting works for the generation of electricity for the purposes of lighting, electric traction, motive power, and as to suitable area and the relative advantages of steam and water power.

Turkey.—We read that Sir E. Ashmead-Bartlett, M.P., gave a grand banquet at Constantinople last Saturday, to celebrate the granting of the first electrical concessions ever obtained in Turkey.

Valparaiso.—The *Review of the River Plate* says that a syndicate, called the Electrical Corporation, Limited, has been formed for the purpose of acquiring the concessions granted by the Municipality of Valparaiso to Mr. Josiah Harding, M.I.C.E. The syndicate is backed by some of the most powerful capitalists in London, who are prepared to provide the whole of the capital required for the construction. Mr. Harding recently returned to Valparaiso from Liverpool, accompanied by Mr. Maclaren, the engineer to the corporation, who will come back to England after the above-named preliminaries are arranged, and Mr. Harding will then remain as the representative of the company. Although steam will at first be used for generating the electricity, it is expected that water-power from the River Aconcagua will ultimately be transmitted electrically for the purpose of supplying the necessary current, not only for the tramways, but also for lighting and power throughout the city. The capital for purchasing and transforming the existing horse tramways will be also ready, so that a complete system may be installed as soon as possible.

Wakefield.—Messrs. Laing, Wharton & Down are pushing on with the electric lighting, heating, and power installation at the Wakefield Asylum. The engine house contains four sets of steam dynamos, two driven by 100 H.P., and two by 120 H.P. Willans engines. Electric radiators are provided. The number of lamps is 2,800, of which about 56 are arcs. The work has been in hand for about nine months, and is now completed. Mr. H. Kay has supervised the carrying out of the work.

Walker.—A deputation from the Council has visited Oldham and Rochdale for inspecting the electricity works. Negotiations has been opened with the Newcastle Corporation for the purchase of a site for electric works.

Winchcombe.—The Rural District Council has granted formal assent to the Corporation of Cheltenham to establish certain electric works in the parishes of Bishop's Cleeve, Southam, and Woodmancote.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—The laying of rails and preparation of track for the electric tramways is proceeding with great expedition in the hands of Messrs. Macartney & M'Elroy, of London and New York.

Bedford.—The Electric Light Committee recommends the laying of a light railway between Bedford and Kempston.

Blackpool.—Several drivers of cars on the Blackpool and Fleetwood Electric Tramway have been fined sums varying from 10s. to 20s. for furious driving.

Bradford.—The Tramways Committee has let the contract for the rails and granite setts which will be required in the construction of three new electric lines: the White Abbey, the Thornbury and Stanningley, and the Lister Hills. The contract of the Demerbe Company for the whole of the rails was accepted, and the order for the setts was divided among several firms. Five or six years ago, as an experiment for the benefit of the Corporation, the Demerbe Company laid a short length of their rails on the Leeds road section of the Bradford tramways from Chapel Street to Harris Street, a portion of the line upon which the traffic is particularly heavy. The result has been highly satisfactory, and when the Bolton road electric tramway was constructed the rails were used for a length of 1,000 yards, from Bolton Church to the city boundary. They were also used by the Eccleshill District Council for another length of 1,000 yards in their district. That they have answered the purpose is shown by the committee's decision to use them solely in the construction of the three new lines. It is stated that the cost of the construction with the Demerbe rail is about £320 per mile less than with the old girder rail.

Darlington.—At Monday's meeting of the District Council a communication from the Light Railway Commissioners was read, stating that the Commissioners had decided to submit to the Board of Trade an order authorising the Darlington light railways. They recommend that the electric energy should be supplied by the Corporation of Darlington, and it was hoped that the promoters, before the scheme was finally sanctioned by the Board of Trade, would have made this arrangement.

Darwen.—At the last meeting of the Town Council, a statement was made upon the agreement which it was proposed to enter into with the Blackburn Corporation for working the recently acquired tramway between the two towns. It was proposed that instead of Blackburn paying a definite sum to Darwen and taking the whole of the receipts, the two Corporations should take the receipts in their own districts. The cost would be divided according to mileage. It was expected that the work of converting the tramways to the electric traction system would take about 12 months.

Eccles.—The Corporation General Purposes Committee has considered the report of the town clerk as to the proposed construction of electrical tramways from Salford to Whitefield. Six out of the nine districts represented at the joint conference, voted for a syndicate carrying out the whole of the scheme and three against. The borough surveyor, Mr. A. C. Turley, has prepared a scheme for the reconstruction of the tramways for electrical purposes. The length is over two miles, and the estimated cost of the reconstruction of the track, together with the provision of 10 passenger cars and the necessary plant, is £32,500.

Electric Railway Construction in Germany.—The *Society of Arts Journal* says that of the most important German cities, Aix la Chapelle, Brunswick, Chemnitz, Dresden, Hamburg, Hanover, Leipzig, Munich, and Stetten have almost completely abandoned horse cars, and are supplied by electric roads. In the cities of Berlin, Breslau, Cassel, Cologne, Frankfort-on-the-Main, Düsseldorf, Barmen, Elberfeld, Königsberg (East Prussia), and other places, horse lines are being converted into electric roads, and most of these have suburban electric roads completed. According to the

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United States Consul at Düsseldorf, a large number of electric lines are being constructed in the country districts about Aix la Chapelle, Bochum, Gelsenkirchen, Düsseldorf, Vohwinkel, Elberfeld, Barmen, Elbthal, Essen, Krais, Hoerde, Reisengebirge, Waldenburg (Silesia), Witten-Ruhr, and in the mining districts of the Saar (southern Rheinland), and in Upper Silesia. In 35 cities and districts, not mentioned in the above lists, electric roads were in the course of construction on September 1st last, in nine of which the roads were completed and put into operation before the close of the year, so that at the beginning of the year 1899 there were 77 cities and districts in the empire supplied with electric roads. In 35 of these places extensions were being made to the lines in operation on September 1st, 1898, some of which were completed before January 1st. From a return which has been prepared on the subject, it appears that there were on September 1st last 888 miles of electric roads as compared with 595 miles at the corresponding date in 1897. There were in September last 3,190 motor cars as compared with 2,255 in 1897. Adding the roads put in operation since January 1st, 1899, it is estimated that there are now 930 miles of electric roads, with a total of 1,300 miles of tracks in Germany. From the city of Düsseldorf there are now four suburban electric lines completed. From Düsseldorf to Crefeld about 12 miles, from Düsseldorf to Rattigen about 8 miles, from Düsseldorf to Benrath about 6 miles, and from Düsseldorf to Kaiserwerth about 5 miles.

Electrical Omnibuses.—Whilst London has been promised and been expecting during the past year or two the arrival of a street service of electric omnibuses, the centre of promise now appears to have been transferred to Berlin, according to a *Financial Times* correspondent. The General Omnibus Company of that city has informed the municipal authorities that, in accordance with previous arrangements, a line of electric omnibuses will be experimentally placed on the streets during the present month in connection with the International Exhibition of Motor Cars, and that at the close of the exhibition the number of electric street cars will be increased. Suitable provision has been made for the recharging of the accumulators with which the omnibuses will be equipped, and the company hopes that the experiments will afford a practical test of the commercial value and prospects of electric omnibuses for the purpose of dealing with the passenger traffic of a large city like Berlin.

On Sunday last electric omnibuses were placed on the Berlin streets for public hire, the fare for about one mile being 20 pfennige (about 2d.). The speed is nowhere to exceed eight miles an hour. They are to run for the present in connection with a motor car exhibition, but should they prove a success the police are prepared to permit their general use.

Greenock.—The Law and Finance Committee of the Police Board conferred with a deputation from the Greenock and Port Glasgow Tramways Company last week, with a view to doing away with the deadlock in the negotiations with regard to the future working of the tramways and the adoption of electric traction.

Italy.—Ingegneri Arno & Caramagna is the style of a new firm which has just been formed in Turin, with a capital of £4,000, to introduce a new conduit system of electric traction.

Leeds.—The work required to be done before a service of electric cars can be permanently run between Boar Lane and Headingly is still unfinished, says the *Leeds Mercury*. In the early part of the year the members of the Tramways Committee thought that the cars would be running by the end of June or the beginning of July. They are still devoting their energies to pushing forward the work at the generating station. Only the engine and dynamos need completion; everything else is practically ready. Great efforts are being made by members of the Council to have the service in operation by November 1st. There are now 41 electric cars in the city. For the ordinary service between Kirkstall and Roundhay 21 are used, though at busy periods 30 are employed. By the time electric cars are required for the Headingley route, probably there will be another dozen motor-cars to hand. The tramway shed at Chapeltown is now being adapted for the accommodation of electric cars.

Liverpool.—Since the joint report of the city engineer, the city electrical engineer, and the general manager was issued in regard to a scheme of electric tramways for the whole city, the Tramways Committee have carefully considered the schedule of proposed new lines, with the result that 19 have been deleted out of the 42 proposed. The remaining lines, together with one or two additions not included in the report, will, says the *Liverpool Mercury*, come before the City Council at a special meeting to be held on Wednesday, October 4th, when the Council will have to consider, and if thought expedient, approve of a memorial to the Board of Trade for a provisional order for the construction of the proposed lines.

At Wednesday's meeting of the City Council the Tramways Committee asked for authority to reconstruct the lines for electric traction from Old Haymarket, along Victoria Street and North John Street to Lord Street, at an estimated cost of £4,284 for permanent way and paving, and £729 for overhead electric equipment.

Luton.—Mr. A. T. Snell has reported to the Corporation *re* electric traction. Notes are given of the Brussels system. The cost of the overhead wire system is given at £7,000 per mile and the conduit £11,000.

Newcastle.—The 14 tenders submitted for the boilers for the new tramway power station has been referred to the chairman of the Tramways Committee and the town clerk to report upon. Mr. Laws, the city engineer, advises the use of single-deck cars to accommodate 20 to 25 persons. The committee has agreed to this, but double-deckers will be also obtained for the Gosforth and Byker sections and to meet additional traffic. The engineer will report as to the cost of erecting car sheds. Mr. Charles Hopkinson has reported on the subject of lighting the thoroughfares with electricity. Arc lamps placed 40 yards apart on alternate sides of the main streets, and 80 yards apart in the outskirts, are recommended. Each lamp will cost £30, and the interest and redemption would amount to £5 15s. per lamp per annum. The cost of current would bring the cost per lamp per annum to £16 13s. 9d. There are at present 23 electric lamps in use at £42 per lamp, and the Electric Supply Company has offered to charge £18 per lamp if 100 are erected.

Sheffield.—On Monday the electric tramways, which are described elsewhere in this issue, were publicly inaugurated, the mayor setting the first car in motion. The guests numbering about 200, afterwards rode over the route in the new cars, subsequently inspecting the power station and sheds.

Staffordshire.—A Birmingham paper says that the British Electric Traction Company are proceeding with the reconstruction of the Dudley and Wolverhampton tramways, and their conversion to a 3 feet 6 inches gauge, the object being to assimilate it with that of the Dudley and Stourbridge and Kinver lines. The work will be pushed on vigorously, and it is hoped by the middle of next summer electric cars will be running on the Dudley and Wolverhampton line.

Sunderland-South Shields.—It is stated that the British Electric Traction Company proposes to connect Sunderland and South Shields, also Hebburn and Jarrow, with electric tramways.

Surrey.—The Highways and Bridges Committee of the Surrey County Council have prepared a memorandum for the consideration of the local authorities of Surrey, in the course of which they say that the fact "that the London County Council proposed to introduce light railways into Surrey and that extensive schemes for the county have been brought forward by other parties, have led this County Council to move in the matter, and to endeavour to secure in the interests of the county that a carefully-devised scheme, designed to meet the convenience of the inhabitants generally, shall be prepared for consideration and discussion as early as practicable. The first portion of the scheme will naturally deal with the districts more immediately adjoining the county of London, but eventually the requirements of the whole county must be considered; hence this invitation is made to all local authorities to express their views and to make proposals if they desire to do so, and communicate them to the Highways and Bridges Committee of this Council by October 20th."

Worcester.—The Streets and Electricity Committees reported to the Council on Tuesday regarding the application of the tramway company for the Council's co-operation in extending and improving the tramways. The company also proposes to construct light railways from the Cross to Kempsey and Red Hill. A deputation from the company had explained their proposals, and on the advice of the engineer consulted by the Committee, Mr. Waller, the deputation were asked to submit a draft agreement showing the best terms they could offer with reference to the price to be paid for electric current to be obtained from the Corporation for existing tramways and extensions and proposed light railways, and other details. After consideration of the reply of the company, the Committee passed a resolution that they would not advise the Council to consent to the Worcester Tramway Company's application for power to construct light railways in the city, but recommended the Council to oppose that application, and to take over the existing tramways at such time as was thought best, and to reconstruct them and to construct such additional tramways in the city as might be considered necessary, and to work the whole of the tramways. The company expressed disappointment at the recommendations of the Committee, which aimed at the defeat of the company's scheme, without making any definite alternative proposals. The project of the company had been to at once introduce into the city an improved electric system of tramways, and to extend similar advantages to all the principal suburbs and adjacent villages, the application for powers to construct light railways to Red Hill and Kempsey being preliminary only to further extensions for opening out the whole of the environs of Worcester. If the project was opposed by the Council, they would have to consider the necessity of advising the company to withdraw from the scheme altogether, and probably the much-needed light railways to places like Kempsey, Ombersley, Powick and Hallow would be wholly frustrated. It was not for them to express an opinion upon the wisdom or probability of the municipality embarking upon a speculative expenditure, the merely preliminary portion of which their advisers estimated at £73,000, which was not likely to fall short of £100,000, and from which the same advisers estimated a return of only £2,884 a year.

TELEGRAPH AND TELEPHONE NOTES.

Cables in the Pacific.—We make the following extract from an able article on "The New Pacific," which appeared in a recent issue of the *Saturday Review*:—"If Great Britain does not remain mistress of the Pacific as of other seas, the fault will be that of her sons under the Southern Cross. Federated Australia should count for at least as much as Japan; Canadian interests will be second only to those of the United States; British interests in China

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are predominant, and the measures taken to protect them costly. From Hong Kong to Sydney, from Sydney to Vancouver, from Vancouver to Hong Kong, British interests eclipse all others. In a very large measure the future depends on the development of the spirit of unity between Australia and Canada under the fostering ægis of the mother country. The British Pacific cable will be both sound business in itself and an excellent sign and symbol of British solidarity. The United States will not probably be far behind with a cable from San Francisco to Hawaii and the Philippines. Neither Australia nor Canada is blind to the opportunities latent in the waters which at once unite and separate them. Of that they have given ample proof in the last few years in the starting of steamship lines, in their readiness to bear their share in the cost of constructing the proposed cable, and in their attitude on the subject of imperial defence. Australian federation is as momentous a fact in Pacific history as was the triumph of Japan in the war with China. Both events mean that new powers have arrived prepared to dispute with all comers for their respective rights. Australia a nation, however, will enjoy dignities, and must face responsibilities unknown to the individual colonies."

Continental Telephony.—It is stated that in consequence of the increased telephone traffic between Berlin and various places in Denmark, a new line will shortly be opened. Telephonic connection is now being established between Berlin and Warnemünde, whence a telegraph cable runs to Gjedser.

Dover Telephones.—The town officials are to report on the question of municipal telephony.

Harrow Telephone Service.—It is stated that the National Telephone Company has threatened to disconnect the Harrow subscribers from its system, in consequence of certain disagreements between itself and the Middlesex County Council regarding wayleave rentals.

The Pacific Cable.—A correspondent of the *Financial News* writes:—"Unlooked-for delay has arisen over the steps to be taken to secure the laying of the proposed cable across the Pacific to Australia. The Imperial Government and the Canadian and Australasian Colonies have come to terms, and the Colonial Legislatures are passing the necessary resolutions authorising their Governments to contribute to the cost. New South Wales is the only one that has not, though it is understood there is no fear as far as finance goes. Meanwhile the Colonial representatives in London appear to have got at loggerheads. On the committee to be set up Australasia has been allotted three representatives, Canada taking two seats and the Home Government three. New Zealand wants one of the three Australasian seats definitely allocated to her, because of her separate contribution and her geographical position. All the other Colonies are willing, with the exception of New South Wales, who is standing out for no 'earmarking' of any representation. In consequence of this, the whole matter of the representation has been referred to the Colonial Governments, and a couple of months, which could have been usefully spent in going into preliminary questions relating to cost of construction and maintenance, have been wasted. In fact, nothing has been done; and unless the Colonial Governments come to an understanding much quicker than their London representatives seem able to do, the question will have to be hung up for an even more indefinite period; for the Agents-General leave at the end of this month for America, to attend, at Philadelphia, the International Commercial Conference. Great irritation and annoyance exist in colonial circles over this delay."

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa...	April 4th, 1898 ...	...
Latakia-Cyprus	June 20th, 1899 ...	...
Accra-Grand Bassam... ...	August 1st, 1899 ...	...
Corea-Japan	August 7th, 1899 ...	...
Cheik Saiid-Perim	Sept. 3rd, 1899 ...	...
Jamaica-Colon	June 30th, 1899 ...	...
Jamaica-Porto Rico (Ponce)	August 15th, 1899...	...
Cape Haitien-Puerto Plata ...	August 21st, 1899...	August 31st, 1899
Cape Haitien-Mole St. Nicolas	August 21st, 1899...	Sept. 1st, 1899
Landlines.		
Communication between Salonika and Monastir ...	March 23rd, 1899 ...	...
Communication between Bolama-Bissao	July 28th, 1899 ...	...
Puerto Plata-St. Domingo ...	August 23rd, 1899 ...	Sept. 1st, 1899
Communication with Campeche and all offices beyond Yucatan (Mexico)	August 31st, 1899...	Sept. 3rd, 1899
Lines from Haiti to Gonaives, Gros Morne, Port de Paix Plaisance, and Cape Haitien Port au Prince to Miribalais and Jacmel	August 18th, 1899...	...

Telegraphic Rates to South and Central Africa.—The *London Gazette* for last Tuesday states that on and after the 1st inst. the following rates will be charged for each word in telegrams to the undermentioned countries and territories in South and Central Africa:—Cape Colony, Natal, Orange Free State, Transvaal and Zululand, 4s.; British Central Africa (Nyassaland), 4s. 5d.; Portuguese East Africa—Beira, Fontesvilla, Anconzi, Bandara, Candida, Chimara, Chinde, Chiromo, Iumbo, Macaze, Maquivalvilla, Masangona, Mbgurrumba, Mechure, Mhassenge, Mularara, Ntumbe, Pinda, Quaqua River, Quilimane, Singal, Tangalene, Tete and Vicente, 4s. 6d.; Swakopmund (German South-West Africa), 4s. 2d.; Northern Rhodesia, 4s. 5d.; and Southern Rhodesia, 4s. 6d.

Uganda Telegraphs.—In a note on the departure of Sir H. H. Johnston's expedition for Uganda last week, the *Times* says that direct communication between the Imperial Government and its representatives in Uganda is now a *fait accompli*. The telegraph line has in fact reached the shores of Victoria Nyanza. The wire is working admirably, and telegrams are now constantly being received at Downing Street from the acting Commissioner well within 24 hours of their despatch from Uganda.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking Town.—October 24th. The District Council wants tenders for boilers, pipe work, two 100-kw. steam dynamos, switchboard, motor and trailer cars, trucks and electrical equipment, overhead equipment, underground feeders, conduits, road work, &c., for the Barking and Beckton light railways. See "Official Notices" September 1st.

Barnsley.—September 16th. Tenders are wanted for electric light wiring and fittings at the Harvey Institute, Eldon Street, for about 700 lights. See "Official Notices" August 18th.

Belfast.—September 31st. The Electric Committee wants tenders for c.i. floor plates and w.i. rails for the electric light department. Specifications from the city electrical engineer on payment of one guinea, returnable as usual.

Bermondsey.—September 13th. The Vestry wants tenders for electric lighting work at the Town Hall. See "Official Notices" September 1st.

Blackburn.—September 20th. The Corporation wants tenders for 40 electric cars and two 256-kw. steam dynamos. See "Official Notices" this week.

Carlisle.—September 11th. The Corporation wants tenders for extension to steam, drain, and feed pipes, feed pump, and extension of economiser at the electricity works. See "Official Notices" August 18th.

Carlisle.—September 18th. The Corporation wants tenders for extension of switchboard for dynamos 5 and 6, and for traction work. See "Official Notices" September 1st.

Darwen.—September 25th. The Corporation wants tenders for a high speed vertical engine and dynamo (300 to 350 kw.); also switch work. See "Official Notices" to-day.

East Ham.—September 9th. The Urban District Council wants tenders for combined electric light and traction plant, engines, generators, overhead line equipment, cars, switchboard, arc lamps, &c., water-tube boilers, condensers, and other steam plant, electric light cable. Mr. W. C. Ullmann, The Limes, White Post Lane, East Ham, is the Council's electrical engineer. See "Official Notices" August 4th.

Germany.—September 20th. Tenders are being invited until September 20th by the Cotton Wool Exchange authorities in Bremen for a complete installation of electric lighting in the new Exchange. Tenders are to be sent to Das Banbureau für die Bremer Baumvoll börse la Dechanatstrasse, Bremen, whence particulars may be obtained.

Germany.—October 16th. Tenders are being invited by the municipal lighting and tramway authorities of Königsberg, Prussia, until October 16th, for the supply of six boilers required in connection with the extension of the electric power station, to supply steam to new engines aggregating 1,800 E.H.P. Tenders to be sent to Die Direction der Städt, Belenchtungswerke und der Electr. Strassenbahnen Kaiserstrasse 41, Königsberg, Prussia, whence particulars may be obtained for 1s.

Glasgow.—October 10th. In connection with the tramway scheme the Corporation wants tenders for switchboards, fuel economisers, two 50 and one 30-ton electric travellers, power station steel work, and cables. See "Official Notices" to-day.

Hackney.—September 12th. The Vestry wants tenders for four sets of direct current steam dynamos (either high or low speed). See "Official Notices" August 11th.

Heckmondwike.—September 20th. The District Council wants tenders for the supply of water-tube boilers, economiser, pipe work, steam dynamos and motor boosters, accumulators, switchboard work, travelling crane, mains, arc lamps and posts, and station lighting. See "Official Notices" August 25th.

Ilfracombe.—September 25th. The District Council wants tenders for boiler plant, engine plant, dynamos, condensers, switchboard, mains, lamp-posts, accumulators, meters, crane, buildings, &c. See "Official Notices" August 18th.

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Luton.—September 22nd. The Council wants tenders for boilers, superheaters, engines, dynamos, switchboard, steam and other piping, batteries, street conduits, boxes, feeders, arc lamps and posts, and various other plant and machinery for the electric lighting installation. See "Official Notices" August 25th.

Middleton.—September 20th. The Corporation wants tenders for Lancashire boilers, superheaters, economisers, steam pumps, condensers, steam dynamos, balancer and boosters, switchboard, accumulators, cables, crane, &c., for electricity works. See "Official Notices" September 1st.

Oldham.—The Electric Light Committee invites tenders for rolled steel girders, concreting, and other works required in the foundations for "Kleins Tower Water Cooler" at the electric light station, Gas Street, Oldham.

Rotherham.—October 9th. The Corporation wants tenders for Lancashire boilers, engines, dynamos, piping, condenser, economiser, battery, switchboard and boosters, feeders, mains, road work, &c., for electric lighting. For particulars see "Official Notices" this week.

Runcorn.—September 27th. The Urban Council is inviting offers for the electric lighting of the district, to be sent to the chairman of the Highways Committee.

Russia.—The municipal authorities of Perm are at present inviting tenders for the concession for the establishment and exploitation of a central electric lighting station in the town.

St. Annes-on-the-Sea.—September 11th. The Council wants tenders for high speed engines, continuous current dynamos, and balancing booster, for electric lighting. See "Official Notices" August 18th.

Salford.—September 12th. The Tramways Committee is inviting tenders for 100 tramcars. See "Official Notices" September 1st.

South Wales.—September 28th. The proprietors of Margam Copper Works, Port Talbot, wants tenders for the electric lighting (arc and incandescent) of their works. See "Official Notices" this week.

Sunderland.—The Corporation wants tenders for four 270-KW. three-crank direct current steam dynamos, and two surface condensers and cooling tower. See "Official Notices" August 18th.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

Warrington.—September 30th. The Committee of Visitors of the Winwick Asylum, near Warrington, invite tenders for Contract No. 1.—Generating plant, including three sets of condensing engines or turbines, with directly coupled dynamos, each of 100 KW. output at 220 volts, booster set, motors, surface condensers, cooling tower, steam and exhaust pipes, &c. Contract No. 2.—Switchboard. The drawings can be inspected and specifications obtained of J. P. Muspratt, Clerk to the Committee of Visitors, County Offices, Preston, on payment of £2 2s for each specification, returnable. A separate tender must be sent in for the work included in each specification. See "Official Notices" this week.

CLOSED.

Aberdeen.—The Council has accepted tenders for supplies in the electric lighting department as follows:—Electric meters, Messrs. S. Z. de Ferranti; service cables, British Insulated Wire Company; house fuse boxes, Alex. Spark (local).

Dundee.—The following are the contracts for the laying of the Lochee and Perth Road electric tramway lines:—Perth Road, other than rails and fixings, Messrs. J. & C. Hay, £9,652 1s. 6d.; Lochee Road, Mr. R Sheach, jun., £11,892 11s. 1d.; rails, points, and crossings for Lochee Road and Perth Road, Messrs. Dick, Kerr, and Co., Limited, £9,698 5s. 8d. For the electrical equipment of the two routes the tender has been given to Messrs. R. W. Blackwell and Co., London, whose price was £5,931 10s. 2d. The total for the whole work is thus £37,174 8s. 5d.

FORTHCOMING EVENTS.

Friday, September 8th, at 2 o'clock.—Meeting of the Brush Electrical Engineering Company at Cannon Street Hotel.

Wednesday, September 13th.—The meeting of the British Association for the Advancement of Science opens at Dover with the presidential address of Sir Michael Foster. The sectional proceedings continue until Wednesday, 20th inst. The papers already announced include the following:—"Recent Applications of Electro-Metallurgy to Mechanical Engineering," by Mr. Sherard Cowper-Coles; "Electrical Machinery on Board Ship," by Mr. A. Siemens; "Earth Currents from Electric Tramways," by Mr. J. Swinburne; "The Niclausse Boiler," by Mr. M. Robinson.

On Saturday, 16th inst., in Section A, there will be papers by Profs. J. J. Thomson and Oliver Lodge, with a special view to the visit of the French Association.

On Monday, September 18th, Prof. Fleming will lecture on "The Centenary of the Electric Current."

On Tuesday, September 19th, the Automobile Exhibition opens at the Athletic Ground, and continues until 21st. Also on the 19th inst. there will be a paper by Prof. Threlfall on his gravity metre, and a discussion on "Platinum Thermometry" will be introduced by Prof. Callendar and Drs. Chappuis and Harker. In Section F a paper is expected by Mr. R. Donald (editor of the *Municipal Journal*) on "Municipal Trading." On Friday, 15th inst., Mr. Parsons will read a paper on "Turbines for Fast Cross Channel Service," in Section G.

Monday, September 18th.—The National Electrical Congress opens at Como and continues until September 23rd.

Tuesday, September 19th, at 10.30 a.m. (also September 20th and 21st).—Tenth annual general meeting of the Institution of Mining Engineers at University College, Sheffield. Among the papers down for reading is one by Mr. S. F. Walker, on "Alternating Currents and their Possible Applications to Mining." Part I.

NOTES.

Examination Tests.—Moralists sometimes tell us that the sum of evil on earth is a constant quantity, and there are many happenings that give support to this contention. The adoption of the system of entrance by examination by the Institution of Civil Engineers appeared at one time to have added a distinct load to the sum of evil, but, after all, it was not to be. The counterbalance has come in the shape of a notice from the Lords of the Committee of Council on Education that they have under consideration the discontinuance of the examination test in assessing grants in the elementary stage of science and art, the discontinuance to date after the year 1900. If there be nothing else, surely this will mark the date as a real *fin de siècle*. To assess the efficiency of education by inspection has much to recommend it. Much depends on the inspector. Not too lightly to disturb the existing calm of grantees, there is reserved provision for examination of such as wish to be examined and certificated on payment of a certain fee. This reservation spells weakness. If the examination system be faulty, why not reform it altogether? Half-measures are useless.

Indian Water-Power Scheme.—An Indian paper publishes a despatch from Simla (August 16th), stating that the Government has sanctioned a deputation to Europe and America of Captain A. de Lotbeniere, R.E., deputy chief engineer, Mysore Public Works Department, for six months, in connection with the Mysore Government's scheme for utilising the power of the Cauvery Falls at Sivasamudram, for generating electricity with a view to supplying the power obtained to the Kolar gold fields.

A Spelter Combine.—The latest in combinations is a scheme for controlling the world's production of spelter. Although details of the scheme are not yet divulged, the *Standard* learns that a combination of spelter producers is forming, and an agreement has been already arrived at between the Silesian and Belgium firms interested. It now only remains for the negotiations with the American producers to be brought to a successful conclusion. Such negotiations are now proceeding.

The Glasgow Electrical Tramway Contract.—A telegram from Glasgow late last evening informs us the Council has decided that Messrs. Musgrave and the Allis Company shall each make two of the main engines, but that a new detailed specification is to be made for the auxiliary engines. This is, after all, probably the best course that could have been taken.

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The Conductivity Method of Studying Moderately Dilute Solutions of Double Salts.—In the *Philosophical Magazine*, (V.), Vol. 45, pages 151—157, there is a paper by James G. MacGregor and E. H. Archibald on the calculation of the conductivity of aqueous solutions containing two with no common ion. According to the dissociation theory, the specific conductivity of a complex solution, volume v of which contains N_1, N_2, N_3, &c., gramme equivalents of the electrolytes 1, 2, 3, &c., respectively, is given by the expression—

$$\frac{1}{v}\left(\alpha_1 N_1 \mu \infty_1 + \alpha_2 N_2 \mu \infty_2 + \alpha_3 N_3 \mu \infty_3 + \&c.\right)$$

where the α's are the coefficients of ionisation of the electrolytes, and the $\mu\infty$'s their specific conductivities per gramme equivalent at infinite dilution. It is shown how equations sufficient for the determination of the α's and N's may be obtained for solutions containing two electrolytes with no common ion. A series of observations and calculations of the conductivity of solutions containing sodium and potassium chlorides and sulphates was made to test the results. The agreement between the observed and calculated values in the case of the more dilute solutions is satisfactory. There is a further paper by the same authors in the *Philosophical Magazine*, (V.), Vol. 46, pages 509—519. In the cases which they have investigated so far, the conductivity of solutions containing two electrolytes with a common ion is calculable by means of the dissociation theory up to a concentration of about 1 gramme equivalent per litre. The conductivity of solutions of the double sulphate of potassium and copper is similarly calculable only up to a concentration of about 0·1, and has at concentration 1 a considerably smaller value than that calculated on the assumption that no double molecules are present. The solutions of double salts have, at concentration unity, an appreciably smaller conductivity than the equivalent mixtures. The conductivities of mixtures, in molecular proportion, of solutions of zinc and copper sulphates, and of potassium and sodium sulphates, are calculable within the limits of observational error up to a concentration unity; and, therefore, the non-calculability in the case of the double salt solutions is probably not due to defective data. The differences between the observed and calculated values of the conductivity of the double salt solutions and of the equivalent mixtures, and between the observed values in these two sets of solutions, are such as would be accounted for by the presence of double molecules in both, and their presence in slightly greater number in the double salt solutions than in the equivalent mixtures.

The Institution of Electrical Engineers' Reunion in Switzerland.—Our representative writes:—"Up to the present the tour has been most successful and enjoyable, while at the same time it has embodied no small amount of real hard work. The only regrettable feature has been the unfortunate illness of Colonel Huber, who has done so much to facilitate the arrangements and render the reunion a success; Colonel Huber is seriously, but, we are happy to say, not dangerously ill, and is thereby debarred from taking part in the excursions and meetings. We trust that his recovery may be speedy and complete. The programme has been faithfully carried out as arranged, the members of the party having visited the magnificent power station at Rheinfelden, and the splendidly equipped works of Messrs. Brown, Boveri & Co., the Maschinenfabrik Oerlikon, and Messrs. Escher, Wyss & Co., besides various minor places of interest. Some disappointment having been occasioned by the visit to Messrs. Escher, Wyss and Co.'s works being alternative to that arranged for Messrs. Sulzer Bros., the energetic secretary of the Institution, Mr. W. G. McMillan, succeeded in arranging for an extra visit to the latter works to take place on the return journey from the Schaffhausen power station. On Tuesday a number of the members visited the Landes Museum in Zurich, which contains a most valuble collection of antiquities and objects of interest, while others, including several of the ladies of the party, inspected the Rüti Silk Weaving Factory. On Tuesday evening the members were entertained by the Schweizerischer Elektrotechnischer Verein and some Swiss firms to a banquet at the Tonhalle."

A New Calorimeter.—A new calorimeter for the testing of coal and other solid or liquid fuels is described in the *Street Railway Journal* as the invention of J. R. Chapman, of the North Chicago Street Railway Company. It consists of a water-sealed vessel, with an internal bomb, and suitable pipes for filling and emptying. At the top is an open glass tube, graduated, and 20 inches long. A funnel on a side stand pipe communicates to the bottom of the vessel. The bomb is closed by a plug screwed into its base, which is in one with the bore of the outer vessel. To use the apparatus this plug is removed, a given weight of fuel is placed in the bomb, and ignited by a platinum wire and battery. The outer vessel is filled with water until this stands at the zero mark in the glass tube. The whole is allowed to attain the temperature of the room; oxygen is passed into the bomb, and the fuel is ignited, when a given predetermined pressure has been attained, and temperature has become equable and uniform. Combustion is rapid, the bomb expands by heat, and forces water up the graduated tube, the maximum point being noted, and the differences of reading are observed between different fuels. There is no calculation necessary. Results are comparative and approximate alone, and obviously the rapidity of combustion will cause a variation of reading. Given a pure charcoal as a datum, it is probable that, as between one coal and another, there would not be serious difference in rapidity of combustion for a small sample, while the same may be said of different samples of liquid fuels. The use of more accurate instruments, such as Mahler's bomb, is debarred to the ordinary man, because of the necessity for special care and accuracy, and probably this new calorimeter, however far from absolute accuracy, and useless for an actual calorific evolution, will be sufficient for everyday comparisons. The difficulty with all fuel tests, other than those of liquid fuels, is, of course, the extreme difficulty in selecting a true sample.

Municipal Tramways of Neath.—The town of Neath has a tramway system, and has recently equipped it with gas motor cars on the system of the British Gas Traction Company, thus superseding the system of horse traction. In these days, when municipal authorities set every possible obstacle in the way of conveniences for ratepayers, whose servants they ought to be, it is satisfactory to find that the men who rule Neath have some ideas of progress. Gas traction may be a long way behind electric traction, but it is a long way better than the horse. There seems to be a good deal of unnecessary secrecy about this gas traction business, which we see referred to as the new system of the Gas Traction Company. We thought the system had been "perfected" long ago at Blackpool. Why this continued newness? It is nearly 20 years since a friend of ours considered a scheme for using gas engines on tramcars with vessels of compressed gas, but he went no further at the time as a patent was secured soon after by a Melbourne engineer on the same lines, and it did not seem advisable to pursue the matter to the length of a patent. How is it that to-day there can still be patents for gas traction? Does the British Gas Traction Company possess anything further than a gas engine worked by gas from a compressed charge—compressed only for convenience of carriage and arrangement on a car?

Magnetic "Lines of Force."—"E. R. P." writes to *Nature* as follows:—"In some text-books and by some lecturers (*e.g.* Prof. A. Gray, as reported in *Nature* of August 17th, p. 379), the lines of magnetic force are said to be the curves along which iron filings are marshalled when sifted over a piece of card laid over a horizontally placed magnet. Surely this is hardly correct. The true line of magnetic force must be represented, like those of all other radiant forces, by radiating straight lines drawn through the points of action of the resultants of all the forces residing in the individual molecules of a given magnet (such points, though varying in position with the position of a magnetic body in the field, being often referred to as fixed 'poles'). The symmetrical figures traced out by iron filings merely show, of course, the directions in which a line joining the poles of a very short magnet will lie in different parts of a magnetic field, under the influence of the true lines of force."

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The Paris Electrical Congress of 1900. — With regard to the Electrical Congress of 1900, Mr. Howard J. Rogers, director of education and social economy of the United States Commission to the Paris Exposition, has issued the following memorandum, which we cull from the *Electrical World and Engineer*, of New York :—"The Universal Exposition of 1900 is sure to gather together in Paris a great number of the scientists and engineers of the whole world. This justifies the French electricians in their efforts to organise an International Electrical Congress, which has received the official patronage of the French Government. In previous conferences questions of units and nomenclature have been settled by international agreement, to the immense advantage of all concerned. During the last 20 years there have been unexpected discoveries, new applications of what seemed once to belong to pure science, and an extraordinary expansion of electrical industries. Practice has thus started up a great number of problems on which it will be interesting and profitable to have the views of technical authorities. The discussions of the Congress will, therefore, have especially an industrial and economical character. The work is, provisionally, divided as follows :—(1) Scientific methods and instruments of measurements ; (2) production of electric energy, transformers, transfer and distribution, electric lighting, traction ; (3) electro-chemistry, electro-metallurgy, accumulators, electric furnaces ; (4) telegraphy, telephones, and various applications ; (5) electro-physiology. The Congress will last one week, beginning Friday, August 18th. The subscription for membership is 20 francs.

Presentation.—On Friday evening last at the Alexandra Hotel, Dale Street, Liverpool, an interesting presentation of a silver tea and coffee service with an illuminated address, was made to Mr. P. H. Naftel, of the Liverpool Corporation Electric Supply Works on the occasion of his marriage. Mr. Alfred Clough (works manager) who occupied the chair in the unavoidable absence of Mr. A. B. Holmes, the city electrical engineer, referred in felicitous terms to the respect and esteem in which Mr. Naftel is held by the whole of the staff and employés, and to his 15 years connection with the Liverpool Electric Supply Works. Mr. B. H. Collins, in supporting the chairman's remarks, briefly epitomised the progress made as regards the supply of electrical energy in Liverpool since 1883, when 120 lamps only were connected to the mains whereas there were now 103,000 16-c.p. lamps supplied.

The Car Injured.—A River Plate contemporary recently had the following :—"In the Paseo de Julio the electric tram ran over an old lady and was badly injured." Doubtless the lady will pay heavy compensation with a light heart.

Personal.—We hear with regret that Mr. Sutherland, the electrical engineer at Worcester electricity works, has been compelled to tender his resignation owing to ill-health, and the Council has unanimously granted him leave of absence for 12 months. A *locum tenens* will be appointed at £250 per annum, and the balance, £100, will be paid to Mr. Sutherland to act as consulting engineer. The advertisement appears among our "Official Notices" to-day.

Mr. Arthur Wright has accepted the appointment of managing director of the River Plate Electric Light and Traction Company, Limited (78, Coleman Street, E.C.), and has, in consequence, arranged with the British Thomson-Houston Company, Limited, to terminate his engagement as their retained consulting engineer on electric lighting matters.

Appointments Vacant.—The vacant chair of Natural Philosophy at Glasgow University, which carries with it £1,000 a year and an official residence, is now being advertised. Applications have to be submitted by 15th inst.

The Sunderland Corporation wants a competent engineering assistant to act as clerk of works and inspector in connection with the electric tramway construction works. Salary £250. See "Official Notices" this week.

Experiments with Nickel Steel Tubes.—Some very instructive experiments have been made by Mr. Yarrow on tubes of nickel steel with a view to ascertain the unstability of the material for tubes in boilers. We need not give the results in great detail as given in Mr. Yarrow's paper before the Institution of Naval Architects, sufficient to say the alloy known as nickel steel contains 20 to 25 per cent. of nickel. The tests simulated the more severe action to which tubes are exposed in boilers. Comparison was made with tubes of mild steel. Exposed to a dilute solution of hydrochloric acid, the nickel steel had a waste of only one-sixteenth to one-seventeenth that of mild steel tubes. Exposed to fire under the same conditions, the nickel steel lost by oxidation less than one-third of what the mild steel tubes lost. Tubes were heated, and at the same time exposed internally to a slow current of steam, and under these conditions a nickel-steel tube lasted out two and one-third tubes of mild steel, indicating much less frequent need for re-tubing. The same experiment, but with a dull in place of a bright red, showed 2·8 times durability of nickel steel in one case and a double durability in another case. A mild steel tube repeatedly heated and cooled showed a *decrease* in length of $\frac{56}{64}$ inch, where a nickel-steel tube *lengthened* only $\frac{14}{64}$ in the same length of 42 inches. Nickel steel appears to expand by heat one-third more than mild steel, as shown by tests on tubes 22 inches long, 1 inch diameter, and No. 16 L.S.G. This should be taken as a warning not to use nickel tubes amongst others of mild steel, as an element of risk will be introduced by the differential expansion. The ductility of nickel steel is considered ample for ordinary purposes. It is also tougher to work than mild steel, and involves greater wear and tear of tools, &c. Nickel steel is costly, but perhaps not less than its durability warrants. Small percentages of nickel, as 5 per cent., give a greater durability than mild steel possesses, but not sufficient to be of practical value. The nickel must be present to an extent of 20 to 25 per cent.

Lord Kelvin.—Lord Kelvin, although retiring from the Chair of Natural Philosophy at Glasgow University after 53 years, hopes that the change will not imply loss of intercourse and association in scientific work.

Appointment.—Mr. E. T. Williams, of Manchester, has been appointed assistant electrical engineer at the King's Lynn Corporation Electricity Works.

NEW COMPANY REGISTERED.

Robert W. Blackwell & Co., Limited (63,446).—This company was registered on August 29th, with a capital of £200,000 in £1 shares, to carry on the business of electricians, suppliers of electricity, manufacturers of cables, wires, lines, accumulators, lamps, and electrical accessories, and apparatus of all kinds; railway and tramway proprietors, engineers, &c.; and to enter into an agreement with Robert W. Blackwell, Philip Dawson and Benjamin H. Howell, carrying on a business under the style of "Robert W. Blackwell and Co." The first subscribers (each with one share) are:—A. J. T. Barker, 9, Throgmorton Avenue, E.C., gentleman; P. Dawson, 39, Victoria Street, S.W., engineer; F. H. Barker, 9, Throgmorton Avenue, E.C.; C. Dickenson, 122, Cannon Street, E.C.; A. H. Barker, Warnford Court, E.C., gentleman; B. H. Howell, 27, Portman Square, W., engineer; R. Brown, 5A, Wisteria Road, Lewisham, S.E., engineer. The number of directors is not to be less than three nor more than five; the first are Robert W. Blackwell, Philip Dawson, Benjamin H. Howell, and Francis H. Barker; qualification, £1,000; remuneration, £200 each per annum.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Chili Telephone Company, Limited (29,252).—This company's annual return was filed on August 23rd, when 44,000 shares were taken up out of a capital of £250,000 in £5 shares. £5 per share has been paid; total, £220,000.

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Langdon-Davies Electric Motor Company, Limited (55,830).—This company's annual return was filed on August 16th, when 8,500 preference and 44,007 ordinary shares were taken up out of a nominal capital of £70,000 in 20,000 preference and 50,000 ordinary shares of £1 each. £12,507 has been paid on 8,500 preference and 4,007 ordinary shares, and £40,000 is considered as paid on 40,000 ordinary.

Edmundson's Electricity Corporation, Limited (52,013).—This company's annual return was filed on August 16th, when 4,500 deferred and 26,100 ordinary shares were taken up out of a nominal capital of £200,000 in 4,500 deferred and 35,500 ordinary shares of £5 each; £5 has been called up on each of 17,400 ordinary shares, resulting in the receipt of £87,000; £66,000 is considered as paid on 8,700 ordinary and 4,500 deferred.

Edison & Swan United Electric Light Company, Limited (18,984).—This company's annual return was filed on August 18th, when 116,400 "A" and 23,564 "B" shares were taken up out of a capital of £1,000,000 in 150,000 "A" and 50,000 "B" shares of £5 each; 10s. has been called on each of 89,621 "A," resulting in the receipt of £44,630 10s.; £456,667 10s. is considered as paid on 139,964 shares (£3 on 10,000 "A," £2 10s. on 89,261 "A," and £5 on 17,139 "A" and 23,564 "B.")

CITY NOTES.

Stock Exchange Notices.—The Committee has appointed Thursday, September 14th, a special settling day in Edmundson's Electricity Corporation, £75,000 4½ per cent. first mortgage debenture stock, and Willans & Robinson, Limited, further issue of 10,000 ordinary shares of £5 each, £1 paid, Nos. 80,001 to 90,000, and 10,000 6 per cent. cumulative preference shares of £5 each, £1 paid, Nos. 60,001 to 70,000. The application to quote Imperial Tramways Company, Limited, 10,000 6 per cent. cumulative preference shares of £10 each, fully paid, Nos. 1 to 10,000; 20,000 ordinary shares of £10 each, fully paid, Nos. 1 to 20,000; and 200,000 4½ per cent. first mortgage debenture stock, has been refused.

Prospectus.—The prospectus of the Kalgoorlie Electric Power and Lighting Corporation, Limited, will be found in our advertisement pages. The capital is £250,000, of which £150,000 6 per cent. preference capital is offered for subscription until Wednesday next. This sum will be entirely employed as working capital. In the first instance plant of 4,000 H.P. capacity (continuous supply) is to be installed.

Davis & Timmins, Limited.—The directors announce a dividend on the preference shares for the period ended June 30th last at the rate of 6 per cent. per annum, payable on 15th inst.

Commercial Cable Company.—The board has declared a quarterly dividend of 1¾ per cent. on the capital stock, payable 2nd prox.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending September 2nd, 1899, were £1,471 7s. 2d.; receipts for week ending September 2nd, 1898, £978 15s. 3d.; aggregate for half-year to date, £13,462 5s. 5d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending September 1st, 1899, were £3,498 1s. 8d.; corresponding period 1898, £3,181 3s. 1d.; increase, £316 18s. 7d.

The City and South London Railway Company.—The receipts for the week ending September 3rd, 1899, were £891; week ending September 4th, 1898, £916; decrease, £25. Total receipts for half-year, 1899, £9,532; total receipts corresponding period, 1898, £9,611, decrease, £79. Miles open, 8½.

The Dover Corporation Electric Tramways.—The receipts for the week ending September 2nd 1899, were £293 4s. 11d.; week ending September 3rd, 1898, £248 0s. 10d.; increase, £45 4s. 1d. Total receipts to date, 1899, £6,781 5s. 8d.; corresponding period, 1898, £5,505 10s. 7d.; increase, £1,275 15s. 1d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,932; 1898, 3,771. Number of cars, 1899, 12; 1898, 10.

The Dublin United Tramways Company.—The receipts for the week ending Friday, September 1st, 1899, were as follows:—D. U. T. Co., horse cars, £1,831 12s. 6d.; ditto, electric cars, £1,746 11s. 5d.; D. S. D. Co., electric cars, £1,121 15s. 2d.; total, £4,699 19s. 1d.; corresponding week last year—D. U. T. Co., horse cars, £2,924 9s. 8d.; ditto, electric cars, £498 18s. 10d.; D. S. D. Co., electric cars, £1,124 15s. 8d.; total, £4,548 3s 9d.; increase, £151 15s. 4d. Aggregate to date, £42,723 8s. 8d.; aggregate to date last year, £41,184 11s. 2d.; increase to date, £1,588 17s. 6d. Worked:—The mileage open is 21 miles electrically, 28 miles by horses, as against 12 miles electrically, and 30 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways. — The receipts for two weeks ending September 2nd, 1899, were £1,531. Miles of track open, 10. Car miles run, 22,906. Number of cars, 21. The receipts for two weeks ending September 7th, 1898, were £590. Miles of track open, 8½. Car miles run, 7,570. Number of cars, 10. Increase, £941.

The Liverpool Overhead Railway Company.—The receipts for the week ending September 3rd, 1899, amounted to £1,994; corresponding week last year £1,617; increase, £377.

The South Staffordshire Tramways Company.—The receipts for week ending September 1st, 1899, were £747 17s. 3d.; aggregate receipts for 35 weeks, £23,119 3s. 3d.; week ending September 2nd, 1898, £629 1s. 9d.; aggregate receipts for 35 weeks, £21,918 7s. 3d.

STOCKS AND SHARES.

Wednesday Evening.

Politics is the dominating feature of the Stock Exchange for the time being, and even the most optimistic of House men have shaken their heads this week at the Transvaal developments. The public are showing very little disposition to buy anything at all, and, consequently, trade in the steady-going electrical market is reduced to a minimum. The dealers stand idle in the market place all the day long, and admit that they see small chance of a general revival until the South African *impasse* has been broken, one way or the other. The telegraph section is naturally affected by the same cause, and in traction descriptions there is hardly a change to record.

In the electrical supply market the most noticeable alteration is in a name, not a quotation. The House-to-House Electric has been turned into the Brompton and Kensington Electricity Supply Company, but the old shares retain their place for the time being in the official lists, and no change is marked in the price. Edmundson's shares are quoted ex rights, and we understand that the new issue was fully subscribed. The price, however, remains unaltered. Of the metropolitan companies, City of London alone are being dealt in to any extent, but in these the daily bargains booked now are far short of the number done a month ago. Nothing has yet been announced with regard to a new issue of capital by the Charing Cross Company—in fact, there is even some doubt expressed in the Stock Exchange as to whether the company will avail itself of the right to enter the City, at any rate, for some considerable period. It is quite certain that a heavy emission of fresh capital to-day would meet with a very poor response, owing to the general caution that prevails.

Beyond the quoting of a few bonds ex dividend, the telegraph market is almost unchanged. Eastern Ordinary has given way, as it naturally would do upon growing fears of a war with the Krugerian band, but Eastern Extensions hold their ground with remarkable pertinacity. It is a matter of opinion as to whether the actual outbreak of hostilities would not be an excellent thing for the two Eastern companies, and hardy investors are picking up cheap stock when it comes into the market. Operators in Anglo-American telegraph stocks are resting upon their oars—the phrase, perhaps, applies literally, having regard to the empty appearance of the market in the Stock Exchange. There is very little to "go for," as the House says, and prices change too slowly for the average speculator to be tempted into dealing.

Electrical railway securities are lifeless. Central London Preferred half-shares are now £5 paid, but there is no business doing in them. "I dealt in Central Londons yesterday," quoth one of the principal jobbers to-day, "and it was the first bargain I had done in them for a week." Waterloo and City has not regained the point it lost last week. The price of City and South London has hardly moved for the past month.

We believe we are correct in stating that important negotiations are on foot for the absorption of the Birmingham Omnibus Company by the British Electric Traction, but no details have reached us at present. The British Electric should be able to acquire the 'Bus Company cheaply, and the bargain would probably turn out well. No change has taken place in the price of the shares. Calcutta Tramways show a slight tendency to react after their rapid advance, but there is a small buyer in the market at 9. Considering that some little time may elapse before the company is likely to reap any practical benefit from the electrifying of its line, we should imagine that holders whose shares show them a profit might do worse than take it.

The Tramways Union Company announces that it has now sufficient money in hand to pay off the debentures in full, to return the capital to shareholders (*i.e.*, at the rate of £5 per share), and to add another 30s. per share thereto. Subsequent distributions will be made as its assets are realised, and the market is hoping that these will amount to at least a further £2 10s. per share. The price is now 8½—9. Barcelona Trams are 11—13, and Bordeaux keep steady at 12—14.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, August 30th.	Closing Quotation, September 6th.	Business done during week ended September 6th, 1899. Highest.	Lowest
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	63 — 66	63 — 66	64	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	115 —116	115 —116	115⅞	115
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	14½— 15	14½— 15	14⅝	14⅝
205,151	Brasilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	15½	15
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105⅛	104
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½%	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,009	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,981	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10⅛	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3¼%	3½%	11⅜— 12¼	11⅜— 12¼	12⅛	12⅛
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	153 —158	151 —156	155	152½
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	99 —102	99 —102	99⅜	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	116 —121	116 —121	...	...
260,009	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14½— 15	14½— 14⅜	14⅝	14¼
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,826	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,827—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	115 —120	115 —120	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	103½	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	4 %	...	...	102 —105%	102 —105%	104½	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	5½%	10⅜— 11¼	10⅜— 11¼	11 7/16	10⅜
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15 — 15½	15 — 15½	15¼	15
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	...	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	49	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	6 %	6 %	...	109 —112	106 —109 xd	106	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	⅝— 1	⅝— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½%	6 %	6 %	5¼— 5½	5⅛— 5⅜	5⅜	5 5/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5½	5¼— 5½	...	...
1,339,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	100⅜	100
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,881	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	130½	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5½	4⅜— 5½	...	...
151,738£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	100 —103	98 —101 xd	100½	98½
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	⅝	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	101 —104	101 —104	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	103 —106	103 —106	105	...
88,321	West India and Panama Telegraph	10	1 %	⅝%	...	1⅝— 1⅝	1⅝— 1⅝	...	...
34,568	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10¼— 10⅜	10¼— 10⅜	10¼	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	103 —106	103 —106	105	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	100 —105	98 —103 xd	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10½— 11¼	10¼— 11¼	10⅞	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6¼	6 — 6¼	6¼	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8¼	7½— 8¼	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	113 —115	113 —115	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11½— 12½	11½— 12½	12 1/16	11⅝
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13½	13½	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	128⅝	128½
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 11½	11 — 11½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13½— 14½	13½— 14½	...	...
220,000	Do. 4½% Deb. Stock, Prov. Certs (£30% to be paid) Rd.	...	...	...	...	81 — 84	82 — 85	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5 — 5½	5 — 5½	5 5/16	5½
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	8 — 9	8 — 9	8¼	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 7	6⅝	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	105 —107	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	15 — 16	15⅜	15¼
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14½— 15½xd	14½— 15½	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	16½— 17½	16½— 17½	17⅛	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3⅞— 4⅛	3⅞— 4⅛	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	15½—16½	15½— 16½	15 11/16	15 9/16

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Aug. 30th.	Closing Quotation Sept. 6th.	Business done during week ended Sept. 6th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	3 — 3½	2¾ — 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	97 —102	97 —102	...	...
30,000	British Electric Traction	10	...	...	6 %	17½ — 18½	17½ — 18½	8 1/16	18
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13¾ — 14¼	13¾ — 14¼	14	13¾
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	...	...	...	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	129½	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	2 1/16	2
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6¼ — 6¾	6¼ — 6¾	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	3 %	5 %	1⅞ — 2⅛	1⅞ — 2⅛	2	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛ — 2⅜	2⅛ — 2⅜	...	...
125,000l	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	108 —112 xd	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13½ — 14½	13½ — 14½	14¼	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼ — 10⅜	10¼ — 10⅜	...	...
178,303	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	2⅜ — 3¼	4⅜ — 5¼	5 1/16	5
71,447	Do. do. Def. do.	5	...	...	...	5¼ — 5⅜	5¼ — 5⅜	...	...
630,000l	City and South London Railway	Stock	1 1/16 %	1⅞ %	2⅛ %	65 — 67	65 — 67	66½	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6¼ — 6¾	6¼ — 6¾	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½ — 4	3½ — 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½ %	6 %	6 %	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½ %	6 %	6 %	4 — 5	4 — 5	4⅜	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛ — 2⅜	2⅛ — 2⅜	2 3/16	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	102 —105	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝ — ⅞	⅝ — ⅞	...	...
9,600l	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	25 — 26	...	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	20 — 22	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	110 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21⅝	21¼
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	103¼	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞ %	3¼ %	3¼ %	7⅝ — 7¾	7⅞ — 8	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13 — 13½	13½ — 13⅝	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	38 — 42	38 — 42	...	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	104¾	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼ — 9¾	9¼ — 9¾	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅝ — 6¼	5⅝ — 6¼	...	...
540,000l	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	101 —104	102½	102

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

***Birmingham Electric Supply, Ordinary £5 (fully paid) 8¼—9¼.**
British Aluminium, Ordinary, 9½—10; 7 % Pref., 10—11.
House-to-House, 4½ % Debentures of £100, 105—108.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 2—4.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 13—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7¼—7¾. Debentures, 105—108. Dividend, 1898, on Ordinary Shares 10%.
***T. Parker, £10 (fully paid), 19.**

* From Birmingham Share List.

Bank rate of discount 3½ per cent. (July 13th, 1899).

MARKET QUOTATIONS, Wednesday, September 6th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	32/-	32/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	85/-	85/-	..
a Ammonia, Muriate (crystal) .. per ton	£25	£25	..
a „ „ .. .. per ton	£23	£23	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£23 10	£25	£1 10 dec.
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a „ White Sugar .. .. per ton	£31	£31	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3½d.	3½d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8½d.	..
c „ Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c „ Wire, basis .. .. per lb.	..	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g „ Wire (basis price) .. per lb.	10½d.	10½d.	..
g „ Sheet .. .. .. per ton	£88	£88	..
g „ Rod .. .. .. per ton	£88	£88	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. .. per lb.	4/2 to 4/3½	4/3	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	67/6	64/9	2/9 inc.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£12 17 6	£12 17 6	..
g Lead, English Ingot .. .. per ton	£14 18 9	£14 18 9	..
g „ „ Sheet .. .. per ton	£15 7 6	£15 7 6	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 12	£8 12	..
d Mica (in original cases), small per lb.	2d. to 6d.	1½d. to 6d.	..
d „ „ „ medium per lb.	1/9 to 2/6	1/9 to 2/6	..
d „ „ „ large per lb.	3/6 to 7/-	3/6 to 7/-	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd strip & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£8 10	£8 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£146 10	£146 10	..
g „ foil .. .. per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/10	1/10	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	..
j „ Best Flax, 6 lea. .. per lb.	4½d.	4½d.	½d. inc.
j „ Hemp, 3 ply 10 lbs. .. per lb.	3¾d.	3¾d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£13	£12 10	10s. inc.
j „ Manila, 24 thread .. per ton	£35 10	£35	10s. inc.
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£27	£27 10	10s. dec.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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SOME FORMS OF MAGNETIC SEPARATORS, AND THEIR APPLICATION TO DIFFERENT ORES.*

By H. C. McNEILL, Assoc.R.S.M.

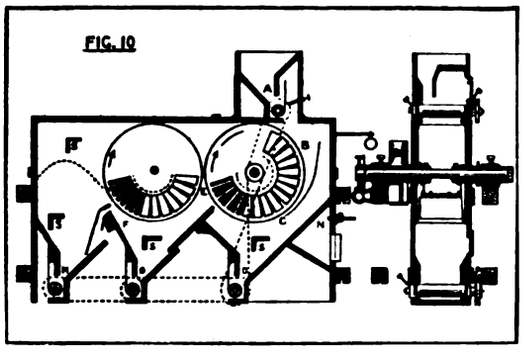
(*Concluded from page* 375.)

2. The Monarch Separator.

The Monarch separator may be regarded as a Wenström with the single drum duplicated; it is, however, of a rather more delicate construction, and is a modification of and improvement on the original Ball and Norton machine, a class which includes the most successful machines of the eccentrically placed internal electro-magnet and the revolving drum pattern. Fig. 10 shows a sectional elevation of this separator. It is necessary that the ore treated should be quite dry, and in both cases where the author was enabled to see the machine at work in Sweden the best results have been obtained upon material crushed to pass through a 1 millimetre screen.

The ore of the size mentioned, after drying, is fed in an even stream into the machine by means of the roller at A, the feed being capable of adjustment as shown. The mineral falls on the revolving drum, B, which moves over the fixed electro-magnets, all the material being compelled to pass close to the drum by means of the bent shield, B C. Having passed the point, C, the non-magnetic portion, or tailings, fall into compartment D, and are fed out at that point by a similar roller. At or near the point E the particles hop across to the next drum in consequence of a stronger current being employed in drum No. 2, and are possibly helped by an induced current of air caused by the superior velocity of this second drum, the relative speeds being as

FIG. 10



6:1. Those particles containing a little magnetite are whirled off drum No. 2 at about the point F, the centrifugal force being the stronger force of the two, and drop into the compartment, G, constituting "middles" or "middlings." The wholly magnetic particles are whirled off drum No. 2, at about the end of the electro-magnets, and are flung against the end of the machine, and are fed out at H.

The "middles" may be re-crushed and re-treated, if necessary. A combination of three such machines, where the middles from two of

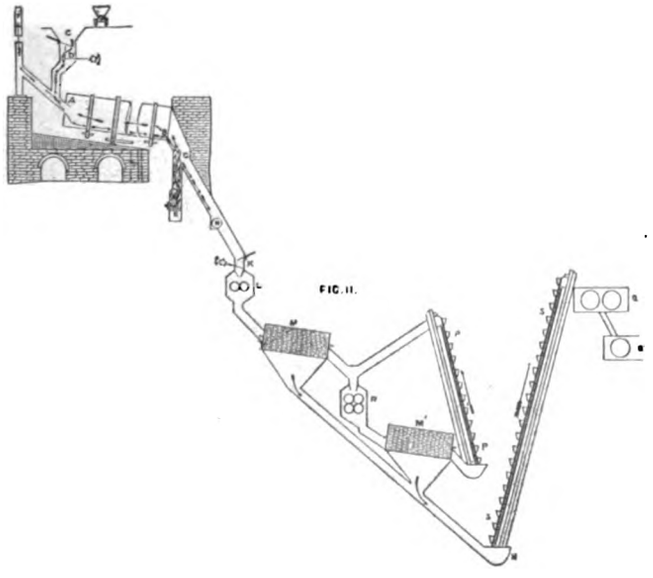


FIG. 11.

them are passed through a third, is said to be capable of treating 200 tons of uncleaned ore per day of 24 hours.

One of the later improvements on this separator is the introduction of drums made of German silver, which has been found to increase the efficiency of the machine.

This form of machine, when used after a careful preliminary treatment, such as drying, crushing, screening, &c., is applicable to two classes of ore:—

1. Those in which magnetite is more or less intimately associated with worthless material.

2. And those in which the magnetic portion is of secondary importance.

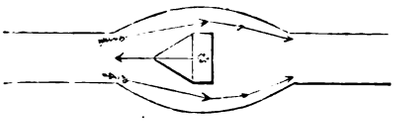
To both of which cases the machine is successfully applied.

The extensive plant seen by some of the members of this Institute whilst at Lulea, in the north of Sweden, last summer, may be taken as a case coming under the second of these conditions, and which may be briefly described as follows:—

The ore which is put through the mill assays from 0·01 per cent. to 3 per cent. phosphorus, and is correspondingly low in iron, the phosphorus occurring in the form of apatite. Only the ore richest in the latter mineral, and hand-selected on this account, is put through the mill.

It is first put through a Blake crusher and then through a single pair of Swenson rolls, the ore being thus reduced so as to pass through a ½-inch mesh screen. This product is then thoroughly dried by passing it through the revolving cylinder, A B, fig. 11. This cylinder is 48 feet in length and 4 feet 8 inches diameter; it is inclined 1 in 18, and rotates once every five seconds. The ore from the hopper, C, is by means of the feed-plates at D, passed in a constant stream into the cylinder, meeting the heated gases, &c., coming from the coal-fire at E. Having arrived at B, the ore, which is now quite dry and hot, falls down shoot G, being divided at that point into two streams (fig. 11A), in order to miss the uptake from the fireplace, E. At H is a revolving drum, and at K are placed an adjustable baffle-plate and a vibrating feed-tray, which not only acts as a safety catch to prevent

FIG. 11A.



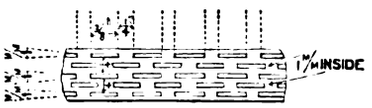


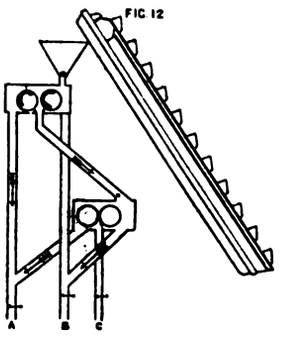
FIG. 11B.

any object, such as a hammer-head, getting into the rolls, but also regulates the feed of ore, so that the rolls, L, have just sufficient ore to deal with, and do not get clogged up. After passing these rolls the ore enters the circular screen, M. This screen is of $\frac{1}{16}$th inch thick steel plate with oblong holes, the details of which are given in the sketch (fig. 11B). A certain proportion of the ore, about 20 per cent. of the whole, which finds its way, or is small enough to pass through M, drops right down to the bottom chamber, N, whilst the rest passes out of the screen, and is fed into the double rolls, B, and after that passes into a second and similar screen, M^1. The ore fine enough to pass through this second screen joins that which has already passed through the upper trommel, M, whilst that which is still too large is returned to the double rolls, B, by means of the elevator, P P, and is re-crushed. Assuming the chamber, N, to contain nothing but ore 1 millimetre diameter, this is then transferred to a Monarch separator, Q, by the elevator, S S, the "middlings" from which pass down, and are sent through a second separator, Q^1.

The plant is in duplicate, *i.e.*, fig. 11 represents just one-half of the mill, each half working independently of the other half, and there are, therefore, four separators at work, two to each half.

The arrangement made for joining the like products from two separators is shown in fig. 12, where the two concentrates join

FIG 12



together and are collected at A, and the tailings similarly at B, whilst the "middles" from the top machine are taken to the lower separator, and the "middles" from which again collected at C.

All the screens, rolls, separators, elevators, shoots, &c., are boxed in with wood, and the dust from them, by means of mains and exhaust fans, drawn to a separate house, allowed to settle, and removed when necessary for further treatment.

* Read before the Iron and Steel Institute at Manchester, August, 1899.

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It might be of interest to note that the tailings, consisting of apatite, with a very small proportion of magnetite and some hæmatite, constitutes the most valuable product delivered from the separators.

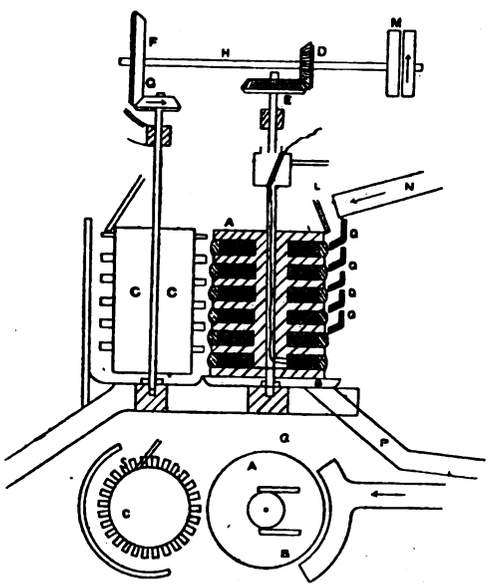
This then goes forward and receives further treatment for the separation of the small residual portions of iron compounds, and the finished phosphate of lime is finally converted into the soluble phosphate of soda by the Wiborgh process.

A similar plant to the one just described is also used, as already mentioned, where magnetite has to be separated from other and worthless minerals. In this case, the only point that it is necessary to draw attention to is that the ore itself, in the absence of any appreciable quantity of apatite, may be harder, and the initial crushing more difficult to accomplish. At Herräng a No. 5 Gates crusher is employed for this purpose.

3. The Dellvik-Gröndal Separator.

This machine is designed to treat those ores in which the magnetite exists in a state of intimate admixture with other and in general worthless minerals. At present it is at work, and is successfully treating low-grade magnetite ores. The preparation that the ore has to undergo before it is passed to this form of separator will be described when dealing with a plant now working at Bagga, in

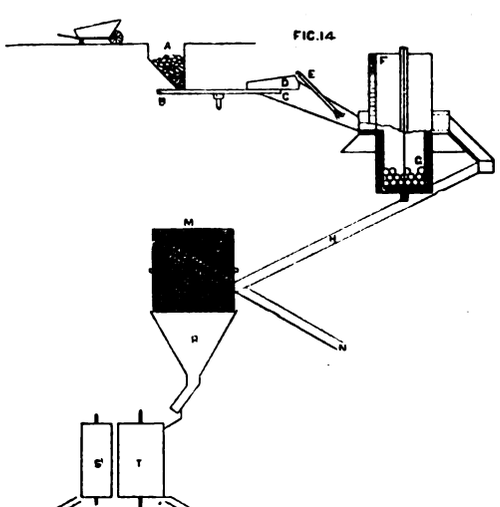
FIG. 13.



Sweden. For present purposes, the material may be described as a slime. Fig. 13 shows a sectional elevation and part plan of the machine. A B is of cast-iron, and consists of a series of rings. In the spaces between each of two is placed the copper wire conveying an electric current. This drum is rotated by means of the bevel gearing, D E, and the pulley-shaft, H.

C C is a solid drum of wood caused to revolve three times faster than A B by means of the gearing shown at F G, and is studded with

FIG. 14.



soft wrought-iron bolts or pegs, each ring of which revolves exactly opposite to the rings on A B. It will be noted, as indicated by the arrows, that A B revolves from right to left in front, and C C from left to right in front. The slime is carried to the machine by means of the launder, N, which terminates in the circular launders, Q Q Q Q, which enclose the drum, A B, for about one-third of its circumference, as seen in plan, and offer a larger area of the slime to be acted upon. Further water is supplied by the pipe, L. The magnetic particles thus brought under magnetic influence attach themselves to the rings on A B, and are carried round. Those particles which escape the first ring are caught lower down, and so on, each successive ring being more strongly magnetic than the one above. The unmagnetic portion of the ore, being unattracted, is washed down and into launder P, together with the excess water. As each peg of the drum C C is successively presented to the rings of the drum A B, magnetism is induced therein, and the magnetite hops over and forms in tufts on each peg, and is thus carried out of the magnetic field, where most drops away, and the rest is washed off by a strong jet of water from the pipe shown, this separated magnetite being run by the launder into settling pits, from which it is dug out.

The copper wires conveying the electric current are protected by carefully fitted brass rings and special jointing.

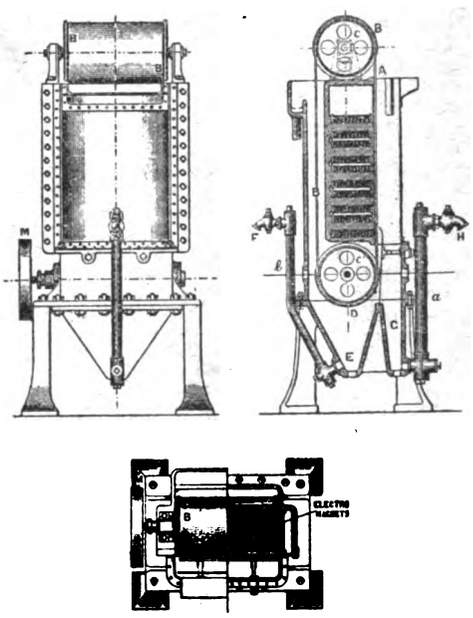


FIG. 15.

The necessary fine crushing before treatment in the separator is accomplished by means of a ball-mill. Fig. 14 is an attempt to show a small plant designed for the purpose of treating a low-grade ore, in which it is necessary that crushing should be carried to such a point that all the material shall pass through a 12-mesh screen. The first coarse crushing is done by means of a Blake machine, which reduces all the ore to about walnut size, after which it is passed through a ball-mill, a feature of which is an ingenious arrangement, by which a regular feed of ore is supplied to the mill. B C is a horizontal circular revolving plate, the height of which can be adjusted so that the distance between the bottom of the hopper, A, and the moving plate, B C, can be so regulated that just sufficient ore is allowed to drop through, and is carried round on the plate. D is a fixed guide-plate, under which the plate, B C, revolves, and the ore, in coming up against it, is slowly pushed off and into the shoot leading to the ball-mill F G. This is of cast-iron, lined internally with chilled plates, the latter removable, and is caused to rotate 40 times per minute upon hollow trunnions, through which ore is fed in on one side and out on the other, water being supplied by pipe E. Coarse slime is thus produced, and passes out with the excess water down an open launder H, and into a revolving screen M, of wire gauze, with 140 holes to the square inch. The stuff, already fine enough to pass through, drops into the shoot B, and is treated in the Dellvik-Gröndal separator S T, whilst that not sufficiently fine is carried up on the gauze inside, and drops from the top on to the enlarged end of a launder N, and is returned to the mill by a small pump.

Prof. G. Nordenström, in a paper read before this Institute at the Stockholm meeting last August, mentions the fact "that the Dellvik-Gröndal separator has been advantageously used at Pitkaranta, in Russian Finland, since 1894, for concentrating poor iron ores."

4. The Heberle Separator.

There are two distinct types of machine, each of which is shown in separate figures.

Fig. 15 is a type designed for the separation and concentration of low-grade magnetic ores only.

Fig. 16 is designed for the treatment of galena blende ores when occurring with magnetic oxide of iron; also the separation of roasted spathic iron and blende, &c., or in the treatment, which will be described below, of a complex ore consisting of galena blende, magnetic oxide, pyrrhotine, and quartz.

In fig. 15, the ore to be treated, after reduction to size of about 30-mesh, is fed in at A with water. B B is a continuous gutta-percha belt travelling round the pulleys C C, and over the fixed electro-magnets placed in the casing shown, the whole machine being enclosed in a wooden box, which is kept full of water to a height a little above the highest of the magnets. The magnetic portion of the ore attaches itself to the belt, and is carried down with it until,

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arriving at D, and out of the field, falls away into E, and is withdrawn through F. The worthless portion falls into G, and is withdrawn through pipe H. The width of the belt may be from 1 foot 8 inches to 2 feet 6 inches, and a machine of the latter size is capable of treating 35 tons of crude ore per day. These separators may with

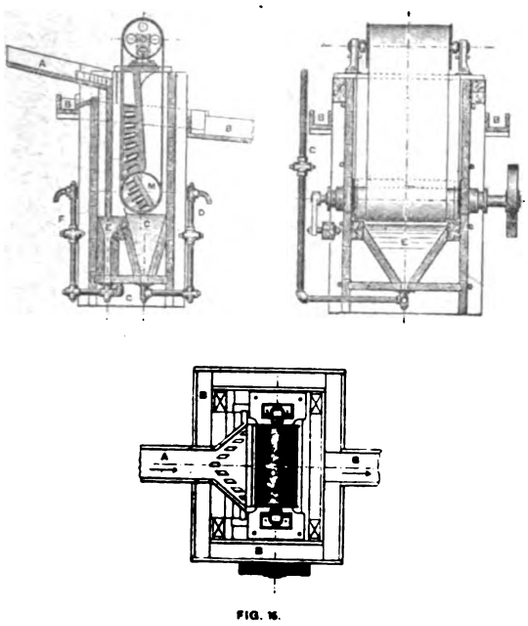


FIG. 16.

advantage be used in series where a favourable percentage of the magnetic iron might be obtained from the ore by a primary crushing of from 6 to 3 millimetres and treatment in separator No. 1, Fig. 17, the rejected portion being further reduced in size to, say, 3 to 2

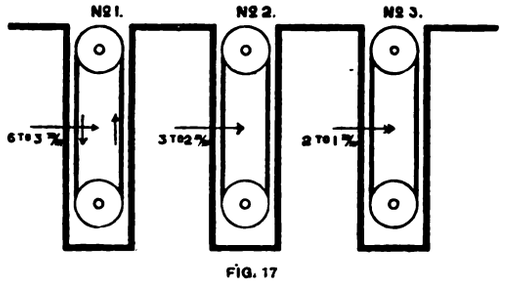


FIG. 17

millimetres, and treated in No. 2 separator, and so on with intermediate crushing between two such separators.

At Saxburget, in Sweden, where, by the kindness of Mr. Wenström, I was permitted to see their mill, they were treating an ore consisting of approximately—

	Per cent.
Lead	11
Zinc	22
Magnetic oxide...	14
Pyrrhotine (magnetic pyrites), Fe_8S_7 ...	2 to 5
Silica	15 to 20

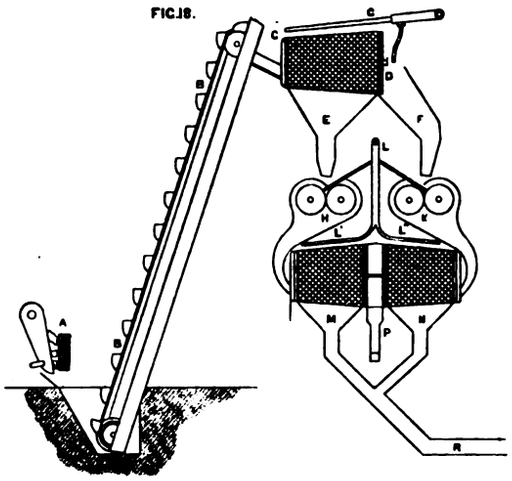
which is obtained from the adjacent Langfallsgrufvan mine.

The ore is first hand-cobbed and picked over to roughly pieces of 6 inches diameter. It is then passed on a Blake breaker, A, fig. 18, which reduces it to the size of about $\frac{3}{4}$ inch diameter. It is then lifted into the trommel, C D, provided with $\frac{3}{8}$-inch holes, by means of which the material less than $\frac{3}{8}$ inch passes through and goes on the fine rolls, H, together with water supplied by the pipe, G. Material larger than $\frac{3}{8}$ inch, or between $\frac{3}{8}$ inch and $\frac{3}{4}$ inch, passes down F to the coarse rolls, K; also with water supplied by the pipe shown. From these rolls the crushed ore passes to further trommels, M and N, provided with holes of about $\frac{1}{32}$ inch. The stuff already small enough passing down in the shape of a slime by launder R, direct to a Heberle separator of type shown in fig. 16, anything above $\frac{1}{32}$ inch is returned from F to the fine rolls, H, and re-crushed. The ore now consists or a slime containing all the minerals mentioned above, and in this state is run into the separator, fig. 16, at A. The magnetic portion is carried down on the belt and deposited into chamber C, and withdrawn by a pump through D. The coarser portion of the remainder of the mixture accumulates in E, and is withdrawn through the pipe, F, the outer case of the separator being kept full of water up to launder B by means of the water pipe, G, the finer portions of mixture consisting mostly of the blende and silica, together with about 3 per cent. magnetite, in a state of suspension, are carried away by the overflow, B, to setting pits for subsequent re-treatment as fine slimes.

The magnetite, after withdrawal from C, here disappears from the process, as, although it contains a little zinc and lead, it is found unprofitable to treat it further.

The material which collects in chamber E then goes forward to a four-compartment jig, whereby the coarser galena becomes a separated and sized product and the other products are re-ground in a special form of mill designed by Heberle, and shown in fig. 19, and consisting of two fluted plates rotating concentrically against each other, after which as much as possible of the other minerals are separated by means of pointed boxes, continuous revolving buddles, and Rittinger side recoil tables, &c.

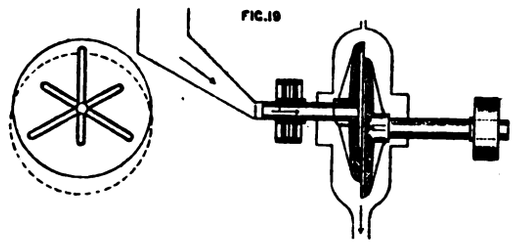
FIG.18.



5. The Wetherill Machine.

This machine has been designed to treat the ores met with at the Franklin Mines, New Jersey, U.S.A., which contain Franklinite (the chief iron and manganese bearing mineral) intimately mixed with zinc oxide and Willemite (zinc silicate) in a limestone matrix. The problem was to utilise the natural and slightly magnetic properties of the Franklinite, separate it from the admixture of the other ores, and so concentrate the zinc minerals sufficiently high to admit of their

FIG.19



reduction in the Belgian spelter furnaces. The original treatment was to roast the ore with anthracite, so increasing the magnetic properties of the Franklinite, and to treat the roasted product on a Wenström separator. Mr. J. P. Wetherill found on experiment that, by concentrating his magnetic field, the Franklinite, described by Dana as slightly magnetic, could be separated without preliminary roasting.

There are two types of Wetherill separator for treatment of ores of different grades.

Messrs. H. A. J. Wilkins and B. H. C. Nitse, in a paper read before the American Institute of Mining Engineers at the Pittsburg meeting, February 1896, gave sketches and some detail of these machines, from which it appears that the crushed and dry ore is subjected to the selective action of a highly concentrated magnetic field.

The author has had no experience with this type of machine, but there is little doubt that, in the treatment of complex ores, many of which consists of minerals described as "feebly" or "slightly" magnetic, considerable possibilities are opened up in the direction originated by Wetherill.

Messrs. Wilkins and Nitse mention "That amongst the minerals which have been found susceptible of attraction by the condensed magnetic power of these machines may be mentioned red and brown hæmatite, siderite, chromite, menaccamite, rutile, Franklinite, pyrolusite, &c. In fact, almost all minerals containing iron or manganese, or both, also salts of iron, manganese, and chromium; and with the introduction of still higher magnetic powers, it is hoped that even iron pyrites will come within the scope of successful separation treatment."

In conclusion, attention may be drawn to the increasing utilisation of magnetic iron ore, not only in this country, but to a still greater extent on the Continent, and to the growing importance of magnetic concentration as a branch of technical industry. There is undoubtedly a large field open both to the inventor and for the remunerative employment of capital, and the author hopes that these notes, as describing more particularly the Swedish practice, may not have been without interest.

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THE SYNCHRONISING OF ALTERNATORS.*

By M. GARDNER and R. P. HOWGRAVE-GRAHAM.

The authors do not, in this paper, propose to deal with the manifold practical difficulties arising in the synchronising of alternators, as most of them are purely mechanical, or dependent on the individual skill and care of the switchboard attendant who is told off to perform this rather difficult and skilled operation.

This paper, then, is on the actual apparatus and methods of connection used in the synchronising of alternators, though we must first, to make the subject clearer, touch upon some of the more important points in the parallel running of alternators.

When coupling alternators so that their outputs may be combined, the conditions to be fulfilled differ in most respects from those in the case of continuous current machines.

Three conditions must be fulfilled that alternators may be run in parallel.

1. The machines must be in synchronism, that is, they must be running at such speeds that their frequency is the same.

2. They must be in phase or in step, which means that they must all give a maximum electromotive force of the same sign to the same bus bar at the same moment.

3. The voltage in most cases should be the same, but this condition is the least important of the three. In fact, the excitation of one machine is sometimes deliberately lowered to throw more load on to the others.

It is stated above that three conditions must be fulfilled that alternators may be run in parallel. The running of alternators in series was not considered, for the simple reason that alternators cannot be run in series.

It is well, perhaps, to just give a few words of explanation of this rather curious and inconvenient impossibility. We must first assume that we have got two alternators designed to give equal electromotive forces at a fixed frequency.

Let the curves A and A_1 (fig. 1) represent the electromotive force

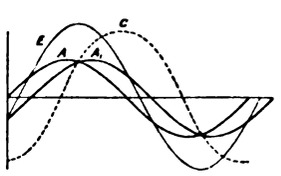

Fig. 1.

waves of two alternators with their armatures connected in series, the machines been driven independently, but so as to give the same frequencies and pressures, and suppose them to be running synchronously, but to be out of step by a small angle.

The curve, E, represents the algebraic sum of the ordinates of A and A_1, and hence represents the resultant electromotive force of the two machines.

The current curve, C, lags behind the resultant E.M.F. curve E, on account of self-induction.

Now, the total work done in the circuit equals the product of the sums of the E.M.F. and current waves respectively, that is, the product of the ordinates of the two curves E and C. The work done in the circuit by either machine equals the product of the ordinates of its E.M.F. and current curves, that is, of its E.M.F. curve and the total current curve C, which is the same for both machines.

Since the pressure wave, A_1, of the lagging machine is nearer to the curve, C, than that of the leading one, it is quite clear that the products of its ordinates, and those of the curve, C, will be larger than those of A and the curve C.

Therefore the lagging machine, A_1, is furnishing more work to the circuit than the leading machine A.

If the two machines were rigidly connected, either on the same shaft, or by other mechanical means, this condition of things would continue indefinitely.

In practice, however, the machines are generally driven by separate belts or engines, and in this case, if connected in series with the leading machine, the lagging machine, being more heavily loaded than it, tends to slow up and lag more.

Clearly the more it lags, the more work it supplies to the circuit, and by reason of this lags more still, and so goes on until the pressure waves of the two machines are exactly opposed. The machines are now in stable equilibrium, but supply no power to the circuit.

If they were started exactly in step, they would do equal work, but the least mechanical disturbance to either of them would cause it to fall out of step, as described above.

The condition of equilibrium is then unstable, and it is therefore impossible to run alternators in series, unless they are rigidly connected on the same shaft, which is in nearly every case, either of alternators in series or in parallel, impracticable.

Alternators in Parallel.

The possibility of running alternators in parallel is due to their reversibility, or ability to act as synchronous motors.

We know that an alternator connected up to another alternator which has been brought up to synchronism and voltage, will run it as a motor, and that there will be a very powerful tendency in the motor machine to keep in synchronism with the generator.

A considerable load may be put on it, and still it will keep in synchronism.

In fact, it is essential to an ordinary single-phase motor that it should be in synchronism with the generator.

A precisely similar thing happens with alternators running in parallel, for if one, by reason of mechanical or electrical disturbances, tends to slow up, the other will pump current into it, run it as a motor, and hurry it up into synchronism again. So strong is this effect, that if the machines are thrown in in parallel when they are in direct opposition of phase, they will right themselves in time, provided, of course, that they are in synchronism, or nearly so.

However, we shall return to this later on.

For parallel working the speed must be uniform, and if the cranks of the two engines are crossed, each machine will tend to alternately speed up and speed down, for when one engine pulls, the other will be at its dead point.

If the governing is not good, and the fly-wheels not heavy enough, the armature reactions will set up a kind of hunting or pumping action, and a consequent fluctuation of the lights with each period of the engine's revolution.

If the engines have two cranks, this will, of course, be obviated. More need not be said on this part of the subject, as it is not exactly within the province of this paper, and has been already so excellently dealt with by Mr. Wilson in his paper on "The Parallel Running of Alternators."

We will now pass on to the results of putting two alternators, which are out of synchronism, in series with a negligible load such as a lamp.

It may simplify matters to liken the two machines to two pendulums of slightly different lengths.

If the pendulums are started swinging in phase, they will, after a short time, get out of phase, until when one is swinging in one direction the other is swinging in the other, and similarly, in the same space of time which they took to get out of phase they will get into phase again.

Two alternators will behave in exactly the same way when they are connected in series but are out of synchronism. At one moment they will supply a voltage equal to the algebraic sum of their voltages, and the resultant voltage will be a maximum, and as time goes on, they will oppose each other, and the algebraic sum will be the arithmetical difference, therefore we shall have a minimum resultant voltage.

In fig. 2 you will see the two black curves, which represent the

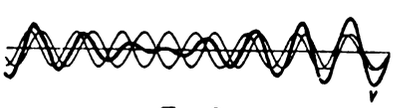

Fig. 2.

curves of two alternators slightly out of synchronism. The red curve is obtained by taking the algebraic sum of the ordinates of the two black curves, and you will see from it that the resultant voltage grows and dies away. The more nearly the machines are in synchronism the slower will the fluctuations be. This effect is very important as it is made use of in most synchronising apparatus.

We have here a model to illustrate it. A commutator and two slip rings are mounted on a shaft and revolved at a high speed by a motor. Each slip ring is connected to one half of the commutator, and has a brush pressing on it.

A continuous current is lead in at these brushes, and if two more brushes are put on the commutator at opposite ends of a diameter, we can get from them an alternating current. We have another similar commutator with travelling bearings, and it is arranged so that by sliding it along we cause a little rubber-banded wheel on it to move along a cone attached to the shaft of the first commutator. We thus have the speed of the first commutator fairly constant and that of the second variable.

We can now consider them as two little alternators, and though if connected in series with a lamp they will behave as described above, causing the light of the lamp to periodically grow and die away, either slowly or fast according to the position of the wheel on the cone, they cannot, of course, be actually synchronised because there is no sort of dynamo and motor action between them, and nothing corresponding to armature reactions.

Let us now consider the effect of throwing in two machines in parallel, regardless of step, but having got them up to synchronism first.

Immediately they are put in parallel, a current will oscillate between them, which, if they are in direct opposition of phase, may be enormous, especially in ironless armatures, in which case it will probably destroy them.

This enormous rush of current will, if the armatures stand the mechanical and electrical strain caused by it, slow up one of them a little, and they will get out of synchronism and begin that kind of see-saw action which will bring them into phase, and motor actions will start between them and bring them into synchronism. All this may sometimes take several seconds to accomplish, during which time the lights blink and go up and down.

This naturally limits the use of this method of throwing in absolutely to motor circuits, and also limits it to machines with ironclad armatures. If we were to do it in the case of ironless armatures such as Ferranti's, Mordey's, or Siemens' there would be such a rush

* Read before a meeting of the students of the Institution of Electrical Engineers on Wednesday, March 22nd, 1899.

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of current as not only to destroy the armatures by mechanical shock, but perhaps to burn them out. In the case of ironclad machines, especially those with big teeth, the self-induction is so large that the current is limited, besides which all the mechanical strain is thrown on the iron and none on the conductors. Commercially, however, alternators are hardly ever thrown in in parallel regardless of step, and in the very few admissible cases it is done with ironclad armatures and motor circuits.

It may be well to mention that it is found that machines of the same type and wave form have the most synchronising power. As regards the last condition, it has been said before that slight inequality of voltage does not much matter, and is, in some cases deliberately arranged for, when it is desirable to throw more load on to one machine than on to another.

Methods of Synchronising Alternators.

The simplest form of synchronising apparatus is shown in fig. 3. A_1 is the alternator already running and connected to the bus bars. A_2 is the alternator to be thrown in. When the switch of A_2 is off

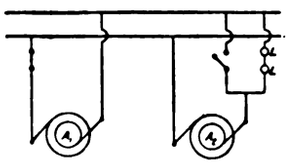

Fig. 3.

and the little auxiliary synchronising switch (which is not shown) is on, when tracing out the connections, you will see that the machines are in series with the two lamps, L L. As A_2 comes up to speed, the light of these two pilot lamps will flicker, and the flicker will get slower and slower as the speeds get more nearly equal, until the light takes about two seconds to grow and die away.

All this time the operator has been carefully regulating the voltage by means of a rheostat in series with the field coils. When the vibrations get just to the right speed, which is a matter of judgment and experience, the operator waits till the light in the pilot lamps is very nearly at a minimum, and then switches in sharply. Now, when the dynamos are out of phase as regards the synchronising circuit, that is, when the lamp is at a minimum, they are in phase as regards the bus bars, for the one is a series circuit and the other a parallel.

We have then the following condition of things when the operator has switched on:—The machines are in phase, but very slightly out of synchronism, and it has been already explained that if a machine has been slowed up a little bit, the other or others will run it as a motor, and hurry it up into synchronism, provided they are in phase. The machines will now go on quietly running in parallel. It is by no means such an easy job as it sounds, and if the man doing it switches on too late, when the machines are out of step, he may do considerable damage, and if it is a lighting circuit bring down torrents of wrath and indignation upon the heads of the company for whom he works. Even old hands seem to have to concentrate all their attention on their pilot lamps and voltmeters when synchronising, and seem to be in a sort of "Do not speak to the man at the wheel" frame of mind.

(To be continued.)

INTERMEDIATE RECEIVERS ON ELECTRICAL TRACTION ENGINES.

[COMMUNICATED.]

It is an axiom of the steam engineer that the best results from a steam engine are to be sought for only when the cylinders are dry throughout. A wet cylinder implies re-evaporation, and re-evaporation causes initial condensation. The effect is cumulative, and many engines have an initial loss of 50 per cent. of the steam admitted. A shallow thinker might demand that the steam should be so far superheated that the additional heat was equal to the missing latent heat of the quantity condensed. This is now recognised as an erroneous view. The action of superheat is also cumulative. It begins by reducing the amount of initial condensation; less re-evaporation takes place, and this means less condensation again. In the course of a few revolutions the action of superheated steam would show itself in a comparatively very large saving.

It is thus held that an initial superheat of 100° might stop all condensation. Whatever be the figure, in any one case it is clear that the steam should be dry when it exhausts to the condenser. In compound engines this is sought to be attained by intermediate reheaters. Now it is very questionable whether an intermediate receiver in a traction generator engine is a thing in the right place, and a reheater must be more or less of a receiver. Perhaps it matters less in engines of high speeds of revolution, but in slow speed engines the variations of load are so numerous and so sudden, that there must often be times when steam is cut off the high pressure cylinder by the governor and is acting on the low pressure cylinder from the receiver with an undesirable energy, for the receiver has become full of steam and proceeds to empty itself into the low pressure cylinder. This cylinder hurries round the unloaded engine at a high velocity, and forces the governor to a position beyond what is necessary, still further depleting the high pressure cylinder of steam. Then the load is thrown on by a number of cars starting on an uphill road. By this time the receiver is empty of steam, and only the high pressure cylinder is capable of doing work until the low pressure cylinder can again commence to draw from the receiver. The engine cannot run at speed; the governor throws more steam upon the high pressure cylinder, and presently the engine is full of steam, and the load goes off again just when the engine is fit to deal with it. Such, modified by fly-wheel energy, is the action of the compound receiver engine, and such, still more, is the action of the triple expansion engine.

The slower the number of revolutions in a unit of time, the more pronounced such irregular action must be.

It is assumed, of course, that the low pressure valves are fixed at about the customary $\frac{7}{8}$ths cut-off. It would almost appear that with slow speed engines the low pressure cut-off should be actuated exactly as the high pressure cut-off, or that some easily actuated throttle valve should be worked by the governor to cut off steam from the large cylinder. With such a provision there would be ready for the next load period a receiver full of hot steam to give energy at once to the large piston, while upon the load being reduced, the receiver pressure would rise against the small cylinder.

This aspect of the compound engine leads to the consideration whether the simple engine and superheating could not with advantage be employed on variable loads. The principle economy for compound working has been because of the evil of cylinder condensation which it has to some extent counteracted. But if there was no cylinder condensation nothing need be done to combat it. In a simple condensing engine there is, of course, always the accelerating influence of the condenser to deal with. If this exceeds the light load of an engine it would be possible for the engine to run away and bring into action the knock-off motion. This is undesirable, and should be met by a provision for cutting out the condenser in the same way as suggested for cutting out the receiver.

The history of electrical traction in America has been a history of many smashes, and its results have been twofold. On the one hand high speed engines have been more employed; on the other hand the low speed engines have been weighted with a large friction brake in the shape of unusually large crankshafts upon which very heavy fly-wheels have been placed to give pressure. The moment of friction has been rendered large, and the fly-wheel energy also has been made considerable. These two items between them have served to hold engines steady under the accelerating influence of the condenser at light loads. The method appears somewhat unscientific, and does not commend itself as an economical method. It is practical—this is undeniable—in fact, it is painfully practical, for it substitutes an internal power wasting brake for some means of regulation of the source of power. The benefits of condensation may be swallowed up in journal friction. It is satisfactory to find the journals of such excessive length. This has been complained of. There is no cause for complaint. Given such huge diameters, there must be great friction and consequent heat. The heat must be dissipated by a sufficient surface, and length forms a convenient means of securing surface. In slow speed engines it should be possible to regulate the energy given by the steam in place of wasting it.

THE CANDLE-POWER OF ARC AND INCANDESCENT LAMPS.*

The Appropriate Light Unit.

By Prof. WILBUR M. STINE.

The action of the American Institute of Electrical Engineers and of the National Electric Light Association in giving official indorsement to the opinion of scientists who have carefully investigated the subject, legalising the amyl acetate lamp as the standard of illuminating power, renders all forms of candles obsolete for light standards. Relinquishing the candle as the concrete light standard, should the term candle-power be given up or retained?

For illustration, suppose the meter were the legalised standard of length, and that this action was generally accepted and measurements were made with metersticks instead of foot-rules, would it be advisable to employ the ratio of the meter to the foot, and having made the measurements with the meter unit, to express the measured dimensions in feet?

* *American Electrician.*

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Much the same dilemma presents itself to photometrists. Scientifically and legally, candles are no longer in repute, and the amyl acetate standard is the new unit of light strength. Shall a ratio between the amyl acetate lamp and the candle be employed and all determinations of the light strength of illuminating sources made against the amyl acetate standard be finally expressed in candle-power terms? The first step towards an intelligent decision is the consideration of the ratio between the light strengths of the amyl acetate lamp and the candle.

It has been insisted upon that experimental evidence has shown that the light strength of the candle is a widely varying and uncertain quantity. Abandoned for this reason, it is vain to seek for a definite ratio between the amyl acetate lamp and the candle, or between any constant standard of light and the candle. The numerous candle-power ratings in the literature of photometry are only mean values obtained between wide extremes, or merely figures, and represent no physical quantity. Violle, a French physicist, states the ratio as low as,

$$\frac{\text{English candle}}{\text{Amyl acetate lamp}} = 1{\cdot}02.$$

The German Physical Institute places it at 1·14, and other investigators as high as 1·22.

The term candle-power being meaningless as a quantitative expression, and the amyl acetate lamp being fairly precise as a standard light, we, in this country, might follow the example of foreign photometrists and express illuminating power in terms of Hefner units (Hefner Licht, is the current term in Germany). It might be especially desirable that the manufacturers of incandescent lamps should begin the innovation by marking their lamps in Hefner units instead of candle-power. An inconsiderable increase in illuminating power, and probably the majority of lamps would need none, would change the present candle-power ratings to conform to the new scale of:—

10	C.P.	...	...	...	...	...	12 Hefner units.
16	„	...	...	...	...	...	20 „
20	„	...	...	...	...	...	25 „
25	„	...	...	...	...	...	30 „
32	„	...	...	...	...	...	40 „

A reasonable objection to such an innovation in lamp ratings is that the change once made, a better light standard than the amyl acetate lamp might be introduced, and the necessity would arise for a second revision of lamp ratings, and so on without an end. Referring again to the analogy between this subject and the meter as a standard of length, it may be advanced that the meter is a purely arbitrary standard of length, though it was designed to be an absolute one, and for similar reasons the candle-power may be retained as an arbitrary light unit both in name and assigned value. The analogy is only apparent, for there can exist no material representation of the candle-power unit of light, because it is an indeterminate quantity. Candle-power is then a mere name corresponding to no physical quantity, and in the adoption of the Hefner unit along with the material amyl acetate standard, there is in reality nothing to relinquish but a mere custom. According to an established scientific custom, there is no inconsistency in naming the unit of light after an individual connected with its development. The custom itself, though now seemingly general and firmly established, is perhaps a questionable one. In the old mythology every aspect of nature was personified and named, and though the application has changed, the principle still survives in scientific practice.

The more rational procedure would be that followed in reference to heat. A quantity of heat is expressed in terms of heat units or British thermal units. This is thoroughly scientific, entirely satisfactory, and produces no confusion whatever. There are certain interested parties now at work, however, who are anxious to impose the name of an individual upon the heat unit, but as the change is unnecessary, it is to be hoped that engineers and physicists will be conservative and adhere to the prevailing practice and continue the use of the term "heat unit."

Let us apply the same reflections to the discussion in hand. Abandoning candle-power units and such descriptive and personified terms, let the illuminating power of all sources of illumination be expressed in light units simply. This is entirely expressive, and can lead to no confusion whatever. The value of the light unit applied to the candle, Methven screen, and such indeterminate light sources, cannot be expressed because of variations in the light strength. But applied to the amyl acetate lamp it is a quantity whose value can be stated within very narrow limits of uncertainty. As the science of light standards advances and the light strength of the actual standard becomes expressible with very great precision, the term Light Unit will still apply with equal force. If the value of the Light Unit is changed by consent of a congress or other body, it will cause no more confusion than was occasioned by the change in the value of the Heat Unit by a redetermination of the mechanical equivalent of heat.

The unit for expressing the quantity of a phenomenon must be of the same character as the thing measured, and this unit value can be no more precise than the value of the thing measured. As the measurement of the phenomenon grows more and more precise, to the same extent will the value of the unit become more definite.

Adhering still to the descriptive designation of the light unit, it has been proposed to call it the "Photon." This would be a perfectly general descriptive term applying equally to all standards. Should the term Hefner unit prove objectionable, and a descriptive unit, based on the amyl acetate lamp, be desired, following the analogy of ammeter, the name "Amate" could be coined. But applying the criterion just established, both the terms photon and amate are objectionable, it being unnecessary to employ for such purposes an intellectual cipher code.

The Incandescent Platinum Standard.—Violle endeavoured to realise an absolute or simple and reproducible standard of light by employing a definite light giving area of an incandescent metal. He finally selected platinum as best adapted for the purpose. In order that the temperature of incandescence which he used should be reproducible with accuracy, he selected the temperature of solidification of the metal. When a metal has been fused and begins to solidify, its temperature remains constant until the change of state has been accomplished. Though the same thing is true for the act of fusion of a metal, there are reasons, discussion of which would prove tedious here, why the temperature at which fusion occurs is not always the same, but varies with the past history of the metal. Platinum, in common with iron, for example, when solidifying, recalesces, or the light emitted suddenly flashes into greater brilliance, for a very short time. Violle, taking advantage of this, selected the moment of recalescence or flashing during solidification for the determination of the light strength. The mass of platinum, about 1 kilogramme, was melted by a compound blow-pipe in a lime crucible. After the fusion of the platinum the crucible was placed immediately under a water-cooled screen, pierced with a circular hole of the area of 1 square centimetre. During the flashing period the surface of the incandescent platinum was found to emit a light strength nearly 19 times as great as that of the amyl acetate lamp for the square centimetre. This standard was legally adopted, though largely hypothetical, by the Paris Electrical Congress of 1881. Subsequent experiments have not confirmed the utility of this source of light, and the attempt to realise a precise standard of light from incandescent platinum has been practically abandoned.

To Recapitulate.—The leading standards of illuminating power proposed and actually used are candles, the Methven screen, the pentane and amyl acetate lamps, and the carbon arc and incandescent platinum standards.

REVIEWS.

Analyses Electrolytiques. By A. Minet. Gauthiér-Villars, Paris, 1899.

This is the fifth text-book which the author has contributed to the "Encyclopedie Scientifique" series, edited by M. Léaute, the other four having dealt with theoretical and industrial electro-chemistry and electro-metallurgy.

The volume is well printed, and contains 170 pages and 18 wood-cuts, illustrating the text. Within this small compass

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a considerable amount of information concerning the theory and practice of electrolytic methods of analysis is contained. We are afraid, however, that M. Minet has sacrificed usefulness to limits of space; and that in his desire to be brief and concise he has produced a work that will be of limited service to the student of the subject.

Electrolytic methods of analysis are of most beautiful and remarkable simplicity—on paper. In practice, however, they are chiefly notable for the amount of bad language which they produce on the part of the unlucky experimenter. And accuracy is only obtained by rigid attention to details of procedure which the novice is disposed to think of no account.

The author would therefore have done better had he devoted more space to details of manipulation and electrolytic deposition.

The arrangement of the chapters is good. Chapter I. is devoted to general principles, and to a description of the apparatus and reagents required. The author regards accumulators as the safest sources of currents for laboratory work. Chapters II. and III. are devoted to brief descriptions of the various methods of separating the metals and non-metals from pure solutions of their salts.

This is the portion of the work that might have been greatly extended, and references to the original researches upon which the methods are founded ought to have been given as footnotes, so that students might know where to turn for further information when difficulties had arisen. Not a single reference to the original literature of the subject has come under our notice in these two chapters, and this defect greatly reduces the value of the work.

Chapter IV. is devoted to details of the methods employed for the electrolytic separation of two or more metals, and Chapter V. to a brief account of the methods worked out by Holland for the electrolytic analysis of commercial copper, brass, and lead.

These two chapters might also have been greatly amplified with benefit to the book as a whole.

The facts and figures are correct so far as we have been able to check them, but surely 5 amperes on p. 107 ought to be 0·5 ampere; and the maximum weight of manganese determinable as manganese peroxide, is 5 to 7 times that stated by the author on p. 110.

The book lacks a good index.

Students and chemists may be able to obtain a general knowledge of electrolytic methods, as used in the chemical laboratory, from this small hand-book; but we doubt whether they will be able to obtain accurate and concordant results without recourse to the larger text-books of Smith, Classen, and Neumann, on the same subject.

The Electrical Engineer's Central Station Directory. London: Biggs & Son.

This directory has now reached its third edition. Like everything else electrical, it has developed considerably during the past couple of years. In a very convenient form, the principal features of the electricity supply systems throughout the country are placed before the reader, and where it has been possible to obtain them, load curves accompany the notes. A later section of the work gives some general notes under the heading "Stations Contemplated." Financial returns of certain electricity undertakings for the years 1896 and 1897, provisional orders existing and applied for, and a copy of the Board of Trade Electric Lighting Regulations complete the electric lighting section. A few notes *re* electric tramways and railways now operating and on paper, follow, and we note that there is a "Biographical Section," in which are photographs of some of our electricity works' engineers.

Schemes on Paper.—Ambitious electric railway schemes are plentiful just now. An American party talks of running an electric line between London and Brighton at high speed and low fares, while the sanguine supporters of the single-rail system propose to construct an electric line between London and York, the speed on which will be 120 to 200 miles an hour.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1889.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

16,903. "Improvements in electric ignition devices for petroleum, oil, and analogous motors." H. Guilame. Dated August 21st.

16,922. "An improved electric spark fuse." G. G. M. Hardingham. (O. R. Schulz, Germany.) Dated August 21st.

16,926. "Improvements in or relating to electric measuring and indicating apparatus." H. Darwie, E. H. Griffiths, and W. C. D. Whetham. Dated August 21st.

16,928. "Improvements in magnet separators." A. Dings. Dated August 21st.

16,956. "Improvements in or relating to conduits for electric conductors." J. J. Bate. Dated August 21st.

16,959. "A new or improved device or tool for fastening insulators for electric wires to the ceilings of rooms and other similar places." G. Dornauf. Dated August 21st.

16,960. "Improvements in rheostats and means for operating the same." C. de Kando. Dated August 21st. (Complete.)

16,980. "Improvements in or relating to electric incandescent lamps and their conducting wires, also applicable to the conducting wires of telephonic and other electrical instruments." W. Gunn. Dated August 22nd.

16,997. "Improvements in rail-bonds for electric railways and other purposes." A. J. Boult. (F. H. Daniels, United States.) Dated August 22nd. (Complete.)

16,999. "Improvements in magneto-electric telegraphs." L. G. Woolley. Dated August 22nd. (Complete.)

17,031. "Improvements in effecting contact with the active matter of accumulator plates and the like." W. P. Thompson. (C. Payen, France.) Dated August 22nd.

17,033. "Improved method of and device for switching on and off the incandescent filaments of electric incandescent lamps or the bodies serving for preliminarily heating incandescent bodies of conductors of the second class." J. Gyergyey. Dated August 22nd.

17,052. "Improvements in or connected with electric batteries." J. Y. Johnson. (Chemische Fabrik vorm. Goldenberg, Geromont & Co., Germany). Dated August 22nd.

17,130. "Improvements in automatic electric alarms." W. Ratsch. Dated August 23rd. (Complete.)

17,159. "Improvements in electricity meters." G. Hookham. Dated August 24th.

17,203. "An improvement in pole pieces for dynamos." H. A. Earle. Dated August 24th. (Complete.)

17,211. "Improved holder for telephones." W. H. Wheatley. (M. Wohlgemuth, United States.) Dated August 24th.

17,229. "Improvements in connection with the polishing or finishing of electro-plated and other articles." J. B. Brooks and J. Holt. Dated August 24th.

17,246. "Improvements in automatic electric testing apparatus." R. J. Wallis-Jones. Dated August 25th.

17,256. "Electric log recorder." L. T. Jones, jun. Dated August 25th. (Complete.)

17,257. "Improved apparatus for generating electrical pressure." G. E. Adams. Dated August 25th.

17,258. "Improvements in or relating to galvanic batteries." A. J. Boult. (J. Trillet, France.) Dated August 25th. (Complete.)

17,260. "Improved means for charging the accumulator batteries of electric motor vehicles." H. Leitner. Dated August 25th.

17,261. "Improvements in secondary batteries." H. Leitner. Dated August 25th.

17,262. "Arrangement of connections and conductors for railways worked by electricity." G. Winter and E. Futter. Dated August 25th.

17,263. "Improvements in connection with electrical measuring instruments employed in combination with current and potential transformers for measuring electrical energy." Siemens Bros. & Co., Limited. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated August 25th. (Complete.)

17,304. "Improvements in incandescent lamps for electric lighting." H. Very. Dated August 26th.

17,319. "Improvements in grips used in the laying of underground electrical cables." The Steel Nut and Joseph Hampton, Limited, and S. Hampton. Dated August 26th.

17,326. "An improved electrolytic current interrupter or circuit breaker for induction coils." W. P. Thompson. (Voltohm Electrizitats Gesellschaft A. G., Germany.) Dated August 26th.

17,337. "An improved battery cell with double case." C. Vogt. Dated August 26th. (Complete.)

17,341. "Improvements in or connected with contact apparatus for electric railways with underground current feed and mechanical partial conductor service." C. F. P. Stendebach. Dated August 26th. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1888.

331. "Improvements in preventing sparking when making and breaking electric circuits." A. Muller and H. Tudor. Dated January 5th, 1888. Relates to improvements in preventing sparking when making or breaking electric circuits. Consists in introducing into the circuit before making or breaking the current a polarisation battery or condenser in series with the current source and the consumption apparatus to stop the flow of current before the making and breaking of the circuit." 4 claims.

586. "Improvements relating to the mounting of dynamo-electric machines." P. R. Jackson and J. S. Lewis. Dated October 7th, 1888. Relates to the mounting of dynamo-electric machines. To carry out the invention two rails are provided, laid in concrete. Between the rails at that part where the engine is to be secured is placed a third rail to act as an additional support. The dynamo is placed with its shaft parallel with the rails, and the pedestals supporting the shaft are secured to bridge pieces which are grooved on their undersides to fit the supporting rails. 2 claims.

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898. "Improvements in or relating to electric illumination of railway trains." B. de Szwantowski. Dated January 10th, 1898. Relates to an arrangement whereby the force of the air currents caused by the motion of the train is so considerable, that even without a head or adverse wind the train experiences an air pressure which actually represents in strength a strong wind. The apparatus consists of a wind wheel which serves to drive a dynamo, and which is driven by a current of air produced by the movement of the train. 4 claims.

812. "Improvements in or relating to dynamo-electric machinery." P. R. Jacksen & Co., Limited, and J. S. Lewis. Dated January 11th, 1898. Relates to dynamo-electric machinery and comprises an improved construction of commutator. In the construction of the commutator the blades or segments, preferably with the radial strips attached are arranged in position with insulation between. They are then forced together so as to form a rigid cylinder. Insulation is then placed round the ends of the bars over a rebate formed on the external periphery, and a steel or iron ring is shrunk on at each end of the cylinder. 5 claims.

1,021. "Improvements in the manufacture of filaments for incandescence electric lamps." C. H. Stearn. Dated January 13th, 1898. A solution of cellulose is employed. It is made by treating cellulose with strong alkali, and then with carbon bi-sulphide and dissolving the product in water. Cellulose is precipitated in a filamentary form by projecting the solution into a precipitating solution such as alcohol. The filaments are then purified by treatment with any of the usual reagents and carbonised. 5 claims.

1,626. "Improvements in and relating to secondary batteries." W. A. Crowdus. Dated January 20th, 1898. Relates to secondary batteries in which the elements are formed by mechanically applying lead salts in the form of paste to metal plates or supports. In order to separate the plates a corrugated non-conducting separator composed for example of India-rubber. The negative plates of the battery are formed by immersing conducting plates coated with lead or oxide in a solution containing sulphuric acid and a sulphate of an easy oxidisable metal such as zinc and passing an electric current through the solution. The positive elements are first formed into negative elements and then forming them into positive elements by reversing the direction of the flow of current. 4 claims.

1,667. "Improvements in electric signalling apparatus." S. P. Thompson. Dated January 21st, 1898. This relates to the apparatus known as coherers, used for receiving electric waves in space telegraphy. Instead of using a solitary point contact or an incoherent mass of filings as heretofore, a number of discreet conductive wires are employed, arranged in series or in parallel, or in series and parallel; in light contact with means for regulating the contact pressures. Clean wires of nickel, brass, or tinned copper, so arranged, are found to work excellently. Or the contacts may be between different metals or between metal and carbon. In some cases the coherer is mounted upon a vibrating sound-board, or upon a mechanical or electric tapper, such as a clock or electric trembler. In some cases the contacts are made between stationary and revolving surfaces. 3 claims.

1,809. "Automatic switch or cut-out." E. A. Claremont. Dated January 22nd, 1898. Relates to a means for constructing a switch controlled by an electro-magnet and so arranged that on the electric current exceeding the normal the switch will be released in any predetermined time proportional to the excess of current. 1 claim.

2,167. "Improvements in and connected with electric generator for cycles and other vehicles." J. Moores and H. C. Farrell. Dated January 27th, 1898. An electric generator to be applied to a cycle or other vehicle, and driven by one of the wheels, mounted on suitable bearings or supports, on which the said generator can rock. 1 claim.

2,269. "Improvement in joints between the glass globes of electric arc lamps and the supports by which they are carried." P. H. Guerin. Dated January 28th, 1898. The apparatus consists of a globe provided with a channel forming a hydraulic or sand joint and a cylinder of a diameter to fit the recess and fixed to the sides or bottom of an electric arc lamp in order to reduce the consumption of the carbons. 1 claim.

2,427. "Improvements in variable electric resistances or rheostats." R. Waygood & Co., Ltd., and P. J. Unwin. Dated January 29th, 1898. Relates to resistances which are especially suitable for the electric starting switches for the electric motor of lifts, &c. Consists of a badly conducting powder, such as flake graphite, and a blade or plunger which is inserted more or less into it. 3 claims.

2,522. "An improved electrical striking mechanism for bells." A. Eckstein and H. J. Coates. Dated February 1st, 1898. The striker is attached by a long arm to one end of a lever near the fulcrum. To the long arm of the lever a plunger is attached. This plunger, when a current is passed through a solenoid, is drawn into it pulling its end of the lever down. This raises the striker and it hits the bell. When unenergised the weight of the hammer makes it hang nearly perpendicular. 1 claim.

2,684. "Improvements in apparatus for the electro-deposition of metals." F. Fisher, B. J. Round, B. J. Round, A. Round. Dated February 2nd, 1898. Relates to improved apparatus to be employed in the process of electro-plating. Consists of a rotating vat or vessel containing the electrolyte and the work to be plated arranged in connection with an inclined driving shaft and having an open mouth of less diameter than the closed bottom, which is provided with an attached metal ring or equivalent cathode element in connection with an outside conductor for the return current, whilst the anode element is suspended within the electrolyte in the vat by means of an adjustable and swinging rod. 3 claims.

2,761. "Improvements in high tension electric switches." E. W. Cowan and A. Still. Dated February 3rd, 1898. Relates to switches of the Hatchet type. Consists in constructing the switch with contacts in recesses and with slotted guard plates with hoods in combination with them. 3 claims.

2,784. "Improvement in electric switches." O. C. Immisch. Dated February 3rd, 1898. Relates to an improvement to prevent sparking at the switch connections. When the switch is actuated, before the existing connections are broken, the switch contact piece is first caused to establish a connection by which a path for the current is established through an electro-magnet, which as soon as it is excited, is drawn into its helix, which movement breaks the circuit. 1 claim.

3,802. "Improvements in or connected with electrical conductors." H. Edmunds. Dated February 15th, 1898. Relates to positions where only one wire may be used, but a return wire is needed. There is an inner conductor covered with lead, and that is covered with another coating of copper which acts as a return wire. The copper may be coated with an electro-deposition of gold, silver or the like to protect it. 3 claims.

3,749. "A method of oxidation and bleaching by means of electrolysis." J. G. A. Rhodin. Dated February 15th, 1898. Relates to a method for the oxidation and bleaching of textile materials by means of apparatus such as that described in Specification 21,509, 1896. In carrying out the invention the carbon anode, described in the above specification, is replaced by anode of iron or other suitable materials. The inner compartment is filled with a solution of caustic soda, the outer compartment being filled with water. The caustic soda is subjected to electrolysis with a result that the alkaline metal is by means of the mercury transferred to and absorbed by the water in the outer vessel. Oxygen is being formed and partly liberated whereby a strong oxidising agent is formed. 2 claims.

4,514. "Improvements in electrolysis and cathodes therefor." V. I. Feeny. Dated February 23rd, 1898. Relates to the cathodes for electrolysis. Consists of covering the cathode with a layer of sulphide and polishing it. The deposited metal can then be easily removed by breaking or brushing. The metal broken away is polished. The sulphide of the metal cathode may be obtained by rubbing the metal with sulphur and water. 3 claims.

4,624. "The electrolytic manufacture of alkaline bichromates." J. Heibling. Dated February 24th, 1898. Relates to a process for the electrolytic manufacture of alkaline bichromates. The process consisting essentially in subjecting to the action of an electric current by means of anodes of chromium or alloys of chromium, a solution of alkaline chlorides contained in an electrolytic vat. The same result can be obtained by employing a solution of alkaline nitrates, and the process can also be carried out by using as the electrolyte a solution of caustic alkali. 8 claims.

5,034. "Improvements in or relating to electrolytic meters." C. O. Bastian. Dated March 1st, 1898. Relates to electrolytic electrical meter. Consists of a glass frame or open work support with thin sheets or surfaces of platinum or equivalent material mounted opposite one another on the frame so that they cannot come in contact, and means to attach the sheets to the frame two vertically extending glass tube connected to the frame, and two conductor wires in said single tube and passing out therefrom, and respectively connected with the circuit wires and the platinum sheets. 11 claims.

5,279. "Improvements in the manufacture of submarine telegraph and telephone cables." W. T. Henley's Telegraph Works Company, Limited, and G. Sutton, and L. L. Hartelgson. Dated March 4th, 1898. Relates to a protective covering for cables. Consists of a protective armouring of two open windings of galvanised iron or steel tape, the second winding covering the intervals between the convolutions of the first. 1 claim.

6,147. "Improvements in the electrolytic treatment of ores and slimes for the recovery of precious metals therefrom and apparatus therefor." H. Rieckes. Dated March 12th, 1898. Relates to the electrolytic treatment of ores and slimes for the recovery of metals, chiefly gold. Consists of an open vat made of wood lined with copper at the sides and bottom. The copper is silver-plated. The sides are inclined. At the bottom is a trough for the collection of mercury, and at the top a perforated pipe for distributing the mercury over the sides. The gold forms on the copper sides over which the mercury flows. The anodes are of carbon fixed to a shaft which traverses the vat and which is rotated or oscillated by any suitable means. It is connected to the + pole of a dynamo, the lining of the vat being the − pole. 6 claims.

6,981a. "Improvements in index needles or pointers for electrical and other indicating or measuring instruments." E. Weston. Dated March 22nd, 1898. Relates to index needles. Consists in having short arms running radially from the pivot and attached to the pointer, so that specially constructed nuts can be screwed on to counterbalance the weight of the needle. The arms are at right angles so as to form a cross with the needle for the longest arm. The whole is made of aluminium so as to give lightness. 20 claims.

6,982. "Improvements in electrical measuring instruments." E. Weston. Dated March 22nd, 1898. Relates to improvements in electrical measuring instruments. Consists of an electrometer provided with a stationary electrostatic field and a movable electrostatic armature or needle adapted to move in said field in combination with an indicating needle attached to or carried by the electrostatic armature or needle, a calibrated scale, and an independent indicating needle all enclosed in a casing, the independent indicating needle being provided with means extending through the casing for moving it by hand to any predetermined point whereby comparative reading may be taken at a distance. 22 claims.

8,439. "Improved means for electrically heating second class electric conductors serving as incandescence bodies for imparting to them the requisite conducting power." M. Deri. Dated April 23rd, 1898. Consists in the employment of an electrical heating body of very weak conducting power, so as to offer so great a resistance to the current that the resulting heat will be transmitted to the conductor of second class, constituting an incandescence body surrounding the heating body, for imparting to this the requisite conducting power. 1 claim.

10,225. "An improved method of casting electric accumulator plates and apparatus therefor." J. Heese and J. Kernaul. Dated May 4th, 1898. Relates to the casting of accumulator plates having tapering projection on them to hold the active material. The ridge plates are cast in the form of an arc or circle instead of casting them directly as desired, and, after casting, bending them into a straight shape. 3 claims.

14,833. "Improvements in and connected with junction boxes for electric cables, inspection chambers and the like." F. Franklin. Dated July 6th, 1898. Relates to ventilated junction boxes which prevents dirt or wet getting in. Consists of a frame having a flange adapted to rest on brickwork, and a channel surrounding the upper part. Holes are formed in the channel. A cover fits on the frame and has ventilating outlets round the edges. To prevent water entering through these a bead is cast round the underside of the cover. 3 claims.

15,886. "Improvements in electro-magnetic ore separators." H. Langguth. Dated July 20th, 1898. Relates to electro-magnetic ore separators in the form of a wheel or rim, consisting of a single rotary electro-magnet with cylindrical or pan-shaped poles of U section situated opposite each other. 2 claims.

16,246. "A new or improved electric sounding device." J. P. Buckley and W. A. Creffert. Dated July 26th, 1898. Relates to long distance sounding apparatus for ships. Consists of a shell or casing containing a liquid contact maker and connected by electric wires to an alarm device, *viz.*, an adjustable float and adapted to be suspended without giving an alarm and when not or only partially suspended to give an alarm. 3 claims.

17,418. "Improvements in or relating to electric tumbler switch appliances and their base plates." C. Markt. Dated August 12th, 1898. Relates to improvements in electric tumbler switch appliances. The base is made of pottery and is provided with two raised cheeks in which screw holes are formed. Two pockets separated by a pocket into which during one operation of the switch the tumbler goes. The contact piece of the switch works upon a hinge and is held up by a spring. The lever is also on a hinge and is not fixed to the tumbler but is provided with a wheel which runs along the tumbler pushing it on to the partition between two holes in the base which is a contact piece. 5 claims.

18,531. "Improved means for electrically operating electric railway switches." R. A. Baldwin and H. Rowland. Dated August 29th, 1898. In carrying this invention an electro-magnet is located in a box in the roadway at some convenient point adjacent to the switch tongue. Current to actuate the magnet is taken from the return circuit of the railway which ordinarily is the rail. In order to do this, a short section of the rails ahead of the switch is insulated, and when the switch is turned the return circuit from the vehicle is passed into the insulated section of the rails then to the magnet and finally to the return circuit. 5 claims.

18,796. "Improvements in and connected with secondary or storage batteries." W. M. McDougall. Dated May 13th, 1898. Secondary batteries are arranged so as to minimise the vibration when mounted on vehicles and the like. The electrodes are made with projecting bosses in which are cut intersecting grooves reaching to the surface of the plate. The plates are covered on both sides with sheets of insulating material in which are holes to receive the bosses, and the sheets are of such a thickness that the bosses lie flush with their outer surface. Division plates are also placed across the electrodes. The plates are made of insulating material, finely perforated and with ribs on one side only, these ribs being turned towards the negative plates in the battery. The bosses may be replaced by projecting horizontal strips or webs, the spaces between which are filled with lead dust. 3 claims.

18,940. "Improvements in alternating current arc lamps." C. D. Abel. (H. O. Swoboda.) Dated September 5th, 1898. Relates to arc lamps in which the vibration of the feed magnets under the action of the alternating currents will not be transmitted to the lamp. 6 claims.

19,248. "Improvements in alternating current electric motors." W. P. Thompson. (C. S. Bradley.) Dated August 30th, 1898. Relates to electric motors having one core or element wound to produce a rotary magnetic field when supplied from a single-phase alternating current circuit, and a secondary core or element having its winding connected with an adjustable phase advancing device such as an electric condenser. 2 claims.

20,989. "A new or improved composition for electrically firing detonators." G. P. Bickford-Smith. Dated October 5th, 1898. Relates to a composition consisting of potassium chlorate, precipitated copper, precipitated silver, antimony sulphide, electrotype plumbago, and sodium tungstate in certain proportions. It is fired in a casing by an electric spark. 1 claim.

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THE

ELECTRICAL REVIEW.

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THE SWISS REUNION AND ITS LESSONS.

Now that the visit of the Institution of Electrical Engineers to the industrial districts of Switzerland has taken its place amongst the proceedings of the past, the time has come to consider what we have learnt as the result of our investigations. Various questions arise of great interest and importance. We will select for consideration the following:—Are we falling behind in the march of electrical engineering progress? If so, what are the causes of our backwardness, and how can they be removed?

We are immediately struck by the fact that the conditions prevailing in this country are not comparable with those existing in Switzerland. In that rugged country an abundance of water-power has taken the place of a natural supply of coal. There is a grand similarity between the two great processes of storage: here we profit by the solar energy stored up countless centuries ago in the form of chemical energy; there the process is in progress before our eyes, as the moisture raised by the same agency crystallises on the mountain tops and stores up potential energy, to be gradually released by the melting of the snows. But there is this important difference between the two cases—that water-power is not commercially capable of transportation over great distances without transformation into some other form, while, on the other hand, it is easy and profitable to convey the coal itself with its store of energy to the place where power is required. Moreover, the localities where water-power is most abundant in Switzerland, are frequently, for the same reason, unsuitable for the sites of factories and towns. Hence arose the need of a system of transformation and distribution of energy over considerable distances, with great flexibility and economy in capital cost. The first attempts in this direction took the form of rope transmission, which in no other place attained to such a high degree of development; but the advantages of electricity soon made themselves apparent, to the exclusion of all other agents. At first, direct current and single-phase alternating currents were employed, but the difficulties attendant respectively upon the use of high pressure direct current commutators, and of synchronous alternating current motors, were such that upon the introduction of polyphase working its superiority was immediately recognised. The simplicity of the machinery, the ready handling of the motors, and the low first cost of the line—a most important factor in this case—were too obvious to be overlooked; and the natural consequence was that the most rapid development took place in the direction of polyphase working, which, in Switzerland, is practically confined to the three-phase system. The adoption of the same system for lighting was due to the desire to avoid the use of the complicated moving machinery which is inseparable from the conversion of alternating into direct currents; some trouble was at first encountered on

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the score of regulation, but this was practically overcome by the use of a neutral or return wire for the lighting circuits, and now the three-phase system is almost universally used for the Swiss lighting circuits, the exceptions being small isolated installations, where the advantages of storage are important. Most of the tramways, it is true, are still worked by direct currents, generally obtained from a three-phase plant with rotary converters; but that there is no bar to the application of the polyphase system to traction has been completely proved by the pioneer work of Messrs. Brown, Boveri & Co.

Now, in Great Britain the supply of motive power has been up to the present an almost negligible factor; lighting has always been the chief consideration, and has been carried out by isolated installations close to, or in the midst of, the area supplied, hence there has been no need of transmission over distances exceeding two or three miles at most in the majority of instances, and even where the distance has been greater, the absence of a demand for motive power has permitted single-phase currents to meet the circumstances sufficiently well. Consequently, the line of development in this country has been that of direct and single-phase working, in both of which branches we hold our own as regards the excellence and magnitude of the generating and transforming plant. Long-distance transmission, and electric supply on a polyphase system, are absolutely non-existent here; even those schemes which are projected for transmitting power over some considerable distances are intended to use polyphase working for transmission only, and to distribute with direct currents.

We conclude, then, that we are many years behind the Swiss in the manufacture and use of polyphase machinery, while they lead the world in this department; nevertheless, we are at least abreast of them in the construction of direct current and single-phase machinery. Their turbines are unexcelled; but so are our engines and boilers. The remarkable progress which they have made in the special branches enumerated above must be in great part ascribed to the natural conditions of their environment, and we have seen no cause to suppose that our less forward state is due to any deficiency in the talent or inventive genius of our engineers.

There is, however, another aspect of the question, and this is, to our mind, by far the most important one. We refer to the economic view. Apart altogether from considerations of environment and engineering skill, we have observed the attitude which the capitalists, banks, municipalities, and the public generally have taken towards the development of electrical engineering and its dependent industries; and here we find a startling contrast with the state of things in Great Britain. We are accustomed to see our councils rising in their might to repel the so-called "monopolist," to resist great schemes for distribution of power over large areas at minimum prices, and to crush all native progress. We have seen them act the part of the "dog in the manger," securing powers to provide electrical supply, absolutely in order to prevent such supply being given! We have seen our great companies starving for capital, unable to carry out the extensions so urgently needed, while foreign-made machinery is pouring into our ports. No sooner is a tramway or light railway scheme projected than immediately meetings are held to devise ways and means to oppose the undertaking, often with a view of being bought off at ruinous prices—a process generally known as jobbery, to use the mildest term. We see our municipalities imposing arduous and unjust conditions on British contractors, and simultaneously giving orders abroad without a thought of controlling the wages there. The parrot-like cry of "disfigurement," so long cast in the way of tramway schemes, is happily becoming rare, as the public learns that the good of the many ought not to be sacrificed to the prejudices of the few; but still we see London destitute of electric tramways and our toilers crowded in mephitic tunnels, 15 to the compartment.

In Switzerland there is nothing of this. Far from opposing engineering projects, the people welcome such, knowing the advantages that are certain to accrue to them; capital flows freely into the industry, and the far-seeing directors of the great banking concerns support the schemes. The beautiful and picturesque streets of the towns and villages, the inter-urban roads, and even the mountains themselves, have their well-laid tramways, operated for the most part by water-power.

High pressure transmission lines of bare copper wires on porcelain insulators are commonplace; they are met with everywhere. Yet our Board of Trade will not so much as sanction a few miles of overhead conductors in country districts between villages and townships, at one-fourth the pressure used by the Swiss, but requires costly underground mains, which weigh down the undertaking with excess of capital, like Sindbad's "Old Man of the Sea." Our electrical industry is cramped and fettered by the restrictions which bind it; were it not so, we should soon see great distribution schemes, power transmission over long distances from the coal areas, and even full-gauge railways, electrically operated, as in Switzerland.

How to remedy these evils? "There's the rub"; it is not easy to reach the roots of the canker. Many maintain that technical education is the great panacea; we are convinced that this is but a minor factor in the problem. We went to Zürich honestly looking forward to the visit to the Polytechnikum, prepared to admire, and schooling ourselves to control our anticipatory feeling of envy. We came away with a sense of disappointment. The physical, or more properly, the electrical engineering, laboratories of which we had heard so much, were superior to those of our own technical colleges in but one respect—they are generously supplied with funds by the Swiss Government, whereas our own are dependent on a confused variety of grants, donations and private endowments, and are always starved for up-to-date apparatus and equipment. The methods of teaching are no better than our own; the apparatus, thanks to the ample funds, looks newer and better made (much of the most modern apparatus in our colleges is made by the students—and demonstrators, when they have time, which is seldom), but the type of apparatus is old-fashioned. The tangent galvanometer dominates the department; we saw but one d'Arsonval, and that was of the old pattern; scales are read with telescopes, a method regarded by us as tedious and primitive; alternate current wave forms are plotted with ballistic galvanometers and condensers. We do not wish to convey the impression that the laboratories are inadequately equipped; but we are convinced by actual observation, that our own are at least as well adapted for their purpose, and are in many respects in advance. We paid a visit to the mechanical engineering

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laboratories, and found them *half-built*; we inspected the designs, which were admirably complete, but up to the present, we find, there has been practically nothing of this kind. Here we are a long way ahead. The most noteworthy feature of the system of education was, in our opinion, the fact that the students pass two years in workshops, as apprentices, *before* they commence the course of technical instruction at the Polytechnikum. We heartily commend this practice to the notice of our authorities.

Our conclusion is that technical training is not the solution to the problem. We believe that the only possible cure lies in the education of the people of Great Britain; teach them to realise that the prosperity of the nation can only be maintained by constant progress, and to understand the irreparable injury already inflicted upon our commerce and prestige by the blind reactionary opposition to all new things, so characteristic of the British public now a days. Let our daily press take up the work, and drive in the lesson by constant repetition—it is their peculiar privilege to reach the mass of the people as no purely-technical journal can. The British nation is at fault, not the engineer; let the nation encourage and support the engineering industry, instead of striving to restrain its progress—let it learn from the gallant little Swiss Republic how to aid and cherish scientific enterprise, on which the prosperity of Great Britain depends!

PROVIDING FOR ELECTRICAL SUPPLY DURING HOURS OF SMALL DEMAND.

The financial success of the supply of electrical energy may be considered to depend to a considerable extent on the maximum and minimum loads on the plant.

A statement of the total output from any works for a whole year does not reveal any indication of the peculiar conditions of electrical supply; but when the actual capacity of the plant is considered, or, in other words, the total possible output in one hour, it seems surprising that, as a rule, the yearly output could be generated in one month. In many works the plant could in three weeks generate sufficient supply for one year's demand, and even if it were commercially practicable to store up this output, ready for sale when wanted, it may well be doubted if a consecutive idleness of 49 weeks in the year would prove beneficial to the plant.

Machinery, with or without storage batteries, must be provided for the maximum load, and as this load is absolutely under the control of the consumers and can be estimated with considerable accuracy, it becomes possible to provide generating plant and storage in such proportions as will ensure a constant load on the steam plant for many months in the year, an economical load during the summer months and during hours of small demand. This is, of course, no new principle, and long before the secondary battery left the laboratory to become an engineering appliance even more ambitious claims were made for its practical utility.

The capital cost of this method of equalising the load on electrical plant has hitherto been almost prohibitive, and though the present cost of batteries is a very serious item, there is so much to be gained by their use that a liberal interest on the capital outlay may be realised.

The use of storage batteries in this manner must of course be confined to continuous current distribution, and it is probable that existing systems of alternating current supply may with advantage undergo a gradual change to continuous current.

In the meantime, distribution by alternating current does not possess many facilities for securing economy during hours of small demand. The sub-division of plant into machines of convenient variety of size is not an easy matter, for if the works are designed for parallel running, it is difficult, if not impossible, to secure a proper division of the load; and if circuit running is adopted, serious trouble is caused by throwing load from one large machine, say, on to several smaller machines. It, therefore, appears that to secure economy in alternating current generation during hours of small demand—probably 80 per cent. of the year—it is desirable to arrange for a separate plant of high efficiency and durability, fed by separate boilers through short steam pipes.

The Electrical Units.

We recently noticed an article in the *Electrical World* (New York), advancing proposals for a change of nomenclature of the electrical units in such a way that the name of each derived practical unit should denote what multiple or sub-multiple it is of the fundamental unit. We expressed an opinion that the gain derived from such a change would not compensate for the incidental temporary confusion, though if any fundamental change in definition were contemplated, such as the introduction of the Heavisidal units, the system of names proposed by our contemporary would be worth careful consideration. The publication of this article in the *Electrical World* has induced M. A. Blondel to publish at once in *l'Industrie Electrique* an article on the same subject, advancing very similar proposals, which he had prepared for the approaching meeting at Boulogne of l'Association Française. M. Blondel proposes two changes:—(1) To transfer the names ampere, ohm, &c., to the C.G.S. units, each with a temporary prefix to be afterwards dropped. Thus for the present he would call the C.G.S. unit of E.M.F. the neo-volt, and as soon as the system was well established it would be called the volt; (2) For practical purposes to use only three sub-multiples, and three multiples, of the units with the prefixes micro, hypo, milli, kilo, hyper, mega; hypo meaning that the fundamental unit is multiplied by 10^{-9}, hyper by 10^{9}, micro by 10^{-15}, mega by 10^{15}, milli and kilo retaining the present senses. We may refer our readers who wish to study M. Blondel's proposal closely to the French journal, in which the question is discussed at considerable length. There can be no doubt that his system would have advantages over our present one. Names for the C.G.S. units would be very useful, and the new multiples and sub-multiples would bear their descriptions in their names. M. Blondel, moreover, thinks the new derived quantities would be more convenient than the old practical units, but we doubt this. If we are to have a change at all let us have the rational units, and a revision of nomenclature may come at the same time as a subsidiary reform.

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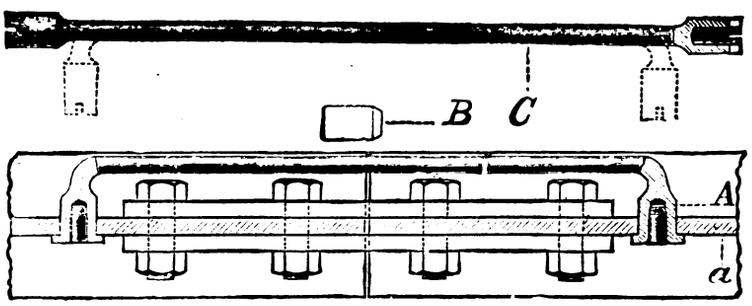
INDISPENSABLE ACCESSORIES OF ELECTRIC TRACTION.

By HENRY E. P. COTTRELL, A.M.I.C.E.

(*Continued from page* 387.)

The last or "uniform" sub-division comprises only one bond, which is known as the "Chicago Crown" bond, and is manufactured in two forms, viz., rigid and flexible. The

The "Chicago" Rail Bond.



Sectional View.

Elevation View.

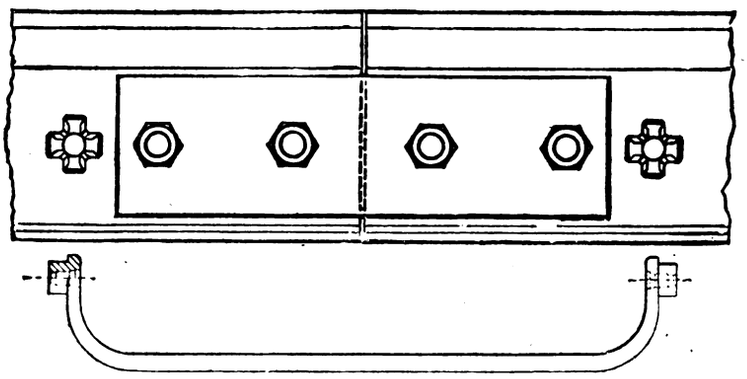


Fig. 90.—"Chicago Crown" "S" Solid Bonds.
For bonding at points and crossings and between tracks.

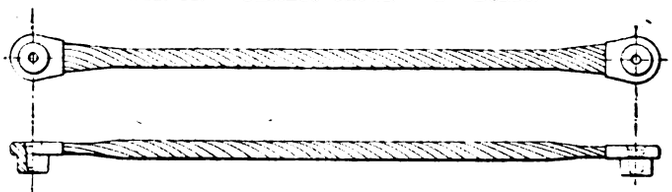
first form belongs exclusively to the group of long exposed bonds, while the second form belongs to both Group A and Group B. The "Chicago Crown" rigid bond (fig. 90) is forged from a single solid piece of copper, the thimble-shaped terminals having tapering conical perforations of a special shape. When the terminals are inserted in the web holes they are secured by expanding one end of the perforation with a tapering punch, then a tapering drift pin, $\frac{1}{16}$th of an inch larger than the holes, is driven home, the terminals expanded and a lip formed at the smaller end, as in a rivet head. The contact between the iron and copper, in consequence of the pressure thus exerted, is so intimate that it can never be rendered less perfect by working loose, by corrosion, or by electrolytic action. The area of the contact surface is over 11 times the sectional area of the copper bond uniting the terminals. The resistance of these bonds when both terminals and web holes are very clean is under 2 microhms (per two terminals in series), while their conductivity is practically 100 per cent. of that of pure copper. The effect upon the resistance offered by this practically perfect bond, when the web holes are oily or oxidised, or both, is most marked and runs it up to four times the minimum, or 8 microhms (*vide* Mr. Parshall's experiments).

The "flexible Chicago Crown bond" (figs. 91, 92A and 92B) is made both in the long type and in the short type; its terminals are identical with those of the rigid form, and it is fixed to the rail in identically the same way. The difference lies in the portion connecting the terminals. This consists of strands of copper wire laid crossing each other at an angle, which provides for expansion and contraction in the rails without sensible alteration of shape, and allows the bond being fitted without difficulty to the rails at any temperature. The terminals and strands are united by a special process of forge welding, and the union is so perfect that when sawn through the weld the strands are found to have lost their identity, and the whole is a homogeneous mass of copper, and capable of standing to all intents and purposes the same tensile tests. The conductivity of the bond is upwards of 93 per cent. of that of pure copper, which with the same effective cross section of web ($\frac{1}{2}$ inch), and contact area with rail web (1·37 inch), and clean condition of bond and holes as the rigid bond previously described would give a resistance of $2\frac{1}{8}$ microhms (per two terminals in series), or an increased resistance of only $\frac{1}{8}$th of a microhm to set off against the advantages of flexibility and adaptability. The fact of its being made in the short or covered type has the further advantage of enabling the initial cost of the bonds to be greatly reduced. It is interesting to note that Mr. Parshall found the conductivity of the Columbia multiple bond to be only 90 per cent. of that of the Chicago Crown rigid simple bond, while its resistance was from $3\frac{1}{2}$ to $4\frac{1}{4}$ times as great, the bonds being identical in every other respect; this shows how essentially superior the simple uniform bond is when compared with the best examples of the multiple monometallic varieties, and *a fortiori* any other multiple varieties.

The third method of bonding is the one which dispenses entirely with added bonds and ordinary fastenings by the substitution of a special joint, or by the total abolition of all joints. The first process is known under the name of the cast-welded joint, and the second as the endless electric welded rail. The conditions of expansion and contraction of the rails on a railway and a tramway are entirely different; in the former, the rails are practically wholly exposed and wholly free to alter in length in accordance with the changes in temperature, while in the latter they are to a great extent protected and prevented from moving by being embedded in the pavement.

The skin friction between the rails and the pavement and the weight of the latter is so great, that even in extreme climates the contraction or expansion, due to variations in the atmospheric temperature, produce hardly any perceptible movement in tram rails, and practically no allowance need be made for contraction or expansion in laying a tramway track. The only precaution that need be taken is to avoid unbedding much track at one time for repairs in the summer time, should the track in question happen to have been laid in the winter, or *vice versâ*, otherwise "hogging" may take place in the first case and ruptured joints in the second. In a tramway, therefore, the ideal track without joints, so

Fig. 91.—"Chicago Crown" "F" Bonds.



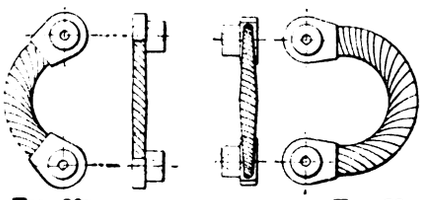


Fig. 92B.
Stranded "Chicago Crown" Bond, Style "T."

Fig. 92A.
Stranded "Chicago Crown" Bond, Style "U."

desirable both from the mechanical and electrical points of view, seems to be a practical possibility. Electrical welding has for several years been the subject of extended experiments in the United States of America, but so far the results have not been such as to encourage tramway companies to adopt this system of bonding. Its drawbacks may be summarised as follows:—

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1. Decreased conductivity of the welded portion as compared with the rest of the rail. 2. Increased temper and even wear. 3. Excessive cost of process as compared with other methods of bonding.

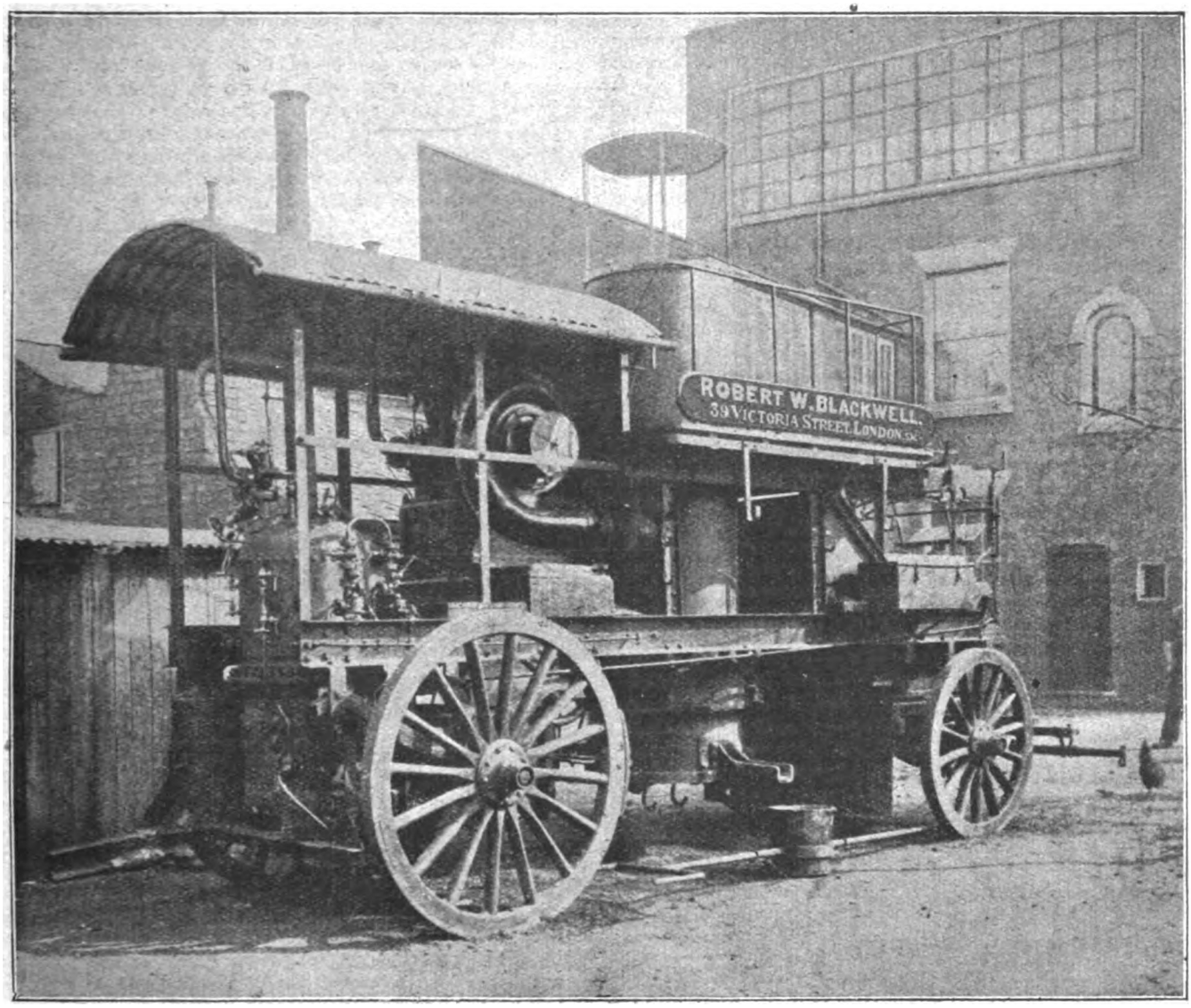

Fig. 93.

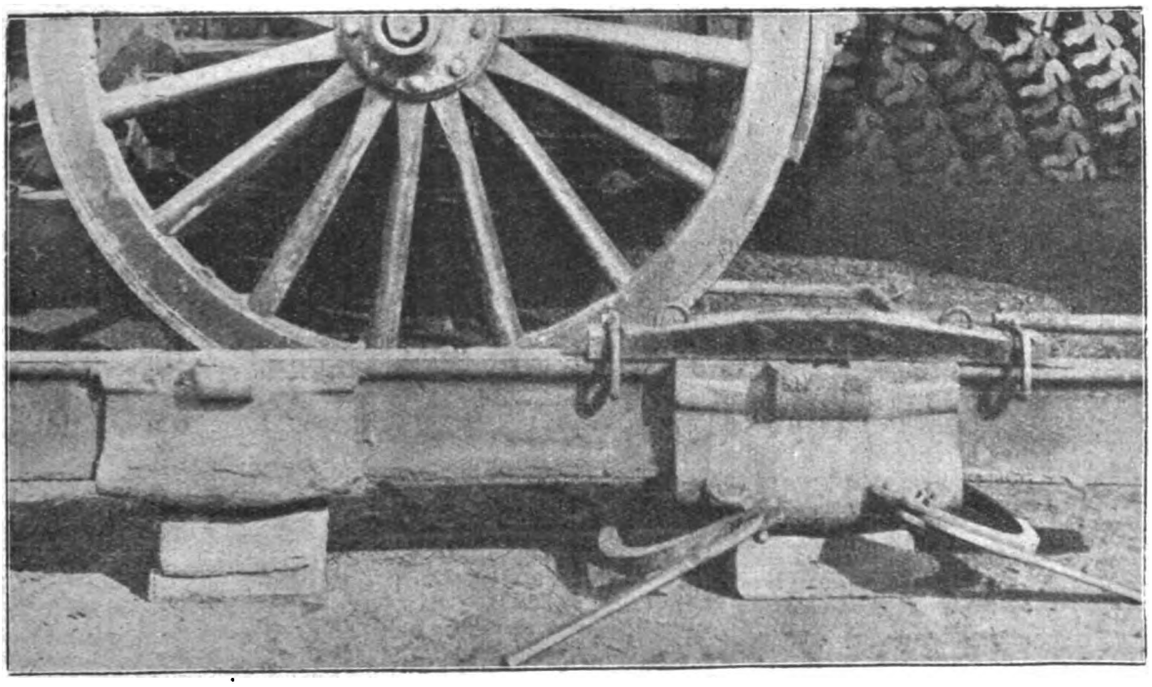

Fig. 94.

brittleness of rail at weld, softening of adjacent portions, and consequent increased liability of rails to fracture and to un-

The apparatus required for electric welding is costly, and in practice the required power is not always easy to obtain,

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so that although the drawbacks mentioned above might no doubt be removed with more extended experience, still it is not to be wondered at if the process has not as yet been tried on this side of the Atlantic.

The cast-welded or "Falk" joint has, on the contrary, been extensively tried in England, both at Coventry and Norwich. By this system the joint is done away with by casting a cast-iron sleeve round the sides and bottom of rails at their joints. A metal mould is fixed round the rail ends, a special mixture of cast-iron is run into this from a portable cupola; the molten metal cooling rapidly in contact with the mould, shrinks, exerting great pressure on the embedded rails, ensuring a thoroughly good mechanical joint and electric bond. The size of the joint is such as to ensure the same tensile strength as in the remainder of the rail. These joints are generally 14 inches in length, and from 70 to 140 lbs. in weight, proportionately with the weight of the rail. Figs. 93, 94 and 95, show the movable cast-welding plant, a joint with mould in position for casting, and a section through a cast joint respectively, as carried out by Robert W. Blackwell and Co. at Coventry and Norwich. This joint has been undoubtedly a mechanical success, owing to the slight clearance

Fig. 95.

afforded by the contracting of the rail after the cast sleeve has set being just sufficient to admit of a slight play for contraction and expansion in the rail ends. But this clearance, though of the slightest description, accounts for the variations that have been observed in the electrical resistance of the joints when new, and will probably cause this to sensibly increase with time by the deposition of a slight film of oxide between the cast-iron sleeve and the embedded rail ends. On the whole, however, this system of doing away with rail joints has been undoubtedly a great success, its only drawback being the question of cost, this being specially noticeable where the casting plant has to be brought into operation for a few joints at a time, such as occurs when small extensions or repairs have to be carried out, especially in this country, where only two or three yards of road can be opened at once. It has been practically demonstrated that unless one mile of street can be opened up at a time the cost of each joint is very great.

THE INSTALLATION OF STEAM BOILERS.

VII.

So far the structure of the boiler has chiefly been dealt with. Before dealing with the fittings, we may take a brief glance at the question of the brickwork in which the boiler is built. It is almost superfluous at this date to insist on the necessity for absolute dryness of foundations, and if only a damp site is available, it becomes necessary to construct a tank of sound concrete, rich in cement, and put in sufficiently wet to be waterproof, and of such size as to be removed from the effect of the heat by sufficient thickness of bricks. Under the most careful construction in such cases the concrete floor should have a fall to some accessible sump, or water catcher. Failing a dry foundation, the moisture creeps up the brickwork of the seating walls, and causes severe corrosion of the plates along the line of seating.

Years ago, when no care was exercised as to the selection of the site of a boiler, explosions from this cause were frequent. This class of explosion has nearly disappeared. In ordinary practice, as developed by long experience, a boiler is set upon two longitudinal walls, parallel to one another, and distant apart over half the diameter of the boiler. On these walls are laid specially formed seating blocks of firebrick, the seating edge of which should not exceed 8 inches in width, and may advantageously be convex in profile so as to touch the boiler plate along a line only. Where the ring seams cross the seating blocks, a rectangular gap should be cut across the seating for purposes of inspection, and specially formed wedge pieces ought to be provided to close these gaps. These are removed for inspection, and at once replaced.

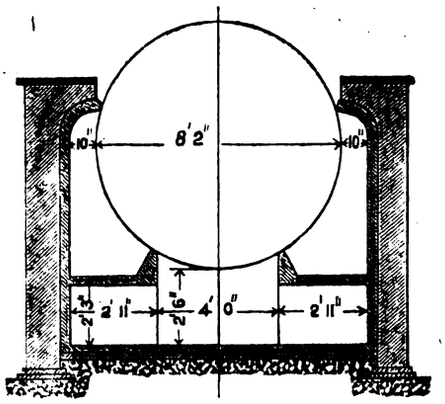

Fig. 19.

The course followed by the gases issuing from the furnace tubes is first along the bottom flue, and this flue should be from 27 inches to 30 inches deep below the extreme bottom of the boiler. This depth admits of convenient inspection. Any much greater depth prevents a convenient seated inspection, but there is no objection to a very deep bottom flue if circumstances render this desirable, in which case the depth should be such as to permit of a standing inspection. The reason for the bottom flue being the first taken by the gases is that the bottom of the boiler may be kept as warm as possible. When the side flues were kept the hotter, the riveted seams on the boiler bottom were liable to be torn. This was known as the seam rip and was due to unequal expansion between the upper and lower parts of the boiler.

The formation of the side flue should be such as to admit the very easy passage of a man with full liberty to inspect along both seat and flue cover lines of contact. The use of

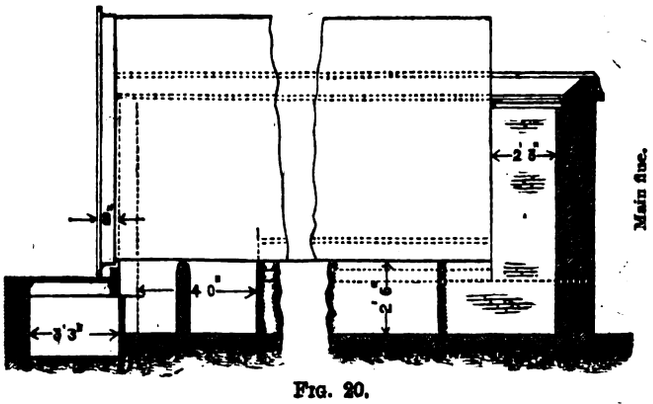

Fig. 20.

the specially formed seating block allows an ample space along the bottom of the side flue, the outer wall of which should not be less than 9 inches clear of the boiler at its horizontal diameter. The side flue covers are quadrants of a firebrick cylinder 8 to 4 inches thick, and these may with advantage be convex on the face next the boiler plate. These covers may be placed about 6 inches above the level of the furnace crown, but there need be no fear, if it is thought desirable, of completely arching in the boiler crown so as to admit the gases over practically the whole crown in a space of 4 inches thickness. It is most essential that all the brick

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work, especially of outer walls, should be sound and air-tight. For this end the front wall should be faced with glazed bricks set in cement, and any exposed side wall should be repeatedly tarred or painted to render it air proof.

Where boilers are set in batteries, the dividing wall between the side flues of contiguous boilers should not be less than 9 inches thick, and all flue walls must be internally lined at least 4½ inches in fire brick. Division walls may be 13½ inches if there is enough ground area to permit of this. The back down-take admitting from the furnace tubes to the bottom flues is often made 27 inches wide from the boiler end plate to the back wall. This is a fair allowance, but it may well be made 30 inches if space permits.

It is usual to build a mid-feather wall to divide the streams of gas from the two tubes, such mid-feather continuing a couple of feet along the bottom flue. Unless the

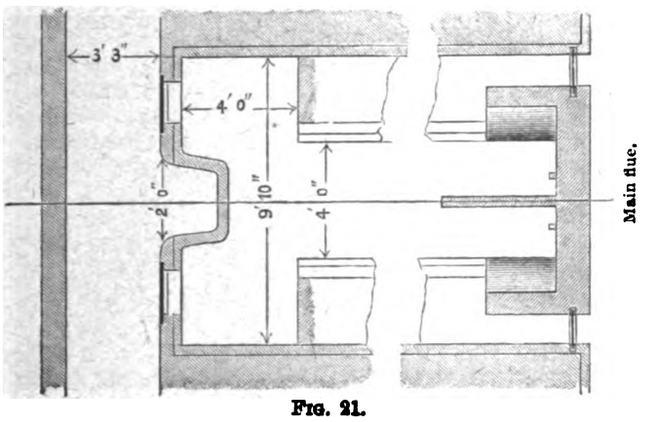

Fig. 21.

boiler is at least 90 inches diameter, anything over 4½ inches thick is rather in the way, while a 4½ wall is very short lived. A mid-feather is often advantageous in preventing a tremulous draught. A bituminous coal cannot be smokelessly consumed where the draught is tremulous. The best covering to these rear down-takes is a larger quadrant tile of the same type as the side flue cover tiles. These will prevent a tremulous draught where one has existed with a flat topped down-take. But by far the most convenient down-take cover is a flat plate of cast-iron fitted in a frame built above the down-take. The flat plate can be lifted by the usual T head key and access gained to the down-take from above. This forms a good mechanical finish. For convenience of inspectors there should be left projecting from the back wall of the down-take one or two brick headers about 2 inches projection. One should be placed opposite the middle half of the flue tube and one or two at a lower position for foot rests in descending to the bottom flue. It is now considered best practice not to build the covering bricks over the side flue cover close up to the boiler, but to leave a narrow trough to enable the shell plate to be got at for inspection, this trough being filled with loose material, easily moved for inspection. Then the shell of a boiler is open to inspection all over, and if not arched over on the crown, this is covered with some compound which is at once loosened and softened by any leakage of steam, which is thus at once rendered visible. The inability to see the boiler crown is the real objection to the arching over of the flues. But if this arching is adopted, it should stop at least 4 inches clear of all mounting blocks. It was because of being closely bound in by the over-arching that a very serious triple explosion occurred some years ago. All the evidence pointed to the probability of the boiler having been hung by the manhole mouthpiece upon the over-arching, the seating below having settled and thrown the weight of the boiler upon this mouthpiece. In our illustrations, figs. 19, 20, 21 and 22, the various points touched upon may be studied. It should be added that the front wall of the seating must be placed behind and clear of the angle ring of the front end plate. This plate thus stands about 7 or 8 inches in front of the wall. This wall is usually 9 inches thick, and where it makes contact with the boiler, it should be reduced at least to half a brick. Indeed, there ought to be special narrow edged bricks moulded for this purpose. Below the boiler this front wall must be recessed and taken behind the blow-out block. When the blow-out pipe comes through the front wall, as once common, it often broke off when foundation settlement let the full weight of the boiler upon this one pipe. A space of 4 feet is left between the ends of the seating walls and the front wall to admit the gases to the side flues. The hearth pit is made at least 6 inches, preferably 12 inches, and often 15 inches deeper than the bottom flue; this prevents danger of water in the flue from the hearth pit. The openings to the flues are best made through the front wall in the hearth pit at each side of the blow-out recess. These openings may be 18 inches square where the bottom flue is not less than 30 inches deep. They consist of a cast-iron frame and a close-fitting door hung on lugs. The frame must be flush with the flue bottom to allow dust to be brushed out easily. The hearth pit often measures 39 inches in width between walls, and should be a continuous trough along the front of a set of boilers. Nothing should be allowed in the hearth pit except the blow-out tap and pipe. It is bad practice to allow feed pipes to be laid along the pit. It is usual to lay the waste pipe into which the various blow-outs discharge along the pits. It is a very undesirable practice to have a waste pipe common to two or more boilers owing to the danger of blowing back into an empty boiler of steam and water from a boiler that is blowing off.

The safeguard of a single key, which can only be removed from the blow-out tap when this is closed, is theoretically infallible, but it is easy to suppose the key lost, a new one obtained, and the old one found, when there would be two keys, and perhaps everyone would not know of it. Therefore, avoid a common waste pipe, carry all blow-out wastes, if possible, to their own independent discharge. Failing that, it is possible that a waste pit with freely open standpipe to the air might be permitted. If a common waste pipe must be used, it should increase in size as it passes along the line of boilers. It should be single-ended only, and each boiler branch should point in the direction of flow, so as to induce a current to the discharge end, which should be protected from frost.

Hearth pits are usually covered by plates of cast or wrought-iron set in a frame. Each plate should be not over a foot in width, and it should not exceed $\frac{7}{16}$ths in thickness, with a stiffening rib. Each plate should be edge planed, and have chipping bits at each corner to fit them free from rocking movement in their places on the framing. It should have a slot at each end for a ⊥ key, and should be free from twist and an easy fit in the frame when the boiler is under full steam. The middle plate requires a small circular hole, with cupped cover plate, to take the blow-off key, and this middle plate ought to be lifted for an inspection of the hearth pit every day. This centre plate is supported by a flange along the

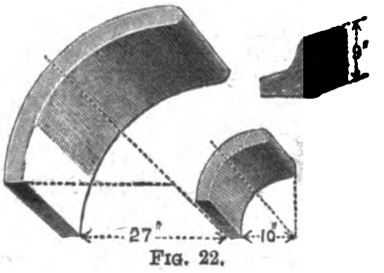

Fig. 22.

under side of each adjoining plate. It is considered permissible to take the waste pipes from the glass water gauges into the hearth pits, because otherwise the blowing out of the gauges is a nuisance, but this practice is rather apt to cause mild corrosion of the shell plate round the blow-out block. If a through draught can be secured from end to end of the hearth pits this should be done. Sometimes hearth pits are uncovered, being merely protected by a kerb of stone. This is good practice, in the writer's opinion, if the stokers will keep the pits clear of ash and coal. A portable plate or two may then be employed to carry the ash barrow when cleaning fires, and each blow-out tap should have a covering cap. By means of a set of rails an ash trolley may be run along the front of all the boilers for this purpose. The bottom of hearth pits, whether these be open or otherwise, should be smooth cemented, and sloped to the middle of the pit and one end to promote drainage. The advantage of the open hearth pit is this: Where cover plates are employed these must be fully 1 inch clear of the

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lower edge of the front end plate, or there is liable to be an accumulation of damp ashes about the angle iron ring. Serious corrosion has been thus caused. The open pit can conveniently be arranged with boilers of 7 feet diameter. But with boilers of 8 feet, and the large angle rings demanded by modern pressures, the grate surface is raised so high above the firing floor as to reduce the efficiency of the fireman.

With open hearth pits the front end plate may project below the level of the floor with safety. Where cover plates are retained, the bearer along the boiler front wall should have a back flange at least 4 inches high, and rising at the middle to fit round the boiler shell. This fender flange is to prevent the fall of ashes into the hearth pit, and generally to give a finish. It is customary to keep this plate bright in well kept boiler houses. Over the whole of the brickwork above the side flues one of the neatest ways of finishing the work is to lay thin, smooth flags of York stone, with rounded edges, where they overlap the brickwork. The best system of damper is that which provides a narrow damper to each side flue. These side flue dampers slide in a light frame of cast-iron built into the walls of the flue, which is here widened out to 12 inches. The damper opening is 12 inches, and the damper itself, if carefully fitted, need not exceed 13½ inches in a well-made frame. If circumstances permit, the narrowest part of the side flues may be greater than 9 inches, but should not usually exceed 12 inches. Each damper should be balanced by a weight hung by a chain over a pulley, carried on a pillar or frame suitably supported. On the axis of the pulley should be fixed a light wheel of 20 inches diameter carrying a flexible steel cord ⅜ths inch diameter. This cord is brought to a convenient spot on the firing floor—preferably down the pillar or pier of the large doors usually found closing the front of the boiler house. By this cord the dampers can be raised or lowered. It may either be a continuous cord or, if single, the balance of the damper must be imperfect, so that the damper will move in one direction by gravity. Obviously the damper gear must be liberally proportioned, and finished in a mechanical manner.

It is to be regretted that in items forming the substance of this chapter the fitting and finish of boilers and boiler houses which have been carried out by electrical contractors are often deplorably behind the best recognised practice.

A distinctly retrograde movement has been made as compared with the recognised standard of the leading boiler insurance companies. Much of what these articles contains is, in a sense, ancient history, and would not have been set down had it not appeared that there was a distinct need for it. An inspection of almost any modern factory in Lancashire, or even in Yorkshire, will show a practice differing but little from what has been here set down.

In actually setting a boiler, it is usual to first build up the brickwork as far as the level of the side flues. The boiler is then supported over its seating upon two sets of timber blockings laid in the bottom flue. It is set with a slope of $\frac{1}{16}$th of an inch to the foot of length towards the front end to facilitate blow-out and washing. The seating blocks are then put in position and firmly wedged in place to carry the weight of the boiler, fireclay only being employed as mortar. The boiler is then allowed to bear on the side walls by removing the temporary supports, an operation, perhaps, best effected by a screw jack, but sometimes by breaking up the old bricks which have formed one layer of the temporary supports. In designing a boiler seating, plain straight line work should be used as far as possible.

(To be continued.)

OVER-COMPOUNDING DYNAMOS.

By E. K. SCOTT.

In over compound wound dynamos it is necessary to increase the magnetism at a rate roughly proportional to the load needing the over-compounding. It is important, therefore, to work between such points on the magnetisation curve that the useful lines of force are somewhere proportional to magnetising force, or, in other words, that part of the B H curve which is immediately below the corner leading to saturation, say, x y, fig. 1. Working at a low point in the curve

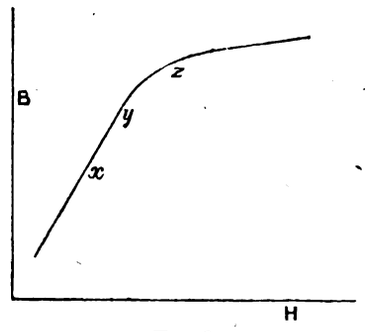
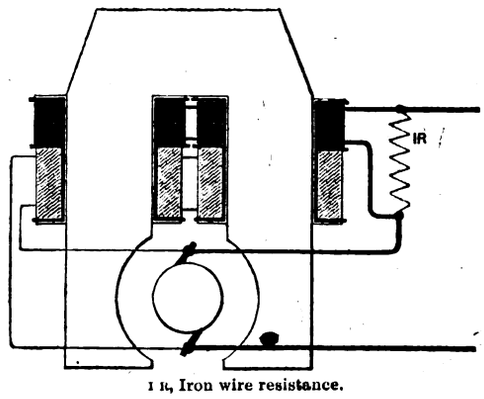


Fig. 1.

naturally means a reduced output per unit weight of material, and various propositions have been made to enable the machine to work at a higher induction density and still give the same over-compounding result. Fig. 2 shows one method



I R, Iron wire resistance.

Fig. 2.

which has the advantage that it is automatic. An iron wire resistance is put in shunt with the compound coils, and its section is so proportioned that increase of load, combined with the high temperature coefficient of the iron, shunts more and more current through the series coils, thus compensating for the diminishing permeability of the magnetic circuit at the part of the curve, y z. The coils themselves, and the losses in them, of course cost money, but the increase in output for a given sized carcase more than covers this.

It will readily be seen that a similar arrangement can be used in which the regulation is by hand, as in fig. 3, and

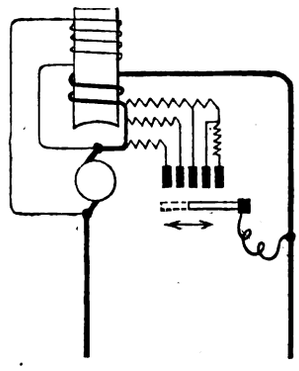


Fig. 3.

this latter method has the advantage that the band of the voltage curve can be compensated for.

An interesting fact, observable especially on traction machines where the load varies greatly, is that over-compounding tends of itself towards sparkless commutation; for the increase of magnetisation corresponding to the increase of voltage from 520 to 580 volts gives just the necessary strength of field for commutation without shifting the

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brushes. In other words, it is a distinct gain to over-compound a machine even when such over-compounding is not absolutely necessary from the point of view of getting a steady voltage at some distant point. Seeing that over-compounding means very little extra complication, it would appear that it might, with advantage, be applied to ordinary central station lighting dynamos, which are at present always wound shunt.

Some specifications for lighting dynamos have recently been issued, in which the ordinary shunt-wound machines to give 460 volts were asked for, but there was also the proviso that if at any time electric traction should be decided on, the dynamos should be able to give the voltage required for this work by the simple addition of series turns on the field coils.

Now, with 220-volt lamps, the voltage of the dynamo is generally fixed at 460 volts, whilst for the ordinary 500-volt traction motor the pressure at the generators may be anything between 520 and 580 volts. Say the highest voltage required is only 560, then it means that the mere addition of series turns to the dynamo has to add 100 volts, or 22 per cent. Such a thing might possibly be done, but what about the expense? As pointed out above, the only way to make provision for increase of voltage is to work low down on the magnetisation curve. To utilise lighting dynamos in the way suggested, therefore, means that when running on lights the fields will be very weak, and this, as everyone knows, is an invitation to sparking troubles at the commutator. As the machine must necessarily be of low efficiency and expensive, the game hardly seems worth the candle; besides, it is more than probable that when the traction scheme does come along, the idea of using the lighting machines for the purpose will have been abandoned. Using a higher voltage lamp than 220 would help to get over the difficulty, but the writer thinks that this idea of working lamps and a traction load from the same machines should be dropped. It looks pretty on paper, but it doesn't pan out quite right in practice.

REDUCED RATES TO INDIA.

We are glad to reproduce the following:—

Upper India Chamber of Commerce,
Cawnpore, *August 15th*, 1899.

The Under-Secretary to Government,
North-Western Provinces and Oudh,
Public Works Department,
Naini Tal.

Sir,

Reduction in Telegraph Rates between India and Great Britain.

In connection with the correspondence ending with your letter, No. $\frac{1343}{125}$M., dated Naini Tal, June 9th, 1899, advising that the Government of India "had addressed the Secretary of State with a view to securing a reduction of not less than 50 per cent. in the present tariff, at as early a date as may be practicable," I am directed to express the hope that His Honour the Lieutenant-Governor will support this further representation on the subject, as the facts which have been recently made public in England, regarding the working of the Anglo-Indian telegraphs, appear to accentuate the practicability of the views held by the Upper India Chamber of Commerce, viz., that a shilling per word rate would largely increase traffic and yield a fair profit on the working of the system.

In the course of an interview granted by the Chancellor of the Exchequer to a deputation of members of Parliament on July 12th, 1899, Sir Edward Sassoon stated that "A new telegraphic line had been sketched out by the Indian Government, which would supersede the existing Eastern Company's route to the East, and would give them cheaper rates and a safer line." The Chancellor of the Exchequer is also reported to have said that he was disposed, so far as his personal opinion was concerned, entirely to admit that; at any rate, with regard to India, there was a very considerable grievance in the cost of telegraphic communication, and that some such system as that suggested by Sir Edward Sassoon would do a good deal to improve the position in this matter.

Again, from the evidence given by representatives of the Eastern and Eastern Extension Telegraph Companies before the Pacific Cable Committee, it would appear that in the case of telegrams to Australia sent *viâ* India, only 1s. 4½d. per word is received by those lines which transmit the message from London to Bombay, the balance of the total charge of 4s. 9d. per word being allotted to the lines on the route further south. In other words, the Indian public is paying 2s. 7½d. more per word for the transmission of its messages to London, than is paid by the Australasian community for the transit of their messages from India to London, exactly the same distance, over exactly the same route.

The Marquis of Tweeddale, as chairman of the Eastern Telegraph Company, in communications addressed to the Press in defence of the company, states that: "With respect to India, the Eastern Company has already intimated to the Chambers of Commerce that it is prepared to negotiate for a reduction in the Indian rate, and has good reason to believe that negotiations with that object will soon be commenced between the India Office and the company." He further adds:—"As for the press rates, they are nominally less than the commercial tariff, no coding is permitted, and 'expansion' is inconsiderable, so that the present charges, it is admitted, bear more heavily than they might perhaps do on the purveyors of news." And he then goes on to say, "Supposing reductions of rates should, however, lead to a great increase of business, our cables would not be sufficient, and we should have to spend money in providing others."

The vice-chairman of the Eastern Telegraph Company, in a letter dated June 8th, 1899, addressed to the chairman of the Glasgow Chamber of Commerce (copy enclosed) clearly indicates, however, that if a reduction in tariff rates be made, the company will look to the Indian Government to bear a share of any *loss of revenue* which may be thereby caused; and in the memorandum accompanying the letter it is stated that experience has shown the traffic between India and Europe to be a non-expansive one. Further, that the company have not received a single application for reduction of rates from merchants, who are the actual users of the telegraph, ignoring the fact that the said merchants and others have for years been in communication with the Home and Indian Governments on the subject, through their representatives, the various Chambers of Commerce in England and India. Again, the allegation in the said memorandum, that the Indo-European traffic is non-expansive, hardly coincides with the chairman's views as to the possibility of a reduction in rates bringing about a large increase of business, necessitating the laying down of additional cables by the company.

But as it pays those interested to convey messages from London for Australia, as far as Bombay, for 1s. 4½d. per word, it would presumably be a fair speculation to either duplicate the existing system, or to provide another route, if need be.

My committee hold that the reduction in tariff rates to 4s. per word in 1896 still left the charge at too high a level to induce any considerable expansion in traffic, but that, as originally advanced by this Chamber, 1s. per word rate, while constituting a great convenience to trade, the general public, and the Press, would yield to an independent line a volume of traffic sufficient to allow of the system being worked at a substantial profit. I am, therefore, directed to express the hope that, when forwarding this letter to the Government of India, his Honour the Lieutenant-Governor of the North-Western Provinces, and Chief Commissioner of Oudh, may be able to countenance and support the opinion of this Chamber as to the feasibility of 1s. per word rate between Great Britain and India, with a maximum charge of 2s. per word for the privilege of priority of despatch over other messages, so as to meet the cases cited by the vice-chairman of the Eastern Telegraph Company, "Limited," in paragraph 2 of the memorandum attached to the communication addressed by him to the Glasgow Chamber of Commerce.

I have the honour to be, Sir,
Your most obedient servant,
W. B. Wishart, *Secretary*.

Reduction of Telegraph Rates between India and Europe.

The case for the Companies.

The following letter and memorandum have been received by Mr. John Galloway, chairman of the Glasgow Chamber of Commerce, with regard to the movement in favour of the reduction of the rates charged for telegraphing to India and the East:—

Eastern Telegraph Company, Limited,
Winchester House, Old Broad Street,
London, *June 8th*, 1899.

Sir,—Referring to our interview of the 1st inst., I now enclose copy of a memorandum which has been prepared with regard to the Indian tariffs. This memorandum can be freely used, and it has been submitted to our partners, the Indo-European Telegraph Company.

I can only repeat that these companies are willing to consider any offer which may be made to them by the Indian Government for a reduction of tariffs, and are equally prepared to bear a share of any loss of revenue which may be caused by the reduction required.

Yours faithfully,
J. Denison-Pender, *Vice-Chairman*.

Memorandum.

From some years past the company carrying the traffic between Europe and India have been memorialised to reduce the Indian rate. The companies have always expressed their willingness to reduce tariffs whenever experience has shown that a natural expansion of traffic has taken place, and is likely to take place by a reduction of tariffs, and have also always been and are now willing to take a fair share in any reduction of tariff, if the Governments concerned would bear a proportion of the actual loss of revenue, the companies not only bearing a share of the loss, but undertaking the extra expense of carrying any increased traffic. The reasons which have influenced the companies with regard to the Indian tariff have been as follows:—

1. The traffic between India and Europe has been shown by experience to be a non-expansive one, and the companies consider that it would require a very large reduction of tariffs to materially increase the actual traffic carried. The following figures will speak for themselves. The tariff was reduced to 4s. per word on July 1st, 1896:—

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	Words.	Revenue.* £		Words.	Revenue.* £
1885 ...	2,158.521	394,270	1892 ...	2,300,823	364,196
1886 ...	2,153,507	374,121	1893 ...	2,367,353	376,237
1887 ...	2,134,002	342,271	1894 ...	2,190,102	347,728
1888 ...	2,110,163	334,129	1895 ...	2,195,916	358,724
1889 ...	2,029,149	328,490	1896 ...	2,180,158	353,683
1890 ...	2,111,456	338,394	1897 ...	2,370,103	370,428
1891 ...	2,250,074	354,749	1898 ...	2,275,371	366,019

* Revenue of administrations owning the telegraph lines between India and Europe.

2. In all the correspondence which the companies have had with the merchants who are the actual users of the telegraph, we have never had a single application for a reduction of tariffs, but we have had applications to be allowed to send at a higher rate, in order that one person's telegrams might have the preference over those of others.

3. The perfection, to which the system of coding telegrams has been brought, practically reduces the charge of 4s. per word to India to about 2d. per actual word sent by the merchant, a figure that cannot be called dear.

4. If the traffic were to increase through a reduction of rate so as to recoup the companies for the total loss made, it would necessitate the laying of extra cables between Great Britain and India, a single line of which could not be laid under a million and-a-half of money, and if this large increase took place, the companies would have to face this additional expenditure of capital, with the consequent annual charges for interest, maintenance and working.

A HAPPY DESPATCH!

How many readers of the Electrical Review have any knowledge of the long-forgotten Pneumatic Despatch Company's railway between the G.P.O, St. Martin's-le-Grand, and Euston Station? It ceased working in the year 1869 or '70, and the first engineering experiences of the writer were gained on that line, abandoned for 20 years, and now about to be again operated by electric traction in place of air pressure and vacuum. A very exhaustive and interesting report on the inception and history of the ill-starred Pneumatic Despatch has just been made by an engineer, Mr. George Threlfall, a copy of which he has kindly placed at our disposal.

In 1895 it came to his knowledge that there was a tube running underground in London, having been built by a company about 39 years back for the purpose of conveying mails, parcels, &c., by pneumatic despatch.

It occurred to him that if the tube was still available it might be possible to utilise it for its old purposes, if worked by electric traction, but the tube had been closed for so many years that all the plans and records of it seem to have been lost, and it took practically three years to collect sufficient information and plans to enable Mr. Threlfall to draft out a feasible if not a perfect scheme.

The tube runs from the G.P.O., up Newgate Street and Holborn to Tottenham Court Road, up the Tottenham Court Road and the Hampstead Road, turning down Drummond Street and Seymour Street, and then turning up to the Northern District post office on Eversholt Street. It is of cast-iron, 4 feet high, and 4 feet 6 inches wide, and about ¾ inch thick.

Mr. Threlfall found it to be nominally the property of a company called the Pneumatic Despatch Company, founded in 1859, but which had lost its rights by efflaxion of time. He hunted up the prospectus and history of the old company, and found that it had been a very powerful one, having been granted special rights by Acts of Parliament enabling it to open up the streets, and do all that was necessary to lay down and keep in repair its tubes for the purpose of despatch in any part of London.

Its board of directors consisted of the Marquis of Chandos, Mark Hulse, Esq., Thomas Brassey, Esq., Edwin Clarke, Esq, John Horatio Lloyd, Esq., Hon. Wm. Napier, Sir Charles J. H. Rich, Bart., W. H. Smith, Esq., with T. W. Rammell, Esq., and J. Latimer Clark, Esq., engineers; John Aird, Esq., contractor; and Baxter, Rose, Norton and Spofforth, solicitors.

He saw all the surviving members of this board with the view of inducing them to aid him in resuscitating the company, and working their tube by electric traction instead of pneumatic despatch, and practically all the old stockholders of the company were interviewed, proxies procured from all, and affidavits from some. After endless delays and disappointments, Mr. Justice Vaughan Williams, in the High Court of Chancery, resuscitated the Pneumatic Despatch Company, with all its original powers, on June 6th, 1896, and an agreement between the Old Pneumatic Company and the New Syndicate (the London Despatch Company) was duly signed in May, 1899.

Mr. Threlfall having satisfied himself that the tube was suitable for electric traction, and that he could obtain possession of it on reasonable terms, he approached the Postmaster-General with a view to finding out the views of the G.P.O. as regards the utilisation of it if re-equipped with electric power. He saw the Secretary, Mr. Preece (chief engineer and electrician of the G.P.O.), and subsequently Mr. Fleetwood (his assistant), who really administers the despatch and electrical departments, and found that although they could not commit the Treasury by making positive statements, they personally were quite ready to entertain the matter, and give it their very careful consideration and qualified support, and there is little doubt but that the Postal Department will utilise the tube when electrically equipped, particularly as the requirements of the G.P.O. have increased enormously since it was laid down on the pneumatic system. One of the chief difficulties the G.P.O. experiences at present is to get prompt delivery of the mails to the different stations in contract time (8 miles per hour), owing to fogs, slippery pavements, congestion of traffic, &c., and there are no parts of London where they suffer more from these causes than in those under which the tube passes.

Since the date of the construction of the old tube, the G.P.O. have built a new Western District office in Holborn, on the route of the tube, and there is a large traffic, both in mails and parcels to and from that office. The Euston traffic is extremely heavy; in fact, the postal authorities state that it is heavier than any of the other station mails, the heaviest hour of the day amounting to 11 tons of mails. That to the Northern District Post Office, Eversholt Street, is also very heavy. They therefore look upon a scheme that will give them, in the first place, quicker service (say, 25 to 35 miles an hour), and one that will not be subject to street traffic obstructions and conditions, with great favour, and although they will not enter into a hard and fast contract until they have plans, particulars of delivery, speeds, &c., put before them, and guarantees offered, there is little doubt but that they mean business, as they have not only given Mr. Threlfall every assistance up to the present, but have offered to do everything in their power to facilitate the re-equipment of the tube.

When first the old company was reinstated, Mr. Threlfall began to consider the best way of re-equipping the tube without raising too much cash capital. He therefore approached some friends, building and railway contractors of first-class repute, with a view to their undertaking to repair and put the tube in order. He also requested a large firm of electrical engineers to undertake the electrical equipment; and he approached Prof. Carus-Wilson for the purpose of his preparing the plans and specifications for the equipment of the tube electrically. After having thoroughly explained the matter to these firms and gentlemen, and having taken their representatives into the tube, they each undertook to contract for the work required, and instead of asking for cash for the work done, undertook to accept payment in debentures of the new company.

The acceptation of the work by each of them on the lines of payment in debentures and shares gives, Mr. Threlfall thinks, the greatest proof possible of what practical men think of the prospects of the proposed company, which will not give them one penny for their work unless the scheme is a success.

During the time the old company was non-existent, the tube was practically no man's property, and the St. Pancras Vestry could not be blamed for taking advantage of it for the purpose of running their electric wires, but we understand they have now fully recognised the ownership of the Tube Company.

Regarding this, the most important vestry along the route, and the only one which is trespassing in the tube, Mr. Threlfall has approached them, offering to give every assistance in his power to enable them to remove their wires in the most convenient manner, and at the same time he has proposed to take from them some of the electric current which will be required in place of building a separate electric station for the generation of electricity.

In Buda-Pesth a line on exactly this principle is at the present time being laid down for identically the same purpose of carrying mails and parcels. At the same time wishing to get reliable and unbiassed opinions on the subject, Mr. Threlfall approached several of the chief authorities, and they all approve of it.

Satisfactory arrangements for financing this undertaking have, we are informed, been made, and a company bearing the name of the "London Despatch Company, Limited," was registered on May 19th, 1899, with its offices at No. 50, Fenchurch Street, London, E.C., with a share capital of £10,000 made up of £10,000 shares of £1 each, and the power to issue debentures up to the same amount.

The idea of forming a small company at the first, instead of a larger one, has been adopted more with a view to allocating the different interests acquired during the last five years in a parent company, and also with a view to the small company finally settling with all vestries, clearing and repairing the tube, drafting out the electrical equipment, equipping one section for Post Office and other experiments, and finally procuring the Post Office contract and bringing out a larger company. For this purpose it is considered the money subscribed, namely, £5,000 cash on debentures already subscribed, having the right to raise a further £5,000 cash on the remaining debentures, is ample.

The steps which the directorate now intend to take are, first, to obtain a recognition of their powers from the various vestries through which the tube passes, and then an undertaking from three of the vestries at least to supply the company at a reasonable rate with the electric current which may be required.

Prof. Carus-Wilson is now drafting out the actual requirements of the company from the electrical point of view, and probably the piece of tube between Euston and Eversholt Street Post Office will at once be equipped for experimental purposes, and the experiments will be carried on under the personal guidance of Prof. Wilson.

While the Professor's experiments are proceeding, an entrance will be obtained to the tube at sundry points, and the tube will be repaired where necessary, and the railroad put in thorough order for running cars.

The minutest details will be obtained of the General Post Office authorities' requirements, so that a full report and scheme may be put before the Postmaster-General with a view to procuring a firm contract from him. The requirements of all the railway companies having receiving offices on the route, of the general carriers and delivery companies, &c., will be carefully studied, and provisional contracts entered into with them where possible.

Having completed all these different details, and having obtained the General Post Office contract, and any other contracts from railway companies or carriers, the parent company will bring out its larger company, and finally equip the tube to its full working capacity.

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The writer, who was closely associated with the final struggle of the Pneumatic Despatch Company, when after six months of regular daily work the scheme was abandoned and passed into oblivion, has often wondered why that which has now come to pass, was not undertaken at an earlier date; but it has been left to Mr. G. Threlfall, the managing director of the new company, to make what we hope will prove a success of an underground railway, which, started at a time when the commercial application of electric traction was unknown, was bound to come to grief, for reasons which we need not stop to discuss, with air propulsion as its *modus operandi*.

Mr. Threlfall is to be congratulated on the energy and perseverance with which he has carried on his self-imposed task during the past four years, and it will not be his fault if the tube now under consideration is not in early operation, and extensions in hand.

On the 11th inst. the *Daily Mail* published a sensational, and technically inaccurate, account of "London's Lost Tunnel." The engines were never increased from 100 to 800 H P. Fancy 800 H P. to drive two or three trucks through the Pneumatic Despatch Company's tube! No wonder the financial results were on the wrong side.

The figures relating to the number of trolleys and weight to be carried are also wholly misleading.

Each electric locomotive is calculated to draw as a maximum, *seven* trolleys, each taking *one* ton, in addition to the weight of the trolley, at a maximum rate of 40 miles an hour.

AMERICAN TELEPHONE PRACTICE.*

Self-induction and Capacity.

By KEMPSTER B. MILLER.

Every insulated conductor is capable of receiving a certain charge when subjected to an electromotive force; for instance, if a metallic plate insulated from all surrounding bodies is connected to one terminal of a battery the other terminal of which is grounded, a certain amount of electricity will flow into the plate until its potential is raised to that of the battery terminal. The plate is then said to be charged, and the amount of electricity held by it determines its capacity. The charge of electricity on the plate will be considered positive or negative, according to whether the positive or negative terminal of the battery, or other charging source, was connected with it.

It is well known that no charge exists by itself—there is always an equal and opposite charge induced by it upon neighbouring bodies. It is also well known that like charges repel each other, while unlike charges attract; that if an uncharged body be brought near a charged body an equal and opposite charge will be induced on the side of the uncharged body which is toward the charged body, and that similarly a charge of the same sign as that on the charged body will be induced on the opposite side of the uncharged body. If now the body which was originally uncharged is connected with the ground, this latter charge, that is, the one of the same sign as the original charge, will be driven to the ground, while the charge of opposite sign will still be attracted by the charge on the first body. The second body will therefore be charged, although it has not been in contact with the first. The action between charges of electricity taking place through an insulating medium is called electrostatic induction. It is found that where two conductors are placed side by side, but insulated from each other, the capacity of each will be greater than if the other were not present. For the purpose of holding charges in this manner the well-known Leyden jars have long been in use. They are usually made by coating a glass jar inside and out with a layer of tin-foil to within a few inches of the top. The outer coating is usually connected with the ground, while the inner coating is connected with a metallic rod approaching it through the mouth of the jar. If the inner coating is connected with a source of electromotive force, a current lasting but an instant will flow into the coating, producing a charge. This charge, which we will say is positive, will attract a nearly equal negative charge to the outer coating, repelling an equal positive charge to the earth, as already described. The amount of charge which the inner coating will receive under these circumstances is very much greater than if the outer coating were not present, and the capacity of the inner coating is therefore much higher than before. A device, such as the Leyden jar, is called a condenser.

The capacity of a condenser is increased as the area of the conducting surface is increased; is increased as the distance between the conductors is diminished, and may be increased or diminished by using different kinds of insulating material between the conductors. The medium separating the conductors is called the dielectric and, as stated above, upon it depends to the greater extent the efficiency of a condenser. Several condensers built exactly alike so far as size of plates and the distance between them is concerned, and using different materials for dielectrics, will be found to have different capacities. This difference is due to a peculiar property possessed to different degrees by different dielectrics and called specific inductive capacity.

The specific inductive capacity of a dielectric is a measure of that quality which enables the dielectric to hold a charge between two conductors, as in a condenser. The specific inductive capacity of air is taken as a standard and is for convenience considered as unity; it is lower than that of any other known substance excepting, perhaps, hydrogen. If two condensers having plates of equal size and distance apart are constructed with dielectrics respectively of air and gutta-percha, it will be found that the condenser having the dielectric of gutta-percha will receive a charge nearly 2½ times as great as the condenser having the dielectric of air. The actual ratio between the two is 2·462, and for this reason the specific inductive capacity of gutta-percha is said to be 2·462. The following table gives the specific inductive capacities of some of the more important insulators:—

Air	1·00	Ebonite	2·284
Glass	3·013	India-rubber	2·220
Shellac	2·74	Paraffin	1·994
Sulphur	2·580	Carbonic acid	1·00036
Gutta-percha	2·462	Hydrogen	0·99967

It is probable that with very rapidly varying electromotive forces, such as are dealt with in telephones, the specific inductive capacities of the various substances would be higher in comparison with air than those indicated by this table.

Specific inductive capacity is a very important consideration in the construction of cables for telephonic purposes. In the construction of these cables it is desirable, as will be shown later, to reduce the capacity of the wires of the cable to as great an extent as possible, and in order to do this the dielectric is, in the best forms of cables, made of dry air to as great an extent as possible. On the other hand, in the construction of condensers it is desired that the capacity may be as great as possible for a given area of plates, and therefore some material other than air is used. Paper saturated with paraffin is perhaps the most commonly used, paraffin having about twice as great a specific inductive capacity as air, and, moreover, lending itself readily to the purposes of insulation. To sum up, the capacity of a condenser varies in direct proportion as the area of its plates, inversely as the square of the distance between the plates, and directly as the specific inductive capacity of the dielectric.

The effect of a condenser bridged across a circuit carrying an alternating current is to absorb a portion of the current as the electromotive force at its terminals increases, and as the electromotive force decreases, to give this current back to the line. Consider such a circuit when the electromotive force active in driving current through it begins to rise. The electromotive force at the condenser terminals will also rise, and current will therefore flow into the condenser. The strength of this current will depend directly upon the rate at which the potential at the terminals of the condenser is changing. When the electromotive force acting in the circuit reaches a maximum, the potential at the condenser terminals will also be a maximum, and will for an instant cease to change. At this point the condenser is fully charged, but as the electromotive force of the line is not changing, no more current flows into the condenser. In other words, the condenser current is zero. As the electromotive force in the line decreases, current will flow out of the condenser and into the line, because the condenser is not

* *American Electrician.*

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capable of holding so much charge at the lower potential. The flow of current out of the condenser reaches a maximum when the electromotive force in the line is changing most rapidly, and this occurs when it is passing through zero. From this it will be seen that the condenser current is zero when the electromotive force in the line is a maximum, and is a maximum when the electromotive force in the line is zero. This indicates, as in the case of self-induction, a phase difference of 90°, or a quarter of a cycle. It is not so easy to say whether this phase difference is lagging or leading, but a consideration of the direction of flow of current throughout the cycle will throw some light upon the subject.

At the instant when the current flowing in the line (which is in exact phase with the active electromotive force in the line*) is positive and at a maximum, the condenser current will be zero. As the active electromotive force decreases toward zero, the condenser current increases, but in a different direction—negative—because current is now flowing out of the condenser back to the line. As the active electromotive force reaches zero, the condenser current is at its maximum negative value, and as the active electromotive force reaches its maximum negative value, the condenser current reaches zero. During the next half cycle the condenser current increases to a positive maximum, and decreases to zero, while the active electromotive force passes from a negative maximum to a positive maximum. In other words, while the active electromotive force and therefore the line current with which it is in phase decrease from a positive maximum value to a negative maximum value the condenser current is negative, and while the active electromotive force increases from its negative to its positive maximum value the condenser current is positive. The condenser current, therefore, reaches its zero value, while decreasing, 90° in advance of the same value of the active electromotive force; its maximum negative value, 90° in advance of the maximum negative value of the active electromotive force; and upon investigation it will be found that every value of the condenser current occurs 90° in advance of the corresponding value of the actual line current. The electromotive force which is in phase with the condenser current is called the condenser electromotive force, and is 90° in advance of the electromotive force which is active in driving current through the line. This latter electromotive force, which, as we have said, is in phase with the current flowing in the line, is the resultant of the impressed electromotive force, and the condenser electromotive force, and therefore leads the impressed electromotive force by a certain angular distance.

The current equation for a circuit containing resistance and capacity is, as before,

$$\text{Current} = \frac{\text{Electromotive force}}{\text{Impedance}}.$$

In this case the impedance depends on the ohmic resistance of the circuit and on its capacity, and is equal to the following expression:—

$$\sqrt{R + \frac{1}{4\pi^2 f^2 c^2}}.$$

Where f is the frequency, as before, R the ohmic resistance, and c the capacity of the condenser in farads. From this the current equation becomes

$$C = \frac{E}{\sqrt{R^2 + \frac{1}{4\pi^2 f^2 c^2}}}.$$

The denominator is the apparent resistance, depending upon the ohmic resistance of the circuit, the capacity and the frequency of alternations. An inspection of this equation will show that as the frequency, f, is increased the impedance or apparent resistance becomes smaller, and this accounts for the fact that a condenser will readily transmit rapidly fluctuating currents, such as voice currents. Evidently the effect of increasing f reduces the second member in the denominator of the equation, and if sufficiently great, this may be neglected, and the equation becomes simply

$$C = \frac{E}{R}.$$

Again, increasing the capacity of the condenser also increases the effective current by reducing the impedance.

Every telephone line possesses electrostatic capacity, and may be considered in the light of a condenser. In the case of a grounded circuit, the line wire takes the part of one plate of the condenser, while the ground and other neighbouring conductors act as the other plate. In metallic circuits the one side of the line acts by electrostatic induction upon the other, and the two together, upon the ground and neighbouring conductors. The capacity of a line, however, differs from that of a condenser in that it is distributed throughout the entire length of a line, while a condenser connected with a line would have all of its capacity at a single point. Capacity, such as that of a line, is termed distributed capacity in order to distinguish it from that possessed by a condenser, which may be termed local capacity. The effect of distributed capacity upon telephone currents may be more readily grasped by imagining a large number of condensers bridged across the two sides of a metallic circuit at frequent intervals. When the electromotive force impressed upon one end of the line increases, a current flows from the source over the line wire and into the condensers, charging them all according to the difference of potential across their terminals.

The difference of potential across the terminals of all the condensers will not be the same, because there is a certain drop, due to the ohmic resistance of the line wire. If the current flows in that direction long enough to charge all of the condensers on the line, then a current will reach the distant end of the line, and if it continues in that direction, will attain its full value, in accordance with Ohm's law. It must be remembered, however, that each condenser is capable of taking a certain charge, and in order to receive this charge, a certain quantity of electricity must flow over the line wire.

The quantity of electricity which flows through a circuit depends upon the strength of the current, and upon the time it is allowed to flow. If the time is insufficient, it will be impossible for enough current to flow through the circuit to charge the condensers up to the potential of the source, and therefore the current at the distant end of the line will not reach its maximum value, and, in fact, may not rise practically above zero. If, therefore, the electromotive force of the source is reversed before sufficient current has time to pass through the line to charge all of the condensers, the current will not reach its full value at the distant end of the line.

It may begin to build up in the opposite direction, and again be stopped on account of the insufficient time to reach its proper value in that direction. The time in which the current in such a circuit will reach a definite portion of its maximum value at the distant end of the line is called the time constant, and if the time represented by one alternation of the electromotive force is smaller than the time constant, the current will not reach that value at the distant end of the circuit, and the transmission will be correspondingly impaired.

The reduction in the actual volume of current transmitted by the effects of distributed capacity is, however, of less importance than the distortion of the wave form. The higher frequencies of current waves corresponding to the higher over-tones are absorbed by the condensers far more readily than the lower frequencies, and, therefore, the waves corresponding to the higher over-tones are reduced to a much greater extent at the distant end of the line than those corresponding to the fundamental and the lower over-tones. This weeds out the upper harmonics, thus tending to destroy the clearness. Capacity, however, acts in still another way to alter the form of the wave. The angle of advance for the higher frequencies is greater than that for the lower, and, therefore, the waves of different frequencies are shifted with respect to their phase relation, thus greatly altering the wave form.

It has been shown that the electromotive force of self-induction lags 90° behind the active electromotive force, while the electromotive force due to capacity is 90° in advance of the active electromotive force. It is not difficult

* The active electromotive force is the resultant of the impressed electromotive force and the condenser electromotive force, and is in phase with the current actually flowing in the line

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to conceive, therefore, that by properly proportioning the self-induction and capacity of a circuit the electromotive force of self-induction may be made to neutralise the electromotive force of capacity, and this result is readily obtained in experimental work.

In this case, even though self-induction and capacity may be present in a circuit to a large degree, the current flowing in the circuit is in exact phase with the impressed electromotive force, and its value is in strict accordance with the ordinary expression of Ohm's law. Unfortunately, however, for long-distance telephony such a balancing of self-induction against capacity can be obtained only for one particular frequency at a time. To thus tune a circuit for one particular frequency would render that circuit capable of transmitting efficiently one particular frequency of vibration, while the requirements of telephony are that all frequencies within the range of the human voice shall be transmitted with equal facility. Again, and unfortunately, it has been found impossible to neutralise distributed capacity with anything but distributed self-induction, and this has not yet been accomplished in practice.

As for trans-oceanic telephony, the high static capacity of the cable has so far proven an insurmountable obstacle. It is impossible to conceive a transmitter capable of forcing such rapid undulations through our present form of cables. Clearly then the solution lies in the betterment of cables, or the substitution of some other transmission medium, rather than the improvement of the instruments themselves.

There can be little doubt that trans-oceanic telephony will finally be accomplished, but the indications are that our knowledge at the present time is not sufficient to cope with the problem.

CORRESPONDENCE.

"Stresses in Steam Engine Shafts for Electric Traction."

Now that the writer of the article on the above has expressed the meaning which he intended to be conveyed by the paragraph to which I took exception, there is, of course, no serious disagreement between us.

It is mostly, as he says, one of terms. I did *not* mean by the "ordinary stress" that corresponding with the current for which the circuit breaker is adjusted. By "ordinary stress" I mean that corresponding with the rated normal full load as generally understood by the manufacturer.

There is no need for me to endeavour to substantiate the 1,000 per cent. rise of torque, as your contributor concedes my point when he says: "If there were no circuit-breaker the braking action might be enormous." Everything depends, as I stated before, on the time lag of the generator and on the machine circuit breakers, and it is just here where, I think, we differ slightly, he assuming that the latter protect the machine absolutely, which I am not so sure of.

Your contributor takes his stand on a possible excess of stress of 100 per cent. above the ordinary not being exceeded; but, even bearing in mind that his "ordinary" stress is taken at from 50 to 150 per cent. above my "normal," I still think he hardly makes a sufficient allowance.

The following suggestions may be offered in support of this view:—

1. On a road on which the service is infrequent, or the grades severe, the *station* load may frequently vary momentarily in regular work to the extent of 100 per cent. above the normal (my normal); and, at the moment of the overload, any one engine may easily get considerably over this due to inequality of division of the load. If the machine circuit breakers were adjusted exactly for this load (100 per cent. above the normal), there would be such frequent openings of the circuit breakers that the station engineers would, I anticipate, soon alter the adjustment. I believe that on the Waterloo and City Railway the machine cut-outs are adjusted for 800 amperes, which is getting on for 140 per cent. above the normal rated output.

2. There can, it seems to me, be a considerable rise of current in the generator, and consequent stress in the shaft (over and above this 140 per cent.) before the circuit breaker acts. Indeed, but for the time lag of the generator itself, I see no reason why there should not be sufficient to shear the shaft, even with the circuit breaker properly adjusted.

I find that, if we could imagine a sudden increase of current sufficient to shear the shaft, this shearing would be performed on a 5-inch shaft, running at 350 revolutions, and transmitting 200 H.P., in roughly ·0007 second; the length under shear being 6 inches. That is to say, in that extremely short interval of time the angle of twist of the fly-wheel would be sufficient to cause shear of the shaft.

I have also made a rough attempt to gauge the time taken by the plunger of an "I.T.E." circuit breaker, before it liberates the catch, and find this to be of the order of ·024 second.

Obviously, therefore, if the generator had *no* time lag the current would easily have had time to shear the shaft before the circuit breaker acted (assuming my figures correct).

Perhaps some of our station engineers may be able to contribute some idea, from actual experience, of the rate of increase of the current, through armature and series coils, when these are short-circuited under an E.M.F. of 500 volts, say, with a 200 KW. set.

With what is virtually a closed secondary of very low resistance (the unlaminated field) the "time constant," as calculated from the dimensions of the magnetic and electric circuits should be reduced several fold.

If Mr. Philip Dawson would give us some particulars as to the numerous accidents which have happened in the United States due to shafts shearing and to faulty circuit breakers, which the remarks in his book and in the lectures before the Institution of Mechanical Engineers (see ELECTRICAL REVIEW, No. 1,045, Vol. 41) suggest, it would probably be very instructive reading.

I must conclude this somewhat lengthy letter with an apology to your contributor for having so imperfectly replied to his questions.

The speed of the shaft he asks for was 350 revolutions.

A. M. Taylor.

September 13th, 1899.

ELECTRICITY AT CRIPPLE CREEK MINES.

The prevailing idea of a gold mine as something inaccessible, is rather dissipated by an article by J. Tonge in the *Engineering Magazine* on the Cripple Creek district. In that favoured locality the miner can proceed to work in an electric street car. Nowhere else in the world can the gold miner do this. Curiously, however, there are mining districts in effete old England where the coal miner, in all his picturesque many coloured rags, can proceed to his work in an electric street car. This will set him down practically at the very pit's mouth, down which he will be wound by an old fashioned beam engine. There, however, he ceases to emulate the Cripple Creek miner who is wound down electrically, keeps his mines dry by electrical pumps, and uses electric drills. However, both the new and the old world miner have to laugh at all London. Thanks to a County Council which is advised to reject the one practicable method of electric traction, we seem to have said farewell to our hopes of securing in London the facilities enjoyed by the Staffordshire miners.

Cripple Creek is a curious district. Little over 6 square miles in area of hills and valley, and situated over 9,500 feet above the sea, one town, Altman, being placed at an elevation of 10,300 feet, this small area contains upwards of 150 productive gold mines, 15 of which send out over 1,000 tons of ore per month. The gold production in 1891 was about £1,600,000. In 1894 it had risen to nearly £3,000,000, and up to this year's July dividends, the shareholders had aggregated £1,600,000 in joint stock mines alone. A remote mountain pasture in 1891, the district now has a population of 50,000. Steam railroads encircle the area, but do not enter it, and the way to the mines was difficult, or, at least, arduous. This led to the construction of the electric line starting from Cripple Creek town and meandering through the district to Victor. It is a line of curves and grades, climbing to a height of 10,514 feet, or 1,000 feet above its two termini. The round trip takes one hour at 12 miles an hour average. The line is driven by water-power at Lake Moraine, 11,300 feet on Pike's Peak, and electricity is transmitted nine miles to a central distributing station. It is shortly to be extended to Colorado Springs, a distance of 32 miles. The mines of the district being so elevated, the cost of water and fuel was very heavy, and coal was hauled from Canon City coalfield, 30 miles distant and 5,000 feet lower in elevation. As a rule the mines are either naturally dry or have been made so by levels at lower elevations, and local streams are few and small. Water has often cost as

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much as fuel, and with the usually inefficient steam plant at a mine power was a very serious item. Obviously the district was eminently suitable for electric power distribution.

In July, 1888, the first electric mining hoist was put into work at Aspen, Colorado, and is still in operation. It was driven by a generator at Hunter Creek. This did other work also, and was of 60 H.P., and later was changed for 125 H.P.

Early in 1893 a 500-H.P. plant was established at Maroon Creek, Aspen. There are to-day at Aspen motors of over 700 H.P., all deriving current from water-driven generators. They have replaced the steam engine and have paved the way for the universal establishment of electric-power plants at the mines in Colorado. The beginning at Cripple Creek was made with the power plants of the Colorado Electric Power Company at Carson City, 30 miles from the creek, and that of the La Bella Mill Water and Power Company at Goldfield, within the district of Cripple Creek itself. In each case power is generated by steam plant, the first transmitting current 27 miles, the second carrying coal 27 miles and transmitting current from a comparatively local station. The former company has a capital of £100,000 and a power of 2,250 H.P. It has worked since 1898. Current is generated at 500, transformed to 20,000 volts, and transmitted by three bare No. 3 copper wires arranged in a triangle on 30-foot poles, one wire being at the top. A telephone circuit of two wires is carried on the same poles. Distribution is made at 500 volts from step-down stations on Gold Hill and Battle Mountain.

Customers for 1,200 H.P. are already on the books, consuming each from 75 to 150 H.P. for large consumers, and down to 5 H.P. for small consumers; a hoist of 15 H.P. will serve a depth of 450 feet; 30 H.P. will serve down to 800 feet, and 100 H.P. may be used for the greater depths. The company leases to a prospector a small hoist, and a small prospector can put all his capital into development. He can purchase as soon as he finds pay streak. The minimum rent of 5 H.P. is £10 per month, including hire and supply. This may seem heavy, but it could be done in London. We are informed by a recent owner of a small steam plant that for a power much less than would be afforded by 5 H.P. of electric motors, his steam power cost, directly and indirectly, at least £300 per annum, and we know of a large printing office in America where the use of motors to each machine saves seven-eighths the power used in similar electrically-driven offices where shafting is employed, and one large motor. Yet the rated motor power of the multiple motor office is double that of the single motor offices. This simply goes towards proving that it is what is not used that constitutes the economy to be sought in electric driving. The Colorado Company rents out in the way described £12,000 worth of machinery. The La Bella Company has a capacity of 3,000 H.P., or 2,250 electric and 750 in compressed air; has 10 miles of underground air mains from its station to various mines, some of them two miles distant, while electricity is transmitted five miles. The power station is thoroughly modern. Coal is dumped into bins direct from cars and mechanically fed to the fires. Ashes are mechanically removed. Condensing engines are used. Being 10,000 feet above the sea, cooling towers are used to save water, the first application of the cooling tower in the State. The vacuum cannot attain 20 inches, for the barometer only stands at 20 inches of mercury.

The triphase system of distribution is used at 6,400 volts directly generated, but at the mines there are step-down transformers to 110 and 440 volts for light and motors respectively. Only 2 per cent. is lost between the power house and a 300-H.P. motor one mile distant. Lights can be operated from the motor circuit without flicker or any indication of fluctuating load. The chief uses of electrical power are hoisting and air compressing for drills, the latter being the chief power consumer at most mines.

The saving effected is estimated at from 15 to 50 per cent., according to location and circumstances, irrespective of reduced wage account, of greater reliability and convenience, and freedom from stoppage by frost. The use of electricity has thus rendered possible the use of lower grade ore, hitherto not available, this being unprofitable at the high rates for power. We commend this brief history of electrical power distribution to the hesitating and uninformed men who seem to fill so many of our local councils. Their one aim seems to be to make tours of inspection to see things they do not understand, and they return just as wise as they set out, and all the more confused as to the system they should adopt. If they would accept once for all that electrical distribution is *un fait accompli*, just as much as steam power, they might get something done. The sight presented at this end of the 19th century by some of England's local authorities is indeed pitiable.

BUSINESS NOTICES, &c.

Annual Outing.—On Saturday, September 9th, the employés of the British Thomson-Houston Company, Limited, to the number of 65, went to Bournemouth for their third annual outing. On arrival, the party adjourned to the handsome dining room of the Grand Hotel, where a sumptuous repast was served. Mr. Ireland, of the supply department, presided in the absence of Mr. Monks, managing director. Mr. Ireland in his remarks said, among other things, that the B.T.H. would shortly put a cricket team in the field. We are also pleased to note that it is proposed to have some B.T.H. smoking concerts this winter. After the banquet the party assembled on the lawns of the Grand Hotel, where they were photographed.

Book Received.—"Télégraphie et Téléphonie," by J. Pierart. New edition. Brussels: Hayez, editeur.

Electrical Wares Exported.

Week ending Sept. 13th, 1898.		Week ending Sept. 12th, 1899.	
Adelaide	Value £18	Adelaide, Teleg. wire	Value £767
,, Teleg. mat.	184	Amsterdam	25
Alexandria	16	Antwerp	38
Amsterdam	51	Auckland	75
Boulogne	140	Bombay	81
Calcutta	313	Bordeaux	10
Cape Town	242	Buenos Ayres	50
Colombo	238	,, ,, Teleg. mat.	125
Copenhagen	140	Bushire	25
Durban	943	Calcutta	257
Gothenburg	114	Cape Town	529
Hamburg	18	Channel Islands	17
Helsingfors	27	Chinde, Teleg. mat.	565
Hong Kong	320	Christchurch, Teleg. wire	124
Madeira	124	Colombo	44
Malaga	62	Copenhagen, Teleg. wire	53
Melbourne	1,172	Durban	94
Ostend	8	Flushing	124
Port Chalmers	14	Gibraltar	7
Rio Janeiro, Teleg. mat.	875	Hamburg, Teleg. mat.	65
Rosario, Teleg. mat.	154	Hong Kong, Teleg. mat.	41
St. Petersburg	160	Ibrail	15
Stockholm, Teleg. wire	105	Madras, Teleph. mat.	181
Sydney	864	Melbourne	293
,, Teleg. cable	370	Ostend	123
Tientsin, Teleg. mat.	65	Perth	41
Wellington	882	Port Said	10
Yokohama, Teleph. mat.	302	Rotterdam	150
		,, Teleg. wire	57
		Shanghai, Teleg. wire	116
		Singapore	548
		,, Teleg. mat.	50
		Stockholm	74
		,, Teleg. wire	321
		Sydney	599
		Tientsin	12
		,, Teleg. mat.	78
		Wellington	902
		Yokohama	218
Total	£7,866	Total	£6,689

Foreign Goods Transhipped.

Sydney. Elec. light fittings. Value £25

The American Electrical Trade.—The *Electrical World and Engineer* says that a large quantity of new work is opening up in the electrical field as the fall season begins, giving promise of a very active winter. There would be even more if the prices of steel and iron and copper had not run to such an inordinate height, but it begins to look pretty certain that copper will have to come off its lofty perch and that electrical industries will not much longer be hampered and held back by the cost of their raw materials. It is hard to tell just how much new business is checked in this way, but the percentage is definite. In some respects, the "going slow" has done no harm, but has given the electrical factories a chance to get belated orders cleaned up, and a fair preparation made for future contracts.

Bankruptcy Proceedings.—A receiving order has been made in the case of J. Stewart Edwards, electrical engineer, Moorgate Street, E.C. The first meeting and public examination will take place on September 19th and October 18th respectively, at Bankruptcy Buildings, W.C.

In *re* the petition in bankruptcy of Mr. S. F. Walker, carrying on business at Severn Road, Cardiff, as electrical engineer, under the name of "Sydney F. Walker & Co.," the first meeting of creditors was held on Monday at the offices of Mr. George David, the Cardiff official receiver. Debtor attributed his failure to "want of capital and illness in August, September, and October, 1898," and returned his liabilities at £2,729, of which £1,923 7s. 10d. is expected to rank for dividend; the deficiency is £1,862 16s. 11d. According to the observations of the Official Receiver, the debtor commenced business at Nottingham in 1876, with a capital of £500. In 1882 he entered into partnership with a Mr. F. G. Oliver. The business was then extended to Nottingham, Cardiff, and Newcastle, and it was carried on jointly for seven years, when the partnership was mutually dissolved, Mr. Oliver paying the sum of £1,000 and Mr. Walker taking over the whole of the assets and liabilities. The debtor had 23 apprentices when he filed his petition, and preferential claims for over £650 are likely to be made for the return of premiums. Mr. C. E. Dovey was appointed trustee, and a committee of inspection was nominated.

Liquidations, Dissolutions, &c.—Messrs. W. H. Clegg and C. D. Falcke (Birmingham Installation Company), electrical engineers, have dissolved partnership, and Mr. Falcke will continue the business under the same name and will attend to debts, &c.

The Railways Electric Supply Syndicate, Limited, has decided to wind up voluntarily, and Mr. F. B. Townsend, of 24, Queen Victoria Street, E.C., has been appointed liquidator.

Creditors of Nernst Lamp, Limited, are required to send their names and the usual particulars to the liquidator, Mr. W. Chaplin, Dashwood House, E.C., by October 21st.

Bristol.—Messrs. Gilbert J. Lloyd & Co., of Bristol, who are very busy in that neighbourhood, have recently received a contract for an installation for Messrs. C. Baylor & Co.'s new factory at Easton for 400 lights. Current will be supplied from two dynamos. The wiring is being carried out in duplicate throughout the building, so that if one machine fails, every alternate lamp is extinguished only. Wiring is being done on the 5-ampere distribution system.

Catalogues, &c.—Messrs. Mather & Platt, Limited, have in circulation a very nicely printed leaflet illustrating one of their multipolar dynamos coupled direct to a vertical engine, also giving general particulars and dimensions of same.

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We have received also from the same company a copy of a small illustrated pamphlet describing the marine type of engine which they have manufactured in considerable numbers during past years. The standard sizes embody all the improvements in design and construction, which several years of experience and careful observation have demonstrated as advantageous. The engines are specially suited for various classes of work, and being of an open type, all parts are easy of access and supervision; they have a low steam consumption and are arranged to run at a moderate rate of speed. A special type of electrical machine has been constructed for mounting upon the extended bed of this class of engine, the generator being driven direct from the engine, and running at the same rate of speed. Large numbers of these combined plants are now at work in various parts of the world and giving very great satisfaction. In the latter portion of the catalogue, is found a description of a few small sizes of enclosed engines, which have been designed to meet the requirements of customers. All particulars of sizes, weights, and overall dimensions are fully given. The list contains some good illustrations.

The Stilwell-Bierce and Smith-Vaile Company of St. Louis send us a list of the Victor atmospheric water cooling towers and condensers.

Mr. C. R. Heap, of Victoria Street, S.W., sends us a mounted and varnished sheet of illustrations for the wall, showing some of the standard types of C. & C. and Wagner machines.

Claim against India-Rubber Company.—An application came before Mr. Justice Kenny at Dublin last week in the case of William Cameron *v.* India-Rubber, Gutta-Percha and Telegraph Works Company. Although the case can hardly be called an electrical one, it is of interest to mention its character. Plaintiff, of Newry, claimed damages for breach of contract to manufacture and sell a pneumatic shin pad, and to pay the plaintiff a royalty of 10 per cent. The amount of the claim was £50,000, this being arrived at by calculating that there are a million football players, and each pad would sell at 4s.!

Connolly v. Lovelock.—At the Shoreditch County Court, on 25th ult., this interpleader matter came before Judge French. Mr. Alec. Neilson appeared on behalf of the plaintiffs, and submitted the claimant to a stiff cross-examination. This elicited the fact that the claimant was the father of the defendant Lovelock, and he had permitted the defendants to use his works when they had any jobs requiring a big lathe or machinery. He swore that he had nothing to do with Lovelock, Seabourne & Lee, and that he was not, and never had been, a partner in that firm, and, moreover, that he carried on a different kind of engineering business which had nothing to do with electricity, consequently he could not have had the benefit of the goods. He knew nothing about 8, Jeffery's Square, and had only been there since this action was commenced. The Judge, in the absence of any evidence connecting J. F. Lovelock with the defendant firm, consequently found for the claimant with costs.

Deed of Assignment.—Notice is given to creditors of S. B. Apostoloff, of 5, Fenchurch Street, E.C., to send particulars of their claims to the trustee on or before October 15th next. For further information, see our business columns.

Incandescent Lamps.—Messrs. Philips & Co., of Eindhoven (Holland), who are represented in the United Kingdom by Mr. G. Braulik, send us a copy of their catalogue of incandescent lamps. We understand that the firm's works have been largely extended recently, and a first-class staff of 450 men, including eminent technical men, is engaged at the works, the buildings of which now cover 4,500 square yards. Messrs. Philips claim that high class quality and low price have built up the large lamp business which they are now conducting. Lamps of 15,000 C.P. are turned out daily. The firm has just brought out a new high voltage lamp with two short unsupported spiral filaments. It is said to be quite new in construction and there is a good demand for it. A prominent feature of Messrs. Philips's business is the manufacture of special lamps for illumination purposes, for which a new lamp has been recently introduced. The method of manufacture consists of taking a tubular lamp with bayonet cap so made that it is possible to screw a coloured bulb directly over the lamp without interfering with the shadeholder, &c. It is therefore claimed that they may be used for theatre and saloon lighting and garden illumination without interfering with the Bohemian glassware or shadeholders. The catalogue before us contains illustrations of incandescent lamps of all shapes and sizes, fancy and otherwise.

Ross v. National Telephone Company.—In the cause list for the Vacation Court at its sitting on Wednesday (6th inst.) A. Ross *v.* The National Telephone Company, Limited, and T. K. Ross *v.* The National Telephone Company, Limited—which were both motions for injunctions to restrain trespass on plaintiffs' land—stood for hearing before Mr. Justice Cozens-Hardy. Counsel, however, intimated that the matter had been settled on terms between the parties and there would be no order.

Soldering Paste.—Messrs. Beanland, Perkin & Co., of Leeds, send us a sample of Burnley's soldering paste, for which they are the sole English agents. This preparation is in very general use in the United States. Messrs. Beanland are supplying it regularly to prominent electrical firms in this country, including Messrs. Johnson & Phillips, Siemens Bros. & Co., and Mather & Platt, &c. Small samples will be sent upon application.

Trade Announcements.—The firm of Julius Sax & Co., Limited, having gone into voluntary liquidation, we have received notice that Messrs. E. Bulstrode (general manager), Thos. Wilson (accountant), E. Buhler (chief engineer), W. Krause (second engineer), and John Plumb (manager of installation department), being the heads of the various departments named, have formed themselves into a syndicate to carry on the business of electrical engineers and electric light contractors (the Saxon Electrical Engineering Company) at Gervase Works, Gervase Street, Old Kent Road, S.E., assisted by several of the late employés of the old company, and working on the same lines.

Messrs. Boulton & Wade, patent agents, Hatton Garden, have taken into partnership Messrs. B. E. Dunbar Kilburn, M.A., and W. J. Tennant, A.M.I.Mech.E. The firm will in future be known as Boulton, Wade & Kilburn.

Messrs. Chamberlain & Hookham's London testing station and depôt at 6, Cecil Court, has been removed to Messrs. Venner & Co.'s new premises at 6, Old Queen Street.

Wiring Contracts.—The British Electric Installation and Maintenance Company, of Blackheath, have secured the contract for lighting the extensive premises of Messrs. Chiesmann Bros., drapers, and furnishing warehousemen, of High Street, Lewisham. They have also received the contract for the lighting of the Parish Church of Lee (St. Margarets).

ELECTRIC LIGHTING NOTES.

Aberdeen.—There is a deficit of £203 on the first seven months of the current year; the output during that time has increased 36 per cent. It is anticipated that the deficit will be annulled by the end of the year.

Mr. Bell, the electrical engineer, has issued a circular to the electricity consumers, stating that when anyone wishes to use a large number of lamps for a special display, he may, on giving 24 hours' notice, have his demand indicator cut out of action, so as not to increase the price charged for the whole supply for the half-year, provided that this does not occur oftener than once a month. We commend this very reasonable arrangement to the notice of supply engineers. It is a small matter, but may obviate much dissatisfaction.

Accrington.—The Board of Trade has decided to allow the Corporation's provisional order to remain operative, seeing that steps are being taken to provide electricity works.

Bristol.—At the Bristol City Council on Tuesday afternoon, Mr. George Pearson moved the adoption of a report from the Electrical Committee recommending the purchase of over nine acres of land for a new generating station, the rapid progress of the demand for electricity having almost exhausted the capabilities of the site already in use. The proposal excited some surprise in Bristol, where, during the recent controversy with the tramway company, so much had been heard of the advantages of combining electrical and power stations. The tramway company's power house is being erected close to the civic electrical works, but the new Corporation station now proposed is in another part of Bristol—perhaps three-quarters of a mile from the existing works, and on the south-eastern edge of Bristol. The explanation for the new proposal was that the progress of the electrical undertaking had greatly exceeded the estimate formed at the time when it was established, and the capacity of the works at Temple Backs, although increased by the addition of adjoining land, is insufficient to supply more than the present demand, while the proposed extensions of the land recently sanctioned will not suffice for more than one year's additional growth. The committee found it, therefore, necessary to prepare for a considerable extension of the undertaking. They failed to find land in the neighbourhood at a price they could recommend the Council to pay, and ultimately selected a site at St. Philips Marsh, costing roundly £15,000. The property has good approach from road, water and rail, and Mr. Pearson explained that it would permit an extension of business 10 times as great as that already done. In commenting on the position in which the committee found themselves, Mr. Pearson said the committee commenced in 1893 in a very small way with 16,000 lamps. In March, 1899, their lamps numbered 68,000, and at present the aggregate was 74,484. They commenced by selling 300,000 units in the year, and last year the sale amounted to 1,362,000 units. The revenue grew from £6,624 in the first year completed to £26,233 last year. With the growth of revenue and output the cost of production had decreased from about 4½d. to not quite 2½d. The profits at first—if a Hibernianism would be allowed—were a loss. The profits last year carried to the net revenue account were £12,630, from which had to be paid interest and sinking fund. It was said that it was improper for a municipal authority to talk of profits until interest and sinking fund had been met. He dissented from that view. No one would dream of saying a public company must not speak of its profits until it had paid its debenture interest and dividends on its shares. He considered the profits they might legitimately consider as profits were what they transferred from the credit of the general revenue account to the net revenue account. They had made a profit notwithstanding a reduction in the cost to private consumers and for public lighting. It showed they had got hold of a good and a growing undertaking, and the growth justified the large proposal he asked the Council to adopt. If they did not hand over actual cash to the city they were benefiting the citizens by reducing the cost. The new site would be equal to supplying 800,000 lamps, or rather more than the total number of gas lights in the city. The site would have an advantage compared with the former one that piling would be less expensive and a river wall would not have to be built. There was the important disadvantage—a division of their work and the cost of working two establishments instead of one. He had asked their engineer what he suggested, and the engineer said the best method

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would be to use the present site for the day load, their power and their public lighting. They would want three shifts as at present. He would propose to use the new station to supply their heavy load in times of pressure, and as a stand-by in case of breakdown at the older station, and for that purpose one shift only would be needed. They had proceeded so far in the extension of their mains very much on the principle of supply and demand for the moment, but now their business was getting so big they ought not to proceed on such haphazard lines, and they should lay down for themselves—though they might not carry out the works at once—certain lines on which they would proceed. As to the cost of current, it would be their duty to see if they could not at no distant date reduce the price of public lighting. They had made mistakes, no doubt, but when they had done a stupid thing they thought it best not to advertise the fact, and he should not, therefore, take the Council into his confidence on that matter. He would, however, say they hoped to see the cost of production considerably reduced, their coal bill reduced, and their output increased.—During the discussion on the report, an appeal was made to the Electrical Committee by members of the Libraries Committee to light the libraries with electricity at a lower cost. Mr. Pearson replied that if the electric lighting of the libraries cost more than gas lighting, there must be waste somewhere. He had the light in his own house, and he had more lamps than ever he had, and his last bill was less than his last gas bill. The Council adopted the report.

Messrs. Mindham & Co., of the Western Electrical Works, have secured the contract for lighting St. Stephen's Church, one of the oldest historic churches of this city. They have also in hand several important electric lighting contracts, including a large new Nurse's Home in connection with the Bristol Royal Infirmary; a large new suite of offices, and several steamships that are now running from this port.

Bucksburn.—A meeting of the ratepayers was held last week to consider the electric lighting scheme for the village, proposed by Messrs. P. C. Middleton & Co., electricians, Aberdeen. The firm offered to pay £50 per annum for the surplus water at present running from the turbines of the Waterton district supply, as well as to erect a house for the official who would have charge of the lighting station, and to pay his salary. They were also prepared to supply 60 street lamps of 16 C.P. at 25s. 6d. each per annum. The light would be provided for nine months of the year, and the contract between the district authorities and the electrical engineers would be binding for 21 years. A resolution was unanimously passed to take the necessary steps for forming a special lighting district.

Cheltenham.—Residents in Cleeve Hill want a supply of electric current. The Council is willing to undertake this when powers have been obtained.

Chorley.—Messrs. Lacey, Clirehugh & Sillar have been requested to report to the Council on the subjects of electric lighting, traction, and refuse destructor.

Colchester.—The Local Government Board has sanctioned the proposed loan of £6,500 for electric lighting purposes, the money to be repaid in 25 years.

Coventry.—The electric lighting of the new extensions to the cycle works of Messrs. Rudge Whitworth, Limited, is being carried out by Messrs. Ellis & Ward, electrical engineers, of Birmingham. The plant consists of upwards of 200 incandescent lamps and several arc lamps. Arrangements are also being made to supply the lift, which is one of Messrs. Waygood's, with electric power.

Darlington.—The Town Council has received sanction from the Local Government Board to the borrowing of the sum of £25,940 for electric lighting purposes, such sum to be repaid within a period of 25 years. The question of the town supplying electric power to the tramway is being considered.

Darwen.—We hear that the electricity works have been so far completed as to allow a supply of current to be given for private lighting. Street lighting will commence in about 10 days or a fortnight.

Dawlish.—The District Council has accepted Messrs. Taylor & Field's offer to report on the electric lighting of the town for 20 guineas.

Dewsbury.—The Local Government Board has intimated to the Town Council that before sanction can be given to the borrowing of £9,060 for the purposes of electric lighting, it will be necessary to obtain the permission of the Board of Trade to the alteration of the standard pressure on the mains.

Dorchester.—The Edmundson Electricity Corporation having given notice to the Council of their intention to apply for a provisional order to light the town, it was decided to oppose on the grounds that the Town Council intended introducing the electric light into the borough in the near future.

Dundalk.—Representatives of the Irish Development Syndicate have had a private interview with the Dundalk Urban Council with reference to the terms of transfer of the electric lighting powers of the Council to the Electric Tramways Company. The proposal to construct and work a system of electric trams for the town and its seaside neighbour Blackrock, and to combine with this undertaking the electric lighting of the town, was made a considerable time ago, but difficulties arose as to the terms on which the provisional order obtained by the Town Commissioners should be transferred. It is now stated that the basis of an agreement has been arrived at, and that work will shortly be commenced on the construction of the tramlines and works.

Erith.—The Urban District Council have instructed Mr. W. C. C. Hawtayne to prepare plans for the generating plants and mains, they having decided to take steps to establish a municipal electricity supply for the district upon the basis of Mr. Hawtayne's scheme, dated June, 1898.

Farnworth.—Messrs. Lacey, Clirehugh & Sillar have received instructions from the Urban District Council to proceed with the scheme for lighting and traction.

Festiniog.—A special meeting was held last week to consider the desirability of lighting the district by electricity. After some discussion, it was resolved that the Council apply to the Board of Trade next session for a provisional order with the view of carrying out electrical supply works for the district. Mr. T. J. Warden Stevens was appointed out of seven candidates to prepare a report upon the matter.

Fort William.—The Electric Light Company's annual report has just been published, and is of an encouraging nature. During the past year the electricity supply has been extended to the villages of Banavie and Corpach. By arrangement with the Burgh Commissioners the company has acquired the use of the surplus water supply of the town, and has erected an additional turbine.

Frimley.—The District Council has appointed Mr. F. H. Medhurst to report on the subject of electric lighting.

Gillingham.—The District Council has resolved to enter into an agreement with Mr. Jasper for the supply of electric light to arc lamps in the public street at 2½d. per Board of Trade unit; the lights will be turned out at 11 o'clock.

Grimsby.—The Public Lighting Committee has issued invitations for laying the foundation stone of the new electricity works by Alderman Dobson, on Thursday, October 5th, at 2 30 p.m.

Hales Owen.—The District Council approached the Gas Company with a view to purchase; the company demurred to the proposals, and now the Council has invited the British Electric Traction Company and the Midland Electric Power Distribution Company to discuss the question of taking over the Council's powers for electricity supply.

Harrogate.—The Gas and Electric Lighting Committee have resolved that from January 1st next the rate of charges to consumers of electric light be as follows:—Under 15,000 units per annum, on the demand indicator system, at 6d. per unit for the first 1½ hours, and 3d. per unit afterwards; over 15,000 units per annum, on the demand indicator system, at 6d. per unit for the first hour, and 2d. per unit afterwards.

Heywood.—The Electric Light Sub-committee advises that Mr. W. P. Adams, of London, be appointed consulting electrical engineer, and that his scheme be adopted. The scheme provides for the erection of works on the new town's yard site in Hind Hill Street. The works are to be capable of meeting the estimated demand for the first two years and are to be so arranged as to be easily extended. They will also be so arranged as to enable the works to supply power for traction.

Ilford.—Colonel A. C. Smith, R.E., held a Local Government Board inquiry at Ilford last week into the Council's application for sanction to borrow £4,000 for site for depôt, electric lighting, and tramway station. There was no opposition.

Inverness.—The proposal to utilise water-power from the Caledonian Canal for electric lighting purposes has fallen through. The Council has decided to adopt steam-power, and has appointed Mr. Craven, Edinburgh, to draw up plans and specifications for a suitable scheme.

Lerwick.—At the monthly meeting of the Burgh Commissioners last week, a report by Mr. R. F. Yorke, electrical engineer, Glasgow, was submitted as to the proposed introduction of the electric light into Lerwick. Mr. Yorke finds that the Sandy Loch, from which the water supply of the town is at present drawn, contains sufficient surplus water for motive power purposes, and would give 80 H.P. for six hours per day, the gross fall being 220 feet. He recommends that a turbine house should be built at the Loch Clickimin, which would involve the laying of a 16-inch pipe from the Sandy Loch to that point, a distance of about 2,000 yards. In order to avoid drawing too largely on the Sandy Loch during the summer time, the engineer proposes to utilise a smaller loch near to it, by which means an additional storage would be obtained of 6 feet over the whole area, which he estimates would be capable of giving sufficient water in summer for, say, a period of three months. The electric current will be conveyed from the turbines to the accumulator house at Union Street. The total cost of the undertaking is estimated at £9,260, and the working expenses, including interest and sinking fund, at £967. The revenue from the public and private lighting, charging 6d. per unit, is estimated at £1,720, leaving an apparent surplus of about £760 per annum. The present price of gas in Lerwick is 7s. 6d. per 1,000 feet. Before discussion, it was decided to circulate the report among the commissioners prior to next monthly meeting.

Llanrwst.—At Llanrwst Urban Council a letter has been received from the Electricity Supply Company, regretting that owing to inability to get delivery of required material, they were unable to give light by the specified date, but stating that they were doing all they could to give the light as early as possible, and should the delay inconvenience the Council, promising to "meet" the Council with a corresponding reduction in price.

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London.—At the St. George's-in-the-East Vestry last week, a letter was read from the County of London Company intimating that they were going to commence laying the mains for the electric lighting in the main streets in the district.

Manchester. — The Electric Light Committee is to borrow £5,000 for transformers, meters, &c., required during the next 12 months.

Merionethshire.—At Dolgelley, the county town of Merioneth, a decided move is being taken to light the town by electricity, and a comprehensive scheme is likely to be placed before the next meeting of the District Council. It is stated that the Council now pay £150 per half-year for lighting, and that they can borrow £2,500, and only pay £150 in interest.

Nenagh.—The Town Commissioners are considering the question of electricity supply. The feeling of the town is entirely in favour of electric lighting, the prevailing idea being that neither the municipal body nor private consumers are being favourably treated by the gas company.

Newport.—Mr. H. M. Taylor, the assistant electrical engineer, having resigned his appointment, the Committee met recently to consider the question of rearranging the electrical staff. It transpired that the working of additional plant now being laid down would necessitate further assistance. It was resolved not to fill the vacancy caused by Mr. Taylor's resignation, but to appoint two additional electricians at a salary not exceeding £2 per week each, and to increase the salary of Mr. C. D. Copland, the borough electrical engineer, from £225 to £300 per annum. At a subsequent meeting, the chairman, Alderman John Moses, said that he could not be a party to this arrangement, as it would throw increased responsibility on him, and he therefore resigned his position.—The borough electrical engineer submitted his usual report upon the condition of the plant and machinery. A comparison of the plant with the number of lights showed the plant to be overloaded. The office manager submitted his report as to the progress of the business for the month of July, based upon the number of units generated, showing a satisfactory rate of increase. He also presented a report of his canvass during the past month, from which it appeared that he had obtained orders for new connections equivalent to 278 lamps, bringing the total connected and on order up to 30,380 8-c.p. lamps. The question of reducing the charges for electric energy for motive power so as to meet the large consumption required by Messrs. Griffiths & Sons (clothiers and manufacturers), who intend to put down additional motors, was considered. The present charge is 2d. per unit for a consumption of 3,000 units per quarter. It is understood that Messrs. Griffiths would require about 7,000 units per quarter. It was resolved that the scale be extended so that the charge to all consumers shall be 1½d. per unit for a consumption of 3,000 units per quarter and upwards, provided that Messrs. Griffiths will enter into an agreement to take the energy required for the additional plant they are about to lay down. The station emergency plant is shortly to be sold for £750. As it is impossible to make two of the underground sub-stations watertight, they are to be rebuilt above ground.

Nottingham.—The net revenue of the electrical department, after payment of all charges, was for the past year £3,576. The total profit for the year on an income of £12,847 was £7,776 2s. 4d., but this was subject to the deduction of £4,200 for the contribution to the sinking fund and for interest on loans, &c.

Oldham.—Smoke nuisance from the Corporation electricity works gave rise to a brief discussion at a meeting of the Sanitary Committee.

Paisley.—The electricity works was formally opened on Tuesday last week. The capacity of the works is at present 1,000 H.P., but tenders for additional machinery are to be invited shortly. The total expenditure, so far, has been £53,000. Mr. Francis Teague, formerly of Coatbridge, is in charge of the work, which has been carried out under his supervision.

Penmaenmawr.—At Penmaenmawr the Urban District Council has received a letter from a firm of Worcester electrical engineers, suggesting that the district is particularly well placed and situated for electric lighting. The town water supply could be used for producing the power, and so the streets could be lighted without cost, and a revenue would probably accrue for a reduction of the rates. The matter has been referred to Committee.

Plymouth.—The opening of the electricity works in Plymouth, and the formal installation of the electric light and tramway, have been set down for the 25th inst.

Rochdale.—The Town Council has decided to borrow £30,000 from the Public Works Loan Commissioners for the purpose of the electric lighting in the borough.

St. Pancras.—The Electricity and Public Lighting Committee informed the Vestry on Wednesday of having accepted numerous fresh applications for current. Dr. Walter Smith, chairman of the committee, explained that the requirements of the new customers were equivalent to 500 amperes, thus showing that the undertaking was progressing rapidly. On the recommendation of the committee, the Vestry resolved to apply to the Board of Trade for a license under Section 3 of the Electric Lighting Act, 1882, to supply electricity in Brecknock and York Roads in accordance with the consent given by the Islington Vestry, and to convene a special meeting of the Vestry to pass the necessary resolution in regard to the matter. The Vestry sanctioned an expenditure of £1,661 on laying new mains, accepted the resignation of Mr. R. Minchin, one of the electricians at the Regent's Park station, and granted him a testimonial.

Sale.—The Town Council has rejected a proposal to lay down a municipal installation, and having read Mr. Charles Hopkinson's report, has resolved to approach the Manchester Corporation and the Altrincham Electric Supply Company, with a view to obtaining a supply of electricity in bulk at 3d. per unit.

Ventnor.—The Works Committee on 4th inst. recommended that the District Council should accept the tender of the electric light company for lighting the whole district, at the annual rate of £15 per arc lamp and £2 10s. per incandescent lamp, £707 10s. altogether. The Council asked for an alternative scheme omitting the arc lamps.

Walthamstow.—The Local Government Board has sanctioned the Council's £5,500 loan for the electrical wiring of houses in the district.

Warrington.—The Council is making application to the Local Government Board for sanction to a £44,966 loan for electric lighting.

Welsh Quarry Districts.—At Festiniog (the capital of the Welsh quarry trade) the District Council have decided to apply to the Board of Trade next session for a provisional order to light the district with electricity. Some of the works in the district already make use of the light.

West Glamorgan.—Arrangements are understood to be in progress for lighting Clydach, a populous district in West Glamorgan, by electricity.

Whitby.—The Council has adopted an electric lighting scheme drawn up by Messrs. Preece and Cardew, the total expenditure being £18,500. This scheme was adopted in preference to a £26,000 one.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Blackpool.—Last week the Council adopted the recommendation of the Electric Lighting and Tramways Committee that the tender of the Barrow Hematite Steel Company, Limited, for the supply of steel rails and fishplates required in the construction of the tramways through Claremont Park be accepted; also the tender of the British Thomson-Houston Company, Limited, for the electrical equipment (except the sand blowing) of the 10 new tramcars now in course of construction. Alderman Brodie, in moving resolutions to this effect last week, referred to the delay in certain work, and apologised for the unfinished state of the trolley heads. It was the difficulty experienced in obtaining materials that caused the delay in the progress of the tramways. They had commenced the overhead system six months before they should have done, but it had been beneficial to the town. It was very gratifying to find that their takings were £4,000 more than they were in the corresponding period of last year. There was every reason to believe that if they had double lines they would do a great deal more on the front. They were told that they did not want any more power, though they were now driving 30 cars by the overhead system against 18 by the conduit system. They instructed Mr. Quin to get out a scheme for going round Marton. They should want more power then, but it would be well worth the money. It would be advisable to take into consideration the question of 1d. stages for next year. The Claremont Park tramways will cost about £18,000.

Boston.—The British Electric Traction Company has written to the Council with reference to the establishment of a service of electric tramways from the Sleaford Road to the Wainfleet Road, or to the Dock, and the letter has been referred to the Paving and Lighting Committee for consideration.

Burnley.—The Tramways Committee has recommended the Town Council to seek in the next session of Parliament the requisite powers to convert the existing tramway within the borough, after its acquisition by them next year, into a double line, as far as practicable, and to include powers to construct tramways in the Burnley Wood district, Manchester Road district, and Accrington Road (with a view to an extension to Lowerhouse).

Dalmuir.—The Glasgow Corporation is considering the advisability of extending the tramway to Dalmuir.

Darwen.—The Tramways Committee has decided to order 10 cars, five from each of two firms. The cars will in many respects be similar to the Blackburn cars, and will be run under the management of the Blackburn Committee. The Committee thought that formed a fair basis, which would endure until the cars were electrically equipped, and after that they would have to make a permanent arrangement. It was estimated that the completion of the line would take place in about 12 months.

Failsworth.—The Manchester Corporation has advised the District Council that the latter would shortly have to give notice to the Manchester Carriage and Tramways Company for the purchase of the lines within the district. The chairman said it was for that Council to give notice, and carry out the transaction; but the Manchester Corporation would be the real purchasers, as they had an agreement to work the trams after the conclusion of the transaction. A special meeting will be held to consider the matter.

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Grimsby.—The Town Council has decided to adopt an agreement with the Great Grimsby Streets Tramways Company, whereby the present lease to the company has been extended for 21 years. The agreement contained conditions *re* extensions of the line, and supplying of electrical power by the Corporation to the company.

Hungary.—The Raab-Oudenburg-Ebenfurth Railway authorities are about to carry out some trials of accumulator traction on their line between Kleinzell and Esterhaza.

Isle of Man.—The Tramways Company is still going ahead; a turbine is to be put down at Laxey to supply power to the line during the winter season, and also to assist in the summer. It is anticipated that a great economy will be effected in this way. A deputation from Belfast Corporation visited the island last week and inspected the whole of the tramways.

Limerick.—The city engineer has presented a report to the Corporation on the proposed electric tramway scheme, in which he points out that the promoters have made no offer of wayleave, whereas in Belfast the company pays £4.000 a year, and in Dublin £500 per mile, or a minimum of £10,000 per annum; in Cork, however, no charge is made. The engineer enumerates various conditions, which should, in his opinion, be imposed on the company, one of which—that the latter, if called upon by the Council, must introduce any new system of electric traction instead of the then existing system—appears to us to be unnecessary and unreasonable.

Liverpool.—At last week's City Council meeting the Electric Power and Lighting Committee recommended the Council to enter into a contract with Messrs. Willans & Robinson for the supply for the Lister Drive and Cobbs Quarry Stations of four 3-V triple expansion engines, each coupled to a multipolar dynamo of Siemens' make, for the sum of £6,939 each set, and three 3-H.P. compound engines, each coupled to a two-pole dynamo, for the sum of £1,377 each. Mr. Rutherford wished to know what sort of engines they were to be, and what their horse-power was to be. Mr. Petrie, as ex-chairman of the committee, said that some two years ago the subject of these engines was fully discussed in the Council, and a certain type of engine was adopted for certain valid reasons. These were the engines which it was now proposed to buy, as being those which, in the opinion of experts, were the best suited to these stations. [It was here discovered that a quorum was not present, and therefore the matter could not be decided.] Mr. Petrie said that unless this contract were soon entered into, the whole of the electric tramway system would be delayed unduly, and he hoped that a Council meeting would be held as soon as possible to deal with the subject.

Some opposition has been raised by commercial interests to the introduction of electric traction into certain streets, where it is feared the heavy traffic of the port would be hampered by the tramcars. The matter will be considered at a special meeting to be held on October 11th.

Newcastle-on-Tyne.—At last week's City Council meeting Mr. Cail presented the report of the New Tramways Committee. The report stated that on February 21st the Council adopted the overhead trolley system of electric traction on the tramways with the proviso that the system be not constructed in the streets in the centre of the city until the Council had considered and decided whether in those streets some system of electric traction other than overhead traction was practicable, and could be worked in conjunction with the overhead system in the other streets upon the tramway routes. The New Tramways Committee was requested to get the opinion of experts on the point. Prof. Kennedy had given his opinion that as a matter of mere practicability, the Committee's question must be answered in the affirmative. There were systems, he said, not requiring overhead wires, which could be worked in conjunction with an overhead system, but whether it was desirable for the Committee to adopt a combined system of this kind was a matter which the Committee must decide for themselves. There were several cities in which an overhead system and a conduit system were running together and in connection. In cost of construction they certainly would be more than an ordinary overhead line, but he was sure there would be no special difficulty in working from one system to the other. Mr. Chas. Hopkinson, in his report to the Committee, advised the Committee not to combine the overhead trolley and conduit systems. He advised that the trolley system be installed throughout, but that in the central part of the town, where overhead wires were objected to, it be regarded as temporarily installed, pending proof from prolonged use elsewhere of one or other of the surface contact systems. The Committee, after having given careful consideration to the subject, recommended the Council to adopt the trolley system for the entire tramways in the city, as recommended by Mr. Charles Hopkinson, on the distinct understanding that the trolley system in the central part of the city is to be recognised as only a temporary arrangement in order that the views of those who object to the overhead system may be met when this can be satisfactorily accomplished. It was decided to have a special Council meeting on 13th inst., when the report will be considered.

Oldham.—The Town Council last week discussed the minutes of the Surveyors' and Tramways Committee, which contained the following:—"Resolved, that the motive power to be employed in Oldham be electricity, and that the system be the overhead trolley system."—Alderman Eckersley, in his capacity as chairman of the committee, gave a lucid and exhaustive explanation of the proposed scheme, and made it clear that, as against the alternative plan of the conduit system, the overhead or trolley system of traction was the best for a borough like Oldham. It commended itself on account of its cheapness in construction and maintenance, its simplicity and ease in effecting repairs, and the rapidity with which the lines could be constructed, and the comparatively small interference with the surface of the streets and the traffic. The opposite conditions would, he said, attend the conduit system, in addition to the enormous expenses of construction which it would entail. The borough would scarcely be justified in spending a million of money when a quarter of the sum would suffice to provide a system of traction which, in the future, would not require as much in maintenance as its rival. The minutes were ultimately adopted unanimously.

St. Helens.—The Council is applying for a provisional order authorising extensions of the tramways along certain thoroughfares.

Sheffield.—The Tramways Committee intend to obtain powers for doubling all single lines at any suitable time, to carry goods and merchandise on the tramways, and to construct 11 new sections of tramway.

South Australia.—The Adelaide correspondent of the *British Australasian* says that it is reported that an English syndicate is willing to find the necessary capital to convert the principal tramlines into an electrical system. The proposal is to amalgamate the companies and form one large company, and to subscribe the additional capital required.

Stirling.—The British Electric Traction Company applied to the Central District Committee last week for approval of a scheme for a tramway or light railway from Stirling along the Hillfoot district, on the overhead trolley system. The Committee unanimously agreed to give a general approval to the scheme.

Stockport.—The Council has given notice to the Manchester Tramways and Carriage Company requiring them to sell to the Council so much of their undertaking as is within the borough of Stockport. The Council has adopted a report of the Tramways Committee ordering a survey of certain routes with a view to the introduction into the borough of an electric tramways service, and appointing sub-committees to confer with the local authorities of Reddish, Cheadle, Bredbury, and Bramhall, whose districts adjoin the borough. There was a general expression of opinion that this Committee should prosecute its special work with all vigour.

Swansea.—The relaying of the tramlines is now completed, the poles are in position, and the power station is said to be nearly ready. The cars will complete the system.

Wakefield.—The Corporation is being besieged by applicants for permission to promote a light railway or tramway in and about the town, three communications having been received recently.

West Riding.—The District Councils of Queensbury, Sowerby Bridge and Elland, have been in negotiation with the Halifax Tramways Committee with regard to proposed extensions of the Halifax tramways to their respective areas. Queensbury has also conferred with Bradford as to the junction of the Halifax and Bradford tramways, and Elland is inquiring of the Huddersfield Corporation as to an extension to Elland. Yeadon has invited Rawdon and Horsforth to consider proposals made by the Leeds Parliamentary Committee with regard to the proposed extension from Kirkstall to Yeadon.

Worcester.—Messrs. Kincaid, Waller & Manville have advised the Council to take over the tramways and work them municipally as electrical lines. Their report also referred to the scheme of the Tramways Company, and the light railway extensions, which the company proposes, are said to be really extensions to the existing tramways. The negotiations between the company and the committees were referred to last week. The Council has referred that matter and the report of Messrs. Kincaid to the Joint Street and Electricity Committees for reconsideration. The report says that if the Corporation gave their assent to the light railways scheme, they should be prepared to assent to the Tramways Company having a new tenure in some form of the existing lines. If, on the other hand, the Corporation desired to avail themselves of the powers of purchase in respect of the tramways, there was no question but that the application of the Tramways Company for extensions should be vigorously opposed. They estimated the cost of acquiring and reconstructing the existing tramways, and of making the extensions, equipping the lines with rolling stock, and incidental expenses, at £72,180, without providing for generating plant, or feeders, leaving that important point to be considered in conjunction with the electric light undertaking. They estimated the receipts per car mile at 9d., as compared with 9¼d. given in the company's balance-sheet for 1898. Thus the total receipts on an estimate of 500,000 car miles would be £18,750, to which must be added £500 per annum for advertisements. They put the working expenses at 6d. per car mile, £12,500; interest on £73,000 at 3 per cent., £2,190; redemption of loan, £1,776; total, £16,336. The estimated net profits would, therefore, amount to £2,884 per annum.

Rennes Telegrams.—Reuter's agent says that as many as eight or nine million words were despatched over the telegraph wires from Rennes in the course of the Dreyfus trial, and on Saturday last the telegraph receipts amounted to 450,000f. (£18,000). The number of direct telegrams sent announcing the sentence and verdict was about 3,000.

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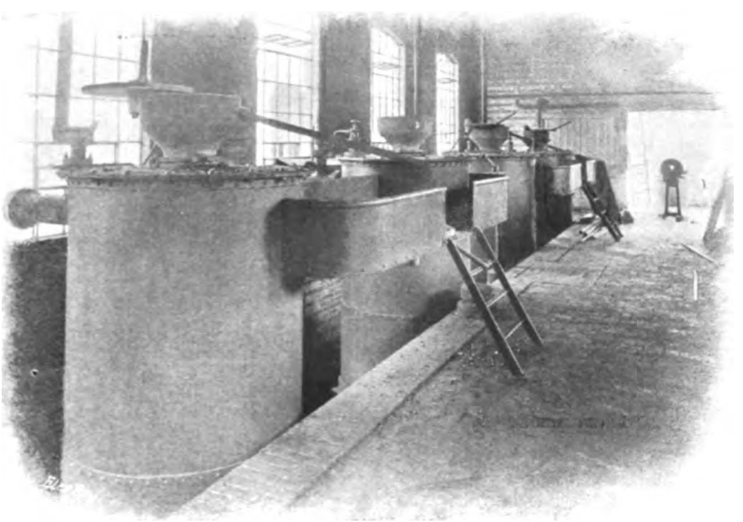
THE LIGHTING OF LYNN.

A mere glance at an ordinary railway map of Norfolk brings home to the mind of the electrical engineer who is acquainted with the course of electric lighting progress in this country what a small amount of such work has, so far, been accomplished within the county. We think of the attempts made by a company to light Thetford, attempts which were not rewarded with sufficient business to allow the continuance of the works, which consequently came under the hammer a few years ago. We think of Cromer, the fashionable and quiet watering place on the north-east, where, although the electrical engineer has done his best during recent years to bring a scheme to a head, nothing has been actually done. There are Hunstanton, Dereham, and a host of other towns, where the electrical engineer has yet to find his way, and this he will probably do within the next few years.



Gas Producers.

The municipal plant at Great Yarmouth, with its electric tram scheme now working out, and the electricity supply system of the Norwich Company, are satisfactory undertakings. But beyond these, there is practically nothing to speak of, for the county consists of some scores of small villages or towns, the largest of which can boast of only 3,000 to 5,000 population—a population which varies, we should think, very little indeed in the course of the year, save in the case of the more prominent holiday resorts on the coast.

Electrical engineers are so fully occupied with large lighting, traction, and power schemes just now, that it may be

Gas Producer House, Holder, Etc.

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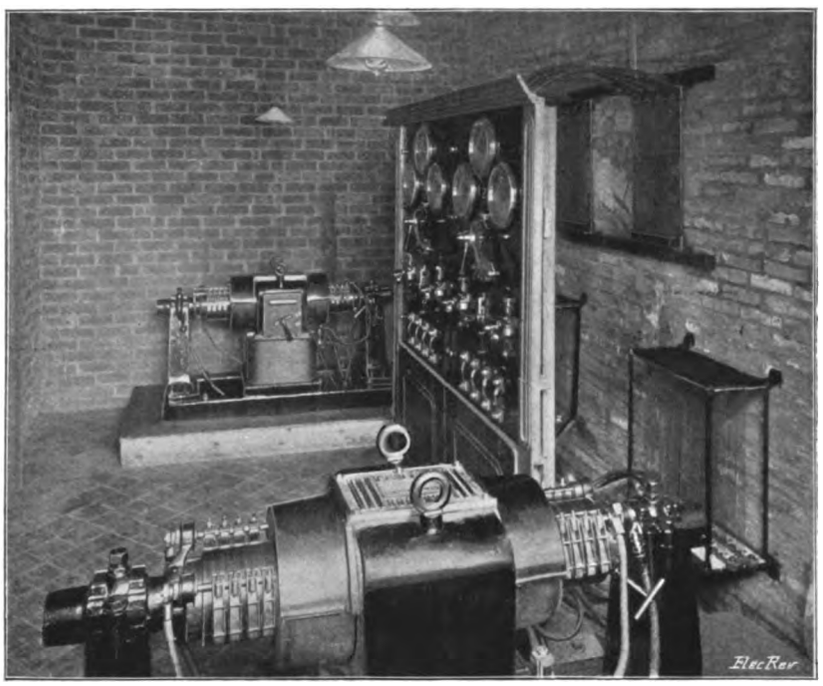
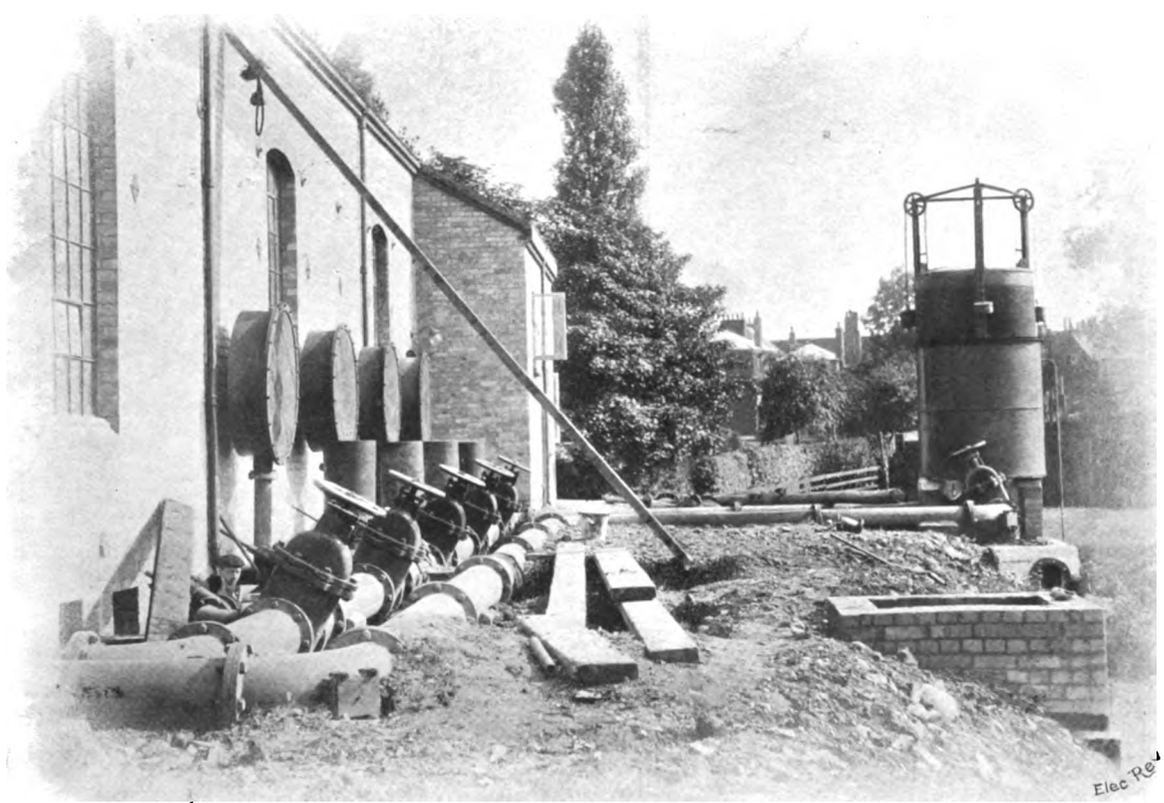
thought to be hardly worth the candle at the present moment to consider the numerous small districts throughout the country. When the needs of larger towns have been attended to, however, the question of electric lighting must be eventually raised, unless gas or oil is for ever to hold sway. There is, of course, the very important question arising as to whether it would pay at all to introduce electric lighting by a public installation into these small scattered, and by no means wealthy, districts until the costs can be reduced to a lower figure than at present. We imagine that the most likely way in which it may be arranged will be for the Yarmouth, Norwich and Lynn, and any other of the larger works to distribute current for meeting the needs of the adjacent smaller places, unless small isolated gas-driven plants can be put down.



Town Hall Substation.

In the preceding remarks we have not made particular reference to the town of Lynn, or King's Lynn, the population of which is somewhere between 18,000 and 20,000; this fact bringing it outside the category mentioned. There seems to be a good future in store for electric lighting here.

We need hardly refer to the history of the negotiations leading up to the adoption of a municipal electrical scheme. The opposition of gas interests is a foregone conclusion nowadays, inevitable as electric lighting is, but at Lynn in the matter of street lighting there is to be a clean sweep made, electricity being adopted throughout, although incandescent gas, which is proving so powerful an opponent—perhaps only temporarily—for street lighting in Bolton, Liverpool, and other towns on account of cost, has been on its trial here for some time. In some streets the mantles are still employed pending the completion of the erection of the electric light standards. It is little consolation to gas interests at Lynn to know that the plant is gas-driven, for while the town supply of gas is drawn upon, this is done only to a very limited extent, as the gas-producing plant installed in accordance with a scheme of Prof.



Auxiliary Gas Holder.

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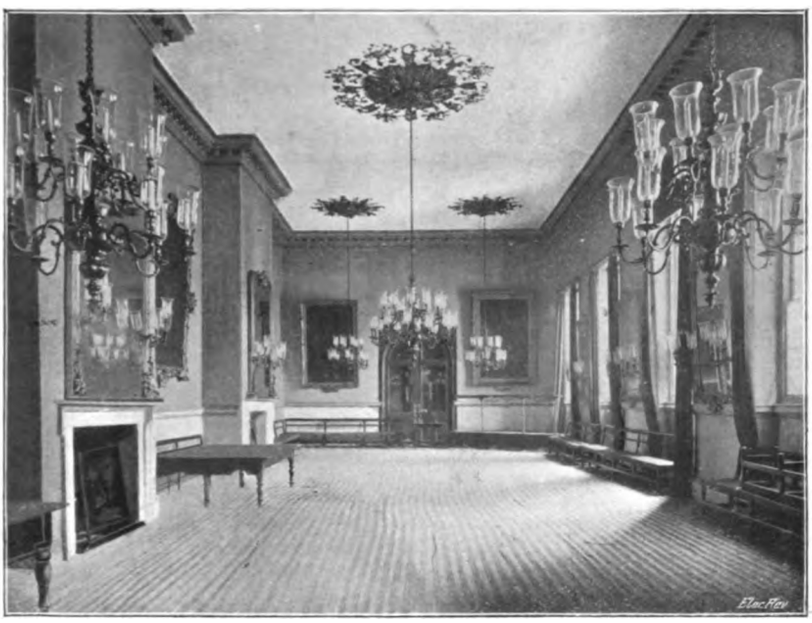
H. Robinson is primarily responsible for the supply. The gas street lamps are being shut off in batches at certain prearranged periods, and when the electric lighting scheme is completed, there will be electric arc and incandescents for public lighting to the number of about 400.

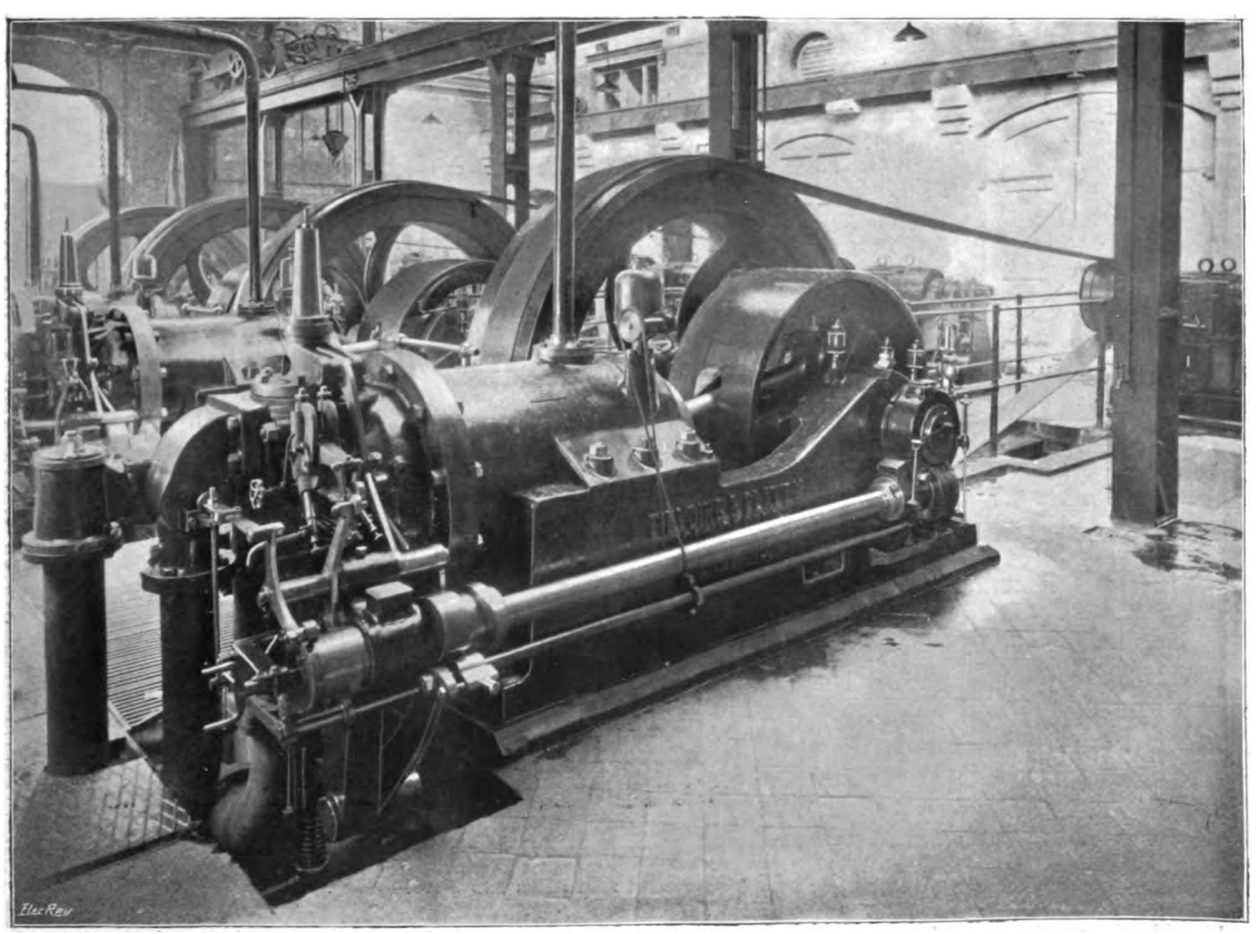
The subject of gas-driven installations is an interesting one. The vicissitudes through which some public works have passed, leading to the abandonment of the Coatbridge and Morecambe plants, and the adoption of steam driving for extensions at Belfast, formed important chapters in the history of this particular class of installation, chapters in which so much has been already written, that we need not enlarge further. The successes of the Midland Railway plant at Leicester must not be forgotten, and more particularly we must not overlook the works of the Leyton Town Council, where Dowson gas plant has been used for the past two or three years in accordance with the scheme drawn up by Prof. Henry Robinson. The generating costs at Leyton have, we understand, worked out at a very low figure.



The Ball Room.

The King's Lynn electricity scheme also has been designed by Prof. H. Robinson, although the equipment differs somewhat, the experience of Leyton working having been taken advantage of. We may therefore hope that the results of the Lynn supply may be equally, if not more, successful.

The Lynn contracts were placed just about twelve months ago, and things would have been ready earlier but for the effects of the engineering strike. The total amount of loan raised for the works is about £30,000. The area supplied is a compact one, and the small consumer predominates. Consumers are charged 5½d. per unit, with a discount beyond certain consumptions. The Corporation has its own house wiring department, and it is, perhaps, needless to remark that this arrangement is not



Interior of Station, showing Gas Engine.

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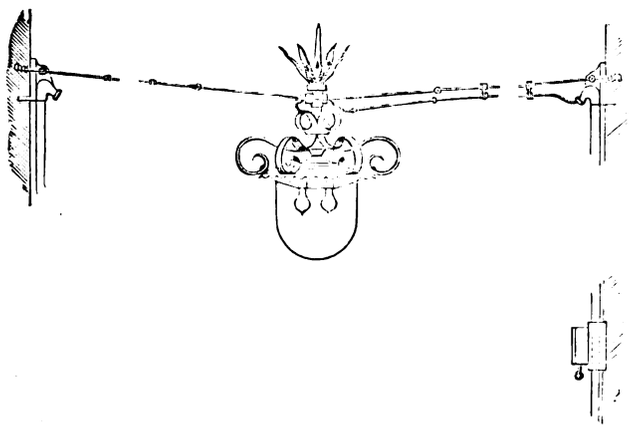
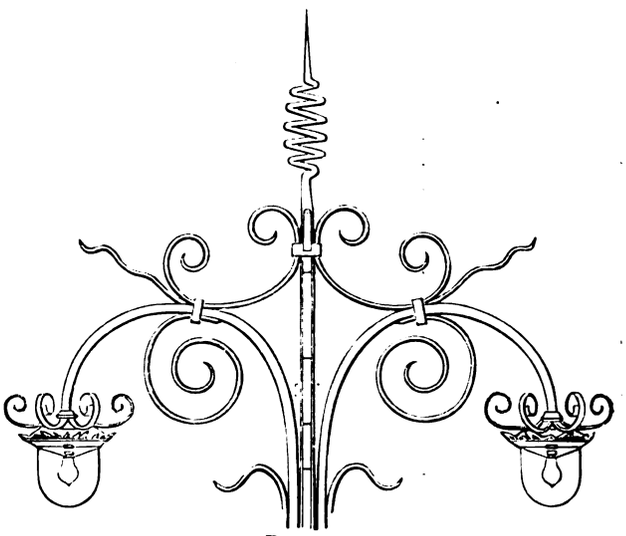
altogether palatable to the many ironmongers who have suddenly been metamorphosed into "electrical engineers." At present there are 150 consumers connected, with 4,000 8-c.p. lamps. Gas engines are very largely used for mill work, so that there is room for a good business in the supply of current for motor driving if that branch is energetically pushed. The Council is its own best customer, for the



Suspended Lamp.

Town Hall departments have 350 lights and the theatre another 350, all of 8 c p.

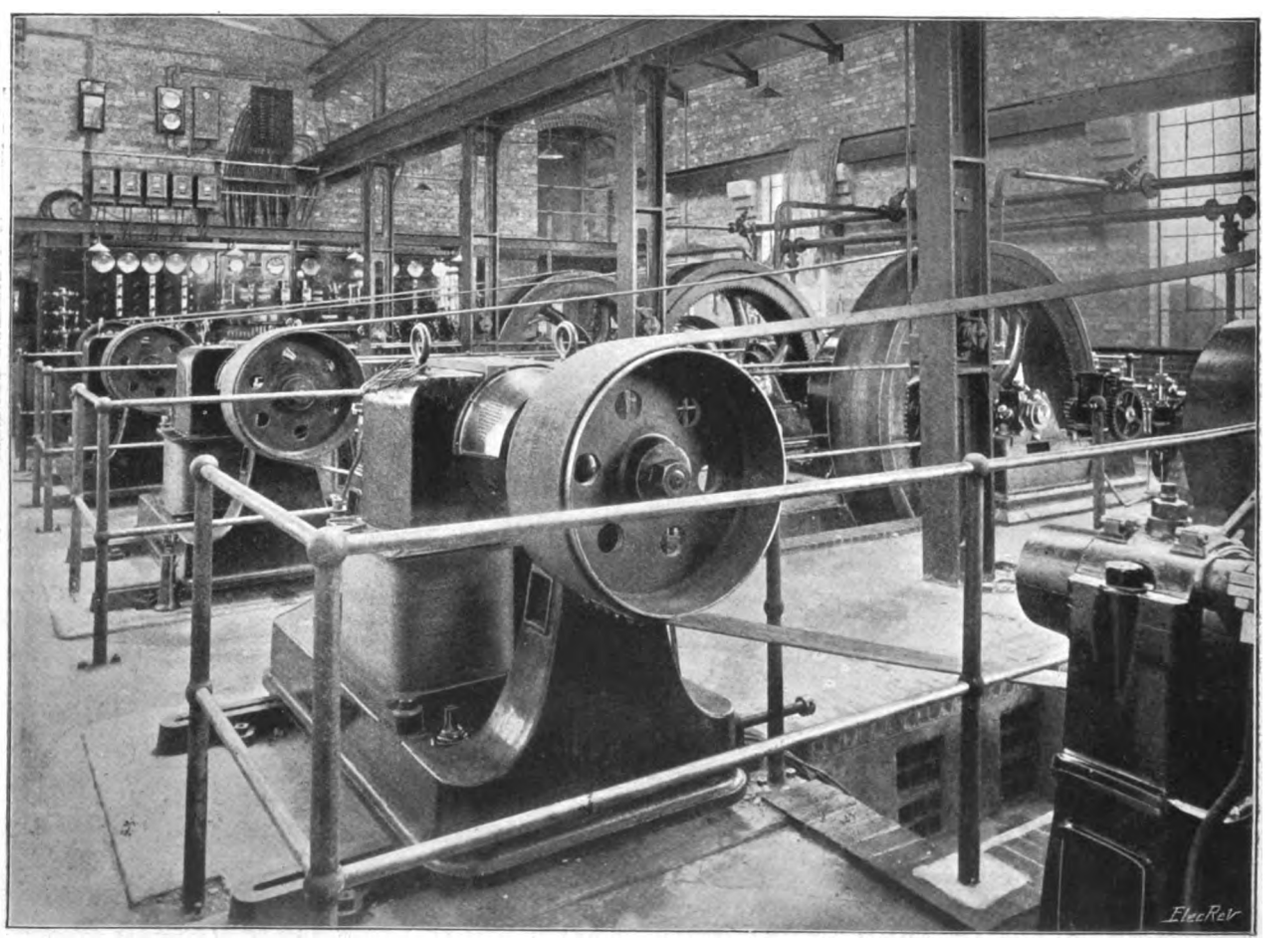
On the occasion of our visit to Lynn, we inspected the wiring and fitting work which had been carried ont by Messrs. Spagnoletti & Crookes at the Town Hall buildings. The various departments are now furnished with very artistic fittings for electric lighting. The Court of Sessions has several wrought-iron electroliers of an exceedingly pleasing design, with nine 16's. In the ballroom a number of very



Bracket.

descents, and the four others have sixteen 5's. The wall fittings bring up the number of electric candles in this room to 140. Messrs. Spagnoletti & Crookes were also the contractors for the wiring of the various other departments here, as well as the theatre already mentioned.

The site of the electricity works is on the ground of the Old Water Works, where there is a convenient siding to the G.E.R. The buildings are engine and dynamo house, with battery room and offices, and the producer house which is situated a few yards away. An idea of the general arrangement of the gas-producer house, gas-holder, scrubbers, &c., can be obtained from one of the exterior photographs accompanying this article.



Interior of Station showing Dynamos and Switchboard.

valuable old spider fittings have been converted into electroliers. We give an illustration showing this piece of special work. The centre fitting has 24 candles with 5 c p. incan-

The system of supply is three-wire continuous current distribution at 400 volts pressure, 200 volts on each side of the middle wire. Consumers are supplied at 200 volts.

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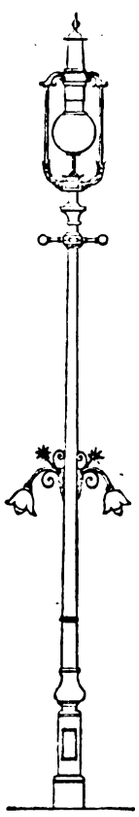
The gas-producer house contains, as will be seen from the picture, plant of the usual type for working with anthracite coal, or coke when necessary. All the gas-producing plant was supplied and installed by Messrs. Fielding & Platt, Limited. There are four sets of gas generators lined with firebrick, set in fireclay and ground cinders. They are fitted with steam jet air injectors, fire bars, cleaning out doors, and feeding hoppers with cover lids. All of the generators are of the same external size, but one has a thicker firebrick lining to reduce the area of the furnace to three-fourths of that of the other three generators. It is, however, so constructed that it can be easily re-lined at a future time to form a full-sized furnace. Each generator (with full-sized furnace) is capable of producing 13,000 cubic



Lamp-post.

feet of gas per hour, of a calorific value of not less than 145 B.Th.U. per cubic foot. Each of these producers is for driving two of the engines in the station. They all feed, as shown, into one common gas-holder, so that the production of gas can be regulated in proportion to the requirements of the station. This ensures fuel economy. The fuel used is anthracite peas, the consumption upon preliminary tests being found to work out at under 1 lb. per I.H.P. per hour. The generators are placed 10 feet apart from centre to centre, and close to the edge of the feeding platform. An iron hood is erected over each producer, with an outlet chimney, and the waste gas pipe discharges under the hood. The gas passes through a series of vertical cast-iron pipes erected outside the producer house, and is cooled by water trickling down the outside of the pipes, with even distribution over the surface. After leaving the cooler the gas passes through a cast-iron hydraulic box fitted with water supply and overflow pipes; it then passes through two scrubbers, one of which is filled with coke and supplied with a water spray and trapped outlet drain, and the other is filled with sawdust. The gas outlet from the sawdust scrubber is provided with a breeches piece and two 6-inch stop valves. In one corner of the producer house there is a small vertical boiler for supplying steam to three generators when working together. It is for delivering 39,000 cubic feet of gas per hour into the gas-holders at a pressure of 1½ inches of water. When required, however, a steam supply will be available from the existing waterworks boilers. The main gas-holder, which was let down before our photo was taken, and therefore does not appear to advantage, is of wrought-iron, 20 feet diameter, with a 10-foot lift. The inlet and main outlet pipes are 12 inches internal diameter, and a 2-inch diameter outlet supplies the ignition burners of the engines. In another view we show an auxiliary gas-holder, 5 feet diameter (with 5 feet lift), which is erected at the extreme end of the gas main, and close to the engine side of the electricity works. The mains from the scrubbers to the main gas-holder are 12 inches diameter, and from there to the auxiliary holder 10 inches diameter. The branches to the engines are 5 inches diameter, and to the generators 6 inches diameter.

Coming now to the interior of the electric generating station, of which we give views taken from either end, there are in position four sets of Fielding & Platt gas engines and General Electric Company's dynamos. The fifth dynamo is on the ground, waiting for its engine. The present night demand requires two of the sets to be running, and a third turning round. The engines consist of the latest designed Fielding patent gas engines, driven by belt direct from the fly-wheel on to the dynamo. Each engine is capable of giving off 100 B.H.P. as a maximum, the ordinary constant working load being 76 B.H.P.

The engines are of exceedingly massive design, specially designed for electric driving. They are fitted with single heavy fly-wheel and outer bearing, the fly-wheel weighing 8 tons, to ensure absolutely steady running. Each engine is fitted with Fielding's patent self-starter and hand turning gear for positioning the engine, enabling one man to start either engine with ease. An improved arrangement of timing cam has been adopted, enabling the point of ignition to be adjusted whilst the engine is running. This is of great importance where varying loads occur.

The dynamos supplied by the General Electric Company, Limited, of London, are of the continuous current shunt-wound type, which can be separately excited off 400-volt mains. They have self-oiling ring bearings. The driving pulley has been proportioned to suit the speed of the engines (150 revolutions per minute). Each dynamo has a normal speed full load output of 40 KW., ranging from 88 amperes at 450 volts to 80 amperes at 500 volts. For battery charging the speed may be exceeded by 10 per cent., and the output may then increase to 80 amperes at 540 volts. The dynamos will be run with separate excitation ordinarily, but upon emergencies they will be run self-exciting, a resistance being provided in the negative lead to the change-over switch to reduce the field circuit pressure by 110 volts.

The accumulator room is arranged in an exceedingly convenient manner. Instead of being arranged in the usual way on tiers, the cells are on two floors, the top one being open through. There are four rows of cells on each floor. There are 225 cells of the well-known Chloride "R" type. The boxes are of glass, and each contains eight positive plates and nine negative plates of the makers' standard size. The specification required that the battery should be capable of discharging at the rate of 40 amperes for 10 hours or 80 amperes for 4 hours without the E.M.F. of any cell falling below 1·85 volts. The cells are mounted upon pitch pine bearers, being insulated from same with the usual glass insulators. The bearers rest upon cross bearers, the latter being insulated from earth by large porcelain insulators. The connections between the regulating cells (which are 38 in number) and the switchboard consist of copper rod so far as the engine room wall, when they are changed to cable by means of a terminal board. This battery is intended for balancing on the three-wire system, and also as a stand-by.

At the Town Hall there is a transformer sub-station, which we illustrate. Here it will be seen that there are two motor transformers (of the Byng-Hawkins type) for balancing the load. The armatures are wound on the same drum with an 80 segment commutator at each end. They are wound for 50 amperes at 200 volts, or 400 volts across the two windings. The normal speed is not less than 1,200 revolutions per minute. The magnets are excited at 400 volts from the outers. The exciting circuit is provided with a fuse and switch arranged to discharge the field through a non-inductive resistance. The leads connecting to the mains have positive main, middle conductor, and negative main switches. The sub-station switchboard, which is seen on the right in our photograph, has two voltmeters, reading up to 250 volts, with fuses in porcelain boxes on the leads connecting to the mains.

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The main switchboard in the generating station is made up of slate slabs mounted on vertical iron supports fixed by the builder. The rheostat switches are placed on a slate table supported on iron brackets in front of the centre of the board. The switchboard contract as well as the sub-station equipment, the main dynamos, the station lighting, &c., was carried out by the General Electric Company, Limited, who were represented during construction by Mr. W. A. Dyer, A.M.I.E.E.

In the power station there is a 10-ton traveller for the gas engine side, and a 3-ton for the dynamo side, as shown in our interior view.

The system of distribution, as already mentioned, is a three-wire one, with 200 volts on each side, and the mains are fed by two-wire feeders at six different points. The balance is obtained by a third or neutral wire feeder from the sub-station balancing machine at the Town Hall, and two distributing mains, which are run directly into the generating station.

The cables supplied up to the present are as follows:—

·15 sq. in.	Concentric unarmoured feeder ...	1,863 yards.
·1 sq. in.	Concentric unarmoured feeder ...	622 „
·1 sq. in. ·033 sq. in. ·1 sq. in.	Triple concentric unarmoured main...	1,506 „
·15 sq. in.	Concentric armoured feeder	1,281 „
·1 sq. in.	Concentric armoured feeder	472 „
·15 sq. in.	Single (neutral wire) armoured feeder	140 „
·1 sq. in. ·033 sq. in. ·1 sq. in.	Triple concentric armoured main, A size	8,628 „
·05 sq. in. ·025 sq. in. ·05 sq. in.	Triple concentric armoured main, B size	4,242 „

The cables leaving the generating station are two ·15 square inch, and one ·1 square inch unarmoured feeders, and one unarmoured main in a line of six-way Doulton casing, and also a triple concentric main A size, which serves a new district near the dock, and enters the station in the opposite direction from the other cables. The conduit line runs out into the main road where the ·1 square inch feeder divides into two cables, one running as an armoured cable to a point in the Gaywood Road, and the other continuing in the conduit line to a feeding box opposite the railway station. The cables are in all cases carried across the roads in cast-iron pipes, two 4-inch pipes being provided on all conduit lines to allow of extension, and each armoured cable being drawn into a 3-inch cast-iron pipe. The six-way conduits are laid from the generating station to the junction of Blackfriars Road and Norfolk Street, where they are continued in a four-way conduit, one line carrying a ·15 square inch feeder and main being laid down Norfolk Street to the junction of Broad Street and Chapel Street, where the conduits stop, and the feeder divides into two armoured feeders, one branch running to the post office and the other to St. Nicholas Church at corner of Chapel Street. The other four-way conduits are laid down Blackfriars Street past the railway station, where the ·1 square inch feeder is connected into the network, and the conduits are then continued with three-ways, carrying the other ·15 square inch feeder and a distributing main. These run to the junction of London Road, where the conduits stop, and this feeder divides into two armoured cables, one serving the London Road, the other running to the end of High Street in the St. James's Road. The armoured cables are everywhere covered by a creosoted board laid over them to serve as a protection, and as an indication of their existence in the case of further excavation in the streets.

The cables themselves are composed of plain copper conductors, insulated with impregnated fibrous material and lead cased. The unarmoured cables are further protected by a short layer of tarred yarn and thoroughly compounded, and the armoured ones by two layers of steel hooping and tarred yarn as usual.

The insulation resistance measured when laid before service connections were made was 2,000 megs. per mile between either conductor and the other two connected to earth.

The method of making services and the various joint and fuse boxes are all of Prof. Robinson's design, and we hope to give drawings of some of these in our next issue. In order to simplify the making of services on both sides of the system, the polarity of the outermost conductor of the mains is reversed at intervals by means of special boxes, and as the neutral wire is the middle wire the cable connections need only be made on to the outer and neutral, thus obviating the necessity of cutting down to the innermost conductor, and enabling connections to be put on with only one side of the system cut off at the street disconnecting boxes. The middle or neutral is earthed at the generating station.

The public lamps and private services are connected to the mains by means of I.R. braided wire run in wrought-iron tubes, and connected by fuses to the terminals in the service boxes.

The incandescent lamps for street lighting are placed in specially-designed ornamental lanterns on posts in streets where the paving or roads are sufficiently wide, and supported on wall brackets or on suspension wires where the streets or footways are too narrow to allow of posts being used. For the lighting of "The Walks" a special double arm standard is used, as will be seen from one of our sketches; while for cross corners here some of the standards have four arms. The lamps are run off the distributing mains in parallel, and 200-volt lamps are used throughout. In the more important thoroughfares and corners arc lamps are to be placed, and these are either open arcs run four in series on the 200-volt mains, or enclosed arcs run two in series on the same voltage. Eight of the lamps are of Siemens's "Band" (5-ampere) type, and eight (7-ampere enclosed) are by the Davy Company. The arc lamp standards also carry two 16-c.p. incandescents. The lamps are controlled from the base of the lamp-posts. The arrangement is such that the lamp-lighter's occupation is not gone.

In High Street, which is a narrow and busy street, the lighting is to be effected by means of lamps suspended on ornamental wrought-iron arches carried on the walls of the buildings on opposite sides of the street.

The whole of the work connected with the mains and conduits and street lighting is being carried out by Messrs. Siemens Brothers & Co., with the exception of the lamp-posts, brackets and arches, which have been purchased direct from the founders (Messrs. Law, of Glasgow). The street lighting extensions which have been arranged for since the original contracts were placed, are also being carried out by Messrs. Siemens.

The following is a list of the contractors:—

Buildings	Messrs. Merredew & Wort, Stevenage.
Gas producing plant and gas engines.	Messrs. Fielding & Platt, Limited, Gloucester.
Dynamos, switchboards (main and sub-station), &c.	General Electric Company, Limited.
Accumulators	Chloride Electrical Storage Syndicate.
Public lamps, lanterns and main work.	Messrs. Siemens Bros. & Co.
Lamp-posts, brackets and arches for public lighting.	Messrs. J. & A. Law, Glasgow.
Meters...	Long-Schattner.
Arc Lamps	Messrs. Siemens and the Davy Company.
Stoneware conduits	Messrs. Doulton & Co.

It would not be fitting for us to bring this article to a close without acknowledging our indebtedness to the consulting engineer, Prof. Henry Robinson, and to some of the contractors who have taken part in the Lynn installation. To Mr. Leigh Robinson, son of the consultant, who has been on the spot for the past 11 or 12 months controlling the carrying out of the work, we especially owe a debt of gratitude for placing at our disposal certain material for the compilation of our description, and also for the kindly and courteous way in which he placed himself at the service of our representative on the occasion of a recent visit.

The resident electrical engineer, appointed about five months ago, is Mr. J. Pilling, and Mr. Williams has been appointed assistant.

Change of Name.—We note that our esteemed contemporary, the *Railway World*, has changed its name to the *Tramway and Railway World*. This is not to denote any alteration in the policy of conducting the paper, as our contemporary has always been, what we regard over here, more of a tramway journal than anything else.

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TELEGRAPH AND TELEPHONE NOTES.

Bedford.—The Town Council has unanimously empowered its Telephone Committee to apply to the Postmaster-General for a municipal telephone license under the powers conferred by the new Act.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa	April 4th, 1898	...
Latakia-Cyprus	June 20th, 1899	...
Accra-Grand Bassam	August 1st, 1899	Sept. 8th, 1899
Corea-Japan	August 7th, 1899	...
Cheik Saiid-Perim	Sept. 3rd, 1899	...
Jamaica-Colon	June 30th, 1899	...
Jamaica-Porto Rico (Ponce)	August 14th, 1899	Sept. 13th, 1899
Landlines.		
Communication between Salonika and Monastir	March 23rd, 1899	...
Communication between Bolama-Bissao	July 28th, 1899	...
Lines from Haiti to Gonaives, Gros Morne, Port de Paix Plaisance, and Cape Haitien, Port au Prince to Miribalais and Jacmel	August 18th, 1899	...
Moulmein-Bangkok	Sept. 8th, 1899	Sept. 8th, 1899
Saigon-Bangkok	Sept. 12th, 1899	...

The Telegraphic Wire Export Trade.—The past month proved to be a relatively quiet one as regards the export trade of this country in telegraphic wire and apparatus connected therewith. The returns just issued for August show that the value of the shipments only amounted to £87,517 as compared with £97,635 in the preceding month, and no less than £265,501 in August, 1898. Earlier in the year, 1899 gave promise of seeing record figures set down, but the quietness of the past few months has put the total behind that of last year, the value of the exports during the eight months ending with August last having reached a total of only £686,825, which compares with £811,997 in the corresponding period of last year, and with £700,748 in the first eight months of 1897.

Wireless Telegraphy.—According to the *Review of the River Plate* a representative of the Wireless Telegraph and Signal Company, of London, has been establishing the Marconi patent in River Plate and other South American countries. A set of apparatus has been at work in Buenos Ayres recently.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking Town.—October 24th. The District Council wants tenders for boilers, pipe work, two 100-kw. steam dynamos, switchboard, motor and trailer cars, trucks and electrical equipment, overhead equipment, underground feeders, conduits, road work, &c., for the Barking and Beckton light railways. See "Official Notices" September 1st.

Barnsley.—September 16th. Tenders are wanted for electric light wiring and fittings at the Harvey Institute, Eldon Street, for about 700 lights. See "Official Notices" August 18th.

Belfast.—September 31st. The Electric Committee wants tenders for c.i. floor plates and w.i. rails for the electric light department. Specifications from the city electrical engineer on payment of one guinea, returnable as usual.

Birkenhead.—September 29th. The Corporation wants tenders for boosters, switchboard, accumulators, cables, and laying same. See "Official Notices" this week.

Blackburn.—September 20th. The Corporation wants tenders for 40 electric cars and two 256-kw. steam dynamos. See "Official Notices" September 8th.

Cardiff.—September 27th. The Corporation wants tenders for cast-iron arc lamp-posts. See "Official Notices" this week.

Carlisle.—September 18th. The Corporation wants tenders for extension of switchboard for dynamos 5 and 6, and for traction work. See "Official Notices" September 1st.

Darwen.—September 25th. The Corporation wants tenders for a high speed vertical engine and dynamo (300 to 350 kw.); also switch work. See "Official Notices" September 8th.

Germany.—September 20th. Tenders are being invited until September 20th by the Cotton Wool Exchange authorities in Bremen for a complete installation of electric lighting in the new Exchange. Tenders are to be sent to Das Banbureau für die Bremer Baumvoll börse la Dechanatstrasse, Bremen, whence particulars may be obtained.

Germany.—October 16th. Tenders are being invited by the municipal lighting and tramway authorities of Königsberg, Prussia, until October 16th, for the supply of six boilers required in connection with the extension of the electric power station, to supply steam to new engines aggregating 1,800 e.h.p. Tenders to be sent to Die Direction der Städt, Belenchtungswerke und der Electr. Strassenbahnen Kaiserstrasse 41, Königsberg, Prussia, whence particulars may be obtained for 1s.

Glasgow.—October 10th. In connection with the tramway scheme the Corporation wants tenders for switchboards, fuel economisers, two 50 and one 30-ton electric travellers, power station steel work, and cables. See "Official Notices" September 8th.

Heckmondwike.—September 20th. The District Council wants tenders for the supply of water-tube boilers, economiser, pipe work, steam dynamos and motor boosters, accumulators, switchboard work, travelling crane, mains, arc lamps and posts, and station lighting. See "Official Notices" August 25th.

Huddersfield.—October 2nd. The Corporation wants tenders for five Lancashire boilers. See "Official Notices."

Ilfracombe.—September 25th. The District Council wants tenders for boiler plant, engine plant, dynamos, condensers, switchboard, mains, lamp-posts, accumulators, meters, crane, buildings, &c. See "Official Notices", August 18th.

Luton.—September 22nd. The Council wants tenders for boilers, superheaters, engines, dynamos, switchboard, steam and other piping, batteries, street conduits, boxes, feeders, arc lamps and posts, and various other plant and machinery for the electric lighting installation. See "Official Notices" August 25th.

Middleton.—September 20th. The Corporation wants tenders for Lancashire boilers, superheaters, economisers, steam pumps, condensers, steam dynamos, balancer and boosters, switchboard, accumulators, cables, crane, &c., for electricity works. See "Official Notices" September 1st.

Oldham.—The Electric Light Committee invites tenders for rolled steel girders, concreting, and other works required in the foundations for "Klein's Tower Water Cooler" at the electric light station, Gas Street, Oldham.

Rotherham.—October 9th. The Corporation wants tenders for Lancashire boilers, engines, dynamos, piping, condenser, economiser, battery, switchboard and boosters, feeders, mains, road work, &c., for electric lighting. For particulars see "Official Notices" September 8th.

Runcorn.—September 27th. The Urban Council is inviting offers for the electric lighting of the district, to be sent to the chairman of the Highways Committee.

Russia.—The municipal authorities of Perm are at present inviting tenders for the concession for the establishment and exploitation of a central electric lighting station in the town.

Salford.—September 28th. The Corporation wants tenders for 16 Lancashire boilers and superheaters. See "Official Notices."

Sculcoates Union.—September 21st. The Guardians want tenders for the installation of electric lighting and telephones at the Workhouse. See "Official Notices."

South Wales.—September 28th. The proprietors of Margam Copper Works, Port Talbot, wants tenders for the electric lighting (arc and incandescent) of their works. See "Official Notices" September 8th.

Sunderland.—The Corporation wants tenders for four 270-kw. three-crank direct current steam dynamos, and two surface condensers and cooling tower. See "Official Notices" August 18th.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

Warrington.—September 30th. The Committee of Visitors of the Winwick Asylum, near Warrington, invite tenders for Contract No. 1.—Generating plant, including three sets of condensing engines or turbines, with directly coupled dynamos, each of 100 kw. output at 220 volts, booster set, motors, surface condensers, cooling tower, steam and exhaust pipes, &c. Contract No. 2.—Switchboard. The drawings can be inspected and specifications obtained of J. P. Muspratt, Clerk to the Committee of Visitors, County Offices, Preston, on payment of £2 2s for each specification, returnable. A separate tender must be sent in for the work included in each specification. See "Official Notices" September 8th.

CLOSED.

Bexhill.—The Council has approved the acceptance of the tender of £3,600 by Mr. Minter, for the erection of electricity works buildings.

Colwyn Bay.—At a special meeting of the Council held last week the tenders of Mr. Bertram Thomas, of Manchester, for carrying out the electric lighting of the town to the specification of Messrs. Lacey, Clirehugh & Sillar were accepted.

Glasgow.—An exchange says that the following tenders have been accepted in connection with the equipment of the electric tramway power station for the Corporation: Mirrlees, Watson, and Yaryan Company, Glasgow, surface condensers and air pumps, £15,000; Mavor & Coulson, Glasgow, centrifugal circulating pumps; G. and J. Weir, Glasgow, boiler feed pumps.

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Grimsby.—The Town Council has confirmed the acceptance of the following tenders for electric lighting plant and machinery:—

Boilers.—Messrs. A. Anderton & Sons, Accrington	£1,875
Engines, Dynamos, &c.—Messrs. Mather & Platt, Limited, Salford Iron Works, Manchester (this to include series windings)	12,510
Battery.—The Tudor Accumulator Company, Limited, London	850
For maintenance	54
Switchboard.—Messrs. James White, Limited, Glasgow	1,350
Mains.—The British Insulated Wire Company, Prescot	14,967
Total	£31,606

There was some discussion as to the reason of the original estimate being exceeded, but after explanations as to additional machinery and buildings the minutes were adopted.

Halifax.—The Council has confirmed the acceptance of the following tender:—Messrs. Belliss and the Electric Construction Company, Limited, for the supply of three 1,200-H.P. engines and 750-KW. generators for £7,419 each.

Leeds.—The City Council has accepted the tender of Mr. E. C. Wallis for an electric light installation (£462) for the wholesale meat market.

Leeds.—The Tramways Committee has accepted the tender of Mr. T. Harding Churton for the electric lighting of the car sheds, for the sum of £1,170.

Wigan.—The Council has accepted the tender of Mr. W. Winnard, of Wigan, for the erection of electricity works buildings at £15,789. The highest tender was £16,289.

THE LONDON COUNTY COUNCIL AND ELECTRICITY.

The Highways Committee of the London County Council has just issued a very lengthy report of its proceedings for the year ended March 31st, 1899. On the question of tramways, it says that by the London United Tramways Bill it was proposed, among other things, to repeal Sections 17 to 28 of the London United Tramways Order, 1895, relative to the use of mechanical power, and it was also proposed to authorise the use of electrical traction upon the whole of the company's system, which extends not only within but outside the County of London, and for this purpose, among other things, to place poles to carry wires over the streets. The Council, while it has not offered objection to the use of the conduit system of electrical traction, has consistently refused consent to the introduction into any part of the county of the overhead system. As the undertakers were not prepared to accept the terms of the Council, the Council decided to oppose the introduction of the Bill, and the company, in order that the measure might be allowed to proceed, withdrew from it all proposals for the construction of new tramways within the county.

On the subject of the electric meter-testing station, the Committee says the amount of energy supplied to any consumer is, unless otherwise agreed, to be ascertained by means of an appropriate meter, which must be of a construction and pattern approved by the Board of Trade, and must be certified to be so, and to be a correct meter and properly connected with a service line, by an inspector appointed by the Council. This is the case with regard to most of the electric lighting orders under which energy is supplied in London. It does not apply, however, in the cases of the St. Pancras (Middlesex) Electric Lighting Order, 1883, and the St. Luke's, Chelsea, Electric Lighting Order, 1891, under which application has to be made to a court of summary jurisdiction to appoint an inspector to settle any dispute. This has been the cause of some inconvenience to consumers in the past, although in some cases the Council's inspectors have, by consent of both parties, adjudicated upon disputes arising outside its area of jurisdiction. For the purpose of meter-testing the Council maintains a testing station, with the necessary appliances for testing meters of all patterns up to a capacity of 600 amperes, at Nos. 42 and 43, Cranbourne Street; and qualified inspectors are engaged there in testing meters. In 1887 the Board of Trade intimated its approval of two patterns of meters, viz., the Ferranti meter and the Hookham meter for continuous current, and in 1899 the self-winding Aron meter for continuous and alternating current; and these, with the Shallenberger meter for alternating current, are the only meters approved by the Board of Trade. The Council has adopted rules and scales of fees with regard to the testing of electricity meters and to other services under the Electric Lighting Acts and orders, and these rules and fees have been approved by the Board of Trade. The Council's officers have for many months been engaged, in conjunction with the officers of the Board of Trade, in the examination of various meters, and the noting of their performance under ordinary working conditions. Thirty-six meters have been under observation for this purpose, and these have been tested at Cranbourne Street before being fixed at consumers' premises. During the year 279 meters of various patterns, the accuracy of which was in dispute, have been tested at the station, and all of these have also been examined at the consumers' premises; 444 meters have been tested for electric supply companies and found to be correct, and sealed accordingly; and 368 tests have been made for meter manufacturers. The amount of the fees received during the year 1898-9 was £387 3s. 5d. This sum does not, however, include anything for the Board of Trade meter-tests, for which no charge is made.

The Council has, since the date of the last annual report, received and dealt with about 290 notices, some of which referred to works extending over large areas; and each of these notices has been separately considered, and, in nearly all cases, special conditions have been attached to the Council's consent. The Council has, during the year, sanctioned the laying of mains in about 132 miles of streets and roads, in addition to a very large number of service lines to consumers' premises. Of these mains, those in 55 miles of streets were for currents of high tension, and in 77 miles for those of low tension. The Council has in all cases required that the mains should be laid under the footways wherever it was found practicable to do so, and that the covers of the street boxes should consist of iron frames filled in with material to suit the paving. The Council also requires that where high-tension mains other than concentric cables are used, each of the street boxes shall be provided with an inner as well as an outer cover, the two being insulated from each other as far as practicable, the outer cover being efficiently connected to earth, and that adequate precautions shall be taken to prevent the accumulation of gas in the boxes and conduits, and any risk of accident through defective insulation of mains.

An official is employed to inspect the works of the companies in the public streets, in order to see that the requirements of the Council are complied with.

As stated in previous reports, a system of supply has been adopted under some electric lighting orders, which involves the construction of transformer boxes or converting stations of very large dimensions to be placed under the public thoroughfares. The Council has, during this year, again taken exception to proposals for the appropriation of large portions of the space under the streets for this purpose, there being, in its opinion, no necessity for such appropriation, as the requisite provision might be made upon private ground. The Board of Trade has, however, as in former cases, overruled the Council's objections, and the Council has, in consequence, when dealing with applications of this nature, given its consent upon the conditions laid down by the Board of Trade in deciding on the cases submitted to it on appeal by the companies concerned.

The Council requires that, in connection with any notices for the construction of transformer boxes, full particulars and plans shall be supplied, showing the exact position to be occupied by, and the internal and external dimensions of, each of the boxes proposed to be constructed, and also the existing works which will be disturbed thereby.

The Council was empowered by its General Powers Act, 1893, to establish an installation for the electric lighting of the Victoria Embankment and the Westminster and Waterloo Bridges. Since the passing of the Act the Charing Cross and Strand Electricity Supply Corporation has obtained permission to lay its mains across Waterloo Bridge, upon condition that the corporation do supply light to the lamps of the bridge and maintain them free of cost, and the terms of this arrangement have been embodied in an agreement prepared by the solicitor. Provision for the lighting of Waterloo Bridge having thus been made, it was necessary to provide only an installation for the other bridge and the Embankment.

The Council has adopted a scheme in which provision is made for 144 arc lamps, to be distributed as follows:—

Victoria Embankment, &c.:—

On the kerb of the carriageway (land side)	28	
" " " (river side)... ...	29	
" parapet wall	64	
" Northumberland Avenue approach, &c. ...	8	
	—	129
Piers adjacent to the Embankment		5
Westminster Bridge and approaches		10
		144

The lamps on each side of the carriageway of the Embankment are to be about 240 feet from each other, and those on the parapet wall about 66 feet apart, while those on Westminster Bridge and Northumberland Avenue approach will be placed at convenient distances. The whole of the parapet lamps and the alternate lamps on each kerb of the Embankment, and also some of the lamps on Westminster Bridge, will be extinguished at midnight, thus decreasing to an appreciable extent the cost of maintenance. It may be mentioned that the parapet gas lights now in use are extinguished at midnight, so that what is proposed would in this respect be no departure from the present practice.

As regards the plant, it may be stated that by the provision of forced draught the necessity for a chimney at the generating station will be avoided; and that, should the Council at any time decide to light all or any of its subways by electricity, the machinery would be sufficient for the purpose.

The capital expenditure for the installation, according to the estimate submitted to the Council, will probably be about £25,300, made up as follows:—

Buildings	£6,900
Boilers and machinery	9,600
Mains	4,200
Lamps, standards, &c.	4,300
Salaries	300
	£25,300

The probable annual cost of maintenance is estimated at £3,509, made up as shown below, the amount of the capital charges being calculated on the repayment of capital cost being spread over a period of 42 years, the length of time allowed by the Council for repayment of loans to London local authorities for similar works:—

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Maintenance	£2,387
Rates and taxes	110
Capital charges	1,012
	£3,509

The Council has accepted the tender of Messrs. McClure & Whitfield, amounting to £3,726 5s., for the supply of the dynamos, and of Messrs. J. E. H. Andrew & Co., amounting to £2,100, for the supply of gas engines, required in connection with the installation, and these portions of the work will shortly be proceeded with.

NOTES.

The Scarcity of Paraffin Wax.—The prevailing scarcity of paraffin wax seems likely to become a matter of some seriousness to the makers of electrical conductors in this country. The importance is all the greater in view of the rapidly increasing demand for this product, the requirements now amounting to double the available supply. About one-half the supply of oil coming to this country is Russian and the other half American and Rangoon, but as paraffin wax cannot be obtained from Russian oil, one has to look for a remedy for the present situation by endeavouring to cultivate the importation of American wax to this country. We are not aware what may be the difficulties, if any, standing in the way of such a development, but we should think it would be worth the while of American traders to give the matter attention.

Charterhouse Science and Technical Schools and Rogers' Memorial Institute.—The winter session of this, one of the largest and oldest science schools in the United Kingdom, will commence on Saturday, September 23rd, 1899, under the presidency of the Rev. H. Swann, M.A. During the late session a large number of students availed themselves of the privileges afforded by this institution, and of these (who were mostly elementary teachers) the majority presented themselves for examination. Instruction of a practical character is given in most of the sciences at a very nominal fee. Those who have leisure can attend, at a very moderate charge, the day science classes. Day classes will also be held to prepare candidates for matriculation (London), clerical, medical (including dental), legal, and other examinations. Students who aim at becoming proficient in physics and chemistry have the opportunity of working in well-fitted laboratories. During the session artizans, apprentices, improvers and others will have the privilege of attending the London County Council technical classes. Full particulars of the classes may be obtained from C. Smith, organising secretary. Those interested in education will rejoice to learn that the work commenced by the late Rev. W. Rogers, M.A., and ably continued by the late Rev. John Rodgers (formerly vice-chairman of the London school) is so vigorously continued by the present president and committee.

Steinmetz, of the General Electric Company of America.—The name Steinmetz is one that future generations will have cause to remember on account of his brilliant experimental work in electrical science. He is of German birth, and was educated partly in Germany and partly at the Zurich Polytechnic. When quite a young man he was exiled from the Fatherland on account of Anarchistic writings, but his ideas on social relations and government have been considerably modified since then. Steinmetz is always smoking, and there is a characteristic story to the effect that when the directors issued a regulation prohibiting smoking in the Schenectady works, he wrote them that if such a bye-law was enforced he should stay at home. Needless to say, an exception was made in his case. The subject of our sketch is a cripple, but rides a specially made bicycle, which enables him to pursue his studies out of doors in natural history and mineralogy.

Another Strike!—An American exchange says it is reported that the "punkah pullers" in West Borneo are in revolt because the Rajah of Koti has bought $30,000 worth of electric fans, and the coolies who formerly worked fans, or punkahs, by hand, will now be out of a job.

Commemoration at Como of the Discovery of the Voltaic Pile.—The recent fire at the Como Exhibition, which destroyed many of the relics of Volta, is not to be allowed to stop the celebration of the centenary of the discovery of the battery. Another exhibition has been organised, and a Congress of electricians is to be held at Como during the current month to read and listen to papers on electrical matters, and to do honour to Volta. We have received a circular giving information about the arrangements. The Congress has been organised by two societies acting conjointly, the Associazione Elettrotechnica Italiana, and the Societa Italiana di Fisica. It is to be opened on September 18th by Prof. Augusto Righi, of Bologna, with an address commemorative of Volta, and will last a week. Papers are to be read, and there will be dinners, *fêtes*, a reception, visits to the tomb of Volta, and to neighbouring electrical installations. A competition in electrical science for a prize of L.3,000, presented by gentlemen of Como, is to be arranged by the committee, but the details are not announced. The principal papers to be read are the following:—

Prof. P. Blaserna.—"On the Disturbances produced in Galvanometers by Electric Tramways."
" " "On the Secular Variations of the Magnetic Inclination in Ancient Times."
Prof. S. P. Thompson.—"Magnetic Images and their Application to the Theory of Motors with Revolving Fields."
Prof. G. Grassi.—"Studies and Experiments on the Transformation of Triphase into Monophase Currents."
Signor G. Semenza.—"The Practice of Electrical Transmission at High Voltage."
Profs L. Donati and G. Grassi will introduce a discussion on electrical terminology.

The president of the Executive Council is Prof. Giuseppe Colombo, the vice-presidents are Prof. P. Blaserna and Prof. G. B. Cadenazzi, and the secretary is Signor Alessandro Panzaresa. The address of the committee is Via S. Paolo, 10. Milan. The general programme is as follows:—

September 18th	10 p.m.	Inauguration of the Congress. Commemoration of Alessandro Volta by Prof. Augusto Righi.
"	7 0 p.m.	Dinner given by the members of the Congress to foreign electricians and other distinguished persons.
" 19th.	9 0 a.m.	General sessions of the Congress.
"	2 0 p.m.	" " "
" 20th.		*Fête* on the Lake given by the city of Como.
"	9.0 p.m.	Grand Venetian illumination of the city of Como, arranged by the Executive Committee of the Exhibition in honour of the electricians.
" 21st.	9.0 a.m.	Meeting of the two organising societies.
	2 0 p.m.	" " "
"	7.0 p.m.	Dinner given by the Prefect of Como, Comm. Felice Segrè.
" 22nd.	Morning.	Visit to the tomb of Volta.
"	2 0 p.m.	Meeting of the two organising societies.
" 23rd.	9.0 a.m.	" " "
"	2.0 p.m.	General session and close of the Congress.
"	9.0 p.m.	Reception and Concert at the Casino.
" 25th, 26th.		Excursions to the electrical works at Paderno, Milan, and Vizzola.

Sir W. H. Preece's Wireless Telephony.—It is stated by the *Carnarvon and Denbigh Herald* that for some weeks past experiments of great interest in wireless telephony have been carried on by Sir W. H. Preece near Carnarvon. As a matter of fact it is telegraphy, not telephony, which Sir W. H. Preece has been working on, telegraphy on what may be called the "buzz r" Morse system, a telephone being used as a receiver. All the London papers have naturally fallen into the same error as is their wont.

A Large Electric Traveller.—Our New York namesake says that the largest electric travelling crane ever designed is to be built in Milwaukee, Wis., for a leading Philadelphia plant. It will be of 150 tons capacity. There are other 150-ton cranes, using 75-ton trolleys, but this crane will have one 150-ton main trolley, with a test load of 200 tons, and an auxiliary trolley of 25 tons capacity.

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The British Association.—The Dover meeting, although not the smallest by two or three, promises to be exceedingly small in numbers, for up to Wednesday night only 1,216 names were registered. In Section A the proceedings yesterday, after the presidential address, should have been papers by Dr. Bauer, on "Recent Magnetic Work in North America," and the presentation of a report on the "Methods of Determining Magnetic Force at Sea," but the paper was not read nor the report presented. The Sectional Addresses were well received, especially Sir W. White's on "Steamships." Sir E. Carbutt and Sir W. H. Preece proposed votes of thanks. In the physiology section a report on the "Electrical Changes Accompanying the Discharge of the Respiratory Centre," was read. In the chemistry section, Prof. Dewar read a paper on the "Solidification of Hydrogen."

Brighton System.—The following comes to hand as we go to press:—"Will you kindly give me a simple explanation of the system of charging for current known as *the Brighton system?* Also an illustration of, say, 20 16-c.p. lamps burning an average of four hours per night. I shall esteem your answer a great favour, as I have asked so many times and always got different answers.—Yours truly, CURRENT."

[We refer our correspondent to an article on this subject in our issue of November 6th, 1896, p. 595.—EDS. ELEC. REV.]

Appointments Vacant.—The Watford Council wants a junior assistant engineer. See "Official Notices" this week.

The York Electric Lighting Committee wants an assistant electrical engineer and other members of the staff for the electric lighting works. See "Official Notices" this week.

The Corporation of Newport (Mon.) wants an electrical engineer with experience in alternating current stations, at a salary of £2 per week; also a mains superintendent with a thorough knowledge of sub-stations, transformers, &c. See our "Official Notices."

Two assistants are required in the electrical engineering department of the Central Technical College, City and Guilds of London Institute. Salary, £100 per annum. See our "Official Notices."

The Institution of Electrical Engineers' Reunion in Switzerland.—On Wednesday last week the first annual summer meeting of the Institution was held at the Polytechnikum, and was followed by a lunch given to the Swiss Association and other friends at the Tonhalle. In the afternoon the Polytechnikum was visited; the party afterwards proceeded to Lucerne. On Thursday most of the members travelled by the Stansstad-Engelberg Electric Railway to Engelberg, and then went on to Interlaken, *viâ* the Brünig Pass, one of the most interesting and enjoyable experiences of the tour. The Jungfrau Electric Railway was inspected on the following day, amid magnificent surroundings, and on Saturday the tour concluded with a visit to the Burgdorf-Thun Electric Railway. Many of the visitors remained in the neighbourhood of Interlaken, to rest after their exertions; others went to Como, some to Paris, but the majority returned home on Saturday and Sunday. It was agreed on all hands that the tour had been most successful, and it is highly probable that a similar excursion will be made next year, in response to Dr. Rathenau's generous invitation, to the works of the Allgemeine Elektrizitäts Gesellschaft, at Berlin, and to other places of interest in that district. We hope to give our readers a full account of the whole of the proceedings in future issues.

Accident to the P.O. Pneumatic Tubes.—Hundreds of important telegrams were delayed at St. Martin's-le-Grand one day towards the end of last week. A number of carriers became blocked in one of the tubes. It was about five hours, says the *Daily Mail*, before the telegrams were released and sent on their way.

Electrical Resistance of Human Blood.—In a recent communication to *Nature*, Dr Dawson Turner says that it is not easy to measure the electrical resistance of the blood of a living person. His best results were obtained by placing five cubic millimetres of freshly drawn blood between two cup-shaped electrodes three millimetres in diameter, coated with spongy platinum, and fixed ·75 millimetre apart. He says that the average resistance of normal blood at 60° Fahr. measured by Kohlrausch's method is 550 ohms; but an observation which may be of great value to the physician is appended: "A striking change may be observed in pernicious anæmia, the resistance in this disease being sometimes diminished to about one-half that of normal blood. It is suggested that the blood contains an abnormal amount of salts.

"Welcome, Dewey!"—When Admiral Dewey arrives at New York Harbour on September 28th, he will find the place rich in electrical illuminations in honour of his return. We read in a New York exchange that the displays will exceed anything ever before seen in New York. The great span between New York and Brooklyn will shine out a "Welcome, Dewey," in letters 36 feet high. The legend will be 300 feet long, and more than 8,000 high c.p. incandescent lamps will be used in it. There are to be "Welcome" legends on a smaller scale, and other electrical illuminations everywhere.

Electric Locomotives for Japan.—The *Engineer* says that two electric locomotives have recently been supplied, by an American firm, to the Japanese Government. They will be used in coal mines. Their height from the rail, exclusive of the trolley, is 2 feet 10 inches; width, 4 feet 2 inches; and length over buffers, 11 feet 8 inches. Each locomotive complete weighs 12,050 lbs., and is of 20 H.P., to run at a speed of 8 miles an hour.

NEW COMPANY REGISTERED.

Pulford Brothers, Limited (63,544).—This company was registered on September 8th, with a capital of £3,000 in £1 shares, to acquire and take over as a going concern the business of an electrical engineer, now carried on by Egerton G. Pulford at Moorfields and Brooks Alley, in the City of Liverpool, and to carry on the business of manufacturers of and dealers in electric lamps, electricity meters, electrical switches, cut-outs, and all kinds of apparatus, machinery and appliances, capable of being used in connection with the generation, storage and utilisation of electricity or other force; cycle and carriage makers, ironfounders, saddlers, platers, japanners, annealers, galvanisers, &c. The first subscribers (each with one share) are:—Egerton G. Pulford, 15, Moorfields, Liverpool, electrical engineer; John Macleod, 41, Upton Road, Birkenhead, engineer; John Macleod, 41, Upton Road, Birkenhead, manager; Miss Mary C. Macleod, 41, Upton Road, Birkenhead; Miss Maggie S. Macleod, 41, Upton Road, Birkenhead; John H. Buyer, Exchange Chambers, Bixteth Street, Liverpool, warehouse owner; Daniel Higson, 36, Dale Street, Liverpool, solicitor; and Mrs. Elizabeth Pulford, 34, Grove Road, Rock Ferry. The number of directors is not to be less than two nor more than five; the first are Egerton G. Pulford and John Macleod, jun.; qualification, 250 shares; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Greenwood and Batley, Limited (27,098).—This company's annual return was filed on July 24th, when 11,066 preference and 18,052 ordinary shares were taken up out of a capital of £400,000, in 14,000 preference and 26,000 ordinary shares, all of £10 each; £10 has been called on each of 6,934 preference and 12,134 ordinary shares, and £3 on each of 1,466 preference and 1,252 ordinary, resulting in the receipt of £198,834; £73,320 is considered as paid up on 2,666 preference and 4,666 ordinary shares.

Globe Telegraph and Trust Company, Limited (7,465 C).—This company's annual return was filed on August 18th, when 180,042 preference and 180,227 ordinary shares were taken up out of a nominal capital of £5,000,000 in 250,000 preference and 250,000 ordinary shares of £10 each. £10 per share has been called up, and £3,602,690 has been paid.

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CITY NOTES.

Huddersfield Corporation Electricity Works Accounts.

Last year, when dealing with the Huddersfield accounts, we referred to the steady and sound progress shown by the results of the working of the business up to the end of the year 1897. We are glad to see that the surplus of 1897 was more than doubled in 1898, and it may be noted that the "surplus" for last year is very nearly the same as the loss for the first year, 1893. The items in the "Costs" show small decreases, with the exception of "Oil, waste, &c.," the total decrease in costs amounting to as much as ½d. per unit, the increased production or output being over 150,000 units. The total cost per unit has now been reduced to just below 2d.

The following statement shows the general position of the undertaking:—

	1897.	1898.	Increase.
Total capital expenditure	£69,415	£93,494	£24,079
Number of units sold	438,848	593,377	154,529
Number of lamps connected	41,702	54,154	12,450
Gross revenue	£9,060	£11,866	£2,806
Gross profit	£4,964	£6,936	£1,972
Average price per unit sold	4·66d.	4·51d.	—0·15d.

Revenue Statement.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current	£8,533	4·66d.	£11,158	4·51d.	—0·15d.
Meter rents	458	0·25d.	630	0·25d.	...
Supply of lamps	...	...	83	0·04d.	+0·04d.
Sundry fees, &c.	69	0·04d.	...	...	—0·04d.
Gross revenue	£9,060	4·95d.	£11,866	4·80d.	—0·15d.

Cost of Production.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal	£901	·49d.	£1,170	·47d.	— 02d.
Oil, waste, &c.	104	·06d.	161	·07d.	+ 01d.
Wages	985	·54d.	1,309	·53d.	— 01d.
Repairs, &c.	794	·43d.	840	·34d.	— 09d.
Works' cost..	£2,784	1·52d.	£3,480	1·41d.	— 11d.
Rent, rates, &c...	311	·17d.	317	·13d.	— 04d.
Management, salaries, &c. Establishment charges.	1,001	·55d.	677 455	·27d. ·18d.	— 10d.
Other expenses	...	...	...	...	...
Total costs	£4,096	2·24d.	£4,929	1·99d.	— 25d.

Profit Statement.

	1897.	1898.
Interest on loans	£3,780	£2,601
Sinking fund for repayments		1,898
Net profit carried to depreciation	1,184	1,237
„ cost of altering circuit	...	1,200
Gross profit	£4,964	£6,986

Comparative Annual Statement from the Commencement of the Undertaking.

Year ended	No. of consumers.	No. of 8-c.p. lamps connected.	B.T. units sold.	Income.	Expenditure.	Balance. Deficiency paid from borough fund.	Balance. Surplus.	Rate in £.
				£ s. d.	£ s. d.	£ s. d.	£ s. d.	d.
Dec. 31st, 1893...	112	9,613	43,224	1,067 3 11	3,614 11 8	2,547 0 0	...	1 9/16
„ „ 1894...	214	15,342	156,169	3,560 8 7	5,625 13 4	2,065 0 0	...	1 1/16
„ „ 1895...	280	20,589	227,753	5,351 5 0	6,724 9 0	1,373 0 0	...	0 7/8
„ „ 1896...	385	28,983	304,163	6,864 2 5	6,429 13 4	...	434 9 1	Transferred to depreciation and contingencies account.
„ „ 1897...	598	41,702	438,648	9,060 12 1	7,876 12 1	...	1,184 0 0	
„ „ 1898...	806	54,154	593,377	11,866 11 2	9,429 9 11	...	2,437 1 3	

The Brush Electrical Engineering Company, Limited.

The tenth annual general meeting of the shareholders of this company was held on Friday, September 8th, at the Cannon Street Hotel, Mr. J. B. Braithwaite, jun., M.I.E.E., presiding.

The Chairman, in proposing the adoption of the report, said that dealing first with the profit and loss account, which interested the shareholders most, they would see that the company had earned in gross profit £4,392 more than the previous year. Their earnings had been £54,039, against £49,647, and what was very satisfactory was that they had been able to retain the whole, or rather more than the whole, of that increase as net profit. The net profit showed an increase of £4,942. So that, broadly speaking, they might say that the additional profit had been earned without any increase of expenditure. That, he thought, was a very satisfactory thing, and one that they had to congratulate themselves upon last year. If they would look at the various items of expenditure they would see that the total general charges this year were £11,780 18s. 1d. against £11,276 9s. 9d., showing an increase of £500 only, and that £500 was the additional directors' fees, which, as they mentioned last year, they proposed to take, now that the company was earning a dividend on the ordinary stock. They were entitled under the articles to take £2,000, but they did not intend to exercise that right to the full. On the maintenance of buildings and plant they had spent £4,438—rather more than last year—but they must always keep their buildings and plant in first-rate condition, and whatever money they required for that purpose must come out of the revenue. The maintenance of patents had cost them £672, and the sum of £5,625, interest on first debenture stock, was the same as last year. There was £2,425 for interest on the second debenture stock, and an item of £611, being the remainder of the cost of redeeming that stock, which was now extinguished. That left them a balance of £31,880 as against £26,938, showing an increase of just on £5,000. They really had another £1,000 beyond that, because last year they put aside £1,000 out of profits to provide the nucleus for an insurance fund in connection with the Workmen's Compensation Act, and as that sum was not required this year, they really had £5,942 more to distribute. They proposed to deal with that money in the following manner:—Extra dividend to the ordinary shareholders, £3,600, raising their dividend to 5 per cent. for the year. Then, under their profit-sharing scheme, their workmen's bonus fund would require an additional £360, and they proposed to raise their carry-forward to over £5,000. Turning to the balance-sheet they would find some very considerable changes there, due to the rapid extension of their works at Loughborough. On the credit side they would see that, as he intimated to them last year, they had spent a very considerable sum on additions to their plant and machinery—no less than £55,956 during the year, and he told them that over and above that sum, they had been obliged to incur additional liabilities. The fact was that at the present time their business was increasing by leaps and bounds, and it was quite impossible to keep pace with the increase by any extensions they might make at the works. He told them last year that they contemplated the erection of a new car shop. They had pushed on with the erection of that building as fast as possible, for they had orders in hand before the shop was finished, and although it was capable of turning out 250 additional electric cars per annum, they had more orders now than they could turn out. The only consolation they had was that all their competitors were in the same boat, owing to the very rapid increase in the use of electric cars in this country. Taking the next item—stock, that had risen to the extent of £31,926. That, of course, they would expect, and it showed that they had not been extending their works without a *raison d'être*, and if they extended the works still further they must expect that item still further to increase. The debtors had increased by £10,820, which was the natural sequence to the increased trade they were doing. Turning to the debtor side of the balance-sheet, they would see that the capital remained the same. The creditors showed some increase, due to the increase in the business, and corresponding somewhat to the increase of debtors on the other side. The depreciation and reserve fund stood at £10,000, which would be increased to £15,000 after that meeting. The Workmen's Compensation Act insurance fund stood at £1,000, and he might say that the experiment they decided upon in that connection last year had turned out successfully. The insurance companies were quoting rates which appeared to them out of all proportion to the risks incurred under the new Act. They, therefore, decided to become their own insurers and to place £1,000 to a reserve fund for that purpose, and to put aside a certain sum every week. They had done so, and when they came to reckon up the claims which they had to pay during the year, they were so exceedingly small, that they were able to recredit almost the whole of that sum back into the funds. There was one great change in the balance-sheet, viz., that whereas last year they had large sums as cash in hand, this year they owed considerable sums, the turnover in that respect being something like £100,000. That was accounted for by the fact that they had put £55,956 into extensions of the works; they had spent in wages and material on extra work in hand £31,926; they had increased their investments by £5,300, and they were owed £10,820 more than last year. Those figures gave them a total of £104,002, and the effect of that was that it would be necessary for them to find some means of raising some additional capital to pay for further extensions in the works. The industry had developed to such an extent as to render such a course prudent and advisable. At the present time they had three to five years' work ahead of them and it therefore became the duty of the directors to see what would be the most

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prudent method of raising the necessary money to carry out these extra extensions at Loughborough. They thought that the time had arrived when they should pay off the remaining 50,000 second debenture stock, which was bearing 4½ per cent. interest, and issue in its place £125,000 4 per cent. debenture stock, which would rank after the existing 4½ per cent. perpetual debenture stock. If they did that, they would obtain £25,000 extra capital at a cost of £500 per annum, in other words, at 2 per cent. They proposed to make that issue about the middle of next month, and they would take care that the present shareholders would have a good opportunity for subscribing for their share of that stock. They were using their best endeavours to spend the money wisely in additions to the works and in endeavouring to avoid creating large shops which would be on their hands if the tide of business should turn. In conclusion, the chairman referred to the new dynamo that the company was introducing—the inductor, in which both the field magnets and the armature coils were fixed. They had, he said, great hopes of the machine, because all who had seen it thought very highly of its mathematical soundness.

Mr. B. H. Van Tromp seconded the motion, and, after some discussion, the report was adopted.

The City of Carlisle Electric Tramways Company, Limited.

The first ordinary meeting of the shareholders of the above company was held at Manchester on the 7th inst. Mr. T. D. Lingard, the chairmen of the company, presided.

The Chairman said in a company of that sort, where a considerable amount of works had to be constructed before the business of the company was commenced there was practically nothing, or very little, to say. Had it not been for the provisions of the Companies Acts, the directors would not have troubled the shareholders to come together on that occasion. He was happy to say that the flotation of the company was in every way satisfactory. The ordinary shares were considerably over-applied for, and the debenture stock had been placed. The engineers of the company had been successful in satisfying both the local authorities and the Board of Trade as to the details of the construction of the Carlisle tramways. The speaker then read reports from the contractors and engineers of the works, from whom it appeared that matters were proceeding in a satisfactory manner. The contractors wrote that the work would be completed up to time, which was December 31st next.

Kalgoorlie Electric Power and Lighting Company, Limited.—The secretary of this company, whose prospectus was contained in our last issue, writes to the *Times* as follows:—

It has been pointed out to me that the wording of the paragraph in the prospectus of the Kalgoorlie Electric Power and Lighting Corporation, Limited, dealing with the report of Prof. George Forbes, F.R.S., may be construed to mean that in addition to having exhaustively reported upon the merits of this undertaking, he also personally made a local examination. My directors do not admit this inference, and it was not so intended, as Prof. Forbes made his report upon materials furnished to him, as explained in the report itself, which can be seen at the office of the company's solicitors.

Stock Exchange Notices.—Application has been made to the Stock Exchange Committee to appoint a special settling day in and to grant a quotation to—Charing Cross and Strand Electricity Supply Corporation, Limited.—Further issue of 20,000 ordinary shares of £5 each.

Royal Electric Company of Montreal.—The directors have declared a dividend of 2 per cent. for the quarter ended August 31st, being at the rate of 8 per cent. per annum, payable on October 2nd.

W. T. Henley's Telegraph Works Company, Limited.—Letters of allotment and regret have been posted for the issue of the 4½ per cent. preference shares, which was largely over subscribed.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending September 9th, 1899, were £1,335 17s. 2d.; receipts for week ending September 9th, 1898, £1,112 14s. 5d.; aggregate for half-year to date, £14,798 2s. 7d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending September 8th, 1899, were £3,697 12s. 8d.; corresponding period 1898, £3,448 1s. 2d.; increase, £254 11s. 1d.

The City and South London Railway Company.—The receipts for the week ending September 10th, 1899, were £886; week ending September 11th, 1898, £876; increase, £10. Total receipts for half-year, 1899, £10,418; total receipts corresponding period, 1898, £10,487, decrease, £69. Miles open, 8½.

The Dover Corporation Electric Tramways.—The receipts for the week ending September 9th, 1899, were £293 13s. 4d.; week ending September 10th, 1898, £244 10s. 8d.; increase, £49 2s. 8d. Total receipts to date, 1899, £7,074 19s. 0d.; corresponding period, 1898, £5,750 1s. 3d.; increase, £1,324 17s. 9d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,916, 1898, 3,807. Number of cars, 1899, 12; 1898, 10.

The Dublin United Tramways Company.—The receipts for the week ending Friday, September 8th, 1899, were as follows:—D. U. T. Co., horse cars, £1,370 3s. 9d.; ditto, electric cars, £2,189 9s. 5d.; D. S. D. Co., electric cars, £1,050 13s. 9d.; total, £4,560 6s. 11d.; corresponding week last year—D. U. T. Co., horse cars, £2,886 5s. 6d.; ditto, electric cars, £604 12s. 7d.; D. S. D. Co., electric cars, £1,213 18s. 8d.; total, £4,704 16s 9d.; decrease, £144 9s. 10d. Aggregate to date, £47,283 15s. 7d.; aggregate to date last year, £45,839 7s. 11d.; increase to date, £1,444 7s. 8d. Worked:—The mileage open is 25 miles electrically, 19 miles by horses, as against 12 miles electrically, and 30 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending September 10th, 1899, were £750. Miles of track open, 10. Car miles run, 11,521. Number of cars, 21. The receipts for the week ending September 14th, 1898, were £306. Miles of track open, 8½. Car miles run, 3,723. Number of cars, 10. Total receipts to date, 1899, from April 1st, 1899, £13,913; total receipts to date, 1898, from June 29th, 1898, £3,188.

The Liverpool Overhead Railway Company.—The receipts for the week ending September 10th, 1899, amounted to £1,614; corresponding week last year £1,528; increase, £86.

The South Staffordshire Tramways Company.—The receipts for week ending September 8th, 1899, were £722 13s. 1d.; aggregate receipts for 36 weeks, £23,840 15s. 10d.; week ending September 9th, 1898, £789 10s. 2d.; aggregate receipts for 36 weeks, £23,657 17s. 5d.

STOCKS AND SHARES.

Wednesday Evening.

A cheerful mind shrinks from the melancholy task that faces it this week in writing the usual Market Notes. Falls have to be recorded in almost every instance where there is any change to report at all. Not that there are very many alterations, however, and some little consolation must be derived by shareholders of the unchanged securities at the strength displayed by their stocks, considering that the Stock Exchange generally has been so shaken in every department. A recovery from its gloomiest mood gave the House more confidence on Tuesday, and it is quite certain that the majority of members will not believe in war until the first shot has been fired by the Boers. Nevertheless, the tension continues, and the heavy fall in the mining markets has caused some realising of electric and kindred shares by people in want of money wherewith to meet their engagements in Kaffirs and Kangaroos.

The electricity supply section has seen its Metropolitan companies' prices sag daily. Citys are exceptional in maintaining their ground, but the market is flabby and dull. Westminsters blazed up at the end of last week, some fairly good buying taking place in a market short of shares, but immediately the broker had been accommodated the quotation slipped back again, and now is even 10s. down on the week.

The Royal Electric Company, a Canadian concern, declares its usual dividend of 2 per cent. for the quarter. The hundred-dollar shares stand at 170, and the price of the 4½ per cent. Debentures is 106. Very little market exists in London for either description of stock, the Montreal Exchange doing what small amount of business there is in them. The company has a contract with the Corporation of Montreal city for electric lighting until 1904, at an average price of about £24 per lamp per annum. We have not yet heard of any proposal to cancel the agreement by the Corporation.

Decidedly interesting is the new Kalgoorlie Electric Power and Lighting Corporation, whose prospectus appeared in our columns last week. The issue of £150,000 Preferred shares of £1 each offers a fair field as a speculative investment. We certainly consider that the purchase price, £25,000 in Deferred shares, is plenty of money, but as the whole of the new emission is to be set aside for working capital, and as the shares issued to the public are preferential, both as to capital and interest, there is not much ground for cavilling. The shares are being dealt in to a small extent by the West Australian mining market, and there is the pro-allotment premium of $\frac{3}{16}$ per share quoted, which we hope will not run off.

Telegraph stocks are inclined to weakness. Eastern Ordinary has shed another brace of points, and now stands lower than it has been since 1894, when the price of the £10 shares fell to 14¾, equal to 147½ of to-day's stock. The fears of fighting in South Africa have led to some inquiry for the stocks of those other African lines which are not likely to be injured by the outbreak of hostilities. West African 5 per cent. Debentures are 1 up. There has been some inquiry for Western and Brazilian 4 per cent. Debenture stock. Anglo-American issues fell upon the news that Cornelius Vanderbilt was dead, it being almost invariably the case that a sudden fall in Yankee rails brings a corresponding drop in Anglo "A" and "B." Otherwise the telegraph market is without feature.

Oriental telephones weakened a trifle at the advent of a small seller. Nationals remain quiescent; the rate for contangoing the shares to-day (Wednesday) has been about 3d., and the making up price 5¼, as against 5⅜ of a fortnight ago.

The Tramways Union Company has voluntarily wound itself up, and nothing remains for the directors to do beyond realising the Bremen asset. As we foreshadowed last week, this will probably mean the return of another 70s. per share to holders. Another company which is thinking of retirement from the toils of public life, is the Paris Omnibus Company, which, it is stated, is considering the offer made by a traction concern that the latter shall take over and electrify the whole of the present tram system in Paris. There ought to be money in the scheme, considering the immense advantage which an electrical service would possess over that at present worked by what are politely called horses.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, September 6th.	Closing Quotation, Sept. 13th.	Business done during week ended Sept. 15th, 1899. Highest.	Lowest
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	63 — 66	63 — 66	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	115 —116	114½—115½	115⅛	114½
3,047,220£	Do. do. Deferred	Stock	...	...	18s. %	14½— 15	14½— 14⅝	14⅞	14½
205,151	Brasilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	14⅝— 15¼	15⅛	14⅜
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105	104⅝
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9⅛	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,981	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107½	103 —107½	...	...
60,710£	Direct United States Cable	20	3 %	3¼%	3½%	11⅜— 12¼	11⅜— 12¼	11⅞	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	1⁰ 2½	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	151 —156	149 —154	152½	149⅛
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	99 —102	99 —102	99½	99¼
89,900	Do. 5 % Debs., repayable August, 1899	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	116 —121	116 —121	119⅜	116⅜
250,009	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	14½— 14⅜	14½— 14⅜	14 9/16	14¼
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	100½	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	115 —120	115 —120	118⅜	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	100¼	...
800,000£	Do. 4 % Mort. Debs., Nos. 1 to 8,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —105%	103	...
180,227	Globe Telegraph and Trust	10	4½ %	4½%	5½%	10⅜— 11¼	10⅜— 11¼	10 1/16	10⅛
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15 — 15½	15 — 15½	15 1/16	15
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	10 %	...	30 — 32	30 — 32	30⅛	30
83,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	49	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109 xd	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000	1	...	...	...	¼— ⅜	¼— ⅜	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	⅝— 1	⅝— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5⅛ %	6 %	6 %	5⅛— 5⅜	5⅛— 5⅜	5 1/16	5 3/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5½	5¼— 5½	5 5/16	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	100⅜	99¾
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅞— 1	⅞— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	...	103 —106	103 —106	...	...
11,889	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	7⅜	...
3,881	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	4⅜— 5¼	4⅞	...
151,738£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	98 —101 xd	99 —102	101⅜	...
80,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	101 —104	101 —104	...	...
389,521	Western and Brasilian Telegraph 4 % Deb. Stock Red.	Stock	...	...	...	103 —106	104 —107	106	105
88,321	West India and Panama Telegraph	10	1 %	8%	...	1⅜— 1⅝	1⅜— 1⅝	...	...
84,563	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	10½— 10⅝	10½— 10⅝	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	8½— 9½	8½— 9½	9⅛	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	103 —106	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds	100	6 %	6 %	...	98 —103 xd	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10½— 11½	10 — 11	10⅜	10⅛
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
84,000	*Chelsea Electricity Supply, Ord.,	5	5 %	6 %	6 %	7½— 8½	7½— 8½	...	...
100,000	Do. do. do. % Deb. Stock Red.	Stock	4½ %	4½ %	...	113 —115	113 —115	113	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000	10	7 %	10 %	6 %	11½— 12½	11½— 12½	12	11⅞
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13½	13¼	12¾
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	127½	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 11½	11 — 12	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13½— 14½	13½— 14½	...	...
220,000	Do. 4½ % Deb. Stock, Prov. Certs (£30% to be paid) Rd.	...	...	...	...	82 — 85	82 — 85	...	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5 — 5½	5 — 5½	5⅛	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	8 — 9	8 — 9	...	...
12,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	...	9 — 10	9 — 10	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 7	6½	...
100,000	Do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	105 —107	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	14½— 15½	15½	14⅝
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14½— 15½	14 — 15	...	...
230,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	16½— 17⅛	16½— 17⅛	16⅞	16 11/16
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3⅞— 4⅛	3⅞— 4⅛	4	3 15/16
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	9 %	12 %	12 %	15½— 16½	15 —16	15 3/16	15 7/16

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Sept. 6th.	Closing Quotation Sept. 13th.	Business done during week ended Sept. 13th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2¾— 3¼	2¾— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	97 —102	97 —102	...	...
30,000	British Electric Traction	10	...	...	6 %	17½— 18½	17½— 18½	18	17¾
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13¾— 14¼	13¾— 14¼	14⅛	13 15/16
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	...	...	...	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6¼— 6¾	6¼— 6¾	...	...
90,000	Brush Elecl. Engng., Ord., 1 to 90,000	3	*nil*	3 %	5 %	1⅝— 2⅛	1⅝— 2⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2 5/16	...
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	108 —112 xd	108 —112	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	101 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13½— 14½	13½— 14½	14¼	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10¾	10¼— 10¾	10¾	...
178,303	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	4¾— 5¼	4¾— 5¼	...	...
71,447	Do. do. Def. do.	5	...	...	...	5¼— 5¾	5¼— 5¾	...	...
630,000*l*	City and South London Railway	Stock	1 2/16 %	1⅞ %	2⅛ %	65 — 67	65 — 67	66	65½
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6¼— 6¾	6¼— 6¾	6½	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½ %	6 %	6 %	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½ %	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	102 —105	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ⅞	⅝— ⅞	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	110 —113	110 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21⅜	21
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞ %	3¼ %	3¼ %	7⅞— 8	7⅞— 8⅛	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13¼— 13⅜	13¼— 13⅜	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	38 — 42	37 — 41	38¾	37¼
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9¾	9¼— 9¾	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅝— 6¼	5⅝— 6¼	5⅝	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	101 —104	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

***Birmingham Electric Supply, Ordinary £5 (fully paid) 8¼—9¼.**
British Aluminium, Ordinary, 9¼—10; 7 % Pref., 10—11.
House-to-House, 4½ % Debentures of £100, 105—108.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 2—4.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12¼—13¼; 1st Preference Cumulative 6%, £5 (fully paid), 7¼—7⅝. Debentures, 106—109. Dividend, 1898, on Ordinary Shares 10%.
***T. Parker, £10 (fully paid), 19.**

* From Birmingham Share List.

Bank rate of discount 3½ per cent. (July 13th, 1899).

MARKET QUOTATIONS, Wednesday, September 13th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	32/-	32/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	85/-	85/-	..
a Ammonia, Muriate (crystal) .. per ton	£25	£25	..
a „ „ .. .. per ton	£23	£23	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. per ton	£24	£23 10	10s. inc.
a Lead, Nitrate .. .. per ton	£23 10	£23 10	..
a „ White Sugar .. .. per ton	£31	£31	..
a „ Peroxide .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3½d.	3½d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8¼d.	8¼d.	..
c „ Tube (brazed) .. .. per lb.	10¼d.	10¼d.	..
c „ Wire, basis .. .. per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g „ Wire (basis price) .. per lb.	10½d.	10½d.	..
g „ Sheet .. .. .. per ton	£88	£88	..
g „ Rod .. .. .. per ton	£88	£88	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/2½	4/2 to 4/3½	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	67/4½ to 69/7	67/6	..
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£12 17 6	£12 17 6	..
g Lead, English Ingot .. .. per ton	£15 5	£14 18 9	6/3 inc.
g „ „ Sheet .. .. per ton	£15 7 6	£15 7	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 12	£8 12	..
d Mica (in original cases), small per lb.	2d. to 6d.	2d. to 6d.	..
d „ „ „ medium per lb.	1/9 to 2/6	1/9 to 2/6	..
d „ „ „ large per lb.	3/6 to 7/-	3/6 to 7/-	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd strip & sheet per lb.	From 1/2⅔	From 1/2½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£149 10	£146 10	£3 inc.
g „ foil .. .. per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/10	1/10	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
f Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	..
j „ Best Flax, 6 lea. .. per lb.	4⅝d.	4⅝d.	..
j „ Hemp, 8 ply 10 lbs. .. per lb.	3½d.	3½d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£13	£13	..
j „ Manila, 24 thread .. per ton	£36 10	£35 10	£1 inc.
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£27	£27	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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THE SYNCHRONISING OF ALTERNATORS.*

By M. GARDNER and R. P. HOWGRAVE-GRAHAM.

(*Concluded from page* 417.)

We will now deal with a few of the methods of connection of synchronising apparatus which depend on the same principle as the method just described. In (fig. 4) the primary, P, of a transformer is put where the lamps were in the former case, and one or more lamps are put in series with the secondary, S. This, of course, is for high tension systems, where it is impossible to put lamps straight on to the machines.

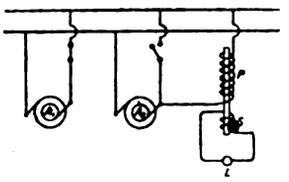


Fig. 4.

Fig. 5 shows a method in which a transformer, with two primaries, is used, one being connected to the bus bars or to A_1, and the other to A_2. This method has the advantage of admitting of the use of a double-pole switch. The arrows show the directions of the electromotive forces and magnetomotive forces at the right moment for

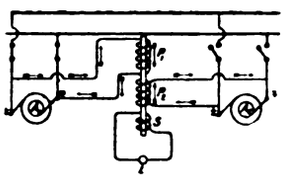


Fig 5

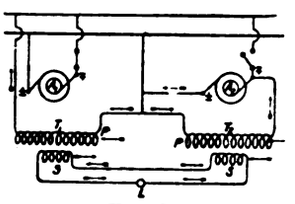


Fig. 6.

switching in. Another way is to have two entirely separate transformers, the primary of one being connected to the bus bars, and that of the other to the machine to be thrown in, as in fig. 6.

If the secondaries are connected in series, the moment for switching in will be that of minimum light. If the secondaries are cross-connected, it will be that of maximum light. The substitution of telephones for lamps was introduced by the General Electric Company. They did not use ordinary telephones but large iron-wire-cored electro-magnets with iron diaphragms in front. They had them quite separate, one to each machine, either with or without transformers, according to the voltage.

These sounders simply howled, and when the machines were getting into synchronism, the sound waves interfered with each other, and beats were produced, rapid at first, but getting slower and slower.

When the note was clear and steady, it was known that the machines were in synchronism, and they were switched in, though they might be ever so much out of phase, and we have spoken of how disastrous this may be. However, it is clear that we can use a single telephone in place of the lamp or lamps in any of the pilot lamp methods described, and that then we may be sure of synchronism and step by switching in when the sound is at a minimum.

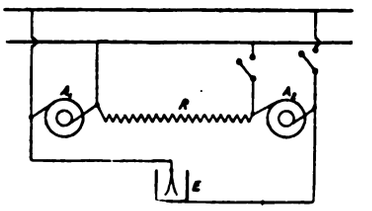


Fig. 7.

I have a telephone here which I can substitute for the lamp in this revolving commutator model. A Cardew voltmeter is a very present help in time of trouble, if used instead of, or even as well as, an incandescent lamp. It reads quite quickly enough, and the exact position of the needle, as it slowly oscillates, is easy to follow, while the exact brilliance of a lamp is difficult to judge, owing to eye fatigue.

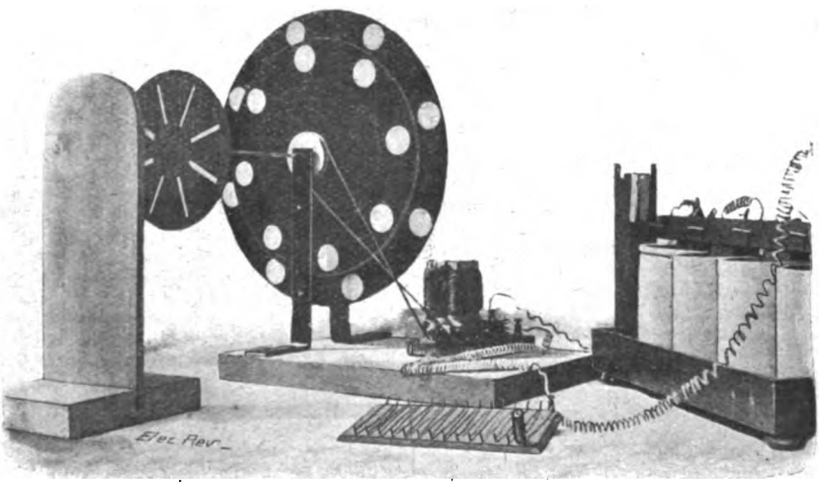
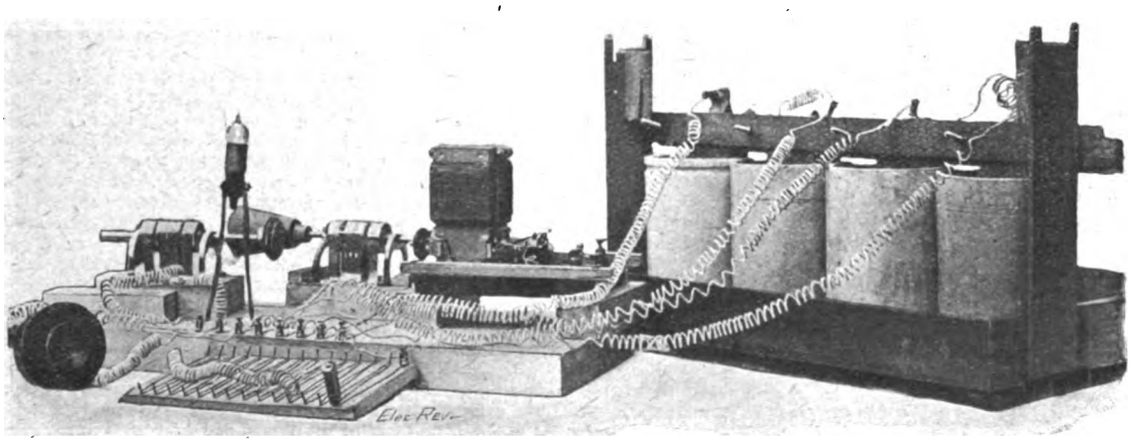


Fig. 8.

Prof. Ayrton mentioned at the Institution of Electrical Engineers in 1894, an electrostatic synchroniser, for the purpose of doing away with transformers in high tension stations. A diagram of connections is shown on the board (fig. 7):—R was to be a resistance, almost as large as you like, say a thin lead pencil line on a piece of slate or ebonite. E was to be any dead-beat electrostatic voltmeter, such as a gold leaf electroscope, which might be made with leaves even a foot and a half long, to be visible all over the station. In such an apparatus the moment for switching in is when the leaves stay closed



Illustrative Model.—See page 416 ante.

* Read before a meeting of the students of the Institution of Electrical Engineers on Wednesday, March 22nd, 1899.

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for some time. Prof. Ayrton claimed that an electrostatic arrangement like this is more dead-beat than a lamp, the luminosity of which remains. He maintained, also, that it is cheaper than the ordinary methods, as it does not involve the use of somewhat expensive transformers, and that it may be as large as you like, and needs no accurate calibration and no scale, and, as an electrostatic voltmeter, may be as wrong as you like, and, lastly, that it is perfectly and absolutely safe.

Sometimes little auxiliary synchronising bus bars are provided. Any machine to be synchronised can be connected to them, and the whole thing done as usual, except that when the right moment comes, instead of being switched straight on to the main circuit, it is put on to these bus bars, between which one or more choking coils are placed, through which the machine cannot possibly force more than 10 or 15 amperes. This current is quite sufficient to synchronise it, and when it is seen to be running quietly and steadily it is put on to the main circuit by a second switch.

Optical Synchronisers.

There is a very curious optical effect made use of in synchronising. It was noticed that if the light from an alternating arc fell upon the alternator lighting it, the fly-wheel appeared to stand still or revolve very slowly, according to the number of spokes in it. Now, if we paint the armature, or revolving part, round with as many spots as there are alternations per revolution, and light it from an arc overhead driven by itself (we mean the armature's self, not the arc's), a spot which we will call A, which is in front of one which we shall call B, will be illuminated when the pulsating light is at its maximum. B will also be illuminated as will all the other spots round the armature.

The light will now die down a little, and by the time the next maximum brightness comes, the spot B will have got to where A was before, and all the other spots will have been shifted on one space. The effect of this will be to make the circle of spots appear stationary. If the same arc lamp lights up another machine similarly painted with spots, and if that other machine is being brought into synchronism, and is running a little bit slower, its spots will appear to slowly rotate backwards, because, instead of moving on one space to each beat of light, if we can call it so, the spots move rather less than one space.

This method is never used for absolute synchronising, but mostly to give the man who is at the engine a rough idea of how the speed is going, while there is a man at an ordinary pilot lamp apparatus as well. The things which appear to happen to the spots as the second machine gradually speeds up, are best seen on this model, where the effects are wonderfully like those on a real machine. I will just roughly describe it.

The large disc (fig. 8) represents the machine already running, is painted round with eight equidistant spots, and rigidly connected to a shaft driven by a motor. At the front end of the shaft there is a small disc, in which eight slots are cut. This disc is also rigidly connected to the shaft, and when a light is placed behind the slots, flashes of light are produced, which imitate the light given out by the alternating arc driven by the dynamo corresponding to the large disc.

The disc between the two others is, as you see, painted with similar white spots, but is loose on the shaft, and when the large disc is revolving we can hold it, and on letting it go, observe the effects, as by friction it gradually gets up to synchronism with the large disc. You will see the spots on the large disc appear to stand still, while those on the smaller one will, after various curious changes, appear to slowly rotate in a direction opposite to that of the real rotation. If the friction were great enough they would finally come to rest.

As regards this method, it will be interesting to quote the words of Dr. Silvanus Thompson in the discussion of Mr. Mordey's paper of 1894, before the revolving spots ever came to be used at all. He says:—

"I remember very well watching the machines built by Gaulard & Co. in the station at Rome."

"The alternators were set in one line."

"You can look through one machine at another, and you can see when the machines are synchronised by merely observing the rotating magnets of one machine across the rotating magnets of the other."

"They will appear to be stationary when absolutely in phase, just as two perforated discs of cardboard do with holes, when they are spun round at equal speeds, one being watched through the other."

"It is quite possible, I think, that some optical synchroniser might be found which would be more satisfactory than either acoustic or electrical synchronisers used with lamps."

The authors humbly venture to suggest that what Dr. Thompson foresaw, before the use of revolving spots was known at all, may be sometime more fully realised than it is now, and that optical methods, which are at present quite in their infancy, and only used as rough guides to the man at the engine, may be the methods of the future.

THE ELECTRIC LIGHTING (CLAUSES) ACT, 1899.

This Act, which has been passed for the purpose of incorporating in one Act certain provisions usually contained in provisional orders made under the Acts relating to electric lighting, comes into operation on October 1st, 1899. It consists almost entirely of a schedule comprising rules and regulations in accordance with which undertakers are to supply electricity in the area named for that purpose in any special order of the Board of Trade, and a short clause of incorporation will have the effect of materially shortening any such order. The provisions of the schedule are to be read and construed subject in all respects to the provisions of the Electric Lighting Acts, 1882 and 1888.

The following abstract, which does not claim to give anything more than a bare outline of a long and complicated schedule, will serve to show the general nature of the rules which must be observed by an electric lighting corporation.

After an interpretation clause which defines the various technical terms used in the schedule, the second section provides that undertakers are to be "the authority, company, or other person named for that purpose in the special order." A reference to the Electric Lighting Act of 1888 shows that the local authority in any given area are not only entitled to be undertakers, but that they may, subject to the provisions of Sec. 2 of that Act, purchase compulsorily the undertaking of any private company or person. This power is in no way curtailed by the new Act.

By Section 5, where the undertakers are not the local authority, provision is made for the deposit of a sum of money to the amount specified in the special order by way of security for the due execution of the works. The sum so deposited is to be repaid in equal moieties as soon as it is certified by an inspector that sums equal in amount have been expended on the works by the undertakers.

The 7th Section makes provision for the outlay of monies received by the undertakers—other than borrowed money or capital—in the following order:—

1. Payment of working and establishment expenses.
2. Payment of interest or dividend on mortgages and stock.
3. In providing any instalments or sinking fund.
4. Payment of expenses of executing the special order not properly chargeable to capital.
5. In providing a reserve fund, if they think fit.

If the surplus in any year exceeds £5 per centum per annum upon the aggregate capital expenditure on the undertaking, the undertakers are to make such rateable reduction in the charge for the supply of energy as in their judgment will reduce the surplus to that maximum rate of profit. This enactment will be appreciated by consumers, but the limitation of profit to 5 per cent. will not afford any very strong inducement to private companies to undertake the supply of electricity.

Where the local authority are undertakers a curious provision in Section 8 prevents them from purchasing ten or more houses which, on the 15th day of December last, before the commencement of the Special Order were occupied by the "labouring class."

By Section 10 it is absolutely forbidden for the undertakers to place any electric line above ground except on their own premises, while connection with earth is prohibited unless with the consent of the Board of Trade and the Postmaster-General.

Sections 11—20 deal with the works which the undertakers may effect, and prescribe the various notices to be served before operations are commenced. By Section 14, if they propose to place any works along any street or public bridge, one month's notice must be given to the local authority and the Postmaster-General, who may approve or object. If any objection is lodged the undertakers may appeal to the Board of Trade. Default in meeting with the requirements of this section is visited with a fine of £10, and a daily penalty of not more than £5.

Where streets are repairable by the County Council, and where the proposed works are likely to interfere with any such street, or any railway or canal, it is provided by Section 15 that notices must be served upon the County Council in the former case and in the latter case upon the body or person for the time being entitled to work the railway or upon the owners of the canal as the case may be. Disputes arising with regard to compensation are to be settled by arbitration.

By Section 16 the person or body liable to repair any street, or entitled to work any railway or tramway which the undertakers are empowered to break up for the purposes of the special order, may, after giving the undertakers notice themselves, perform the undertakers' work, in relation to the breaking up, filling in, and reinstating of roads, &c. Thereupon they shall be entitled to execute the works at the request of the undertakers to whom they may also look for expenses properly incurred.

With regard to alterations of pipes, wires, &c., under streets, these can only be made subject to notice having been given to the owner of the pipes and wires [see Section 17]. This provision applies equally for the protection of the undertakers themselves.

By Section 18, the undertakers are required to give three days' notice to gas companies, water companies, and the local authority of their intention to dig or sink any trench for laying down or constructing any new electric lines. A similar duty is imposed upon these bodies when they are about to take up the road. In each case the interested parties are entitled by their officer to superintend the works. Penalties are imposed for the infringement of this clause.

Section 20 contains stringent provisions with regard to the laying of electric lines in such a manner as to interfere with any existing telegraph or telephone wires.

Sections 21—26, which provide for compulsory works, contain some enactments which are of interest to the consumer. The undertakers are compelled to lay down suitable wires, &c., within two years after the commencement of the provisional order. Twenty-eight days before commencing to lay an electric line in any street, they must serve upon the local authority, and the owners and occupiers of the premises adjoining, a notice of their intention so to do. Default in laying mains within the prescribed period may be punished by fine, or in extreme cases by revocation of the special order. A requisition to lay distributing mains may be made by six or more owners of premises along any one street. This may be refused by the undertakers unless the persons making the requisition, in addition to certain other undertakings, guarantee to take a supply of energy for three years.

Sections 27—30, which deal with supply, provide for a continuous supply of electrical energy. "The maximum power with which any

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consumer shall be entitled to be supplied shall be of such amount as he may require to be supplied with not exceeding what may be reasonably anticipated as the maximum consumption in his premises." Penalties to the extent of 40s. may be imposed upon the undertakers in respect of each day upon which the supply fails—except where it was occasioned by *force majeure* or inevitable accident.

Sections 31—34 deal with the price at which the supply is to be furnished. Quantity supplied may be estimated either:—

1. By the actual amount of energy supplied; or
2. By the electrical quantity; or
3. By such other method as may be approved by the Board of Trade.

The prices to be charged are not to exceed those mentioned in the special order, subject to revision by the Board of Trade.

Electric inspectors may be appointed by the Board of Trade. Their duty will be to inspect the undertaker's lines and works, the meters of consumers, and to undertake any other duties required of them by the special order. Their salaries are to be paid by the local authority.

By Section 36 it is provided that notice of any accident by explosion, &c., is to be sent to the Board of Trade by the undertakers.

Sections 39—48 make provision for the inspection and testing of mains, and also the works and supply on the consumer's premises, for which purpose the undertakers are to provide instruments on their own premises. These tests may be made at all reasonable times by the inspectors appointed in accordance with the provisions of this Act.

Sections 49—59 provide that meters are to be used in all cases, unless otherwise agreed between the consumer and the undertaker. Meters are to be supplied by the undertakers, but must be kept in order by the consumer at his own expense. Where meters are let on hire by the undertakers they must, unless the agreement otherwise provides, keep the meter in order. Any differences as to the correctness of the meter are to be settled by the inspector. Where the method of charge is altered, the undertakers must provide new meters to the consumers.

The undertakers may place upon the premises of any consumer a meter to measure the supply, or to check the measurement of the consumer's own meter.

Sections 61 and 62 make provision for the service of the notices required by the Act, indicating the persons upon whom such documents are to be served. In computing the time within which this duty must be performed, certain holidays and fast days are excepted.

Sections 63—68 deal with the revocation of the Special Order under certain circumstances. It will be revoked under the following circumstances: (1) Where undertakers are insolvent. (2) Where the undertaking cannot be carried on with a profit. (3) Where the local authority are undertakers and the works are not executed; (4) by consent.

By Section 69 it is provided that in certain cases where it is proved (*a*) that the undertakers are supplying energy otherwise than by an approved system; (*b*) that any lines are defective; (*c*) that any work of the undertakers injuriously affects any telegraphic line of the Postmaster-General, the Board of Trade may by order specify the matter complained of, and require the undertakers to abate it, under penalties for delay.

By Section 76 all penalties, &c., and other monies recoverable under the Special Order may be recovered summarily in the manner provided by the Summary Jurisdiction Acts.

Section 77 renders the undertakers answerable for all accidents, damages, and injuries happening through the Act or default of them, or of any person in their employment, by reason of or in consequence of any of the undertaker's works, and imposes upon them the duty of indemnifying all authorities, bodies, and persons by whom any street is repairable and all other authorities, companies and bodies, collectively and individually, and their officers and servants, from all damages and costs in respect of those accidents, damages and injuries.

By Section 79 the Postmaster-General is declared to be entitled to all his rights under the Electric Lighting Acts, 1882—1888, and the Telegraph Acts, notwithstanding that those are in addition to the rights conferred upon him by this Act as incorporated in any Special Order.

By Section 81 it is provided that nothing in the Special Order shall exonerate the undertakers from their common law liability for nuisances.

Subject to certain modifications which are set forth in Sections 83 and 84, the Act is made applicable to Scotland and Ireland.

An appendix incorporates the following Sections of certain public Acts with this Act:—

1. Electric Lighting Act, 1882, Section 12.
2. Gasworks Clauses Act, 1847, Sections 6—12, and Sections 18—20.
3. Gasworks Clauses Act, 1871, Sections 38—42, and Sections 45 and 46.

THE COPPER MARKET IN AUGUST.

Messrs. H. R. Merton & Co.'s statistical report for the fortnight ending August 31st shows that the price of standard copper has advanced 10s. per ton, and that the stocks in European ports or afloat thereto have fallen 630 tons since July 31st. The position, therefore, is slightly less favourable to consumers of the metal than at the commencement of the month. The supplies during August totalled 17,965 tons, against 18,595 delivered, and the stocks on August 31st amounted to 32,389 tons.

The supplies during August from North America and from Chili were below the average of the preceding 12 months, while from all other countries the supplies have exceeded the average. The shipments from "other countries" are less than in July, being 4,245 tons, as compared with 6,767 tons in the previous month; but both of these totals are above the average, and promise well for the future yield of these outside countries.

The relative costs of copper and aluminium, when used as electrical conductors, are now expressed by—

$$\frac{8{\cdot}93 \times 8{\cdot}62 \times 59}{2{\cdot}68 \times 14{\cdot}5 \times 100} = \frac{4,541}{3,886} = \frac{116}{100}$$

Aluminium at 29 cents per lb. (the Pittsburg Company's price for aluminium rods) is, therefore, still considerably cheaper than copper.

The following new copper mining companies have been floated during August:—

Mount Lyall Blocks Copper Corporation, Limited, Capital £300,000.

The capital of this company had been privately subscribed, and the prospectus was published merely for public information. The vendors take £275,000 in shares, and the remaining £25,000 is held as working capital. The property covers 70 acres, and adjoins the North Mount Lyall Company's property in Tasmania. A body of ore 40 feet in thickness has been found, and 121 assays of daily samples taken from the ore face have shown over 10 per cent. of copper. The only report on the property appears to be by Mr. R. Schloesser, M.E., acting for the vendors, the Mount Lyall Blocks Mining Company, of Melbourne. The cost of mining and delivering the ore at Queenstown-Tasmania is estimated in this report at 11s. per ton. Gold and silver are expected to be obtained in payable amounts.

The Caledonia Copper Company, Limited, Capital £750,000.

This company has been formed to purchase and develop two groups of copper ore properties in New Caledonia—the island in the Pacific Ocean. The properties cover an area of over 4,000 acres. The two groups are connected with each other and with the coast by a railway nearing completion. The ores are sulphides. The Pilon property has been extensively developed, and bodies of ore, assaying 8 to 20 per cent. copper, have been located. The Ao property has not yet been satisfactorily opened up, but the indications point to the geological formation being similar to that of the Pilon property. The average value of the ore in sight, *after subjection to hand picking and concentration*, is given as 15½ per cent. copper, 8 oz. silver, and 9 grains gold. An annual shipment of 40,000 tons is estimated, and taking copper at £65 per ton, an annual profit of £265,000, or 35 per cent. on the capital, may be expected.

The International Copper Corporation, Limited, are the vendors, and are realising at a profit. £50,000 is to be appropriated for working capital.

The purchase price is fixed at £700,000 in cash or shares.

Taking the above figures, a simple calculation shows that the estimate of a 35 per cent. return on the capital is based on a profit of £43 per ton of copper contained in the ore. This is too high, and we shall be surprised if the 35 per cent. dividend is ever paid or earned. *If* the International Copper Corporation, Limited, are assured of the latter, would it not pay them to stick to the property?—for 35 per cent. dividends are not very common at the present day.

The Mount Chalmers Copper Mines, Limited, Capital £300,000.

This company has been formed for purchase and development of the Mount Chalmers Copper Mines in Queensland. The properties cover 140 acres, and are situated 20 miles from a railway and 16 miles from the coast. Shafts have been driven through the property, the main body of ore has been located, and 1,500 tons of ore have been brought to the surface. 200,000 tons ore is estimated to be in sight, averaging 6 per cent. copper, 4 ozs. silver, and 6 dwts. gold.

Taking an output of 500 tons ore per week, a smelting plant of this capacity should yield a profit of £78,000 per annum with copper at £50 per ton. The mining and smelting charges should not exceed 22s. 6d. per ton.

Mr. D. W. Blaxter is the vendor, and is re-selling at a profit for £250,000, £175,000 of which is to be paid in ordinary shares and the balance in cash or shares.

In conclusion, we may draw attention to a note in the Foreign Intelligence columns of the *Times* of August 2nd, to the effect that a Russian mining association has obtained a 70 years' lease of a territory which includes nearly all the north of Persia, and is *believed* to contain the richest copper mines in the world.

The Amalgamated Copper Company, of New Jersey, will certainly have to increase its capital to an alarming extent, if any control of all these new producing mines is to be established or maintained.

AUTOCAR TRIALS AT LIVERPOOL.

The recent autocar tests at Liverpool form the subject of some pretty scathing remarks in a contemporary by a writer and an engineer who signs himself "Traction Engine." The gist of these remarks is that the small loads asked for in autocar work are a mistake; that the autocar people are beginning to learn what is now ancient history with traction engine makers, and that road work with steam motors will approach

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traction engine practice; and finally, to sum up, we may almost say that the problem of road traction would have been solved long ago if it had not been for the very severe restrictions imposed upon the use of traction engines.

The writer goes into considerable detail in his letter in respect of the question of flat tyres and other details, and concludes that progress is being made, and that in a few years' time it may be possible to purchase a really serviceable motor van at half the prices asked for the things now being made. He compares £500 worth of motor van with £500 worth of traction engine greatly to the advantage of the latter.

We think, however, that while there must and will be many errors in the early days of the autocar and similar vehicles, there will be some sound practical outcome in the shape of something different from a traction engine. As to the steam traction engine as now built nothing but admiration can be recorded. It is really a fine sight to see a traction engine sunk up to its axles in soft clay on an irregular surface; to see it fed under its wheels with chunks of timber and watch it climb out of the slough by its own energy. There are few specimens of mechanical engineering that surpass a good strong traction engine. The adaptation of means to an end and the way in which an engine accommodates itself to any sort of surface and climbs banks and obstructions are really marvellous. Roads were made for vehicles to run upon. We fail to see that gas and water mains should be allowed to limit the user of the road surface, because gas companies are so busy diluting their product with hydrogen and carbonic oxide—we apologise, we should say water-gas—that they have no time to place their pipes properly. The traction engine makers have met their problem by slow speeds and heavy loads, and if freed from unreasonable restrictions, an immense field would be laid open for their use. But this does not dispose of the fact that there is a need for lighter vehicles also. We are inclined to doubt the value of the small-tube boiler for the work of the autocar. There are many curious feed waters likely to be put into the tank of a road engine. This cannot be guarded against. How will small bent tubes act with such waters, often excessively sedimentary? "Traction Engine" very properly animadverts on the placing of working parts or undergear within 5 inches of the ground. This, of course, cannot be admitted; it cannot endure, and with many other crudities must be eliminated from autocar work.

Such letters will do good. Criticism of a fair nature will not kill. Autocarists have much to learn, and if in earnest will welcome technical criticism.

THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

In view of the meeting of the British Association for the Advancement of Science now proceeding, the reports of the convention of the American Association, held at Columbus from August 21st to 26th, possess a special interest. During the meeting there were 273 papers read, a large number being on electrical subjects. The president was Dr. Edward Orton. We are indebted to the *Electrical World and Engineer* for the following abstract of his inaugural address, as well as for the papers which are also briefly summarised below:—

Dr. Orton reviewed the progress of science and its effect upon civilisation since the human race "first found itself." He looked back so comprehensively and with such a clear mental vision from the closing year of the present century, and compared the 19th century with all past time so ably that much of the final success of the meeting is attributable to his masterly address. White haired and trembling with age, after 50 years of devotion to the progress of human knowledge, yet preserving all those graces that fit him to preside over a deliberative body, the effect of his presence on that occasion was impressive. His language was so simple and well chosen that it would be hard to find a twelve-year-old boy who would not have listened to and understood perfectly what he had to say. Dr. Orton said that the next century seemed destined to show the rounding out of medicine into an exact science; a better knowledge and use of the laws of energy; a nearly perfect understanding of the phenomena of electricity and magnetism; and some comprehension of the mystery of life itself. What is needed to-day in science are builders as well as analysts, for the most useful truths are the great ones, and the new ones destined to be discovered will be arrived at by putting together some of the dry technical facts of which science is full to-day. He said in part:—

"Our contributions to science are often fragmentary and devoid of special interest to the outside world. It is possible that we could make ourselves more interesting to the general public if we occasionally foreswore our reserve and spent a portion of our time in re-stating established truths. We do not always know the real significance of what we have in hand. A fact or an observation that we may put on record here may have in reality a different significance than the one we are disposed to give it, and consequently may have far more importance than we recognise. But every fact has a place in the great temple of knowledge, and the wise master builders, some of whom appear in every generation, will find them and use them all, and then only will their true value come to light. The field which is the world was never so white to the harvest as it is now, but it is still early moving on the dial of science."

After President Orton's address the association divided into sections as scheduled, in order to facilitate special work in each of the various departments of science. There were nine vice-presidential addresses, each before its respective section.

Prof. C. M. Woodward, of Columbia University, was elected president, to succeed Dr. Orton at the 1900 meeting, which is to be held in New York City.

An Apparatus for the Demonstration of the varying Currents in the Different Conductors of a Rotary Converter.—By Prof. F. C. Caldwell, Ohio State University.

This apparatus consists of (*a*) a disc of paper board, having a narrow slit cut along a radius, and occupying nearly the whole of the latter, on the edge of which slit is a scale of plus and minus amperes, with the zero at the middle; (*b*) a paper disc, placed under disc (*a*) and marked with a datum circle under the zero of current, and a sine curve drawn with radial ordinates, its maximum being equal to the maximum alternating current supplied to the converter. Also two lines parallel to the sine curve, and radially distant therefrom by the amount of the direct current; (*c*) a back of paper board, upon which are represented two pole-pieces and two brushes, and upon a pivot in the centre of which disc (*a*) and (*b*) turn. (*d*) Strips representing collector ring connection being so placed, and the disc (*b*) being so attached to the back, that the maximum of the sine curve will come under the slit when the section of the armature disc (*a*), including the slit, is under the centre of the pole-piece, by revolving disc (*a*) the ordinate cut off by the slit from one or the other of the lines parallel to the sine curve will give instantaneous current in the conductor represented by the slit. The different current curves in the conductors, differently situated with reference to the collector connections, may be studied by changing the points of attachment of the latter relatively to the slit. Other phenomena may also be studied.

A New Form of Electrical Condenser having a Capacity Capable of Continuous Adjustment.—By Lyman J. Briggs, Physicist, U.S. Department of Agriculture.

This condenser consists of a stack of spring brass and mica sheets, arranged in the usual manner. The spring brass plates are given a curved form, so as to present an open structure when the condenser is assembled. The capacity of the condenser can consequently be continuously varied by compressing the system of plates. The condenser can be used either in air or oil.

Current and Voltage Curves in Magnetically Blown Arc and in Aluminium Electrolytic Cell.—By Prof. R. A. Fessenden, Western University of Pennsylvania.

Shows that placing an alternating current arc in a strong magnetic field makes the current wave flat-topped and increases the efficiency. Curves of voltage and current taken between different points in an aluminium cell shows that polarisation, not pure resistance effects, are due to the formation of Al_2O_3, but that change of phase absolutely takes place as film acts as dielectric of condenser. Efficiency low.

Electrical Anæsthesia.—By Dr. E. W. Scripture, Yale.

A method is described of producing anæsthesia—or rather analgesia—by direct application of an electric current and without either internal or local application of drugs, and based on the following priciples:—

An alternating current—preferably a sinusoid—with equal positive and negative phases is made to traverse the nerve. At a proper frequency—about 5,000 complete periods in a second—it can be made to cut off all sensory communication by this nerve. Needles can be run into the part of the body supplied by the nerve without any pain being felt.

Groups of nerves, *e.g.*, the brachial plexus, can be cut off from communication in a similar manner. Experiments are now being made in the effort to get at the root of the spinal nerves, and thus it will cut off communication with the various parts of the body. Experiments have been tried in sending the current from the Casserian ganglion through the superior maxillary nerve with a view to cutting the teeth from communication, but the contraction of the facial muscles have proved as yet too disturbing.

The experiments have made evident the fact that with increasing frequency of alternation the muscular contractions decrease; it is proposed to raise the frequency still higher to avoid muscular contractions while retaining the analgesic effect, a machine for this purpose being now under construction.

Concerning the Fall of Potential at the Anode in a Geisler Tube.—By Prof. Clarence A. Skinner, University of Nebraska.

Observations were made with a Geisler tube, cylindrical in form (length, 20 cm., diameter, 4 cm.), provided with disc electrodes (diameter about 2 cm.). The results given below were obtained in nitrogen gas (pressure, 3 to 6 mm.), through which a constant electric current from a storage battery of 600 cells was passed.

The fall of potential at the anode was measured by a quadrant electrometer as the difference of potential between the anode and a movable platinum wire which could be approached to contact with the anode. So far as it can be proven by this method, the fall of potential at the anode is of the nature of a sudden drop between electricity and gas. In the immediate neighbourhood of the anode

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the gas is a perfect conductor, the potential gradient is zero. The space of perfect conduction may extend about 2 mm. from the anode, but its extent decreases rapidly with increasing gas pressure. Outside the potential gradient the potential gradient rises more or less rapidly to a constant value throughout the unstriated positive column, or luminosity. The fall of potential at the anode is: (*a*) independent of the current density, be the gas pure or impure, the anode clean or tarnished; (*b*) increases slowly with increasing gas pressure; (*c*) increases rapidly as the anode becomes tarnished; (*d*) is sensibly influenced by impurities in the gas; (*e*) for all metals with polished surface tested, lies between 18 and 35 volts at 1 mm. gas pressure; whereby of the metals the one which has the smaller fall of potential at cathode shows greater at anode. Further, it was found that the greater the fall of potential at the anode, the greater the distance from the anode in which the gas was rendered a perfect conductor, and also the slower the potential gradient outside this space rose to its constant value for the positive column.

On the Nature of Electricity and Magnetism, and a Determination of the Density and Elasticity of the Ether.—By Prof. A Fessenden, Western University of Pennsylvania.

Fourier's idea of dimensions, as shown by his definitions, was explained, and it was pointed out how these have been departed from by later authors in suppressing dimensions, thus making the formulæ merely a question of units. It was shown how Fourier's ideas may be applied to the problem of the solution of the nature of electricity. All electrical phenomena, whose laws can be formulated in relation to mechanical quantities, are contained in the following three equations:—

$$1 - q/b :: k/u$$
$$2 - ku :: \mathrm{T}/\mathrm{L}$$
$$3 - qb :: \mathrm{M\,L/T}$$
$$4 - qu :: \mathrm{Z}$$

Having but three equations and four unknown quantities (q : : quantity of electricity, b : : quantity of magnetism, k : : specific inductive capacity, and u : : magnetic permeability), we cannot directly solve. Putting, however, q equal to an unknown term, z, and g i, we may obtain all possible theories of electricity, including those already proposed by Lodge, Kelvin, Heaviside and others. For example, if Z be put equal to L T, then k becomes a density, u the compliancy, &c., as given in one of Heaviside's theories. For the solution we must get a fourth equation.

A sketch of work extending over a number of years in search for this fourth equation and its discovery found in the relation between velocity of sound and electric conductivity; other relations were discovered, but none giving a new equation.

Williamson's proof that either k or u must be a density. This proof incomplete. Proof made complete, and same results obtained by two other methods. How to decide which is the density.

We have relations between q and b, and k and u; we must therefore look for relation between q and u, or b and k, *i.e.*, between H and u and v and k. This leads us to the above conclusion through the above three equations.

1. "Either k varies inversely with v, or u with H."

2. "The coefficient which varies inversely with the corresponding intensity is a compliancy."

This gives a touchstone for detecting which of the two theories is correct. It is then shown that k does not vary inversely with v, but that u does with H. Therefore k is a density and u a compliancy. Part 2 of the paper contains additional proof. Shows that the effects of stress, permanent strain, change of composition and elastic properties all agree with this theory and give the results predicted by it. It is shown that all magnetic properties of iron can be expressed by two coefficients, and it is shown that the hysteresis coefficient is equal to one of these multiplied by a constant.

It is also shown that there is a single relation between the density of substances and their specific inductive capacity, and that we are thus enabled to determine the density of the ether. This is done. It is also shown that the variation of density with temperature and with change of state follows this theory.

Part 3 contains an account of the experiments made to establish the relation between H and u and of the precautions taken to avoid error. Curves are given showing results.

The Dielectric Strength of Oils.—By Prof. Thomas Gray, Rose Polytechnic Institute.

At last meeting of this association the author presented an account of some experiments on the dielectric strength of insulating substances, in which the results for oils were somewhat uncertain, and it had been found difficult to form any very decided opinion as to whether the dielectric strength of a layer of oil is or is not proportional to the thickness of the layer. During the past spring Mr. C. E. Keyes, a member of the graduating class at the Rose Polytechnic Institute, continued the experiments on oil. Mr. Keyes directed his attention largely to the questions of proportionality of strength to thickness and the effect of filtering through drying materials like calcium chloride. The difficulties experienced last year, due to the variations of the dielectric strength under continued electric stress, were again met with. It was found that filtering through chloride of calcium or leaving the oil for a day or two mixed with that substance did not remove the trouble and almost always reduced the strength considerably. By making a large number of measurements in cycles of varying thickness of layer and then averaging the results, considerable evidence was accumulated which went to show that the dielectric strength per centimetre thickness is greater the thinner the layer tested. Oil seems, therefore, to agree with gases and most solids in this respect. The author stated that the subject is not by any means closed, but he gave a few of the average results as an indication of the evidence obtained. The absolute value of the dielectric strength is largely a function of the length of time during which the oil has been subjected to electric stress. A considerable number of oils were tested, and many of the samples gave results of a very erratic character. It seems probable that there is a gradual change in the dielectric properties of these liquids while under stress. Possibly the whole difficulty is due to a species of polarisation which may be most marked close to the place.

In the following table the numbers in the headings are the thickness of the layers tested; the first column contains the name of the oil and the numbers in the body of the table are the dielectric strengths in kilovolts per centimetre:—

Kind of oil.	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.
Vaseline	131	120	109	103	105	95	96	91	...	...
Paraffin, 28 G. ...	91	81	76	71	73	70	69	70	72	...
Paraffin, 26 G. ...	101	89	85	79	79	71	66	64	62	60
*N.W.V.O., 29 G.	81	79	74	72	69	62	63	62	60	...

* Natural West Virginia crude oil from 29-30 gravity.

Polarisation and Internal Resistance of Copper Voltameter.—By Prof. B. E. Woods, University of Nebraska, Lincoln, Neb.

The polarisation of electrolytic cells by means of direct current is usually measured upon an independent circuit after the polarising current is removed. The charge from the one circuit to the other cannot be made instantaneously and the polarisation actually measured is less than the maximum. This has its effect upon the apparent internal resistance, r, which is calculated from the formula, $r = \frac{\mathrm{E}-\mathrm{P}}{i}$ where E, P and i are the applied electromotive force polarisation and current respectively. Values of r thus obtained decrease erroneously with increasing i. The experiments indicate that this arises from a failure to measure the maximum of P. This is shown by measuring P at different time intervals after the removal of the current. The time intervals vary from ·00005 to ·045 of a second. The results indicate that constant resistance for all current strengths would probable be obtained if the polarisation could be measured in zero time after the removal of the polarising electromotive force. Measurements were made with the condenser and ballistic galvanometer and the circuits were manipulated by a swinging pendulum. The smallest time interval is very near the time required to charge the condenser through the apparent electrolytic resistance. Therefore shorter time intervals, though desirable, can hardly be obtained by the condenser method. However, greater accuracy in the determination of the shortest time interval is possible and desirable. The observations are limited to the copper voltameter with different size plates.

An Absolute Determination of the E.M.F. of a Clark Cell.—By Prof. H. S. Carhart and K. E. Guthe, University of Michigan.

The paper gives an account of the continuation of experiments made with an absolute electro-dynamometer for the determination of electrical units. While last year the electro-chemical equivalent of silver was redetermined, this year by practically the same method the E.M.F. of the Clark standard cell was found. As a result of the measurements, E = 1·4333 volts at 15° C.

The Equipment and Facilities of the Office of U.S. Standard Weights and Measurements for the Verification of Electrical Standards and Measuring Apparatus.—By Dr. Frank A. Wolff, jun.

The paper briefly outlines the steps so far taken by the office of standard weights and measures for the verification of electrical standards and measuring apparatus submitted by institutions, the trade and by individuals. A description is given of the preliminary standards of references adopted, the methods of comparison employed and the accuracy obtainable as shown by comparisons already made.

To fix the value of the preliminary standards of resistance pending the construction of a number of mercury units, frequent comparisons are to be made of the present standards with each other, with mercury copies, the construction of which is to be taken up immediately, and with new coils known to the highest degree of precision in terms of Reichs-Austalt mercury units, and therefore in terms of the B.A. coils.

The unit of electromotive force will similarly be fixed by a construction from time to time of new Clark and cadmium cells from specially purified materials by the frequent intercomparison of the old ones of each type with each other, and by the determination of the ratio from time to time of the Clark and cadmium cells of the office.

The object of the paper is mainly to announce to the public in general this enlargement of the scope of the work and its policy to guarantee the highest present attainable accuracy.

Effect of Magnetisation on the Modulus of Elasticity.—By Prof. J. S. Stevens, University of Maine.

It has already been found (Cornell Lab.) that temperature changes

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affect the modulus of electricity. This experiment tested the effect of magnetisation. Steel and wrought-iron bars 60 × 1 × 0·64 cm. were used, and loads of 1 kg. and ½ kg. fastened to the centre. These caused a deflection. When the rods were magnetised by forces ranging from 19·9 to 126 C.G.S. units, the deflection was decreased, showing that magnetisation increases the modulus.

The change in deflection was increased by an interferometer, one plate of which was fastened to the bar, and the motion read in wave lengths of light. Temperature changes were guarded against —(1) by a stream of water flowing between coil and rod; (2) by testing with a sensitive thermometer; (3) by noticing that the change in deflection was always sudden; (4) by discovering no change in a copper rod.

The measurements were not considered sufficiently exact to enable it to be stated that there is a regular relation between magnetic force and the modulus increased with the magnetising force.

THE STRESSES IN STEAM ENGINES, WITH SPECIAL REFERENCE TO ELECTRIC TRACTION.

II.

In commenting upon this subject it was the writer's intention to say something on circuit breakers, never having seen a traction plant without some form of circuit breaker; it was something of a surprise to read Mr. Taylor's criticism, which was based apparently on the impression that the first article had been intended to apply to a plant without a circuit breaker. It was, however, simply written on the assumption that circuit breakers, as usual, did exist, and that they would act as desired. It cannot, however, be denied that in the best of plant, apparatus may sometimes fail, and it is a matter on which very wide ranges of opinion may exist, as to how far a plant must be saddled in perpetuity with a charge designed to meet a case that may never arise. American bridges, for example, are sometimes designed to resist wind stresses of 56 lbs. per square foot, when not loaded. When loaded, however, a wind stress of 30 lbs. only is provided for, the reasoning being that anything over 30 lbs. will overturn the train and wreck the bridge, and, in brief, it is as well to be hung for stealing a sheep as a lamb. It is a little curious that Americans, who have so long been reviling English wastefulness of material—they call it ignorant clumsiness—should now be under criticism on the same score. In most instances our English clumsiness has proved correct practice, and American clumsiness seems to be genuinely the other thing. In providing excessive shaft strengths to meet a possible failure of circuit breakers, an engine is charged in perpetuity with a constantly acting brake. The question is thus: Will it pay? It seems to be an axiom of good design that such enormous stresses should be provided against by arranging the parts so that they cannot receive excessive stresses, not that they should be clumsily strong to withstand them. In rolling mill work excessive stresses are so common, and practically outside of design to provide for, that breaking pieces are introduced whose sole duty is to break when the stress exceeds a certain figure. It would have been better had the Glasgow engines been designed with a breaking piece between the fly-wheel and the generator than that the whole structure should have been excessive. Breaking pieces can be cheaply made and can be kept in stock and rapidly changed. But in traction work it is not impossible to design in such a way that the stress due to a short circuit shall not come upon the shaft. To show this up clearly a little steam engine history may not be out of place. Sixty years ago a very usual factory engine was a single beam engine. A large fly-wheel was fixed on the shaft and revolved close against the engine house wall. On the other side of the wall was placed a large spur wheel also on the engine shaft. All interchange of energy between the fly-wheel and the spur-wheel had to pass down the fly-wheel arms, through the keys, along the shaft, through the keys of the spur-wheel, along the arms of this, and so to the teeth.

Had the exchange of energy been very great many shafts would have twisted off. Probably a good number of old cast-iron shafts did break. But in due time all this stress was abolished by one of two systems of construction. One system was that of Fairbairn, who fastened the toothed rim outside the rim of the fly-wheel; hence arose the spur fly-wheel. The other system consisted of casting a bracket on each fly-wheel arm a short distance inside the rim and fixing the toothed rim segments to these brackets. Obviously, in neither case did any transfer of energy take place through the shaft. This served merely to transmit the maximum steam pressure stress to the fly-wheel, and all further stress was dealt with between the fly rim and its load or work. In the Glasgow engines the fly-wheel is properly placed, so far as it protects the engine from sudden and excessive loads, but it is placed on the opposite end of a piece of shaft from that occupied by the generator, and this bit of possibly heavily stressed shaft ought to be the breaking piece, and should be designed as such. Now it is bad design to have what is really looked on as a breaking piece and yet not to design it as such. The suggestion is obvious; reform it altogether by designing a fly-wheel generator. These are made, and have been made. Would not the present be a very suitable time for the question to be discussed? American practice seems to favour a type of generator for traction work which does not possess in itself any qualities of the fly-wheel. The large engines intended at one time to have been employed at Deptford in electric light work would have furnished a good illustration of the suitableness of fly-wheel generators. The present writer has dealt solely with the mechanical and structural side of the question. The fly-wheel generator would at once protect the engines as now a fly-wheel protects them from undue stress, and it would abolish the necessity of abnormal shaft diameter to meet the possible stress arising from a dead short, and not dealt with by circuit breaker, this being assumed to fail. The question is one which deserves attention, for by continuing the use of a generator only connected to the fly-wheel through the medium of a common shaft, there is introduced an element of uncertainty against which the only safeguard is the circuit breaker.

From the tone of Mr. Taylor's criticism there appears, in his mind at least, a certain doubt of the circuit breaker. Given a perfectly satisfactory fly-wheel generator, it would then appear that the enormous stresses of which we have heard so much have been driven into the connection between the fly-wheel and the generator, and any result of a short will be a burn-out. If, on the whole, the circuit breaker is a reliable article, it will prove cheaper to risk a burn-out than a break. But if the circuit breaker is to fail frequently, it might easily prove cheaper to revert to present construction and put in the designed breaking piece.

The reliable character of circuit breakers is certainly an assumption underlying much American engine practice, for the only breaking pieces are the crankshaft and crank pin, through which the stress, described by Mr. Taylor as probably 1,000 per cent. of ordinary stress, is compelled to pass. Does not this prove the generally reliable quality of circuit breakers?

Finally, where a generator must be of such a type as to demand a separate fly-wheel, it would appear to be good practice to allow the necessary shaft strength, by placing both the wheel and the generator on a shaft of sufficient strength, but avoiding the use of such excessive diameters at the bearings. In a pair of engines with generator between this is readily arranged. That this has not been done is evidence that the location of stresses has been little studied.

THE B.A. PRESIDENTIAL ADDRESS.

The address of Prof. Sir Michael Foster, K.C.B., Sec. R.S., the new president of the British Association for the Advancement of Science, delivered at Dover on Wednesday evening, contains very little that is of direct interest to electrical men. We extract the following, re electricity:—

"If there be one word of science which is writ large on the life of the present time, it is the word 'electricity'; it is, I take it, writ larger than any other word. The knowledge which it denotes has carried its practical results far and wide into our daily life, while the theoretical conceptions which it signifies pierce deep into the nature of things. We are to-day proud, and justly proud, both of the material triumphs and of the intelligent gains which it has brought us, and we are full of even larger hopes of it in the future.

"At what time did this bright child of the nineteenth century have its birth?

"He who listened to the small group of philosophers of Dover, who in 1799 might have discoursed of natural knowledge, would perhaps have heard much of electric machines, of electric sparks, of the electric fluid, and even of positive and negative electricity; for frictional electricity had long been known and even carefully studied. Probably one or more of the group, dwelling on the observations which Galvani, an Italian, had made known some 20 years before, developed views on the connection of electricity with the phenomena of living bodies. Possibly one of them was exciting the rest by telling how he had just heard that a professor at Pavia, one Volta, had discovered that electricity could be produced not only by rubbing together particular bodies, but by the simple contact of two metals, and had thereby explained Galvani's remarkable results. For, indeed, as we shall hear from Prof. Fleming, it was in that very year, 1799, that electricity as we now know it took its birth. It was then that Volta brought to light the apparently simple truths out of which so much has sprung. The world, it is true, had to wait for yet some 20 years before both the practical and the theoretic worth of Volta's discovery became truly pregnant, under the fertilising influence of another discovery. The loadstone and magnetic virtues had, like the electrifying power of rubbed amber, long been an old story. But, save for the compass, not much had come from it. And even Volta's discovery might have long remained relatively barren had it been left to itself. When, however, in 1819, Oersted made known his remarkable observations on the relations of electricity to magnetism, he made the contact needed for the flow of a new current of ideas. And it is perhaps not too much to say that those ideas, developing during the years of the rest of the century with an ever-accelerating swiftness, have wholly changed man's material relations to the circumstances of life, and at the same time carried him far in his knowledge of the nature of things."

On Thursday morning the Association settled down to the sectional addresses and discussions. Sections A and G are those in which electrical papers are generally read. The names of presidents, &c., are as follows:—

A.—Mathematical and Physical Science.

President.—Prof. J. H. Poynting, D.Sc., F.R.S.

Vice-Presidents.—Prof. W. E. Ayrton, F.R.S.; Prof. A. R. Forsyth, M.A., F.R.S; Prof. J. J. Thomson, M.A., F.R.S.

Secretaries.—J. L. Howard, D.Sc.; C. H. Lees, D.Sc.; Prof. W. Watson, B.Sc. (Recorder); E. T. Whittaker, M.A.

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G.—Mechanical Science.

President.—Sir W. H. White, K.C.B., F.R.S., Pres.Inst.M.E.

Vice-Presidents.—Sir Benjamin Baker, K.C.M.G., F.R.S.; Sir John Wolfe-Barry, K.C.B., F.R.S., M.Inst.C.E.; Sir W. H. Preece, K.C.B., F.R.S., Pres.Inst.C.E.; E. Rigg, M.A.

Secretaries.—Prof. T. Hudson Beare, F.R.S.E. (Recorder); W. A. Price, M.A.; H. E. Stilgoe, Assoc.M.Inst.C.E.

ELECTRIC RAILWAYS.

A special number of *Cassier's Magazine*, wholly devoted to electric railways, has appeared, and is a creditable production, though it may be doubted whether such a number is not rather out of the way of the true magazine. With nearly a score of writers on the same subject in its many details, it is certain there is a considerable repetition, and some want of variety. Probably the most interesting article at this juncture is that by Mr. F. S. Pearson on the "Conduit System." Someone has described New York as a village compared with London. Very probably New York is this in a certain sense—the sense of gas and water-pipe interference—but New York is big enough and bad enough to be able to produce some shockingly bad photographs illustrative of the conduit system—bad, we mean, for the system, for the pictures show a terrific amount of work involved in laying down a conduit system. And if so much in New York, what may not be expected in London? Cross-sections of New York streets show the work to be very heavy, and we much fear that if London is to wait for the conduit system, so easily laid down on the professional blackboard of experts, we shall never see a decent system in London at all. The author of the paper does not attempt to disguise the expense of the conduit system.

Mr. Benjamin Taylor contributes an article on "Municipal Tramways," which is of special interest. He shows that where municipal tramways have been a success, it has been in spite of, rather than because of, municipalisation.

Mr. Abbott, who writes on electrolysis, points out that very little is now heard of this evil, even in America, and if this be so there can be very little prospect of trouble with our B.O.T. rules as to "drop."

Mr. Lloyds writes hopefully on batteries, for long hardly used in America, but now often put in with very large systems. Usually 250 cells of as much as a ton each are installed. They are wood, lead-lined, and in an optimistic vein the battery is prophesied to take care of all load above average. If this desirable consummation could be attained, what a difference would come over traction work! Plain factory engines would run under steady load so many hours a day. The Metropolitan Company of New York has two battery plants of 540 cells each. These cells measure 4 feet × 21 inches × 24 inches, and are placed in two sections of 270 cells each, operated in parallel. The capacity is 8,000 ampere-hours with a one-hour rate of 4,000 amperes. The battery acts as an equaliser, levelling up or down all fluctuations. A third similar battery is being installed.

The Southside line in Chicago formerly showed a maximum load of 7,500 amperes, and a sudden fluctuation of 5,300 amperes. With batteries the maximum load is 5,700 amperes, and the variation only 2,000 amperes.

We need now to see another article on battery maintenance.

A most interesting article is that of Thorburn Reid on "Early Traction History." The year 1835 is the oldest recorded date of electric traction, when one Davenport, of Brandon, Vermont, drove his motors by primary batteries.

Naturally, the whole of the articles have a strong trans-Atlantic bias, and in the midst of so very much laudation of quantity, it is not difficult to pick out facts that point to a good deal of not particularly first-class quality; not but that perhaps a good deal of cheap American construction has enabled lines to be built where otherwise they could not have been. Here we have delayed so much, that we have lost more than would have built cheap lines, and reconstructed them. Perhaps the worst grumbler at the ways of this side is Mr. R. W. Blackwell; but why he should grumble is not very clear. He has secured his share of the work going, and we believe that competition has so far left him quite a decent profit on his prices. We know whereof we speak.

Finally, there is another recurrence of the inevitable City and South London Railway so oft described, but we do not see why the power house should have been illustrated, unless to show, for the benefit of Americans, that it is driven by ordinary non-weighted engines, for there are glaring faults visible in the picture; for example, dynamos with their pulleys far below the engine pulley, and this gross fault counteracted by another as bad, namely, a jockey pulley. When will engineers learn never to run a belt down hill if it can possibly be avoided?

The magazine is further embellished with the worst collection of portraits of the 18 contributors it has ever been our lot to see. We can only trust that they are peaceful men and will not visit the sin upon the editor, who was evidently so worried as to allow one block to be placed upside down.

We cannot think that on the whole the electric railway number has been a success. The subject is not one that appeals to the public as does a naval subject. A singular misprint occurs in Mr. Brill's article on cars. He speaks of the Blackpool Tunnel in London having been once worked by ropes prior to 1873, evidently meaning the old Thames Tunnel.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

17,372. "Improvements in collectors for electric tramways on the overhead conductor system." J. Kalte, H. D. Becker, M. Sees, M. Ely and P. Robinson. Dated August 28th.

17,379. "Improvements in electric arc lamps." O. B. Hellstrom. Dated August 28th. (Complete.)

17,410. "Improvements in electric accumulators." R. Haddan. (R. Goldstein, Germany.) Dated August 28th.

17,411. "Improvements in negative electrodes for electric accumulators." R. Haddan. (R. Goldstein, Germany.) Dated August 28th.

17,417. "Improvements in and connected with electric fuses." G. C. Maas. Dated August 28th.

17,421. "Electroplating apparatus." L. Pothoff. Dated August 28th.

17,445. "Improvements in electric cables." G. E. Heyl-Dia. Dated August 29th.

17,454. "Improvements in and relating to supports for overhead electric conductors." A. Anderson and J. M. Andersen. Dated August 29th. (Complete.)

17,472. "Improvements in continuous electric ringing bells." C. R. Jeary. Dated August 29th.

17,474. "Improvements in electric massage apparatus." T. Berndt. Dated August 29th. (Complete.)

17,477. "Improvements in mouldings for electric wires and other purposes." M. Chase, De F. W. Chase, G. Code and E. Planta. Dated August 29th. (Complete.)

17,486. "Improvements in or relating to electric indicators." H. L. Howard and L. H. Cline. Dated August 29th.

17,504. "Improvements in means and apparatus for recording deflections of pointers, magnetic needles, coils, and the like, and the fluctuations of electric current, and for utilising such deflections or fluctuations to actuate or control various other mechanisms or apparatus." E. A. Goddin. Dated August 29th.

17,507. "Improvements in electric lamps with illuminating bodies made of second-class conductors." V. I. Feeny. (Allgemeine Electricitats Gesellschaft, Germany.) Dated August 29th. (Complete.)

17,510. "Improvements in electricity meters." W. C. Johnson and T. J. Murday. Dated August 29th. (Complete.)

17,512. "Electrical induction apparatus for igniting combustibles, gaseous charges in gas or oil motors, and the like." J. Hardeln. Dated August 29th.

17,547. "Improvements in or relating to overhead systems for electric transmission of energy." P. J. Tyrrell and J. Tyrrell. Dated August 30th.

17,553. "Improvements in electric dynamos for continuous currents with unipolar induction." O. A. Zander and B. Ingestrom. Dated August 30th. (Date applied for under Patents, &c., Act, 1883, Sec. 103 February 11th, 1899, being date of application in Sweden.) (Complete.)

17,593. "Improvements in transmission dynamometers or torque indicators." A. M. Morgan. Dated August 31st.

17,707. "Improvements in and relating to electric incandescence lamps." V. I. Feeny. (Allgemeine Elektricitats Gesellschaft, Germany.) Dated September 1st. (Complete.)

17,715. "Improvements in appliances for cutting off the current from electric elevator motors, and for arresting the fall of the car." J. H. Johnston and W. R. Weeks. Dated September 1st. (Complete.)

17,719. "Improvements in or connected with variable rate electric meters." J. G. Lorrain. (H. A. Macdonald, France.) Dated September 1st.

17,722. "Improvements in telegraphic apparatus." A. C. Crehore and G. O. Squier. Dated September 1st.

17,733. "Improvements in connection with electric lamp and like apparatus for signalling, advertising, and similar purposes." C. E. Kelway. Dated September 2nd. (Complete.)

17,763. "Improvements in electric switches and regulating appliances." J. D. F. Andrews. Dated September 2nd.

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17,772. "Improvements in systems of, and apparatus for, electrically transmitting and receiving signals, partly applicable to other purposes." P. M. Jerrard. Dated September 2nd.

17,774. "Improvements in ammeters." W. C. Johnston and T. J. Murday. Dated September 2nd. (Complete.)

17,786. Improvements in electric telegraph apparatus." S. G. Brown. Dated September 2nd.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

2,804. "An electric time switch." W. P. Thompson. (The Self-Winding Clock Company.) Dated February 1st, 1898. Relates to improvements in electric clocks and time switches. Consists in a combination in a system of electrical distribution of a circuit forming a part of the system with a switch controlling such circuit, an electrically energized clock, and electric connections for energizing it, a separate electrically energized secondary device acting under the control of the clock to open and close the switch in indefinite repetition and electric connections for energizing said secondary device. 12 claims.

4,317. "A trolley connection for canal boats." F. J. Shewring. Dated February 21st, 1898. Consists of providing the canal boat with a rigid trolley pole reversibly and permanently attached to the boat, a gravity balanced trolley consisting of two trolley wheels journaled in a frame having two depending arms united by a counter-balance, a rod connected to the arms, and a slding ring mounted on the rod, to which and to the arm of the trolley pole is attached a wire. 3 claims.

4,803. "Improvements in primary batteries." J. E. Fuller. Dated February 28th, 1898. Relates to apparatus for generating electricity. Consists in churning the solution while in use as to keep it from polarizing. 16 claims.

5,008. "Improvements in and relating to the carbon feeding mechanism of electric arc lamps." C. Wood. Dated March 1st, 1898. Consists in mounting above the electro-magnets two jointed arms or levers, one having preferably two arms of the first order, and the other one arm of the third order. These are jointed one above the other on a common bracket, and are only connected through the brake band which passes round the brake weeel, and is connected to the ends of the levers. The levers are so mounted that the end of the set screw carried by the one in their movement travels up and down upon the inclined part or projection through the diffferent ratios of the particular throws of their arms. 8 claims.

5,550. "Improvements in and connected with dynamo-electric machinery." M. T. Pickstone, R. S. Portheim, and A. C. Peebles." Dated March 7th, 1898. Relates to a new self-oiling bearing, a new form of commutator, a new form of brush-holder, and a new form of coil former insulation. The bearing consists of a metal covering attached to which are two bosses. The commutator consists in attaching copper connecting pieces to the inside of the commutator sections, insulating them and clamping them together by metal bush rings. The brush-holder consists of a metal casting, the upper portion of which is machined out to form a slide and to the bottom portion of which is fixed a circular disc which is rigidly attached to a rocker spindle. A circular metal sleeve provided with two projections revolves on the disc, and one of these projections press against a similar projection fixed on the brush carrier casting. The other projection on the sleeve contains a compression screw which presses against a suitable spring which is in abutment with the fixed circular disc. The coil former consists of a metal coil former adapted for field-magnet winding and covered with any suitable insulation. 4 claims.

8,147. "Improvements in the electrolytic treatment of ores and slimes for the recovery of precious metals therefrom and apparatus therefor." H. Riecken. Dated March 12th, 1898. Relates to the electrolytic treatment of ores and slimes for the recovery of metals, chiefly gold. Consists of an open vat made of wood and lined at the sides and bottom with sheet copper which is silver plated. The sides are inclined. At the bottom is a trough for the collection of mercury and at the top a perforated pipe for distributing the mercury over the sides. The gold forms on the copper sides over which the mercury flows. The anodes are of carbon fixed to a shaft which traverses the vat, and which is rotated or oscillated by any suitable means. It is connected to the positive pole of a dynamo, the lining of the vat being the negative pole. 6 claims.

6,704. "Improvements in switchboards for the control of high voltage electric circuits and apparatus." H. F. Parshall. Dated March 19th, 1898. Relates to improvements in switchboards. Consists in using the switchboard as an insulating partition between the switch contacts. 3 claims.

6,602. "Improvements in resistance apparatus for regulating electromotors." Siemens Bros. & Co., Ltd. (Siemens & Halske Aktien-Gesellschaft, Germany.) Dated April 27th, 1898. Relates to the starting of shunt electromotors. Consists in employing in place of two sets of resistances only a single set, which is used consecutively for starting the motor and for subsequently weakening the magnetic field. The whole of this set of resistances is employed on one and only a part on the other motor circuit. 2 claims.

9,778. "Improvements in plates for electric accumulators." M. Bernstein. Dated April 28th, 1898. The plate is provided interiorily with a gas chamber, so that gas can be passed in which is capable of renewing the active material. It is specially intended for vehicles. 1 claim.

8,881. "Improvements in means and devices for electrically lighting coin-freed apparatus for displaying pictures." A. W. Witt and M. W. Strikeman. Dated April 29th, 1898. Relates to coin-freed apparatus. The light is given by an electric incandescent lamp in connection with a battery in the apparatus, and is switched on when a handle, which also operates the transparencies, is pushed in and off when allowed to spring out. 2 claims.

10,333. "Improvements relating to electric signalling and similar apparatus." L. S. Crandall. Dated May 5th, 1898. Relates to electric signalling and refers to Specification 13,686, 1895. A monogrammic grouping of lamps is under the control of lock keys. Before the signal proper is lighted, a sight check can be seen. 6 claims.

10,816. "Improvements in automatic apparatus for receiving the charges for telephone conversations and telegrams." C. M. Ericsson and S. Ritter. Dated May 9th, 1898. The coin in the coin-controlled apparatus in falling strikes a gong. The sound is transmitted by the telephone to the operator who does not make the required connection till this is heard. If the connection cannot be made the coin is automatically returned. 3 claims.

10,647. "Improvements in electric incandescent lamps." W. J. Phelps. Dated May 10th, 1898. Consists in a novel construction of the lamp base, whereby a multi-filament lamp may be used interchangeably with ordinary lamps, and in the advantageous use of one or more filaments as relatively dark resistance to modify the current for one or more other filaments within the vacuum. 5 claims.

10,650. "Improvements in and relating to electric arc lamps." F. A. Gilbert and E. O. Lundin. Dated May 10th, 1898. The armature of the solenoid on a tube surrounding the upper carbon. The upper end of this having a piston to enter a centrally supported dash pot at the top of the lamp. The clutch is mounted at the other end of the tube. When the upper carbon is burnt out it drops on to the lower, thus preventing damage to the lamp. 18 claims.

11,360. "Improvements in globe holders for enclosed electric arc lamps." K. Weinert. Dated May 18th, 1898. Consists in detachably securing the globe in position by means of an air tight elastic easily loosened holder, comprising a ring placed under the upper edge of the globe and furnished on its outer edge with recesses, inclined running surfaces and projections. 2 claims.

12,866. "Improvements in electrical circuit controllers." H. H. Lake. (N. Tesla, United States.) Dated June 8th, 1898. Relates to a circuit controller comprising in combination a receptacle containing a conducting fluid, means for rapidly rotating the receptacle or the fluid therein, and a terminal or terminals supported within the receptacle and adapted to make and break electrical connection with the fluid. 52 claims.

13,011. "Improvements in electric arc lamps." The British Thomson-Houston Company, Limited. (H. C. Spinney, United States.) Dated June 10th, 1898. Relates to lamp clutches, and particularly those in which the clutch works directly on the pencil. Consists in an arrangement by means of which the weighted follower may be removed to insert the carbons and then be replaced. 12 claims.

13,707. "Improved electro-acoustic telegraph with Morse transmitter." N. Flocktenmacher. Dated June 20th, 1898. Consists in a manipulator in conjunction with a Morse transmitter in which the anvil contacts, against which the contact screws of the lever of the manipulator strike, are supported by springs for the purpose of minimising the noise. 7 claims.

13,781. "Improvements in automatic electric block signal systems for railways." L. C. Werner. Dated June 21st, 1898. Consists of the combination of a track having a sectional conductor forming insulated blocks, with a vehicle movable along the track, a primary electrical register controlled by a block circuit, and a separately operative secondary electrical register controlled conjointly by the primary register and a block circuit. 7 claims.

14,959. "Switch and contact apparatus for the cars of electrical railways and tramways." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated July 7th, 1898. Relates to the Elektrotechnische Auzeiger, No. 28. Consists in an arangement by means of which the attendant is obliged on leaving the part of the line with the overhead conductor to disconnect the current collecting appliance from the car circuit in which current under pressure exist's. 2 claims.

15,028. "Improvements in the manufacture of electrodes for secondary batteries." H. J. Haddan. (C. Francke, Germany.) Dated July 8th, 1898. A flat grating of lead, without a core, is pressed together mechanically so that the bars forming the grating lie tightly together, leaving small intervals, and thus a plate body expansible in the direction of pressure is produced. 3 claims.

15,246. "Improvements in automatic break apparatus for electric currents." T. B. Kinraide. Dated July 12th, 1898. Consists in making the standard perfectly rigid, and apparatus for keeping the hammer in accurate alignment with the core end and anvil. The connecting surfaces are revolved so that the sparking may wear them evenly. 13 claims.

15,347. "Improvements in electric switches." J. G. Dixon. Dated July 12th, 1898. Consists in forming the contact making blade, with a V-shaped end and to this V end a suitable number of copper strips of the same formation are attached. The strips form the contact making brush, and when contact is made their ends bear against sliding terminal blocks which are adjustable by set screws. 2 claims.

16,602. "Improvements in drums for holding electric cables and in covers to be used with such drums." T. Oxley. Dated July 30th, 1898. Consists in forming the barrels and flanges of drums of steel or iron plate, and form covers to be used with drums of connected lags of wood or steel or iron, or corrugated steel or iron. 11 claims.

16,714. "Improvement in systems of electrical distribution." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated August 2nd, 1898. Relates to a system of electrical distribution, and comprises means by which it is possible to obtain polyphase currents for operating polyphase motors or other translating devices by interlinking a number of sources of alternating electro-motive forces in such a manner that a desired difference of phase is maintained between the different machines, which difference is staple. 17 claims.

18,836. "Improvements in controllers for electric motors." The British Thomson-Houston Company, Limited. Dated September 20th, 1898. Relates to controllers for electric motors. Four or more electric motors are combined. A switch is provided for each of the motors for operating them in pairs, in series, or in parallel, and for cutting in and out resistances in any desired manner, in affecting the change in speed or connection, and a cut-out switch for each motor. The contacts and connections are so arranged that when any of the cut-out switches are operated the remaining motors will be connected only in parallel, and be regulated by the resistance steps of the controller. 6 claims.

18,837. "Improvements in or relating to electric braking apparatus, adapted especially for use in electric tramways." The British Thomson-Houston Company, Limited. (J. B. Linn.) Dated September 20th, 1898. Relates to electric braking apparatus, and has for its object to provide a system of connections which will obviate the slipping of wheels which occur when the brake is applied with too great a force. This is done by connecting the armature of each motor to the field of the other in a two-motor equipment. By this arrangement when the brake shoe upon any axle checks the rotation of the axle too much, the motor upon the sticking axle ceases to generate current, and the field of the other motor is killed, the shoe is released when the axles begin to revolve. 4 claims.

18,836. "Improvements in safety devices for dynamo electric machines." The British Thomson-Houston Company, Limited. (E. M. Hewlett.) Dated September 20th, 1898. Relates to a speed governor and a circuit interruptor combined. The invention is described as being applied to a steam engine. As long as the steam engine is running below a certain maximum speed, the governor rotates without effecting the switch or the valve, but when the speed rises beyond the maximum desired, a pin strikes the adjusting screw in the end of a slot, pulls a bar and trips a latch; a weight then drops, cutting off steam from the engine, at the same time the switch blade is drawn across the contact closing the circuit of the shunt coil and opening the circuit braker. 6 claims.

18,838. "Improvements in safety devices for dynamo-electric machines." The British Thomson-Houston Company, Limited. (E. M. Hewlett.) Dated September 20th, 1898. The dynamos in connection with the driving engines are in the electric circuit. The engine governors are connected mechanically to the engine and electrically to a source or current, so that if the engine races the governor will operate the mechanism and automatically shut off the power supply, and cut out the dynamos from the circuit. 6 claims.

18,841. "Improvements in electrostatic measuring instruments." The British Thomson-Houston Company, Limited. (E. Thomson.) Dated September 20th, 1898. Relates to electrostatic measuring instruments designed to measure high potentials, in which the combination of a vibrating needle, vanes for moving the needle, stationary inductors acting upon the vanes, a scale plate over which the needle moves, a case surrounding the instrument having a glass covered opening and a wire screen electrically connected to the case located over the needle. 12 claims.

21,046. "Improved means for driving the speed indicators of electric motors." The British Thomson-Houston Company, Limited. (E. J. Berg.) Dated October 6th, 1898. Relates to apparatus whereby the drop in speed of an induction motor at the receiving station may be made known at the generating station. Use is made of the fact that currents are developed in the induced member of the motor of a frequency corresponding to the slip. By tapping the windings of the induced member at suitable intervals currents may be taken off of a frequency corresponding to the slip. If these currents be conducted to the generating station and the frequency of the currents there measured, a result is obtained indicative of the speed of the induction motor. 9 claims.

21,240. "An improved telephone call counter." F. M. Richter. Dated October 8th, 1898. Relates to telephone call counters. On inserting a connecting plug into a plug sleeve of the telephone switch double levers and a pallet are moved to operate the pallet mounted on a shaft to engage a pallet wheel, thereby turning the same half a tooth, whereas on removing the plug the double levers and pallet are returned to their initial positions, the broad tooth of the lever simultaneously completing the movement of and arresting the pallet wheel until the plug is again inserted. An arresting device is mounted on the shaft for preventing the registration of calls not effected. 2 claims.

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THE

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THE

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1899

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THE OPERATION OF ELECTRIC TRAINS.

THE operation of an electric railway, as distinct from an electric tramway, brings a new set of conditions into existence, and probably this is better realised to-day than it was 10 or 12 years ago, before the economy and efficiency of electrically propelled tramcars had been demonstrated.

When electricity was first employed for working a railway service, it was not surprising that the locomotive system should have been followed, and for sentimental reasons an electric train with a locomotive in front appeals more to one's sympathies than two or three cars gliding along without any perceptible source of motive power. The most conspicuous instances of trains operated by electric locomotives are on the City and South London Railway and on the Baltimore and Ohio Railway, and in neither of these cases could it be said that the system had not achieved a most striking success.

The later practice in electric train services has been in the direction of employing one or more cars fitted with electric motors, the control and development of the power, however, coming from one car, according to the direction in which the train is travelling. The disadvantages of such a system were not very obvious where the trains were specially made to meet the new conditions, and where, as a rule, lighter vehicles and shorter trains were used than would be generally employed on a steam railway. When, however, the necessity arose of converting existing steam lines into electric, the current systems of electrical operation were somewhat at a disadvantage. We believe we are correct in saying that the experiments that are being conducted on behalf of the Metropolitan and District Railway Companies to test the applicability of electricity to railway working, are on the lines of previous electric railway practice in this country. It is doubtful, however, if such experiments will be conclusive as regards the economy and efficiency of electrical working. It would have been distinctly interesting, and the chances of success might have been greater, if a system similar to that of Mr. Sprague's (which is now known as the multiple unit system) were employed. Reference has been occasionally made in these columns to the principal features of this method, and doubtless many of our readers are familiar with them. A train on such a system would be made up of a number of independent cars, each of which would be completely equipped with motors and controlling apparatus. The conditions fulfilled by such a train would be the simultaneous control of two or more independently equipped motor cars, to start, accelerate, and operate at any speed up to their maximum, to slow down and apply automatic brakes, all with practically uniform effect in each and every motor car.

One of the most striking advantages possessed by such an arrangement is the possibility of shortening or lengthening the train to any reasonable extent without affecting the time of the service. One can hardly help speculating

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on the losses that must arise on most of our suburban lines during periods of light loads. On the Metropolitan Railway one sees during certain portions of the day trains passing backwards and forwards comparatively empty, and probably the whole of the passengers could be, without inconvenience, p'aced in one car. At other times trains are inconveniently crowded, and doubtless the enormous rush, necessitating long trains and heavy loads, means unpunctual service. An electrical railway employing a multiple unit system would be able to add cars up to the capacity of the platforms, and there ought not to be the slightest falling off in speed. In other words, as Mr. Sprague has already pointed out, such a system gives any required rate of acceleration or schedule speed up to the maximum, thus giving the highest schedule with any given maximum, and the lowest maximum with any given schedule. Necessarily the distribution of the driving power throughout the train needs a less weighty driver than would be required if a separate locomotive were employed, and this fact, to some extent, affects the question of bridges and overhead structures. Although the system, so far as theory is concerned, has been well known for some years, it is only within the last two years that it has been practically adopted in actual railway practice. In 1897 the Chicago Elevated Railway adopted the system on the advice of Mr. Sprague, and one of the conditions that had to be met was, that the method of control was to be such that any number of cars so equipped could be coupled together indiscriminately without regard to their sequence; and, when so coupled, by identically the same movement, they were to be controlled from any selected point, at either end of any car, and the rate of acceleration, traction coefficients, speed, and braking conditions which characterise a single car were to be retained in a train unit no matter what the number of cars. At the present moment some 120 motor cars are employed on this line, and, judging only by the financial results, the system merits the most careful consideration on this side of the Atlantic. Taking two comparable periods, the difference in cost is most striking. In the case of steam the ratio of expenses to earnings, including taxes and licenses, amounted to 73·8 per cent., while in the case of electricity, the ratio of expenses to earnings was 45·4, and the total operating expenses per car mile, excluding taxes and rental, were less than 3½d. Although we are aware of the difficulty of making comparisons between this instance and similar lines in this country, it is very interesting to see how the cost of operation compares. The Liverpool Overhead line in the year ending 1897 had a ratio of expenditure to revenue of 65·54 per cent. On the City and South London Railway the working expenses were 56 18. One has to remember that these lines have the disadvantage of being much older systems, and doubtless they might even with similar plant show better results if they were designed to-day. The objection to the multiple system is that the method of control must necessarily need a somewhat complicated apparatus, and a certain amount of skill and care in connecting up and disconnecting separate units. We do not, however, look upon such a difficulty as insurmountable, and it has to be borne in mind that main currents are not carried from car to car, but the electrical connections are necessary only for carrying small currents. Naturally such an arrangement as the multiple unit means smaller motors for cars and a greater space on the car trucks; at the same time a distinct disadvantage is that every car is in a sense a locomotive, and a rigid inspection is necessary for every vehicle. We should imagine that repairs might occasionally figure largely; on the other hand, if a car breaks down it affects merely itself, and does not dislocate any other unit. It is difficult to realise that a multiple unit system would be less in first cost than a train drawn by an electric locomotive, though the special work on the locomotive might more than compensate for equipping every car with electrical apparatus. At any rate, the system has to-day reached such a state that no engineer responsible for the design of an electric railway can neglect it.

Luminous Rings in Rarefied Gases.

THE physicists of late have been much engaged in reviewing the achievements of their science during the century about to expire. They find that a few simple laboratory experiments, not considered to be of much account by contemporaries, have turned out in after years to have been the beginning of great revolutions in theoretical science or industry. Hence, perhaps, the marked tendency among the speakers at the British Association meetings to discover in every little novelty presented to their section the beginning of a revolution which is to change everything in the coming century. To the plain man there do not appear to have been many of the Volta, Davy, Faraday or Maxwell type at the Dover meeting. One exceedingly interesting experiment, however, was shown by Mr. C. E. S. Phillips. A glass bulb was fitted with two iron electrodes which projected into the tube till they nearly met in the centre. The tube was exhausted, and a discharge from an induction coil passed between the electrodes for a short time. The coil was then disconnected, and an electro-magnet applied to the electrodes so as to produce a strong magnetic field between the adjacent ends of the iron electrodes. Immediately a luminous ring appeared with its plane at right angles to the axis of the electrodes, and rotating about this axis. This ring was found to be negatively electrified. The plane of the rotation of the ring changes with the direction in which the exciting discharge is sent through the tube. The best explanation of this curious phenomenon given is that the rarefied air in the tube is dissociated by the discharge into positive and negative ions. The negative ions have been shown by J. J. Thomson to be much more mobile than the positive ions, and they are consequently set in rotation by the action of the changing magnetic field while the positive ions remain comparatively quiescent. Mr. Phillips deserves much credit for his highly interesting and original discovery.

A Third Class of Electrode.—Robert Luther has designed a form of cell in which there is obtained a reversible electrode of a metal which decomposes water, as, for example, the following: Lead in a mixture of calcium and lead sulphates in a solution of a calcium salt. In this case the potential difference at the electrode is $\pi = K \log. k_2/(Pb'')$, but $(Pb'') \times (SO_4'') = k_1$ and $(Ca'') \times (SO_4'') = k_2$; hence $\pi = K \log. k_3/(Ca'')$. The availability of such a form of electrode is proved by the determination of the E.M.F. of chains containing such electrodes of zinc with those containing ordinary electrodes, the values only differed by 0·001 volt. It is evident that the salts employed must be only slightly soluble, and must form no double compounds or mixed crystals. For further details consult *Zeitschrift für Physikalische Chemie*, Vol. 28, pp. 364—366.

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THE INTERNATIONALISATION OF SCIENCE.

The hearty reception which was given to the deputation of the French Association for the Advancement of Science which crossed the Channel early on Saturday morning last to attend the Dover British Association meeting, showed in a very conclusive manner that the narrowmindedness which has been recently evinced by newspaper writers and others over *l'affairs Dreyfus* obtains no sympathy or sanction from the sincere searcher after truth.

We have no doubt that every Englishman present at Dover was profoundly convinced of the guiltlessness of the most modern of French martyrs and the corruption existing among higher officials of the Republic of Liberty; but we have as yet failed to find in these conditions a reason for a rupture between scientific men of the two nations. Although science may do great things to help in the furtherance of the cause of peace, we hope that the day is far distant when political or like differences or disturbances will be allowed to interfere with the cordial relations existing between scientists all the world over. Science should be international, wide as the world, nay, it should be a nation of itself, a nation within nations. We showed to our cross-channel *confrères* on Saturday that whatever untoward events, to use the term of Sir Michael Foster in his presidential address, may rock a people in a turbulent sea of strife, they are without the sphere of science.

The question of next year's Paris Exhibition is one requiring more thought before it can be settled to our satisfaction. It must be calmly considered with slow deliberation. We do not intend to proclaim to the world at large that we shall boycott all electrical exhibitors who take part, and that we shall devote many columns to a description of the work of those who do not. This may be considered a wise stroke of policy for a contemporary, but we think it is a policy which should not have been proclaimed upon the house tops with the precipitancy which seems to have characterised it. Furthermore, it is not a policy which will be adopted by the Electrical Review, for we shall endeavour to see that *l'affaire* is not allowed to control in any way whatsoever the policy of a journal aiming to be a record of electrical science and its progress. We have other like feelings on this matter, but we will not write them—we will merely remark that the questionable policy of boycotting is by no means confined to journalists; it might prove to be a policy to turn and rend one.

Returning to the French visit, Section A mainly interests us. The meeting of the Association, as a whole, has been very poorly attended, as we indicated last week, and the proceedings without any particular excitement; but the monotony of A was certainly relieved by the discourse of Prof. J. J. Thomson "On the Existence of Masses Smaller than the Atoms," with its subsequent discussion, and the discourse of Dr. Oliver Lodge "On the Controversy Concerning the Seat of Volta's Contact Force," which had to be somewhat curtailed owing to the want of time. These addresses formed part of the arrangements made specially in honour of the French visit, and that of Prof. Thomson was followed by several speeches of welcome, worded in the most felicitous terms, as well as some remarks by Sir Norman Lockyer upon his work in the particular field of research which formed the subject of the lecture.

Sir George Stokes said he wished to show how cordially Section A welcomed their friends of the Sister Association across the Channel. The interchange of visits with its interchange of ideas—both associations alike being engaged in the search for truth which is common to the whole world—tended to draw together the heart of the two nations as well as to sharpen the intellects of the individual, and therefore tended not only to the promotion of knowledge, but to the cause of peace and brotherly kindness between different nations. After a few words from Sir George on the subject of the discourse, Prof. Rucker, in his official capacity as secretary of the Royal Society, made some remarks to welcome their French colleagues. He said that it was very curious how the tendency towards internationalisation of science was gaining strength day by day. It had fallen to his lot as secretary to the Royal Society to already attend this year one international meeting in which the great scheme for an international catalogue of scientific literature was discussed. It need hardly be said that a scheme so great was surrounded by difficulties, nevertheless there was a reasonable hope that an agreement would be come to which would help to the publication of such a work at the dawn of the new century. It had further fallen to his lot to go to Wiesbaden to meet German, Italian, and other friends to discuss the question of forming a union between the scientific academies of the world. Should this be carried out, and all those bodies put themselves into touch with one another, they would have reached that state of things in which they had an international court of arbitration to which disputes could be referred, and, further, a body which could discuss on scientific grounds questions of scientific interest. They would then be able to give to their various Governments, not simply the ideas of an individual or country, but well thought out and discussed ideas of the united science of the world.

Prof. Barker, of Philadelphia, after joining with previous speakers in the expression of admiration of Prof. Thomson's paper, said that he had not the right to welcome them to Dover, but the Atlantic was in a few years to be a channel, and they in America hoped to have the pleasure not only of welcoming the French Association in that free and easy and delightful way, but the British Association as well. The suggestiveness was that the time was coming when they would be able to leave America in the morning, to attend the sections of the B.A. through the day, and go home at night. They in America would extend to them all the hospitality which their continent contained, and if it was not big enough "we will put on some more."

Dr. Oliver Lodge found it difficult to get away from the fascinating subject of Prof. Thomson's address, but after a few comments regarding same he proceeded with his address on the "Seat of Volta's Contact Force." When asked to say something on the occasion of the French visit, he remembered that this year the world was celebrating the centenary of that great Italian physicist, Volta. One hundred years ago Volta discovered the electric current. He discovered two facts—(1) that an electric current would be produced when two metals touched each other under liquid, and (2) that two electric charges are produced when two metals touched each other in a dielectric. It was strange, he said, that 100 years afterwards the explanation of those simple facts was not even now complete. It was strange that a controversy had raged around the subject with greater or less vehemence all the time, and last year, or the year before, was resuscitated by Lord Kelvin. He regretted the absence of Lord Kelvin, as he took directly opposite views to his lordship on some points. He then proceeded, by the aid of blackboard diagrams, to explain what were the three facts which Volta discovered, and showed the points of difference between his own and Lord Kelvin's views. In bringing his discourse to a premature conclusion, Dr. Lodge indicated that it was his intention to shortly pursue the subject further before the Physical Society of London.

ELEMENTARY TREATMENTS OF ALTERNATING CURRENT PROBLEMS.

By W. G. RHODES, M.Sc, M.I.E.E.

The transition from direct current to alternating current problems is generally regarded by electrical students with a certain, and often abnormal, amount of fear and trembling; and if we look for the cause of this awe and reverence in which the subject of alternating currents is held by the great majority, we shall, I think, find that the fault is not altogether the students'.

A casual glance at any standard book on the subject is sufficient to show that unless the fundamental notions can be expressed more simply the student, whose mathematical attainments are of a limited nature, cannot hope to gather more than a hazy idea, and he certainly cannot learn enough to enable him to make use of his knowledge in a workshop or laboratory.

There appear to be two types of writers. The first class

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is composed of the few who, by the aid of powerful mathematical analysis, can occasionally hit upon a new result or place an old result in a new and perhaps more interesting form. The second class comprises those whose sole aim is not to cater for the highest intellects but who rather desire to bring the salient points of the subject within the reach and understanding of less cultured minds. The abstruse writer provides only for those of his own class, or, perhaps I had better say, for the favoured few who, thanks to an academic training, are able to follow difficult mathematical demonstrations, and to whom the mathematics is often a greater attraction than the physical bearing of the problem. I do not wish to under-rate the value of the higher mathematics, because it is in a few cases absolutely necessary, but its use where unnecessary is pedantic and selfish. The mass of electrical readers who contribute most towards the advancement of electricity in its applications to commerce must be provided for, and the writer who by simple and at the same time accurate explanations can convey the fundamental principles of alternating currents to the non-mathematical mind, and show the application of those principles in the alternator, transformer, induction motor and such like machinery is of very great use indeed. Unless these principles can be accurately conveyed to those whose daily occupation it is to manufacture the machines, we cannot hope to make adequate headway.

The engineering workshop is the place from which ought to emanate improvements of all kinds of machinery. It is in the actual manufacture of a machine that the need of improvement becomes evident, and the makers of any type of machine are the most likely people to effect the improvements if only they understand thoroughly the underlying principles. The day of the *trial and error* process is fast becoming out of date. The only way now open is, having discovered a deficiency, to think out the true remedy and then apply it with a sure and certain knowledge that it must effect a cure.

The manufacturer is unjust to himself if all that he can do is to find out the defect, and he is compelled to go to someone else to find the remedy. When the ability is there it is often a matter of greater difficulty to find the defect than to ascertain the remedy.

Now, I am persuaded that in most cases mechanical and electrical problems can be approximately solved without the aid of abstruse mathematical calculations.

If a good mental picture of the physical processes involved in the working of a machine is formed, it is better than all elaborate calculations. It was by means of mental pictures of lines of force that Faraday was enabled to perform those experiments which have led to the development of the modern dynamo.

This method of mental and graphic representation is the one which ought to form the basis of every physical study, and the most successful teacher is he who forces upon his students a physical conception of the subject—accentuated by experiment — before attempting to make quantitative calculations. He should only regard mathematics as a set of tools, some of which demand greater skill for use than others, and the rule should be never to use skilled labour when unskilled serves the purpose equally well.

No one would dream of using a steam hammer to drive in a tack, but many would require the use of the calculus to determine the maximum power which a generator of given E.M.F. and internal resistance could give to an external circuit. Why should almost every writer on alternating currents perform an integration to determine the mean power given to a reactive circuit when the result can be arrived at by means of elementary trigonometry? One could multiply such examples almost indefinitely, citing cases in which it is customary to use more difficult methods than are necessary for the solution of simple practical problems.

Simple symbolic reasoning is, if not necessary, at any rate very helpful, but it is always easier to attain results if the whole attention can be concentrated upon the conception of the problem. It is much easier to grasp a subject if written in English than in any other language, because the whole attention is given to the idea, and is not distracted by turning to a dictionary to find the meaning of certain words.

It is the same with alternating currents. If the whole attention could be concentrated upon the conception of the periodically variable quantities without the expenditure of any appreciable thought on the mathematical processes, how much easier it would be! Most electrical engineers are conversant with the elements of algebra and trigonometry, but few have carried their mathematical studies much further. To bring alternating current literature within their reach it is necessary, therefore, to use no more of the higher mathematics than is absolutely necessary, and whenever results cannot be obtained by elementary means they should be stated clearly and succinctly.

I have a small book before me by M. O. De Bast, entitled "Elementary Research on the relations between Electrical Quantities in Alternating Current Circuits," upon which the author must have spent much time in endeavouring to express his thoughts in the simplest possible manner. Not a single application of the calculus is to be found in the whole book, and yet problems concerning circuits containing inductance and capacity are considered, as well as an extremely interesting treatment of polyphase circuits. It is to be hoped that an English translation will quickly be obtainable; it should attract the attention of non-mathematical readers. The idea which pervades the whole book is to place physical conceptions prominently before the reader, and to use only simple mathematics where necessary.

THE BRITISH ASSOCIATION.

Of recent years the annual gatherings of the British Association for the Advancement of Science have been regarded as a series of more or less scientific entertainments on a large scale, or one great picnic party whose festive and social proceedings were interspersed with snatches of science. The series of meetings which have just been brought to a conclusion at Dover have tended to confirm rather than to weaken that view. It has been stated in several quarters that the weather would to a large extent decide for or against the success of the meetings on account of the large number of social events, visits to places of interest, &c., forming part of the programme. We imagine that socially considered there is little room for disappointment in spite of a thunderstorm, and it is very probable that in certain sections the papers and discussions were of value, but we have some hesitation in saying whether, from an electrical point of view, the proceedings may be considered satisfactory. We do not like to write the word "failure," but we will leave our readers to form their own opinion from the list of the papers, &c., which we publish further on, and from the reports or abstracts thereof appearing in our other columns.

The Mechanical Science Section (G) was exceedingly fortunate in having so able a president as Sir Wm. H. White, the chief constructor to the Admiralty, whose very wide knowledge and experience proved of great value in the several discussions—in fact, we might almost say that he was the heart and soul of the discussions. What he said was always of interest, whether it was on the Niclausse boiler, the Parsons turbine, the use of electricity on shipboard, or any other subject.

In the course of the discussion on the paper contributed by the Hon. Mr. Parsons on "Fast-speed Channel Steamers," Sir W. H. White said that he had had a most complete knowledge of Mr. Parsons' invention ever since he began to work upon it, and only those who possessed such complete knowledge could know the many difficulties which he had faced and conquered in bringing into practical shape this individual type of propelling machine. It was a record of which any man might be proud. Prof. Dunkerley, who had assisted Prof. Ewing in tests made 2½ years ago off the Tyne, said that at the time he was considerably prejudiced against the turbine system as regards marine propulsion, but eight or ten days under continuous trial under all possible conditions, speeds, &c., quite convinced him as regards the usefulness of the particular engine. Now he was merely waiting for the time when the very crude contrivance which they called the reciprocating engine, would be a thing of the past. Anyone who had been on the *Turbinia* would have remarked the extreme absence of vibration, the absolute ease with which the turbine was manipulated, and the extreme rapidity with which full pressure steam could be placed on the engine in time of emergency. On the *Turbinia* there was no reversing engine, but Mr. Parsons had now shown that the difficulty had been overcome. In regard to the consumption of this engine.—The steam turbine, as applied to electrical purposes, had, of course, been frequently tested, and those tests showed, he thought, that 15 lbs. of steam per I.H.P. per hour was

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about what might be expected from them. He noticed that Mr. Parsons gave as a result of the *Turbinia* 14½ lbs. per I.H.P. per hour. In such engines the I.H.P. could only be obtained inferentially, and he took it that that had been done by Mr. Parsons. He asked, could Mr. Parsons tell them what was the steam consumption per effective H.P., not per I.H.P.? Mr. Parsons replied that it was 28½ lbs. After further comments from Prof. Dunkerley, another speaker said that Mr. Parsons had adopted the true principle of the rotary engine. They had had hundreds of patents for rotary engines, but 99 out of every 100 were reciprocating engines in a compact form. The speaker asked whether, as the I.H.P. had only been obtained inferentially, the author could tell them of practical methods of finding absolutely the I.H.P. either by measuring the thrust on the screw shafts, or by other means which might have suggested themselves to his mind, because, as soon as they brought this engine into use, they would want ready methods of finding actually the I.H.P. without trusting to inferential methods. Sir E. Carbutt said that they all had had a prejudice against this class of engine, because it swallowed a large amount of steam. But Mr. Parsons had had this engine in electric lighting stations for 10 years, and he ought to be able to give them some figures of consumption for work done, say, per unit of electricity. If he could give some standard to compare it with ordinary reciprocating engines, then they might be able to find out whether it would be a fuel consumer, or whether a good deal of work was being got out of it. If he could give them those figures per pound of fuel, showing what he did in electrical stations, it might enable them to form a judgment.

Mr. Barker, the engineer-in-charge of the Cambridge electricity works, said that he had had charge of 15 steam turbines of 1,000 H.P. for six years. He could speak with certainty first of all as to their great endurance. He ran the 120-KW. set for a whole year. Not one penny had been spent upon up-keep, and at the end of the time to all intents and purposes the engine was in as good a state as on the first day of the run. Another engine for the three winter months ran for 20 hours a day with exactly the same oil, it turned 600,000,000 revolutions, and at the end of that time they could not detect any appreciable depreciation in any respect. Bearing tubes had been put in to the best of his knowledge and belief. One which came down with the engine six years ago was still in use. For a meeting in London he moved two tubes at the end of four years, and they were then in an absolutely good condition. Unfortunately all the tabulated statistics of electric lighting stations were made on the basis of so many pence per unit for coal per unit sold. Cambridge stood next to Dover, where coal was the most expensive of any station known. There was an initial charge of something like 7s. per ton to be paid for carriage, &c. In all the returns made of the Cambridge station there was not a single word said about this. The cost of coal per unit sold was ·3d. at Leeds. At Cambridge it was very nearly 1d. He had no ordinary engine at the works; they were all turbines, so that they could not get the credit of any other engine. The president intimated, in reply to questions by Sir E. Carbutt, that Mr. Parsons would be able to give a comparison under the same conditions of machinery on the two systems.

Another speaker, hailing from the Scarborough electricity works, said he could confirm the statements of the previous speaker from experience at Scarborough. Although coal was rather expensive there, they had no reason to complain.

Mr. Parsons, in the course of his reply, intimated that the indicated dynamometer tests of turbines had been made by Dugald Clerk six years ago, and resulted in figures which formed a basis on which they could make an exact estimate of the steam consumption per B.H.P., and the dynamo efficiency was within 2 or 3 per cent. On that basis the steam efficiency of the turbines up to 900 H.P. had been estimated with the greatest accuracy, and the best result was about 16 or 17 lbs. per B.H.P., which was about 15 lbs. per I.H.P. An exact comparison had been made in regard to coal consumption between the Newcastle companies. The coal per KW. in the two stations was almost indentical, almost within 1 per cent. One station had compound rotary engines by Robey, and Brush dynamos, and the other had turbines. Both stations used Lancashire boilers. The consumption was about three times what it ought to be, 7 to 10 lbs. of coal per H.P.

After the thanks of the section had been accorded to Mr. Parsons, Mr. Mark Robinson's paper on the "Niclausse Water-tube Boiler" was read and discussed. We refer to this in our "Notes" columns.

The paper of Mr. Alexander Siemens on "The Use of Electrical Machinery on Shipboard," which we shall publish next week, gave rise to a discussion, and Sir Wm. White's comments on the extent of the adoption of electricity in H.M. warships, &c., for lighting and power purposes, which may be regarded as those of the Admiralty department, were exceedingly interesting. We hope to refer to them next week.

The joint paper by Prof. W. F. Barrett and Mr. W. Brown on "The Electric Conductivity and Magnetic Properties of an Extensive Series of Alloys of Iron, prepared by Mr. R. A. Hadfield," we may hope to have the pleasure of dealing with at a later date. The very extensive research forming the subject of the paper has produced certain results which add to our knowledge of the electrical conductivity and magnetic properties of various iron alloys. Prof. Hudson Beare intimated to the section that he was making mechanical tests of the alloys for Mr. Hadfield, and it was thought by some who were present that these would be of considerable value when available.

The following is a list of the electrical papers and reports :—

Section A.

Prof. H. L. Callendar, F.R.S., and H. T. Barnes—Preliminary Note on the Variation of the Specific Heat of Water.
T. G. Bedford—On the Expansion of Porcelain with Rise of Temperature.
Report on Methods of Determining Magnetic Force at Sea. (The report simply stated that there was nothing new to report.)
Report on Electrolysis and Electro-Chemistry.
Prof. W. F. Barrett, F.R.S.—On some Novel Thermo-Electric Phenomena.
Report on Radiation from a Source of Light in a Magnetic Field.
C. E. S. Phillips—On the Production, in Rarefied Gases, of Luminous Rings in Rotation about Lines of Magnetic Force.
E. H. Griffiths, F.R.S.—Note on a Form of Wheatstone's Bridge.
Prof. J. A. Fleming, F.R.S.—A Workshop Form of Resistance Balance.
Dr. R. A. Lehfeldt.—On the Theory of the Electrolytic Solution Pressure.
Report of the Committee on Electrical Standards.
Prof. J. J. Thomson, F.R.S.—On the Existence of Masses smaller than the Atoms.
Prof. Oliver Lodge, F.R.S.—On the Controversy Concerning the Seat of Volta's Contact Force.
Report on Seismology.
Dr. L. A. Bauer—On Recent Magnetic Work in North America.
Discussion—On Platinum Thermometry, introduced by Prof. Callendar.

Section G.

Hon. C. A. Parsons, F.R.S.—On Fast Cross-Channel Steamers driven by Steam Turbines.
Mark Robinson, M.Inst.C.E.—The Niclausse Water-tube Boiler.
A. Siemens, M.Inst.C.E.—Electrical Machinery on Board Ship.
Prof. W. F. Barrett, F.R.S., and W. Brown, B.Sc.—On the Electric Conductivity and Magnetic Properties of an Extensive Series of Alloys of Iron, prepared by Mr. R. A. Hadfield.
Sherard Cowper-Cowles, Assoc.M.Inst.C.E.—Some Recent Applications of Electro-Metallurgy to Mechanical Engineering.
Wilfred S. Boult, Assoc.M.Inst.C.E.—Signalling Without Contact, a New System of Railway Signalling.

In other sections there were papers on "The Development of Chemistry in the last 15 years," by Prof. A. Ladenburg; Dr. G. Schott on "Oceanographical and Meteorological Results of the German Deep-Sea Expedition in ss. *Valdivia*" (this paper contained, among other things, some very brief references to deep-sea soundings in connection with submarine cable work, and noted the great advantages obtained by employing electric motors for operating sounding apparatus); Prof. H. E. Armstrong on "A Peculiarity in the Behaviour of Electrolysed Sulphuric Acid"; Mr. R. Donald on "Municipal Trading"; Prof. Dewar on "The Solidification of Hydrogen"; and a report on the electrical changes accompanying the discharge of the respiratory centre. The paper which had been announced on "Electric Tramway Earth Currents," by Mr. J. Swinburne, was not read. Mr. Thorneycroft dealt with "Steam Traction on Common Roads" in Section G, on Tuesday.

On Monday evening Prof. Fleming delivered a lecture in the Dover Town Hall on "The Centenary of the Electric Current and Wireless Telegraphy." He explained that the object of his lecture was, by a few experimental demonstrations, to direct the attention of his audience to consider the main conclusions reached after a century of investigation on this matter, and to indicate the problems which yet remained to be solved. After an exhaustive review of the discovery and development of the electric current, he said these principles had received their most logical extension and completion in the evolution of the electro-magnetic wave telegraphy, which Signor Marconi had developed on such a large scale in the last few years. In order to illustrate and explain the working of the Marconi system of wireless telegraphy, the complete apparatus was established on the lecture table. During the progress of the lecture messages were despatched to the South Foreland and to Wimereux, and replies received. The recent application of electricity to a method of steering self-moving torpedoes by means of an electric spark and sensitive powder tube was mentioned, and it was demonstrated that explosives could be fired by electric waves without wires. Some remarks followed as to the nature of the electric current.

A wireless message was despatched to Boulogne for re-transmission to Como, where the centenary of the work of Volta was being celebrated, and a reply received, another message being sent to the French Association meeting at Boulogne.

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On Tuesday there was an important discussion opened by Prof. Callendar, F.R S, on "Platinum Thermometry," the speakers including Dr. J. A. Harker, Dr. Chappuis, Mr. E. H. Griffiths, Profs. Carey-Foster, Burstall and Threlfall, and Principal Glazebrook and others.

The electric tramway service at Dover was very fully appreciated by the members of the Association, who made good use of it, the cars being each day crowded during the greater part of the morning and afternoon. The only fault one has to find with the system is the very long stoppages which occur at the single line passing places. But this, we suppose, is unavoidable on account of the narrowness of the thoroughfares and the frequency of curves.

President's Address in Section G.

An address such as that of Sir Wm. White is useful as marking time on the progress of mechanical engineering. One of the chief things dwelt upon was the size and power of steam vessels, some comparisons being made of the increase in dimensions during the past 60 years. In 1840 the Cunarder *Britannia* had a speed of 8½ knots, carried 12 lbs. pressure, was 207 feet long, and 2,000 tons displacement with 750 H P. She burned 40 tons per day, or 5 lbs. per H P.-hour. To-day the *Oceanic* displaces 25,000 tons, is 685 feet long, and does 22 knots. We believe the power is over 40,000. Ships have nearly trebled their speed, more than trebled their length, increased tenfold in displacement, forty-fold in engine power, quadrupled their H.P. per ton driven, and reduced their coal per H.P. to one-third. In 1840 one ton of machinery produced 2 H P.; to-day it produces 6 to 7 H.P. Greater draught is needed; this has been kept comparatively small by port facilities and shallow Suez canals.

Curiously enough, the first Channel steamer was built in 1821 by Denny, of Dumbarton, the ancestors of the present firm of famous shipbuilders. The President did not touch much on water-tube boilers, excepting as regards torpedo boats, the boilers of which we consider far ahead of those of our large cruisers.

He did, however, refer to the steam turbine, the high speed of which enables weight to be so much reduced.

Thus the *Turbinia*, only 100 feet long and 44½ displacement, has run at 34 knots with three propellers at 2,000 revolutions, making 2,000 H P. with steam at 175 lbs. About 100 H P. is produced from each ton of propelling apparatus, or double the output of the lightest machinery in torpedo boats yet made: Mr. Parsons claims equal economy with the triple-expansion engine. Two destroyers are now preparing for driving by turbines; 10,000 H P. is anticipated, so the experiment is not small. But we see no reason to doubt the success of the steam turbine on any power, and if at large powers Mr. Parsons is still successful with small propellers he will have done good service.

Further reduction in machinery weights and hulls, and improved forms of hull and larger dimensions with greater draughts, are the factors concerned in securing better speeds, but in large vessels increase can only be slow. Unlike the small vessel the large vessel must reach 47 knots before the reduced resistance comes into play, which holds at 30 knots for small vessels like torpedo boats.

It appears that Mr. Parsons considers he could reduce by one half the weight of the engines and propellers of a liner by the use of his turbine. Liquid fuel also could effect probably a saving of 1,000 tons of weight on a first-class Atlantic liner. But liquid fuel is not yet found in anything like the necessary quantity for such use. As regards material, 1,000 tons of load could perhaps be saved by nickel steel in place of mild steel. Generally, the experience of the past will be reproduced in the future if at a less rapid rate.

Probably the *Oceanic*, just sent out on her first voyage and intended to run to time, may mark a halt for a time until higher speeds can be made with the same punctuality. With an Atlantic liner arriving to a printed time table, we may even look forward to a London suburban train arriving within an hour of its time. We would not, of course, venture yet to include the South Eastern and its partner in sin.

A sound steamship of large size seems to take very little notice of weather, its perils coming chiefly in regard to collisions or from internal causes. Waves hardly affect the largest steamers.

Electric Traction Progress in the North.

It may be said without much fear of contradiction that at the moment the principal seat of progress in electric traction lies in the North. It is true that Newcastle, among other places, has achieved considerable notoriety by exhibiting a spirit of vacillation; but when it is considered that Manchester, Sheffield, Leeds, Glasgow, Blackpool, Bradford, and Hull are either provided with or have decided to adopt an extensive system of tramways, it will be seen that matters have progressed much more rapidly in the Northern counties than in the South of England. It is not easy to account for the difference between the two parts of the country, unless it arises from the greater enterprise in the Northern municipalities, for it must be remembered that electric tramway schemes in the North are being carried on almost entirely by the local authorities. We are promised something exceptional in the way of electric tramways by the London County Council, but apart from this instance electric tramways in the South of England will be carried out mainly by companies. A special instance of the spirit of progress exhibited by Northern municipalities is that of Sunderland, which has embarked upon a scheme of tramways involving a capital expenditure of £250,000. It is an interesting sign of the times that Corporations, after following a somewhat slow policy in regard to electric lighting extensions, should in adopting electric tramways be prepared to pledge the capital of the ratepayers to such a large extent. While one cannot help rejoicing at this, it is to be sincerely hoped that municipalities will not, in developing electric tramways, forget the almost paramount claims possessed by electric lighting.

Unlike its near neighbour Newcastle, the Corporation of Sunderland has arrived at its present scheme of electric tramways with very little delay, and doubtless this in a measure arises from the very admirable and complete reports on the subject of electric tramways that have been issued from time to time by the Corporation. While other towns have been considering the merits of the various systems of electric tramways, a Sunderland deputation went to work and not only obtained valuable information regarding the operation and control of electric systems, but they also made careful inquiries into the operation of surface contact and conduit systems. The system, which is to be carried out in Sunderland, will include some 23 miles of electrically operated lines, and these will be made up of the original lines owned by the local tramway company, and an entirely new system which will be laid down by the municipality. The lines owned by the tramway company were not extensive, being, in fact, hardly 4 miles in length. The Town Council, availing itself of its powers under the Tramways Act, will obtain possession of this system for a sum of £35,000, although the total expenditure of the company up to December, 1898, had amounted to £74,281. It may be remembered that a large contract in connection with the Sunderland tramways has been given to Messrs. Dick, Kerr & Co., but although this contract relates to the reconstruction of the existing lines which are now worked by horse traction, and to the construction of a new route, it only forms a little more than half of the entire system which is to be carried out by the Corporation. Certain portions of the track are to be laid by Christmas, but apparently it is not expected that electricity will be in use before June because provision has been made for working most of the new lines by means of horse traction. It may be expected that the contracts will be completed by June 30th next year, but probably the difficulty of completing orders will result in a little delay; moreover, it has to be remembered that the Town Council is allowed five years in which to complete the whole of the electrical scheme. One of the most difficult matters in connection with electric tramways is to obtain authentic figures as to the cost of operation, but the difficulties which have hitherto existed with regard to this are not likely to be present in the case of the tramways operated and controlled by a municipality, for the statutory returns which a local authority is compelled to make, will enable one to form an adequate opinion as to what it really costs to operate an electric line. The expectations of the Sunderland Corporation with regard to the

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working of the system are fairly moderate, and it is assumed that the annual working expenses for 22·77 street miles, including sinking fund and interest on total capital expenditure, the cost of purchasing the company's undertaking, and sinking fund and interest on existing Corporation lines will be £38,778, while the annual receipts are expected to be £47,844. It is fully anticipated that the working expenses will be covered if 6,997,532 passengers are carried in a year, or, 19,166 per day. The estimates show that 23,648 passengers are expected to be carried every day, or, 8,633,479 per annum, which would yield an annual profit of some £9,666. In the light of experience gained at Stockton and Middlesbrough, the foregoing is an exceedingly moderate estimate, but we believe that one of the most significant causes of success in the operation of electric tramways is a frequent and rapid service. In the case of Middlesbrough and Stockton an exceedingly bold course was adopted in regard to service, and, if we are not mistaken, the headway between the cars on the Stockton line does not average more than one minute; the success achieved on these lines is all the more remarkable, because it was felt by many authorities that electricity would not be economical if a quicker service than one of five minutes were adopted. The operation of the New York line, however, modified many opinions on this subject, and at the present moment it is most difficult to ascertain what is the real limit of an economical service.

THE ELECTRICAL ENGINEERS' SWISS TOUR.

The first annual meeting of the Institution, held in the most auspicious circumstances, has by common consent been voted an unqualified success. No less than 140 members, and 17 ladies, took part in the reunion—a company of quite unexpected dimensions, and which no organisation less perfect than that of Messrs. Cook could have piloted through its wanderings without disaster. Amongst those who were present we noticed the President and Mrs. Thompson, Prof. Perry (vice-president), Mr. Crompton (past-president), Messrs. Fawcus, Hammond, Mordey, Sellon, and Campbell Swinton (members of council), and many other distinguished members of the Institution. Many of the visitors took advantage of the early start on Thursday evening, August 31st, and enjoyed a night's rest at Bâle before commencing the hard work of sight-seeing; but the majority travelled by the later train on Friday morning, and arrived at Bâle at 6 o'clock on Saturday. No time was lost in getting to business, as we set out for Rheinfelden soon after 8 a.m.! At an early stage the discovery was made that the language favoured by the popular taste was a form of German, which put most of the party at a disadvantage; strenuous efforts were made by Mr. Rolph, the indefatigable assistant secretary, and other interpreters, to surmount the difficulty, but as a matter of fact the machinery and works spoke for themselves, far more eloquently than any human tongue.

The magnificent display of generating plant of 16,800 H.P. was most impressive, and formed an excellent introduction to the sights that were to follow.

After spending several hours on the station and the hydraulic works connected therewith, the party proceeded on foot, through picturesque surroundings, to an hotel in the village of Rheinfelden, where the directors of the works had provided an excellent luncheon. Light refreshments were handed round in the garden, in the short interval of waiting, to those members of the party who wore the badges thoughtfully furnished by the committee; many members who had previously worn these in their pockets, perhaps from natural modesty, were now observed to don them somewhat hurriedly.

During luncheon, according to the local custom, short speeches were delivered; the first speaker was Dr. Frey, the general manager of the works, who said:—

Honoured ladies and gentlemen!—The Company of the Rheinfelden Power Works, the directors of which are represented by Mr. Rathenau (the general director of the Allgemeine Elektricitäts Gesellschaft), who is the founder of our enterprise, welcomes the gentlemen of the Institution of Electrical Engineers. It is a great pleasure to us that such a noble company of the electrical profession has honoured us with a visit in order to examine this great undertaking on which, during the past four years great sums of money, as well as energy and knowledge, have been spent; and since the work was completed it has already had a grand effect upon the industrial development of Rheinfelden and its surroundings, and also promises to remunerate those who undertook it. Of course, you, during your short visit, have only seen a small portion of our works and installations; you have also noticed that a great portion of the power generated by the turbines is utilised in our immediate neighbourhood in three great factories, but the other portion is transmitted by subterranean cables and overhead wires to transformers and substations, and thence to a great number of factories for motive power, and to several townships for lighting purposes. We sincerely hope that the slight insight you have had will enable you to form an idea of the entire undertaking. We also hope that on your journey through beautiful Switzerland you will be many times similarly impressed, and we dare to hope that as we shall always think with pleasure of the visit of the Institution of Electrical Engineers, so you will also keep the undertaking of the Power Transmission Works of Rheinfelden in remembrance.

I ask the gentlemen of the Power Transmission Works of Rheinfelden to lift their glasses and to drink with me the toast for the welfare of the Institution of Electrical Engineers of England!"

Prof. Thompson, in his reply, gave a brief *résumé* of Dr. Frey's speech in English, and proposed the toast of the Rheinfelden works.

The next speaker was Mr. Emil Rathenau:—

Ladies and gentlemen:—I think I am the only person here who really has no right to be here, because I am not a member of your honoured Society. . . . . I am sure you will see many things in Switzerland in the highest state of perfection, and you will go back to England having gained in knowledge; but what would you say if I invited you to Berlin? (Cheers)

Well, if you do come, I shall be very pleased to entertain you for two or three days, and I am sure, if I ask you, Messrs. Siemens and Halske will also invite you. (Applause.)

Mr. Rathenau suggested that the visit might be combined with an excursion to the Paris Exposition next year, and concluded by drinking the health of Dr. Thompson, the President, in which all joined heartily.

Mr. Crompton, rising to propose the health of Mr. Rathenau, said that, being one of the older men of the profession ("No, no!") he knew how Mr. Rathenau had fought for the electrical engineering industry, and how by his energy and perseverance he had brought the electrical industry of Switzerland and Germany to its present position in the world's commerce. Mr. Rathenau saw what enormous possibilities there were for the employment of capital, and had done for those countries what we wanted someone to do for England. If that had been done 10 years ago we should not now see so many orders go elsewhere, and we look to the Institution to produce a man like Mr. Rathenau. Mr. Crompton concluded by welcoming the suggestion of a visit to Berlin; and the health of Mr. Rathenau was drunk with cheers and choral honours, not a little to the astonishment of the orchestra, which was simply drowned. The curious little ascending runs with which the band accompanies and prolongs the German "Hoch" were by no means appreciated by the Englishmen, who found the unaccustomed addition to their cheers somewhat disconcerting.

Mr. Rathenau's son having replied on behalf of his father, toasted the adventurous ladies who had come so far to look at machinery; the gentleman who responded for them pointed out the beautiful mountains, beautiful rivers, and—beautiful electrical works!

Mr. Rathenau's generous offer will, we understand, be accepted for next year, but will not be combined with a visit to the Paris Exposition, as it is felt that the two events would constitute too large a programme; moreover, the Institution will, in any case, be represented at the Exposition by an official deputation to the Electrical Conference.

After lunch we adjourned to the railway station, and having taken leave of our hosts, proceeded to Baden, where Mr. C. E. L. Brown cordially greeted his old friends, and led the way to the works of Brown, Boveri & Co. There the party was split up, and each group was conducted through these works, splendidly equipped with modern machinery and full of alternators, motors, &c., chiefly of the three-phase type, in process of manufacture. Our own group suffered from a monopolist who wanted to discuss three-phase induction motors for traction with our guide, to the exclusion of all other men and things; this factor—an *induction factor*, so to speak—was the cause of our group dwindling away to two or three members, the rest, seeing no prospect of obtaining information from our leader as to the machinery, &c., having joined other groups. The chief objects of interest in the

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works were probably the huge alternators, six of which were of 2,000 H.P. and upwards, and 25 were over 1,000 H.P.; most of these were of the inductor type, which seems to be very generally adopted in the Swiss works. A large switchboard for a carbide plant excited much interest, the switches being designed to break a load of no less than 2,000 KW. each, at 16,000 volts! It is very noteworthy that, in the case of all large switchboards, the working parts are placed behind the board, and operated from the front by means of levers; no part of the electrical circuits, or metal connected therewith, is placed on the front of the board.

After taking leave of Mr. Brown the party proceeded to Zurich, which was the headquarters for the greater part of the time; some annoyance was occasioned by the necessity of sharing rooms, owing to the heavy demand, and one load of luggage went astray, but these little difficulties were soon smoothed over, and the visitors passed the week-end in enjoying a rest, in excursions on the lake, or in walks to points of interest in the neighbourhood.

(To be continued.)

ANIMAL ELECTRICITY.

By W. S. HEDLEY, M.D.

GALVANI'S experiment was this:—Laying the nerve muscle preparation on a glass plate, the nerve was raised with a glass rod, and then being allowed to touch the muscle, a contraction ensued. This was the demonstration of animal electricity, the existence of which Volta had denied. But Volta proved his assertion (which Galvani had denied) that metals in contact with a fluid produce an electric current. The demonstration of this latter fact was the discovery of the Voltaic cell.*

Animal and metal currents were first clearly differentiated by du Bois-Reymond. He considered, and it is difficult to prove the contrary, that a natural electric current exists in normal resting muscle, "current of rest." During the action of the muscle he proved the existence of a current in the opposite direction to the "rest current." This was called "the negative variation," now known as the "current of action." Hermann combats the opinion that a resting uninjured muscle shows any current, and holds that the so-called "current of rest" is the result of chemical or other inequalities due to the injury. The views of English physiologists are as follows:—

1. Normal muscle or nerve gives no current.
2. Local injury produces a current through the muscle from the injured to the living part.
3. Local action produces a current through the muscle from the active to the resting part.

Thus an injured or an active muscle produces electromotive force, and as in the Daniell cell the current goes from the active plate (the zinc) to the copper, so does current travel in the injured muscle from the injured part to the sound part. When the circuit is completed through a galvanometer, of course the direction is reversed, and it is usual to describe the direction of a current in its relation to the galvanometer. The manifestation of the sudden difference of potential which is the result of stimulation is sometimes spoken of as the "excitatory variation" when the muscle is referred to, and as the "action current" when the galvanometer is referred to.

The Negative Variation.—If a muscle giving the muscle current ("injury current") be tetanised, an action current will proceed from the uninjured to the injured part, *i.e.*, from the part more capable of action to the part less capable of action. This current being in a direction opposite to the muscle current (injury current) constitutes a counter electromotive force which tends to cut down or diminish the muscle current, and this diminution is the "negative variation" of du Bois-Reymond—"action current of Hermann."

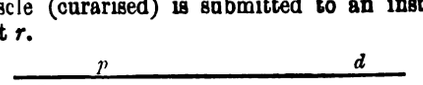
The Diphasic Variation.—A contraction wave propagated along the fibre of an uninjured muscle is accompanied by an electrical disturbance travelling from the active to the resting part, and this variation (as revealed by a galvanometer uniting two electrodes placed at an interval on the surface of a muscle) is double or diphasic for the obvious reason that the action is not simultaneous throughout the muscle, but requires time for its transmission.

By far the most striking manifestations of animal electricity are, of course, to be found in electric fishes; here the nerve surfaces represent the active element of the battery, viz., the zinc in the Daniell cell.

The electromotive action accompanying voluntary muscular contraction in the human subject has been demonstrated by du Bois-Reymond, and that accompanying tetanic contraction from electrical stimulation by Hermann. Physiologists consider that the variation of electrical potential from the beat of the human heart has been demonstrated. It is by some regarded as proved that the white columns of the spinal cord give electrical signs of nerve action, and even that action currents are manifested by the grey matter of nerve centres. The skin of all animals is traversed by an electrical current from without inwards. This is considered to be caused chiefly by cutaneous glands, but partly by the skin itself, as is proved in the case of the eel, whose skin has no glands. The action of light upon the retina causes an electrical change, *i.e.*, a current accompanies retinal activity, as it does muscle activity. Indeed, it is probable that electrical phenomena always accompany vital action.

Certain of the above points have been carefully studied by Sir J. Burdon-Sanderson, and his latest contribution to the subject comes in the form of the Croonian Lecture delivered before the Royal Society, for an abstract of which we are indebted to the pages of *Nature*. As might be expected from the direction of his previous investigations, it was the electrical rather than the chemical or mechanical concomitants of the function of muscular action that chiefly engaged his attention. But it was necessary to begin by explaining some points in connection with the mechanical effects. These could be investigated in two ways:—(1) By observing and recording the changes of form a muscle undergoes when, in response to a stimulus of short duration, it acts isotonically, as in lifting a weight; or (2) by observing the increase of tension which occurs in overcoming a resistance, *i.e.*, when it acts isometrically. The latter method is the best when dealing with an entire muscle, but isotonic conditions are preferable when estimating the time occupied by a *single* element of muscular structure in developing its maximum tension under stimulation.

The method employed consists in observing the change of surface form that occurs in a muscle when a single break induction current is led through it in such a way that the observed surface is at the cathode. A sensitised plate moves behind a slit, upon which a magnified image of the cathode (moving freely with the muscle) is thrown. An observation thus made shows that the process of contraction at the point immediately excited, *i.e.*, at the point immediately underneath the cathode, attains its greatest activity before the end of the first hundredth of a second. It is known, as already stated, that an electrical change, an action-current, accompanies the mechanical change, *i.e.*, the change of form which a contracting muscle undergoes. Are the change of form and the electrical variation synchronous, or does one precede the other? On connecting two parts of the surface of a muscle through a capillary electrometer or other galvanoscope, it is found (1) that similar parts in a similar physiological state are equi-potential; (2) that in similar parts, but in a different state, there is a difference of potential the less capable of function, *i.e.*, the less living being negative to the more living; (3) that transitory differences of potential arise between two parts of the living surface when the one is active and the other resting, the condition of rest or fitness for function being denoted by relative "positivity," discharge of function by relative "negativity." The "first fundamental experiment" was then described. A parallel fibred muscle (curarised) is submitted to an instantaneous stimulus at *r*.



The result is that a wave of excitation passes along each fibre, its progress being marked by electrical and mechanical change. The latter consists of an alteration of shape or

* For this and a portion of the following, see "Therapeutic Electricity," by W. S. Hedley, M.D. (Churchill, London.)

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contour in the contracting muscle. If we have two contacts, *p* and *d*, applied to different parts of the contracting muscle and connected through a galvanometer, the electrical effect of the stimulation appears; it consists in the sudden manifestation of a difference of potential between the two parts of the contracting muscle.

Now, reverting to the mechanical effects (alteration of contour) produced by the stimulation, the photographed curve represents the wave of excitation as it starts from the point of stimulation, *r*, affecting first the near contact, *p*, and then the distant one, *d*. But if, by tying a tight ligature across the path of propagation we limit the observation to what happens at one contact only, "we find that the curve has assumed an entirely different form." It is natural to conjecture, and capable of proof, that the difference of contour in the two experiments represents the arrival of the wave of excitation at the distal electrode, *d*. A curve representing the change which occurs in the difference of potential between the surface of contact, *p*, and the rest of the surface of the muscle during excitation can be obtained by calculation from measurements of the polar ordinates of the curve resulting from the first experiment. Assuming an identical curve at *d*, but relating to a period 15,000ths of a second later, we may obtain the curve which expresses "what must be the successive differences of potential between *p* and *d*, when the effect of the change at *d* is not cancelled." If the curve be deduced from the second experiment, *i.e.*, where the change at *d* is cancelled, it coincides with that obtained by summation, where the change at *d* is not cancelled. Therefore, from *p*, we can obtain the curve which expresses the successive differences of potential required, and the determination of the monophasic variation ought to be the aim of such experiments.

The curves that represent the change of contour also represent the electrical response to excitation. The electrical state of the muscle when at *rest* depends upon the way in which the effect of the wave of excitation at the distal electrode is cancelled. If this be done by applying a ligature between *p* and *d*, the contacts remain equi-potential; if the part of the nerve to which *d* is applied be de-vitalised, *e.g.*, by heat, the unexcitable dead surface is found to be strongly "negative" to the other.

It thus becomes evident that the phenomena observed depend "exclusively upon the state of the surfaces of contact, and consequently when the distal contact is cancelled on that of the proximal contact only."

Having considered the electrical results of a single instantaneous excitation, further experiments were detailed, showing the electrical concomitants of continuous contraction. It has been contended that the continuity of voluntary muscular action is *apparent* only, and an identity in sound emitted by muscle contracting normally, and one contracting under a series of instantaneous stimuli, has been adduced in favour of this view. "It is argued that because we can produce continuous contraction (artificial tetanus) by discontinuous stimuli, that all continuous contraction is so produced." Putting such questions aside, and limiting attention to the electrical concomitants of continuous action, it was shown that under certain conditions a continuous contraction can be produced by a single uninterrupted stimulus, and that in reflex spasms there is no evidence of discontinuity, "at least, in the sense in which this term is ordinarily understood." There is rhythm, but it is central, not muscular. If spasm be artificially produced by exciting the motor apparatus through a sensory nerve, the cells of the cord having been rendered hyper-excitable by a dose of strychnia, a prolonged contraction occurs, the graphic tracing of which is often indistinguishable from that of complete tetanus. But by analysing the electrical concomitants as recorded photographically, it is seen that the curve resembles rather that of complete tetanus interrupted at regular intervals than that of a series of responses to single instantaneous stimuli following each other at $\frac{1}{10}$th of a second or more. Thus a single stimulus to the motor cells of the cord has produced a series of responses in the muscle, but, as already stated, the rhythm is central, *i.e.*, the motor cell has discharged its influence on the muscle at regular intervals, but the effect each time is that of continuous action.

A further interesting point in this connection was adverted to, and lies in the fact that by means of the alkaloid veratrine we can abrogate the mechanism by virtue of which a muscle, after responding to an instantaneous stimulus, returns to its previous state. In other words, under the influence of veratrine a muscle once thrown into action is compelled to continue that action, and the electrical phenomena under such circumstances show the effect to be absolutely continuous. The curve resembles that of artificial tetanus, showing no undulation or unevenness. Although the excitation is instantaneous, the response is continuous, and it is remarkable that a muscle so treated preserves its functional capacity unimpaired. In other words, a veratrinised muscle excited by an instantaneous stimulus will lift as great a weight, or do as much other work, as a normal muscle excited by a succession of instantaneous stimuli.

The contractions of the heart are analogous to those of the skeletal muscles, but, of course, the "relative negativity" spreads radially instead of longitudinally, the electrical effect appearing to precede the mechanical; but the duration of the process is longer, and the rate of propagation slower.

It was then explained that if the leaf of the Venus' flytrap be explored in a similar way, changes occur analogous to those observed in the ventricle of the frog. But the interval of time between the culminations of the electrical response and that of the change of form is more obvious in the leaf than in the heart, for the reason, as the lecturer concluded by observing, that the mechanism by which the change of form shows itself works more slowly in the leaf than in the heart.

It does not seem quite clear how far the above experiments having reference to the time relationship between the electrical and the mechanical concomitants of contracting muscle bear upon certain other views on the same subject which certainly seem plausible. It is known that derangements in shape, produced mechanically, will show themselves electrically, *i.e.*, will produce the electric state, and conversely, that variations in the electric state are accompanied by derangements in shape. According to d'Arsonval given a surface that can be disturbed mechanically, as, for example, in all liquid and semi-liquid bodies, similar phenomena occur. Therefore it is sought to explain action currents by variations in surface tension, and consequently in the electric state, which is due to the "internal mechanical distortion that occurs in every living tissue which is undergoing change of shape." There is little doubt that the mechanical event, the change of form in a muscle, actually commences before it becomes apparent. It has been considered demonstrable that the electrical event actually accompanies the mechanical event. Could it be shown that the electrical disturbance is an event, actually as well as apparently, anterior in point of time to the actual change in shape, such an observation is clearly fatal to the last-named theory.

THE ELECTROLYSIS OF HYDROCHLORIC ACID.

By D. TOMMASI.

The electrodes of the electrolyser being of platinum*, two cases may present themselves according to the degree of concentration of the hydrochloric acid. If the acid is concentrated, the anode is attacked by the chlorine and then acts as a soluble anode; if, on the other hand, the acid is diluted there is also a liberation of products of chlorine but the platinum is not attacked.

I will now discuss these different cases in succession. The electrolyser employed consisted of a U-shaped tube.

(*a*) *Hydrochloric acid highly concentrated* (D = 1·2).—Two molecules of hydrochloric acid in a state of solution absorb, in decomposing, 78·6 cal.; but as the anode is attacked by the chlorine we must deduct from the 78·6 cal. the quantity of heat given off by the formation of the dissolved chloride of platinum, which tends to lower the electromotive force required to effect this electrolysis. In fact, the electrolysis of this acid can be effected with an electromotive force far below 1·7 volt (78·6 cal.) In this way a Daniell element (1·02 volt) and a zinc-cadmium element (·36 volt) decompose hydrochloric acid fairly rapidly, with liberation of hydrogen at the cathode, but without any production of gas at the anode.

A single Daniell element is sufficient, if necessary, to decompose hydrochloric acid, but the electrolysis is effected very slowly.

In order to get more certain results, I employed a Daniell element

* The platinum used was chemically pure.

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and a zinc cadmium element, or a current with an electromotive force of 1·42 volt. After 20 hours the liberation of gas was still continuing at the cathode. The liquid of the electrolyser contained in solution a certain quantity of platinum.

I repeated this experiment, using an electromotive force somewhat higher than that indicated by theory as sufficient to decompose hydrochloric acid, two Daniell elements (2·04 volts). Under these conditions, the decomposition of hydrochloric acid is very rapid, but notwithstanding this, we see no liberation of gas effected at the anode; at the end of an hour, however, we see a few bubbles of gas forming on this electrode. After 20 hours the decomposition was still continuing with libaration of hydrogen at the cathode, and of products of chlorine at the anode.

The liquid of the electrolyser, when evaporated in a water-bath and then calcined in a current of hydrogen, left a residuum of perfectly pure platinum.

Still using two Daniell elements, the results obtained by electrolysing different mixtures of hydrochloric acid and water were the same as described above.

We observe a limit to this action with a mixture containing 10 per cent. of hydrochloric acid; and, in fact, the quantity dissolved is quite infinitesimal.

(*b*) *Dilute hydrochloric acid.*

Hydrochloric acid (D = 1·2)	...	...	5 cubic centimetres.
Distilled water	...	...	100 „ „

As soon as the circuit is closed, we see gas given off at the negative electrode only. After some time, the liquid in the positive branch of the U-shaped tube serving as electrolyser is slightly tinted yellow, and at once discolours litmus paper plunged into it.

The current was passed into it for 100 hours and then the liquid was subjected to analysis, which did not reveal the slightest trace of platinum.

On working with more and more diluted solutions of hydrochloric acid, the results obtained were always the same, which proves that, whatever may be the dilution of the acid, oxides of chlorine are constantly being given off accompanied perhaps by some traces of free chlorine arising from a secondary action.

But do these oxides of chlorine proceed from the decomposition of the hydrate Cl_6H^{20} or from the oxygen of the water acting on the hydrochloric acid?

This it is impossible to find out, for these two reactions may be produced either separately or simultaneously.

In order to make sure that in the electrolysis of hydrochloric acid oxygenated compounds of chlorine really are produced, I precipitated the liquid of the electrolyser by a slight excess of nitrate of silver, I then filtered it and added zinc and sulphuric acid.

After some hours the liquid was filtered and nitrate of silver added to it which gave rise to the formation of a precipitate of chloride of silver. This reaction proves the presence of oxides of chlorine, and leads us to suspect amongst them the existence of hydrochloric acid.

I do not think, however, that in the electrolysis of concentrated hydrochloric acid hydrochlorous acid can be formed, for this as soon as produced would be decomposed, in the presence of hydrochloric acid, into water and chlorine.

PROGRESS IN THE CALCIUM CARBIDE INDUSTRY.

By JOHN B. C. KERSHAW, F.I.C.

The manufacture of calcium carbide continues to attract more attention from capitalists and from company promoters than any other branch of the electro-metallurgical industry.

In the issue of the Electrical Review for January 13th, 1899, the writer gave a list of 32 places where works for the production of calcium carbide were in operation, and of 19 places where similar works were in course of erection.

Table I.—Calcium Carbide Works in Europe and America.

Country.	No. in operation.	No. erecting.
France	21	5
Switzerland	6	5
United Kingdom ...	3	1
America	5	4
Germany	4	...
Austria	3	5
Italy	3	2
Spain	1	1
Sweden	1	...
Norway	...	2
Russia...	...	1
Totals	47	26

Since that article was written, the carbide works at Ijace, Epierre, Chedde, Serres, and Giffre have been started, and works at the following additional places have been planned, and are now in course of erection:—Lourdes, in the Hte. Pyrenees; Niagara; Petrozsmi, in Hungary; Hagneck, in Switzerland; Foligno, in Italy; Paternion, in Austria; St. Felix, in France; Bellegarde, in France; Sinnakoski Falls, in Finland; Gurtnellan and Amsteg, in Switzerland; Villelongue, in the Hte. Pyrenees; Chandiére, in Canada; and Arudy, in the Hte. Pyrenees.

In a paper read before the recent Acetylene Congress at Buda-Pesth, Guilbert, of Paris, gave details of the plant and machinery at each of the 21 carbide works now operating in France. These works are located in the two mountainous districts of the Hte. Savoy and the Hte. Pyrenees, and all utilise water-power. Several of these works were omitted from the present writer's previous estimate of the number of carbide works in operation.

The amended numbers are given in Table I.

From Guilbert's paper mentioned above, the figures in Table II., relating to the H.P. utilised and available for this manufacture in France have been taken:—

Table II.

Horse-Power Utilised in France for Carbide Production.

Works.	Horse-power. Utilised.	Available.
Bellegarde	{ 1. 1,200 2 500	8,000
Chapareillon	800	...
Chedde...	2,000	12,000
La Bathie	{ 1. 1,250 2. 1,500	2,500
N. D. de Briançon	3,000	...
Epierre	2,600	..
St. Béron	2,000	...
Sechilienne	1,200	4,000
Serres	600	3,500
Giffre	880	...
Froges...	275	...
La Praz	?	...
Albas	1,450	15,000
Arudy	...	...
Crampagna	600	2,000
Castelet	?	...
Marsaac	350	2,500
Salies du Salat ...	300	...
Totals	20,505	50,300

Outside France, the more important developments in connection with this manufacture are occurring at Ijace, in Hungary, where 8,000 H.P. is available, at Niagara, where the Union Carbide Works, of 10,000 H.P., is being erected, at Chandiere, in Canada, where 6,000 H.P. is to be utilised for carbide production, and at Sarpsborg in Norway.

The furnaces in use in the 47 works now in operation vary greatly in design and construction. According to one authority, a return is being made to simpler forms, many of the highly complicated structures which formed the basis of patents having, on trial, proved of little practical value.*

At Langenthal, in Switzerland, the furnaces are merely chambers of refractory fire-bricks, into which weigh-boxes of sheet-iron, containing the charges of lime and coke, are pushed.†

Borchers has patented a new furnace, which is designed to utilise the heat lost by radiation and conduction from the furnace walls. The furnace body is of sheet-iron, and is provided with a water jacket. The steam generated during the passage of the current and the cooling of the fused carbide is used for power generation ‡

At Bellegarde the Bertolus form of furnace is in use,§ while at St. Marcel, in Italy, the furnace patented by Memmo has been adopted.‖ It is interesting to note that at Langenthal, at St. Marcel, and at Bellegarde-sur-Valserine, triphase current is being used with success for carbide production.

With regard to the yield of carbide per H.H.P. there is little progress to report, and the actual yields obtained in some of the works now in operation are believed to be much below the maximum possible in well-conducted works.

At Méran, in Austria, an output of 5·2 kgs. per KW.-day is said to be obtained with the Gin and Leleux type of furnace, and according to M. Gin this equals a thermal efficiency of 92 per cent.¶

At St. Marcel, in Italy, with the Memmo furnace, an output of 4·88 kgs. per KW-day has been obtained.** Liebetanz, in his paper before the Buda-Pesth Congress, based his estimates on a yield of 5 kgs. per KW.-day of 24 hours,†† and this may be taken as the average for the best managed carbide factories.

The selling price of carbide still remains much higher than is justified by its cost of production. This is due chiefly to freight

* *L'Industrie Electrochimique*, December, 1898.
† "Excursion Electrotech. en Suisse," Chapter X.
‡ *Electrician*, May 19th, 1899.
§ *L'Industrie Electrochimique*, December, 1898.
‖ *L'Electricien*, July 8th, 1899.
¶ *L'Eclairage Electrique*, May 6th, 1899.
** *L'Electricien*, July 8th, 1899.
†† *Zeit. f. Angew. Chemie*, July 11th, 1899.

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charges, which often add 50 per cent. to the price f.o.r. at the factory.

Thus at Lourdes, in the Hte. Pyrenees, where a carbide factory is now in course of erection, carbide from Switzerland and America is sold for £24 per ton, while it could be produced in the district for less than £12. In Switzerland carbide is selling for £14 per ton, while the same carbide in Paris costs £19 per ton. At Meran, in the Austrian Tyrol, it is estimated that the carbide costs only £7 5s. per ton f.o.r., after allowing for interest on capital and depreciation of plant. At Niagara it is estimated that the carbide now produced there costs between £7 5s. and £8 per ton, and it is hoped to reduce this cost to £6 by improvements in the furnaces and in the details of manufacture.

In a Consular report it has been stated that the wholesale price of carbide in France is £14 (packages extra), while the retail price is at the rate of £22 per ton. Stern, in an article on acetylene lighting in Germany,* states that the sale price of carbide in that country in small lots is at the rate of £17 10s. per ton. He considers this high price to be due to the action of speculators who have little regard for the advancement of the industry.

Liebetanz, in the paper alluded to above, estimates the cost of carbide, with steam-power, at £11 14s. per ton, and at £8 18s. when water-power is used. He points out that when the freight charges are excessive, it may be more economical to produce carbide in the district where it is consumed, by the aid of steam-power, than to import it from a distant factory operating by water-power. This is a truth which needs emphasising in these days, when almost every water-power in Europe is being developed for the manufacture of calcium carbide.

With regard to the financial position of the industry, carbide production does not in every case lead to large profits, and the warning given by the writer in earlier articles on this manufacture are in some cases being justified by events.

Thus the carbide works at St. Béron, in France, have been advertised for sale by auction—a proceeding hardly characteristic of a flourishing manufacture—and one of the few carbide works operating in England is stated to have shown a loss upon its first year's working accounts.

These facts show that the manufacture of calcium carbide is not one that may be lightly rushed into by capitalists ignorant of the conditions of supply and demand in this new industry, or of the position as regards furnace patent rights. Owing to non-acquaintance of promoters and others with the practical necessities of electric furnace work, as applied to carbide production, large sums have in many cases been paid for patents which, on further trial, have proved valueless; and in this manner many of the existing carbide companies have been over capitalised at the commencement of their career. As the price of carbide falls, such companies must inevitably go into liquidation, or write large sums off their capital account: and those companies which are using simpler forms of furnace, and have paid nothing for patent rights, will unquestionably be in the stronger position.

THE ELECTRIC LIGHTING OF LYNN.

We are now able to follow up our description of the electric lighting installation at King's Lynn with a few notes and drawings of the reversing joint boxes, fuse boxes, disconnecting boxes, &c., supplied by Messrs. Siemens Bros. & Co.

Fig. 1 shows a house junction fuse box, which consists of a cast-iron box in two halves, which bolt together; the lower part is filled with compound after the house service leads have been connected. In the top part of the box is a porcelain dish, which contains the fuses. The leads from the mains are brought through ebonite bushes, which are placed in the bottom of the top part of box to the fuse holders. The top covering for this box is glass, so fitted as to keep out water. Each of the boxes is fixed in a brick pit and provided with a cast-iron frame and cover, so that it is accessible at all times.

Fig. 2 is a public lamp service box which is made somewhat similar to the house fuse box, but instead of having a porcelain dish, it has glass tubes to cover the fuse between the service cable to lamp and main. These also are provided with a cast-iron frame and cover.

In fig. 3 are shown sectional views of a fuse box on triple concentric distributing mains. It consists of three parts. The centre part is provided with holes into which are screwed ebonite brushes, and through these the G M. connections from the mains pass which carry the links or fuses. After the connections are made the box is bolted together and the lower part filled with insulating compound. There is a cover of sheet glass, and over this an additional cover made of tin plate, with handle for lifting on and off for inspection of fuses, &c. These also are placed in brick pits with frame and cover.

Fig. 4 shows the type of reversing joint made on the mains, and consists of a cast-iron box in halves, bolted together and filled with compound. In the box the cables lie side by side, but with a space between them, and where the conductors have to be connected the insulation is cut away; a distance piece made of gun-metal is inserted, and the whole bound with copper wire and soldered.

In connecting either of the two outer conductors, a thin tinned copper ring is slipped under the wires to protect the inner insulation from injury by the tinning of the conductors.

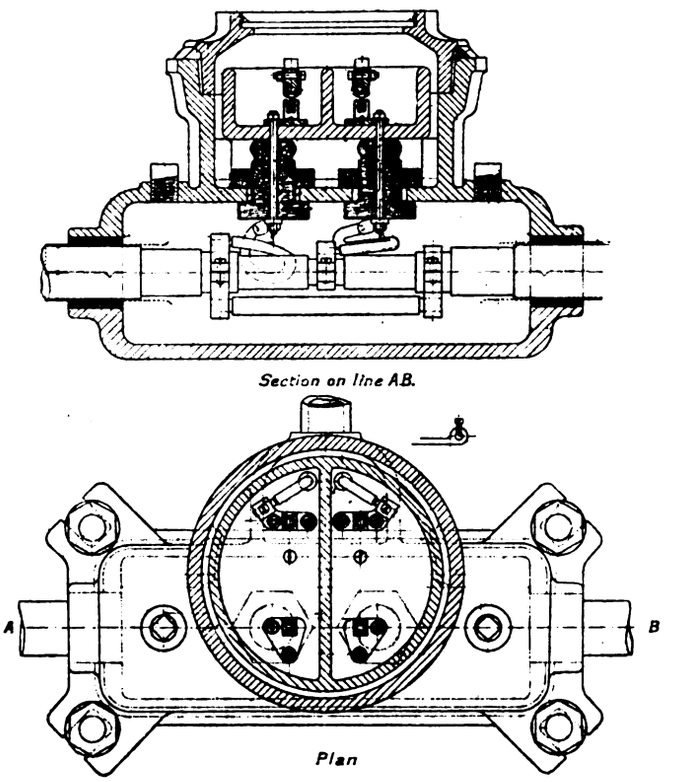
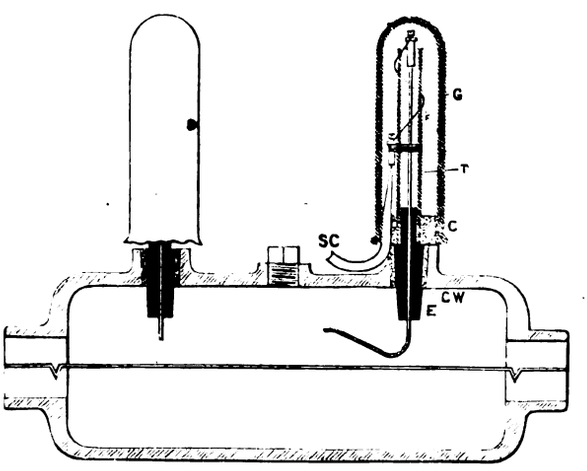


Fig. 1.

After being soldered the whole is taped over before running in the insulating compound.

Twenty-three boxes were supplied for joints between new and existing mains. They consist of cast-iron boxes in two pieces, which are bolted together and filled with insulating compound. The method of jointing is the same as that employed in making the joints shown in fig. 4.



G, Glass case; T, Glass or porcelain tube; F, Fuse wire; C, Cork; S C, Service cable to lamp; E, Ebonite; C W, Cork washer.

Fig. 2.

The Davy arc lamps are of the enclosed type, arranged to burn two in series on a 200-volt circuit. The outside of the lamp consists of an ornamental metal spinning and an opal globe.

The Siemens arc lamps are of the well-known "band" type, constructed to burn four in series on a 200-volt circuit. They are fitted

* *Journal fur Gasbeleuchtung*, 1899, p. 262.

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with globes and lanterns, modified so as to suit special canopies supplied with the posts made by Messrs. Law.

The two-light and one-light ornamental incandescent fittings are of the patterns shown by figs. 5 and 6, and consist of a clear well glass enamelled reflector and ornamental cover. The reflector is made in two pieces: one piece is perforated for the insertion of lamp or lamps, and fixed to the cover of the fitting; the other part is hinged at one side, and fastened by means of a catch to the cover, which is further secured by means of a small set screw. The holders are attached to a small watertight box, which can be opened to facilitate

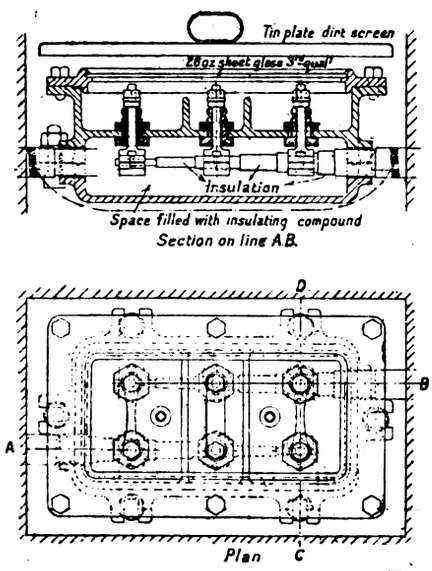
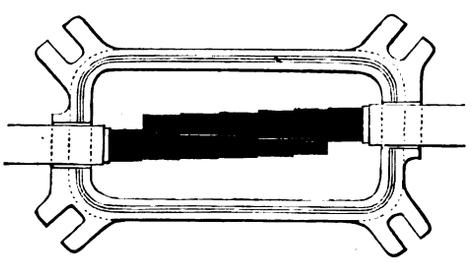


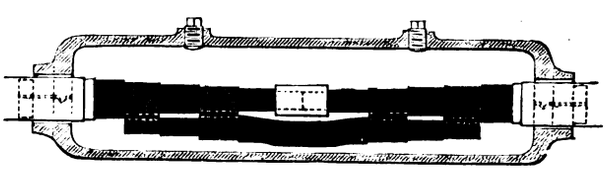
Fig. 3.

wiring in the manner shown by the drawings. It will be observed that the lips of the well glasses are held tightly between rubber gaskets, which help to keep the inside of fittings watertight.

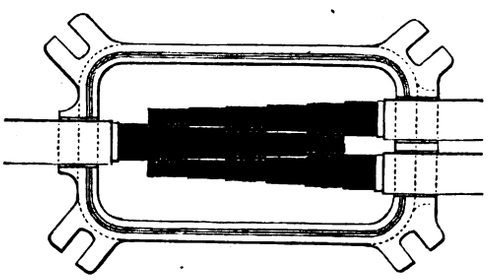
The ornamental finial shown in fig. 6 is only used in the case of the fittings being hung from suspension wires carried across some of the streets, as illustrated last week.



Two-way joint box (reversing polarity).



Two-way joint box (not reversing polarity).



Three-way joint box.

Fig. 4.

The single-light incandescent fittings for arc lamp-posts consist of clear well glass fixed in a hinged frame, attached and locked to the cover of fitting much in the same way as in the case of the ornamental fittings. The inside of the cover is enamelled.

THE ENGINE BOILER AND EMPLOYERS' LIABILITY INSURANCE COMPANY.

The annual report of this company, recently published, contains a few items of some interest, namely, an economy trial of a steam engine showing very low steam consumption and an evaporative test with a water-tube boiler as a reply to numerous enquiries in regard to water-tube boiler performance. The engine test was made on a

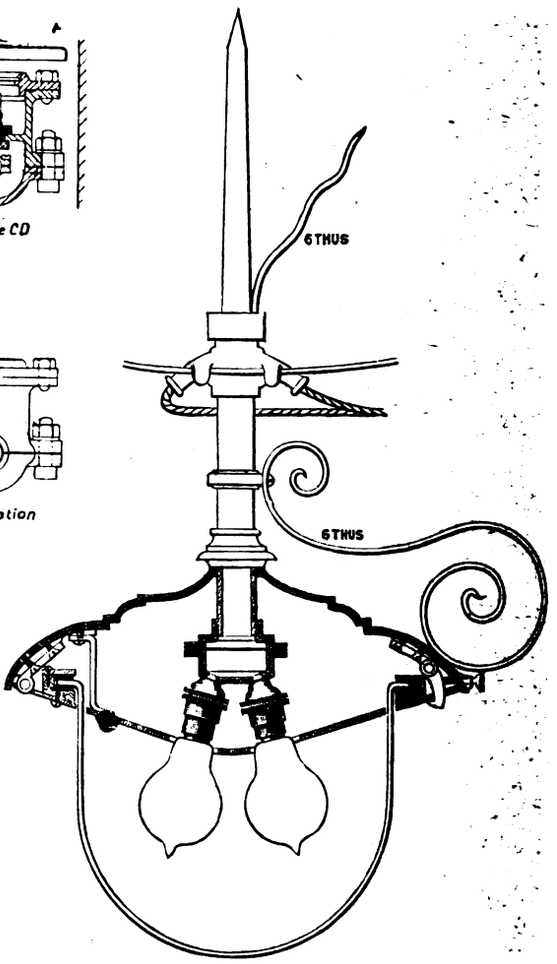


Fig. 5.

compound engine of Messrs. Cole, Marchent & Morley's make. It had cylinder jackets everywhere except to the front of the L.P. cylinder, and Corliss valves throughout. The H.P. cylinder had a thoroughfare jacket, and there was an intermediate heater receiver

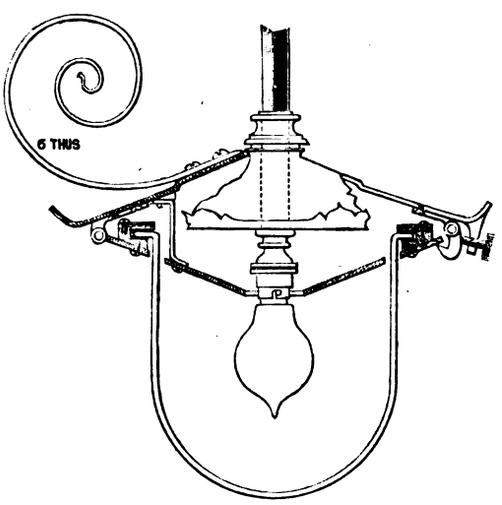


Fig. 6.

with a boiler pressure copper coil. The condenser had 1,500 feet of tube surface, but it was dirty and showed 31° difference of temperature between hot well and discharge. The cylinders were 19$\frac{1}{16}$ and 36$\frac{1}{16}$ diameter, the stroke 4 feet 6. The H.P. piston rod was

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4 inches, and the front L.P. rod was 5 inches diameter. Clearance volume of both ends was 0·462 and 1·8 cubic feet respectively, the clearance surfaces of both ends 11·24 and 31·28 square feet respectively. The revolutions were 73·16 and 73·35, on two trials, the gauge pressure in boiler 105 and 107 lbs. corresponding to 341° and 342° of temperature. The I.H.P. was 508·4 and 497·1, the steam consumption being 14·14 and 14·27 lbs. per I.H.P.-hour, an excellent result at the pressure. Of 214,500 units of work theoretically possible to obtain between the temperature of the boiler and the air pump discharge, 140,000 were actually secured as I.H.P., or 653, the mean effective pressure being 25·35 referred to the larger cylinder. The range of temperature was 102° in each cylinder, and the H.P. per square inch of L.P. cylinder 20·06. Of the actual heat received by the engines, namely, 279·2 units per minute per I.H.P., 42·7 were utilised. Calculations of the clearance surfaces exposed to initial steam have been made and show 15·7 and 41·5 square feet per pound of steam, while the total initial admission surface, *i.e.*, the surface at cut-off, was 25·5 and 62·8 square feet per lb. of steam respectively in the two cylinders, the steam present as steam at the end of admission being 89·4 and 78·6 in the two cylinders respectively, showing 10·6 and 21·4 per cent. of water, while at release the water present was 6·1 and 13·9. An unjacketed cylinder of much the same proportions of clearance surface showed, in 1896, percentages of water at the end of admission 14 and 29 per cent. The difference is ascribed to the beneficial action of the jackets. It is a pity we do not get more data of engine tests, including clearance surfaces. There is nothing about a steam engine which exercises such a serious influence on economy as the internal clearance surface, and no man has done more to point this out than Mr. M. Longridge of the above company. With 25½ feet of surface exposed to each pound of steam, it is obvious that as 10·6 per cent. of the steam was condensed in the H.P. cylinder, this surface must have absorbed 93 heat units, or 3·6 units per square foot, in becoming heated from the terminal to the initial temperature, or say, 102°. To heat up a square foot of cast-iron of 1 inch thickness 102° requires approximately 468 units. As only 3·6 are available, it follows that the mean heated thickness of metal or skin is $\frac{1}{130}$th of an inch, which corresponds closely with the customarily assumed $\frac{1}{100}$th, the difference being jacket benefit. As 93 heat units are still lacking, any further improvement must come from superheat. 100° of superheat would yield about 37 units, which with the well-known cumulative action would probably abolish or nearly abolish the remaining 10 per cent. of liquefaction.

The water-tube boiler which was tested was of the small tube type with tubes vertical or highly pitched and known as the Glasgow boiler. From ·415 to ·563 lb. of coal was burned per foot of heating surface. The coal had a calorific value of 12,012 B.T.U.

Of this 68 per cent. was transferred to the water, 26 per cent. to the chimney, and 6 per cent. was lost as radiation, &c. The heating surface was 4,230 feet for a grate area of 66 feet, the ratio being the high one of 1 : 64, and it is remarked that if 40 per cent. of the surface were put into a feed heater and taken from the boiler the results might have been better, for the gases left the boiler in every test at over 600°, in one at 673°. From 26·6 to 36 lbs. of coal were used per square foot of grate per hour and the "from and at 212°" equivalent evaporation per pound of combustible was 9·22 to 9·63 lbs. The duration of the tests was about 8 hours, the fires being judged as to condition at beginning and end of the tests. This is a method by no means easy to carry out, and where the firing and duty is regular we are much inclined to think that a little used system would prove better. We refer to the system of getting well under weigh and starting the test when the steam pressure commences to drop after the last previous firing, finishing the test in the same way at the instant steam commences to drop in pressure after the last previous firing about the pre-determined hour for stopping. We think in this way that the state of the fire would be more accurately balanced at each end of a run than it can be by estimation.

A further note in the report is on the resistance to the flow of water through surface condensers. With 679 tubes of 6 feet 2 inches length and ⅝ inch external diameter placed in two series, having areas of passage ·814 and ·75 square foot respectively, with inlet and discharge pipes of ·196 square foot area each, a 6-inch centrifugal pump at 820 revolutions per minute caused a difference of pressure of 1·82 and 3·05 feet of water in two tests where 1·21 and 1·72 cubic feet of water per second was flowing. In gallons per hour these figures are about 27,000 and 38,000.

These figures should be useful now that surface condensing is becoming so common. Will not Mr. Longridge now give us some results of steam consumption by direct-acting steam air-pumps? We fancy it might be just as well to work high pressure as to use condensers with these direct-acting pumps.

RECENT EXPERIMENTS WITH STEAM ON COMMON ROADS.

Those interested in this subject should obtain the full text of Mr. Thorneycroft's paper read on Tuesday at the meeting of the British Association at Dover. Mr. Thorneycroft has given great attention to these vehicles, and has built many. He tells us that one Ramsay invented a steam wagon nearly 300 years ago, and that Newton himself gave the subject his attention, though how the steam was applied is not stated. Progress is still hampered by the Locomotive Act of 1896, which, though more liberal than its predecessor, is still far from perfect, and its great drawback is the limit it imposes in respect of weight. Three tons is not sufficient for a commercially possible vehicle to carry the 5 and 10 tons insisted on by merchants to form paying loads.

Greater latitude is allowed in France, where a 4-ton vehicle is found necessary to carry 1½ tons of persons. In Lancashire loads of 10 tons are carried on four wheels at 2 miles per hour, the tyre load being 2·3 tons per inch of width. A steam wagon is recommended of 16½ tons to carry a load of 10 tons on four tyres of 25 inches total breadth. We do not see why there need be much desire to reduce tyre widths. Additional breadth does not add much to the weight, but it does help to preserve the road surface, and to reduce traction. Curiously enough, the widest wheels are found where the roads are best. The County of Lincoln, for example, with so many soft roads, is noted for its narrow tyred carts.

Mr. Thorneycroft doubts whether even the pure feed water is sufficient to counterbalance the air condenser, which sometimes gives very greasy feeds. An air condenser must have gills on its thin copper pipes or it will not act, and it must have a fan to keep it cool, and the fan absorbs about 12 per cent. of the total engine power.

A van supplied to Chiswick Vestry has 65 feet of heating surface in its boiler, 2½ feet of grate area, carries 175 lbs. pressure, has cylinders 3 inches and 5 inches by 3 inches stroke, with cranks at 180°, and cylinders on opposite sides of the shaft for balance. To prevent rust when standing idle the frames, guides, valves, pistons, and rods are of bronze. Renold chain gears are used, and the air condenser has 145 square feet of surface. Steel disc wheels have proved heavy, and the satisfactory wheel is a felloe driven wheel with metal naves, oak spokes and ash felloes, with thick and wide tyres driven on hydraulically. Superheating is of doubtful value, because of the apparatus being unsuitable for such service. Exhaust feed heating is valuable. For ordinary purposes no variable gear is necessary with steam power, which is sufficiently elastic to meet all ordinary wants. A special gear, however, is applied by Mr. Thorneycroft for soft roads and steep hills.

Welsh coal is recommended for fuel, and very much depends on the driver, who should be competent to deal with any small defects that may be met with on the road. Finally, the author believes that the problem of the light locomotive is already solved, but we might add that it has been solved by making the light locomotive heavy, or, at least, by demanding that it should be heavy. We certainly agree with this. For freight traffic we think the roads of this country will meet their best use in a slow and heavy traffic for freight, rather than in a light and fast traffic. But we also believe that the light railway has not been exploited to its full extent. The Light Railways Act was intended to provide for the construction of light railways, but it has been made almost a dead letter as regards electrical working by the foolish and obstructive tactics of the local authorities. We venture to say that the Light Railways Act never intended local authorities to use their powers or rights under the Act purely for the purpose of obstruction.

CORRESPONDENCE.

Stresses in Engine Shafts.

I am somewhat at a loss to catch Mr. Taylor's drift. Let me try to make things more definite. I will say nothing of how much the current may exceed the normal, be it 100, or be it 200 per cent. Instead, I will ask Mr. Taylor to state a maximum figure for the current passing at any moment. Then let it be assumed that this maximum current is suddenly applied from a condition of no current. Assume that a current of 200 amperes is thus suddenly applied upon a previously unloaded set. Then I maintain that the shaft stress set up by this current cannot exceed double that due to a gradually applied load of the same amount. A suddenly-applied load cannot induce greater stresses than are applied by a steady load of double the amount.

Mr. Taylor will please note that I have not fixed any figure as representing what may not be exceeded as between normal and maximum current. What I do claim is that, given a maximum beyond which the current will not rise, the actual stress cannot exceed that due to a steady current of, at most, double that maximum. Now there is the time lag of the machine, and whatever this may be, its effect can only be to reduce the suddenness of application of the stress.

Further, to take Mr. Taylor's figures for the Waterloo and City line, it appears that the circuit breakers are adjusted for a load of 2·8 times the normal. If this figure were given me as maximum, I would calculate torsional stresses to suit a steady load of 5·6 times normal. If, as Mr. Taylor says, there is a rise of current beyond the 2·8, then whatever this is I would provide for double. Obviously, what is now wanted is that we should know what is the time of movement of the circuit breaker. Mr. Taylor evidently believes

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that the lag of the circuit breaker is more than the lag of the generator. The desideratum is a circuit breaker more rapid than the rate of current increase of the generator. Now, no one has suggested that the output is not liable to severe fluctuation. But I am unaware of any tests to determine the information asked for by Mr. Taylor as to the rate of increase of current when short circuited at an E.M.F. of 500 volts or any other figure. Clearly, we are both seeking the same information.

Granting that current may increase beyond that at which the circuit breaker is *set*, does not this point to the need of a comparatively light setting of the breakers? I see no risk by frequent opening of these. There is much risk by overloading them. It is certainly not convenient that the breakers should too frequently act, but if they went off a little oftener, they would afford something for attendants to do in putting them in again. Finally, however, I would point out that the dimensions of a shaft necessary for bearing pressures of sufficiently small intensity per square inch, and of a stiffness sufficient to carry fly-wheel loads, are such as to afford a very large margin of torsional strength.

If a 3-inch shaft, at 90 revolutions, will turn a steady load of 40 H.P., as per same tables, then, for a steady 4,000 H.P., a shaft of 13·8 inches would be needed. But this would neither suffice to carry the fly-wheel nor to provide bearing surface. The true power to provide for, however, would appear to be 4,000 × 2·8 × 2, or 22,400. Call it 24,000 to allow for an internal bore, and the diameter comes out at 25·3 inches, and this corresponds with general ideas as to size, with other reasonable dimensions. Thus a very great excess of load suddenly applied is still provided in the dimensions demanded by considerations quite outside the question of twisting moments. The lesson certainly appears to be that unless circuit breakers can be made to set an absolute limit to output, the design of a generator and fly-wheel should be such, as pointed out in my second article (Electrical Review, September 15th), as will prevent stresses passing through the shaft between the fly-rim and the armature.

The Writer of the Article.

P.S.—Since writing the above, I note that a writer in the *Engineer* has advanced the same idea as myself in regard to the action of a fly-wheel in protecting an engine. Is it not a very obvious error in so many American engines that the crank is placed between the fly-wheel and the generator? This ought never to be done.

Pulverisation of Metal Cathodes.

I have read in the Electrical Review, dated August 4th, a Note entitled "The Pulverisation of Metal Cathodes," in which mention is made of the electrolysis of hydrochloric acid with platinum electrodes. With regard to this subject, allow me to remind you that in 1882 I made a minute and careful study of the electrolysis of hydrochloric acid under various degrees of concentration, using as electrodes sheets of platinum. I send you herewith a copy of the note I presented to the Academy in 1882, and if, as I hope, you find that this note may prove of interest to your readers, you will oblige me very much by publishing it in your estimable journal.*

D. Tommasi.

The Hogging of Welded Tram Rails.—Rails which have been welded up at night are liable to twist if the road material is removed during the daytime if the sun is at all strong. They may be straightened up temporarily by playing cold water on them, but there will always be some uncertainty as to what will happen when welded rails are uncovered for tamping or other purposes in years to come. The last word has not been said about rail bonds, and it may turn out that after all the plastic amalgam bond is the best all-round method from both the financial and practical points of view. The vibration and slight endway movement which is always going on, tends of itself to keep the amalgam joint in good order.

* Dr. Tommasi's article appears in another column.—Eds. Elec. Rev.

BUSINESS NOTICES, &c.

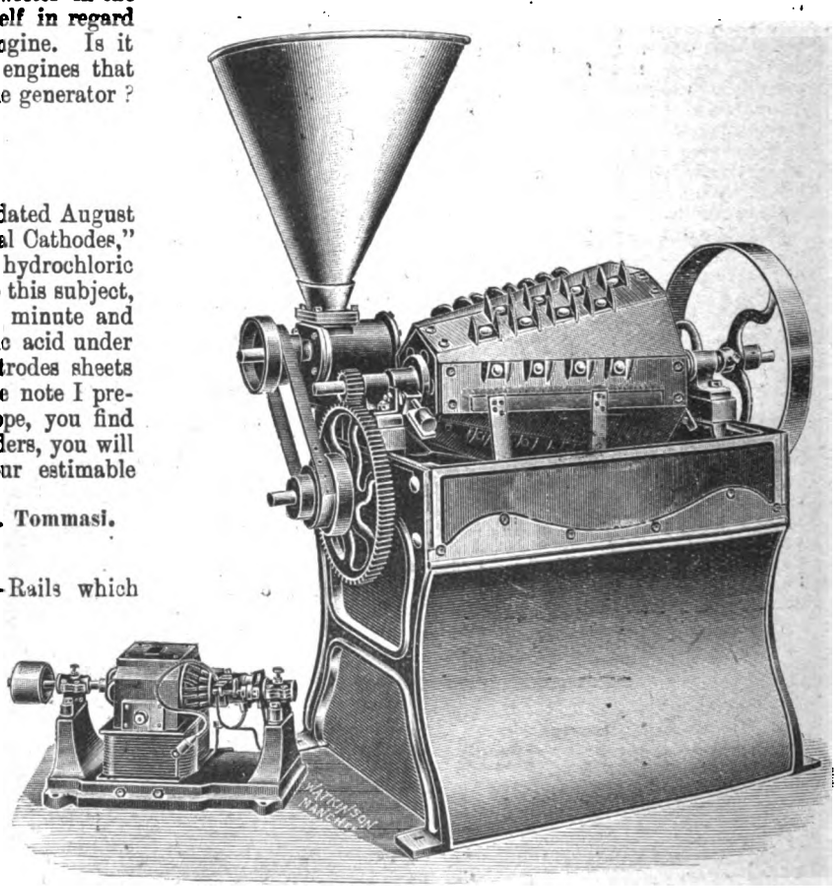
Electrical Wares Exported.

Week ending Sept 20th, 1898		Week ending Sept. 19th, 1899.	
Adelaide	Value £1,150	Amsterdam.	Value £20
Alexandria	20	Bombay	198
Auckland	49	Boulogne	97
Bangkok	256	Buenos Ayres	103
Boulogne	20	,, ,, Teleg. mat.	80
Brisbane	160	Calcutta	868
Buenos Ayres	697	Canterbury	155
,, ,, Teleg. mat.	100	Cape Town	46
Calcutta	96	Channel Islands	830
Cape Town	876	Chinde. Teleg. gear	11
Chinde	1,060	Christiania	27
Colombo	102	Colombo	162
Constantinople	45	Durban	366
Copenhagen	95	East London	113
Delagoa Bay	800	Falkland Islands	10
Demerara. Teleg. mat.	83	Flushing	11
East London	1,058	Hamburg. Teleg. mat.	810
Flushing	24	Korsor. Teleg. cable.	9,900
Gothenburg	79	Lisbon	65
Hamburg	400	Montreal	60
Hong Kong	148	Ostend	290
Melbourne	267	Perth	40
,, Teleg. mat.	54	Port Elizabeth. Teleg. mat.	88
,, Teleph. mat.	146	Rio Janeiro	212
Paris	9	,, Teleg. mat.	87
Rotterdam	12	Rotterdam	65
St. Petersburg	90	,, Teleg. wire	27
,, Teleg mat.	71	Santos	51
Singapore	94	Santiago	85
,, Teleg. mat.	954	Shanghai	65
Stockholm. Teleg. mat.	215	,, Old teleg. wire	157
Sydney	66	Singapore	17
Tientsin. Teleg. mat.	110	Sydney	1,114
Yokohama. Elec. teleg. cable	14,815	Trieste. Teleg. mat.	600
		Yokohama	519
Total	£22,645	Total	£15,596

Foreign Goods Transhipped.

New York. Elec. carriages.	Value £250
Singapore. Elec. light mat.	8
Total	£258

Electro-magnetic Separator.—We illustrate below a patent electro-magnetic separator for which Mr. J. F. Butterworth, of 28, Queen Street, E.C., is the agent over here. The special features of this machine, which distinguish it from others, are:—(1) The use of electro-magnets instead of permanent magnets. This enables the magnetism to be controlled as described below. It secures a constant magnetic force, whereas the so-called permanent magnet gradually



loses strength and becomes useless. (2) The patent automatic knock-off motion whereby the magnets are demagnetised for a small portion of each revolution, allowing the iron collected to drop into the receiver and leave the magnets free for new collection; this is claimed to be a great advantage over the permanent magnets, which are

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most difficult to clear. These advantages enable the electro-magnetic separator to maintain a very high output without skilled labour or attention. A machine with an output of two tons per day runs at a speed of 30 revolutions (7 volts, 21 amperes); the dynamo for driving same runs at 1,800 revolutions, and the power required to drive the dynamo and separator is 1 H.P. actual. The separator is in use at the works of a number of English engineering firms.

Accumulators in Germany.—Die Oberspree Gesellschaft für Accumulatorenwerke is the title of a company which has just been formed in Berlin with a capital of £150,000, to acquire and exploit the accumulator patents of Dr. Majert.

Auction Sale.—From our advertisements may be obtained particulars of the stock and plant of an electrical manufacturer and agent, which is to be sold by auction by Messrs. Percy Huddleston and Co, at 120 Minories, E., on Wednesday next, 27th inst.

Bankruptcy Proceedings.—In the failure of Mr. S. F. Walker, electrical engineer, Cardiff, Mr. C. E. Dovey, of 31, Queen Street, Cardiff, has been appointed trustee.

Before Mr. E. L. Hough, official receiver, on the 19th inst., in the Bankruptcy Court, a first meeting of creditors was held in re J. Stewart Edwards. The debtor, described as an electrical engineer, of Moorgate Court, E.C., states that his business was that of a general commission merchant, which he commenced in June, 1895, with no capital. He estimates his liabilities at about £13,000, the value of his assets not yet being ascertained. Since 1895 he has lost about £1,000 by speculations on the Stock Exchange. It further appears that the debtor has been engaged in ventures which have proved unsuccessful; that he has forfeited about £5,000 or £6,000 in respect of options, and that he has incurred a loss by contributing to the expenses of promoting an abortive company. It was stated that the debtor was desirous of submitting a proposal, and an adjournment was accordingly granted.

Dissolutions.—Messrs. P. Speedy, C. H. Congdon, and G. L. Eynon (Speedy, Congdon & Co., electrical engineers and contractors, 14, Victoria Street, S.W), have dissolved partnership. Messrs. Speedy & Eynon will continue the business as Speedy, Eynon & Co.

Messrs. C. F. Hengst and F. S. Thomas (Saxonia Electrical Wire Company, engineers and electricians, Burwash Road, Plumstead) have dissolved partnership. Debts, &c., will be attended to by F. S. Thomas.

Book Received—"Gas and Electric Lighting Works Directory and Statistics, 1899." 6s. net. London: Hazell, Watson and Viney, Limited.

Catalogues.—Messrs. B. R. Rowland & Co., of Manchester, send us a descriptive pamphlet of the Morrin "Climax" water-tube safety boiler, which they manufacture; the boiler is of the vertical type, very compact, and has been extensively adopted in the United States.

Messrs. John Spencer, Limited, of Wednesbury, sends us a revised price list of gas, steam, and water tubes and fittings.

Deed of Assignment.—Messrs. Woodburn & Holme, solicitors, of Liverpool, inform us that Mr. F. G. Robinson, of 9, Shand Street, Liverpool, electrical engineer, trading as the Shand Electric Company, on 12th inst., executed a deed of assignment of his property for the benefit of his creditors. The trustee is Mr. Wm. F. Levy (accountant), of Central Buildings, 41, North John Street, Liverpool.

Educational Notices.—The next session of the Battersea Polytechnic, S.W., evening electrical and general engineering classes, commences on September 25th. The evening class session at the Northampton Institute, Clerkenwell, also opens on 25th inst. See our Advertisement Pages.

We have received the prospectus of day and evening classes at the South Western Polytechnic, Manresa Road, Chelsea, for the 1899-1900 session. There are a number of classes in electrical engineering re which separate pamphlets are issued. These prospectuses are as usual got up in very interesting style with a number of illustrations showing the various departments.

Electrical Engineering Company for Alloa.—According to the *Edinburgh Evening News*, it is proposed to establish an electrical engineering company in Alloa, where all kinds of plant and appliances used in connection with electrical undertakings can be produced. A convenient site has been offered near the banks of the river Forth, and it is understood that the selection of the site now lies between Alloa and a rival claim by Coatbridge.

Extension to Johnson & Phillips's Cable Works.—Owing to rapidly increasing business Messrs. Johnson & Phillips have just broken ground for a large extension to their cable works. The department has been for some time under the immediate supervision of Mr. S. Paterson, ably seconded by Mr. P. W. Sankey, the works superintendent. The firm hope to get their share of the many underground cable contracts which are now being placed, and, as in the past, they will make special efforts to cope with Colonial and foreign trade.

Intended Dividends.—Notices appear in the *London Gazette* of intended dividends in the cases of W. A. Charles and J. S. Blackwell (Central Electrical and Engineering Company, Leicester), and of F. Marson (F. Marson & Co., Leicester, electricians and ironmongers); also in the case of Thomas Ford (T. Ford & Co., chandelier and electric fittings manufacturer, Birmingham).

Name Plates.—Mr. Paul Goldschmidt, of Featherstone Buildings, Holborn, sends us specimens of some new patent and very neat metal name and address plates which are made on a new improved chemical process by firing and silver enamelling, not by printing. They are claimed to resist all effects of climate, to keep always the original colour, and further, they may be bent without damage to the lettering. They are said to have been well received by leading engineering firms and to be cheaper than ivory plates.

Trade Announcements.—Messrs. Krupka & Jacoby ask us to state that they are still continuing their business at Watling Street, the winding up of the Phæton Electrical Company in no way affecting them.

Messrs. Julius Sax & Co., Limited, inform us, with reference to a note under the above heading in our last issue, that the company has gone into liquidation merely as a formal matter with the object of reconstruction, and for the purpose of introducing new working capital into the business, which will be carried on as before.

ELECTRIC LIGHTING NOTES.

Ayr.—The accounts for the past year show that the electricity works are now beginning to become profitable. The supply pressure is about to be raised to 200 volts, to relieve the overloading of the mains in the centre of the town.

Bangor.—At Bangor steady progress is being made with the installation of the electric light. A contract for laying cables has been let to the British Insulated Wire Company, who have already laid mains along Garth Road and Farrar Road.

Barnsley.—A Committee of the Board of Guardians has recommended that the workhouse be electrically lighted at a cost of £924.

Birmingham.—The electric lighting and power plant for the new works of the Birmingham Railway Carriage and Wagon Company, Limited, has been given to Messrs. Ellis & Ward, of Birmingham, the present requirements consisting of several hundreds of incandescent lamps and some 50 arc lamps. The generators will be driven by steam power, which is also being supplied by the above firm.

Brighton.—Mr. Wright has presented a report to the Lighting Committee, in which he states that even if the present works were extended to cover the whole of the available space, they would be inadequate to meet the demand for more than five years, having regard to the rapid rate of increase of business. He recommends that a site be acquired outside the borough capable of housing generating plant of at least 50,000 H.P., and that a station of 25,000-H.P. capacity be erected thereon. The reduction in carriage of coal and the facilities for condensation will result in an annual saving of over £10,000, allowing for the interest on cost of mains from the site at Aldrington, which he prefers. The pressure to be adopted is 10,000 volts. The Lighting Committee approved of the report, and was to lay the project before the Council yesterday.

Broughty Ferry.—The Burgh Commissioners have received the report of Mr. Fedden on the subject of electric lighting, and have decided to take immediate steps towards obtaining a provisional order.

Cheadle.—The Council has appointed an Electric Lighting Committee with a view to applying for an electric lighting order.

Cheltenham.—An inquiry was held last week by Colonel Hepper, R.E., inspector under the Local Government Board, into an application made by the Corporation for sanction to the borrowing of £16,600 for extension of works, plant, and mains, &c., in connection with the electric light undertaking. The Mayor, as chairman of the Lighting Committee, stated that last year the receipts of the undertaking were £2,148 over and above the working expenses. The current now supplied to private consumers was equal to 20,885 8-C.P. lamps. For street lighting, there were at present 197 arc lamps in use, and 100 more were ordered. The average cost of the current to private consumers (reckoning discount and rebate) was 5d. per unit. Mr. Kilgour, borough electrical engineer, gave details of the new plant, &c., required. There was no opposition to the application.

Coatbridge.—At the last meeting of the Town Council the accounts of the local branch of the Scottish House-to-House Electricity Company, Limited, for the year were submitted. The following is the revenue account:—The expenditure for the year amounted to £1,570 0s. 4d., as compared with £1,319 11s. in the preceding year, and the revenue received is £877 14s. 6d., as against £905 2s. for the preceding year. The loss on the year's working amounts to £693 5s. 10d., which, with the interest paid on mortgages and bonds of £997 14s. 1d, in all £1,689 19s. 11d., as compared with £1,294 7s. 5d. of the previous year. The total losses, &c., at the debit of suspense account, as at December 31st, 1898, amount to £8,076 8s. Electricity generated:—The total quantity generated in Board of Trade units is 61,864, as compared with 64,834 of the previous year, and the quantity unaccounted for is 22,053.

Derry.—The Lighting Committee has received a letter from the British Thomson-Houston Company, Limited, in which the charges (6d. and 2d.) recommended by Mr. Christie in his report are criticised as being too low. Mr. Christie has also sent in a second report, and the Corporation has decided to consult Sir W. H. Preece as well. Have we here a multitude of counsellors, or too many cooks?

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Dublin.—After providing for working expenses, repayment of principal and interest on loans, &c., the Lighting Committee estimates that it will have on March 31st next a credit balance of over £900. This balance would be greater but for the fact that the period covered by the estimate involves the most expensive quarters of the year.

Edinburgh.—The Town Council has resolved that an application be made to the Secretary for Scotland for the borrowing of a further sum of £210,000 for extension of works under the Edinburgh Electric Lighting Order, 1891.

Elland.—The District Council has instructed Mr. W. Emmott, Halifax, to prepare plans, &c., with a view to obtaining a provisional order.

Eton.—The public lighting of Eton College and town will shortly be undertaken by the Windsor Electric Company.

Exmouth.—The District Council has resolved to apply for a provisional order for electric lighting.

Gosport.—The District Council has resolved to apply to the Board of Trade for a provisional order to supply electricity within the districts of Gosport and Alderstoke. It was stated that the Electrical Distribution Company is still willing to lease the order from the Council.

Grays.—Mr. A. H. Preece has advised the District Council that the proposal to supply electricity to neighbouring parishes is undoubtedly a good one, and if carried out would benefit both Grays and its neighbours. The Council is in communication with the Board of Trade regarding the matter.

Hackney.—The Vestry has selected a site for the new electricity works on a cut from the River Lea. It is intended to use water from the cut for condensing purposes.

Hyde.—The Town Council has unanimously passed a resolution to the effect that application be made to the Board of Trade for a provisional order to supply electricity for any public or private purpose within the borough.

Inverness.—The Town Council has finally decided to adopt steam-power for the electricity works, and has instructed Mr. Craven to prepare a scheme, on the understanding that he will sever his connection with the Brush Company.

Italy.—A central electric power station has lately been established at Lama dei Peligni. Water-power is utilised, the electric energy generated being employed for lighting purposes in the town named and surrounding district.

Kilmarnock.—The Town Council has appointed a committee to carry out the electric lighting scheme, for which a provisional order has been obtained.

Kincardine-on-Forth.—The residents are considering a proposal to light the town by electricity, generated with Dowson gas. Mr. W. T. Parves, M.I.C.E., has drawn up a report on the subject.

Liversedge.—The District Council has resolved to promote an application to the Board of Trade for a provisional order authorising it to supply electrical energy in the district.

Mile End.—The County of London and Brush Provincial Electric Lighting Company has given notice to the Mile End Vestry of its intention to commence the work of laying mains; the Highways Committee, however, in view of the fact that the company has made no effort to carry out its order during the last two years, has decided to ask the Board of Trade to revoke the order, and to request the London County Council to support its action.

Newark.—The Town Council has decided to apply for a provisional order, and to have a public meeting of ratepayers. The report of Mr. Vesey Brown shows that the probable cost of carrying out a lighting scheme would be £16,000.

Northallerton.—A small electricity works has been put down by a company for lighting and power supply to the town and district. A noteworthy feature is the use of aluminium for the overhead cables, of which there are about 5 miles; it is stated that the cost was 20 per cent. less than that of copper. This is probably the first instance of its use for this purpose in England.

Peterborough.—Applications are under the consideration of the Town Council to allow overhead wires for the purpose of a private electric supply to some of the business establishments of the town outside the area which the Corporation have scheduled in their proposed electric light works.

Radcliffe.—The District Council has received a letter from the Local Government Board sanctioning the borrowing of £1,100 for the purchase of land, and £14,900 for other works in connection with electric lighting in Radcliffe.

Shoreditch.—At a meeting of the Vestry on Tuesday, Mr. N. Moss, in moving the reception of the accounts of the electricity and dust destructor undertaking during the year ended March 25th last, stated that they had been made out as fully as possible. Every information had been given by Mr. E. A. R. Adams, the accountant to the Vestry, and he thought great praise was due to him for the way in which the accounts had been presented. As the details had only been in the hands of the members for a day or two, and they had not had sufficient time to examine the figures, he suggested that the consideration of the question should be adjourned until the next meeting. It was decided to adopt this suggestion, and to formally receive the accounts. According to the revenue account of the electricity works a gross profit of £7,478 was made, and after deducting the payment of interest and principal there remains a surplus of £5,682. There does, however, not appear to be any sum debited against this for the steam received from the refuse destructor. The total number of units sold increased from 584,295 in 1898 to 1,031,348 in 1899, and the total maximum supply demanded advanced from 408 KW. to 720 KW. in the same period.

The Vestry has completed three blocks of artisan's dwellings, which are fitted with electric light; the charges for the latter are 10d. for three rooms and 8d. for two rooms per week.

Shrewsbury.—The Town Council intends to adopt street lighting by electricity, and has resolved that the extensions should be carried out before the winter sets in.

Southend.—In spite of the vote recently cast by the town's meeting in favour of a municipal electricity supply, the Electric Lighting Committee has again recommended the Corporation to hand over its powers to Mr. Gibbings; as the latter stated not long ago to his council at Bradford, that he had withdrawn his offer, we await developments with interest. Meanwhile, we hear that four other companies have given notice of application for powers.

Southport.—In response to an advertisement by the Birkdale District Council, the Town Council is debating whether to offer to undertake to supply Birkdale with electricity at the same price as charged for the time being in Southport.

Sowerby Bridge.—The District Council has resolved to make application for a provisional order for electric lighting in the Council's gas area.

Ventnor.—The District Council has accepted the offer of the Electric Lighting Company to light the town with arc and glow lamps, *provided* that the company agrees to reduce the price of the arcs from £16 10s. to £15 per annum. Failing this the Council will negotiate with the gas company.

Wednesbury.—The Council has decided to light the main streets with electricity.

West Ham.—Mr. Steinitz has reported to the Electric Light Committee that a four-roomed house could be wired and fitted with five lights at a cost of 10s. per light, and that a charge of 6d. per week added to the rent would be sufficient to pay for the electricity consumed, as well as the interest on capital cost. The report bears more especially upon the question of lighting municipal dwelling houses.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Airdrie and Coatbridge.—The Councils are preparing a joint scheme of electric tramways, and have instructed Mr. Kennedy to frame a Bill granting powers to carry out the undertaking.

Austria.—A preliminary concession has been granted in respect of a projected electric railway between Zabrzech and Schonbrunn.

Bath.—The City Council has approved of the amended scheme for the electric tramways, comprising about 20 miles of single track and 40 cars, and will apply in November for powers to carry out the project. The capital required will be about a quarter of a million.

Bootle.—The Borough Council has resolved that application be made to the Board of Trade for a provisional order authorising the construction of seven additional tramways in the borough, with power to work the same by electric traction.

Bradford.—The Tramways Committee recommended the acceptance of Messrs. Dameree & Co.'s tender for supplying and laying the tracks for the tramway extensions and the light railway to Stanningley, on the "Demerbe" patent system. Several members of the Council objected to this, on the ground that Messrs. Demerbe, being a Belgian firm, were not subject to the fair contracts clause, while their employés worked longer hours for less pay than was customary in England. The rails were not in accordance with the specifications, and weighed only 77 lbs. per yard instead of 105 lbs., as asked for. It was explained that only two English firms tendered, and neither tender conformed to the specification; the committee had invited the Demerbe Co. to tender separately, having found that the experimental section laid on this system in Leeds Road cost nothing for repairs, while the girder rails cost £90 per mile per annum. Other arguments were put forward, but the Council eventually rejected the recommendation. The Demerbe rail is shaped like an inverted U, the hollow being filled up with concrete continuous with the foundation.

Brighton.—Mr. J. Kincaid has reported to the Tramways Committee on the proposed electric tramways, recommending a 3 feet 6 inches gauge.

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Canal Haulage.—The Leeds and Liverpool Canal Company are about to experiment with the Thwaite-Cawley system of electric haulage on a portion of their canal, about a mile in length, near Wigan.

Chatham.—The Board of Trade has authorised the construction of light railways for the districts of Chatham and New Brompton by the "Chatham and District Light Railways Company, Limited," which has been formed with a capital of £150,000. Rochester declined to participate in the scheme. The district is thickly populated, and is greatly in need of transport facilities. The charges will be moderate, and workmen's cars will run each way daily at low rates.

Chester.—The Corporation is considering the question of the acquisition of the tramways, as the company's lease is about to expire. The price asked for the tramways undertaking amounts to a total of £35,320. The company is desirous of obtaining a lease of the tramways, after their being relaid by the Corporation for working by electricity; this would be obtained from the Corporation's supply at the company's expense.

Chorley.—A syndicate has under consideration the construction of an electric tramway 9 miles in length, from Adlington through Chorley to Bamber Bridge, in Lancashire, and negotiations in connection with the scheme are in progress. The authorities whose interests are affected are the Chorley Corporation, the Chorley Rural District Council, and the Adlington Urban District Council. The Rural Council named has just appointed a committee to confer with the Chorley Corporation as to united action. The line will probably be an extension of that which has already been decided on to connect Bolton with the railway town of Harwich, and as it will terminate within 3 miles of Preston, there are hopes that one continuous system will eventually be constructed from Bolton to the latter town.

Collisions.—Two accidental collisions took place last week at Liverpool and Ashton, between electric cars and lurries, the latter in each case being loaded with alcoholic liquors. In the first case, the trolley car was not much damaged, though many bottles came to grief; but in the second instance, the front of the car was bulged in and a passenger injured.

Driffield.—Mr. Ward Thomas, with Mr. Fawcett, has attended one of the meetings of the Highway Committee, and given a short outline propounded by the Drake & Gorham Electric Power and Traction Company, Limited, who asked permission and assistance in applying for a light railway from Driffield to Beeford, a distance of some 9 miles. After hearing these gentlemen, the Committee were of opinion that in the interests of the town of Driffield the Council should approve of the proposed light railway. The Council adopted the Committee's views unanimously.

Dublin.—Another tram accident is reported from Dublin; this time a collision with a load of hay. According to the *Dublin Express*, the car pushed the hay cart a distance of 15 or 20 yards: the cart then collapsed, and the car left the track. No one was hurt, but traffic was delayed for an hour. Seeing that an electric car running at full speed can stop in its own length, how was it that the cart was pushed so far? Did the driver lose his head and turn the handle the wrong way?

Leeds.—The Tramways Committee, having in view the popularity and financial success of the electric cars, intends to adopt the same system on all routes; a meeting is to be held on 24th inst. to definitely settle the matter. The total receipts for August were £12,052 5s. 1d., as compared with £10,272 7s. 10d. last year.

Newcastle.—The Corporation has adopted the report of the new Tramways Committee in favour of installing the overhead trolley system throughout the city.

Mr. C. Hopkinson has reported on the alterations necessary for the Gosforth car-sheds, and has presented plans for sheds to hold 100 cars at Walker. The Corporation last week decided to order 70 single-deck and 30 double-deck cars, to carry 26 and 44 passengers respectively. In accordance with Mr. Hopkinson's recommendation, the tender of Mr. Thomas Beeley, of Hyde, for six Lancashire boilers, economiser, &c., was accepted at the price of £7,298; the engineer's report on the city lighting with 110 arc lamps, costing £18 each per annum, was also approved.

Paisley.—The Town Council is desirous of purchasing the tramways and introducing electric traction, and is negotiating with the tramway company with that object.

A motion to take over the tramways and develop them as a municipal scheme was defeated by a large majority.

Scarborough.—The Parliamentary Bills Committee has decided to defer the question of introducing electric traction in the borough for a year or two.

Sheffield.—The traffic on the electric tramways has already increased enormously; on the Nether Edge route there were three times as many passengers during the first week of electric traction as there had been previously. We hope this is not merely due to curiosity.

The tramcars commenced running on the Walkley route on the 18th inst.; a 12 minutes' service was provided.

Southport.—On Tuesday a public meeting was held at which Mr. Scotter, M.I.C.E., engineer to the proposed light railway between Southport and Ormskirk, explained the scheme. A half-hour service will be given.

Wallasey.—On Tuesday Colonel Marsh and Dr. S. W. Wheaton, inspectors under the Local Government Board, held an inquiry at Egremont regarding the application of the District Council to borrow £18,500 for electric tramway purposes under the Local Improvement Act of 1899. The money is sought at present for the installation only, and not for rolling stock. There was no opposition.

Walsall.—The Council has resolved that, in the event of failure to constitute a joint board of representatives of the Walsall and Wednesbury Borough Councils and the Darlaston District Council for acquiring and working the tramways in Walsall and Darlaston, the Corporation should obtain powers to purchase and work the whole of the tramways in the borough, as well as extend the same to the borough boundaries. This would involve the construction of 13½ miles of tramway, at an estimated cost of about £50,000; the tramways would then connect with the Birmingham and Wolverhampton tramways.

TELEGRAPH AND TELEPHONE NOTES.

The All-British Cables to Australia.—We gather from the Australian press that we were not mistaken in our opinion that the Eastern Extension Telegraph Company would attempt to average matters so that if possible the right to "*viâ*" unrouted telegrams should come into the hands of their employés. The *Sydney Morning Herald* says:—"Speaking in regard to the proposed Cape cable, the Eastern Extension Company's representative here said to-day that the concession required by the company was unimportant to the Colonies, but important to the company. At present they paid a terminal rate to the Governments, who, in return, provided operators, and delivered messages. What the company desired was that they should pay the Government a fixed rate per mile for the telegraph line used. That would mean that they would have the right to use the wire from Adelaide to Melbourne at £5 a mile, or £2,500 in all per year. They could then put on their own operators and employ their own messengers, which would be a saving to the Governments, and would place them in direct touch with the public, with little or no loss to the revenues of the Colonies."

That these offers are appreciated at their true value is shown by the following Melbourne telegram to the *Times*:—

"The proposals of the Eastern Extension Company to lay a cable between South Africa and Australia, and to reduce the telegraphic charges on condition that they are allowed to open an office in Melbourne for the receipt and despatch of messages, have been discussed by the Victorian Assembly. Mr. Duffy, Postmaster-General, said that he had refused permission pending a consultation with England, Canada, and others interested in the Pacific cable proposals. The Eastern Extension Company intended to destroy the Pacific scheme. Mr. Gillies strongly supported Mr. Duffy, and said that it would be a tremendous mistake to alienate the British Government by playing into the hands of a company which had previously refused reductions at a time when competition was not feared."

Canadian Telegraphs.—The *Times* correspondent at Ottawa reports that a contract has been awarded for the extension of the Government system of telegraphs along the north shore of the Gulf of St. Lawrence to Chateaux Bay (Labrador) and Belle Isle. The completion of the line will enable incoming vessels to be reported two days earlier that at present.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa...	April 4th, 1898 ...	...
Latakia-Cyprus	June 20th, 1899 ...	...
Otranto-Corfu	Sept. 16th, 1899 ...	
Corea-Japan	August 7th, 1899 ...	...
Cheik Saiid-Perim	Sept. 3rd, 1899 ...	Sept. 17th, 1899.
Jamaica-Colon	June 30th, 1899 ...	...
Landlines.		
Communication between Saloniki and Monastir ...	March 23rd, 1899...	...
Communication between Bolama-Bissao	July 28th, 1899 ...	Sept. 9th, 1899.
Lines from Haiti to Gonaives, Gros Morne, Port de Paix Plaisance, and Cape Haitien, Port au Prince to Miribalais and Jacmel	August 18th, 1899 ...	...
Moulmein-Bangkok	Sept. 15th, 1899 ...	Sept. 16th, 1899.
Saigon-Bangkok	Sept. 12th, 1899 ...	Sept. 19th, 1899.

Huddersfield Telephone License.—A letter was read at the last meeting of the Cleckheaton District Council from the Postmaster-General intimating that the Huddersfield Corporation had applied for a license to establish an independent system of telephones within the Huddersfield area of the National Telephone Company's

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system, and asking to be informed whether the Council would approve the application, Cleckheaton being partly within the Huddersfield area. The subject will be considered by a Special Committee in conjunction with the Postal Committee of the Chamber of Commerce.

Wireless Telegraphy.—An Adelaide paper says that for some time Sir Charles Todd and Prof. Bragg have been making experiments in wireless telegraphy with a view to its utilisation for communication with the Althorpes and other outlying stations. During the past few weeks many messages have gone to and fro between the Observatory on West Terrace and the temporary station at Henley Beach. The sending and receiving instruments, including the coherers, made after Marconi's pattern, have been gradually improved, until now long sentences can be sent through with very few mistakes. It is intended shortly to carry out experiments in the Gulf, and good results are hoped for. A curious and interesting effect was observed the other day. Messages from Henley Beach were being received at the Observatory. In the instrument-fitter's room at the Post Office, Mr. Unbehaun was making some improvements to his receiving set, and as an experiment he connected it to the Henley Beach telephone wire. He was surprised to find that he could get some of the signals. Apparently the telephone wire had picked them up and guided them into the Post Office. The telephone wire was at the time being used for ordinary business. The coherers were made by Mr. Rogers at the University of Adelaide.

The daily Press says that experiments connected with wireless telegraphy are being made, not, however, by the local authorities themselves, between the works at Mount Pleasant and the General Post Office. Further and more important trials will shortly be carried out.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking Town.—October 24th. The District Council wants tenders for boilers, pipe work, two 100-kw. steam dynamos, switchboard, motor and trailer cars, trucks and electrical equipment, overhead equipment, underground feeders, conduits, road work, &c., for the Barking and Beckton light railways. See "Official Notices" September 1st.

Belfast.—September 31st. The Electric Committee wants tenders for c.i. floor plates and w.i. rails for the electric light department. Specifications from the city electrical engineer on payment of one guinea, returnable as usual.

Belgium.—Tenders are being invited until the 27th inst. by the Belgian Government authorities in Brussels, for the supply of four sets of Hughes printing telegraph apparatus. Tenders are to be sent to La Bourse, Brussels, whence particulars may also be obtained (cahier des charges special No. 22).

Birkenhead.—September 29th. The Corporation wants tenders for boosters, switchboard, accumulators, cables, and laying same. See "Official Notices" September 15th.

Bray.—October 2nd. The Urban District Council wants tenders for 12 months' electrical supplies. See "Official Notices" this week.

Cardiff.—September 27th. The Corporation wants tenders for cast-iron arc lamp-posts. See "Official Notices" September 15th.

Darwen.—September 25th. The Corporation wants tenders for a high speed vertical engine and dynamo (300 to 350 kw.); also switch work. See "Official Notices" September 8th.

Dundee.—September 28th. The Town Council wants tenders for 10 double-decked single and 10 double-decked bogie truck cars, all electrical. See "Official Notices" this week.

Germany.—October 16th. Tenders are being invited by the municipal lighting and tramway authorities of Königsberg, Prussia, until October 16th, for the supply of six boilers required in connection with the extension of the electric power station, to supply steam to new engines aggregating 1,800 H.P. Tenders to be sent to Die Direction der Städt, Belenchtungswerke und der Electr. Strassenbahnen Kaiserstrasse 41, Königsberg, Prussia, whence particulars may be obtained for 1s.

Glasgow.—October 10th. In connection with the tramway scheme the Corporation wants tenders for switchboards, fuel economisers, two 50 and one 30-ton electric travellers, power station steel work, and cables. See "Official Notices" September 8th.

Glasgow.—October 10th. The Corporation wants tenders for the reconstruction of tramways according to specification. See "Official Notices" this week.

Huddersfield.—October 2nd. The Corporation wants tenders for five Lancashire boilers. See "Official Notices" September 15th.

Ilfracombe.—September 25th. The District Council wants tenders for boiler plant, engine plant, dynamos, condensers, switchboard, mains, lamp-posts, accumulators, meters, crane, buildings, &c. See "Official Notices" August 18th.

Leeds.—October 18th. The Council wants tenders for 50 electric tramcars. See "Official Notices" this week.

Leeds.—The Council requires tenders for 50 electric tramcars. Particulars, &c., may be had on application to Thomas Newson Esq., M.I.C.E., city engineer, Municipal Buildings, Leeds. Tenders must be to hand not later than noon, October 18th.

Llandilo.—September 28th. The Council wants tenders for the lighting of the town by electricity. See our "Official Notices" this week.

Oldham.—The Electric Light Committee invites tenders for rolled steel girders, concreting, and other works required in the foundations for "Klein's Tower Water Cooler" at the electric light station, Gas Street, Oldham.

Rotherham.—October 9th. The Corporation wants tenders for Lancashire boilers, engines, dynamos, piping, condenser, economiser, battery, switchboard and boosters, feeders, mains, road work, &c., for electric lighting. For particulars see "Official Notices" September 8th.

Runcorn.—September 27th. The Urban Council is inviting offers for the electric lighting of the district, to be sent to the chairman of the Highways Committee.

Russia.—The municipal authorities of Perm are at present inviting tenders for the concession for the establishment and exploitation of a central electric lighting station in the town.

Russia.—Tenders are being invited until October 2nd by the municipal authorities of Tiflis (Caucasia) for the concession for the working of the tramway system in the town and for the extension of the same. The existing lines consist of about 21 kilometres of horse tramways, which are to be converted to electric traction. While 15 kilometres of new electric lines are also to be constructed.

Salford.—September 28th. The Corporation wants tenders for 16 Lancashire boilers and superheaters. See "Official Notices" September 15th.

South Wales.—September 28th. The proprietors of Margam Copper Works, Port Talbot, wants tenders for the electric lighting (arc and incandescent) of their works. See "Official Notices" September 8th.

Spain.—The municipal authorities of Ledana (Cuenca province) are inviting tenders until the 26th inst. for the concession for the electric lighting of the town during a period of five years. Particulars may be obtained from, and tenders are to be sent to, El Secretariat del Ayuntamiento de Ledana (Cuenca).

Swansea.—October 9th. The Corporation wants tenders for medium speed vertical engines, continuous current generators, booster and balancer. See "Official Notices" this week.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

Warrington.—September 30th. The Committee of Visitors of the Winwick Asylum, near Warrington, invites tenders for Contract No. 1.—Generating plant, including three sets of condensing engines or turbines, with directly coupled dynamos, each of 100 kw. output at 220 volts, booster set, motors, surface condensers, cooling tower, steam and exhaust pipes, &c. Contract No. 2.—Switchboard. The drawings can be inspected and specifications obtained of J. P. Muspratt, Clerk to the Committee of Visitors, County Offices, Preston, on payment of £2 2s for each specification, returnable. A separate tender must be sent in for the work included in each specification. See "Official Notices" September 8th.

CLOSED.

Brighton.—The tender of the Private Wire and Telephone Installation Company has been accepted for installing a system of telephones throughout the new municipal buildings at Brighton. Instruments on the inter-communication system will be fitted in all the offices of each department, and, in addition, communication will be established between all the heads of departments.

Bristol Lunatic Asylum.—The Visiting Committee has accepted the tender of Messrs. F. W. Ball & Co., for the wiring and fitting of the asylum for electric light, at a cost of £1,645.

Carlisle.—The contract for boilers for the City Council electricity works has been given to the Oldham Boiler Works Company at £1,690, that for the engines and dynamos having been given to Messrs. D. Bruce Peebles & Co. at £5,710.

Clerkenwell.—The Vestry has decided to light the library by electricity, and the tender of Messrs. Barlow Bros. & Co., of Shaftesbury Avenue, has been accepted for carrying out the fitting work.

(*Continued on page* 483.)

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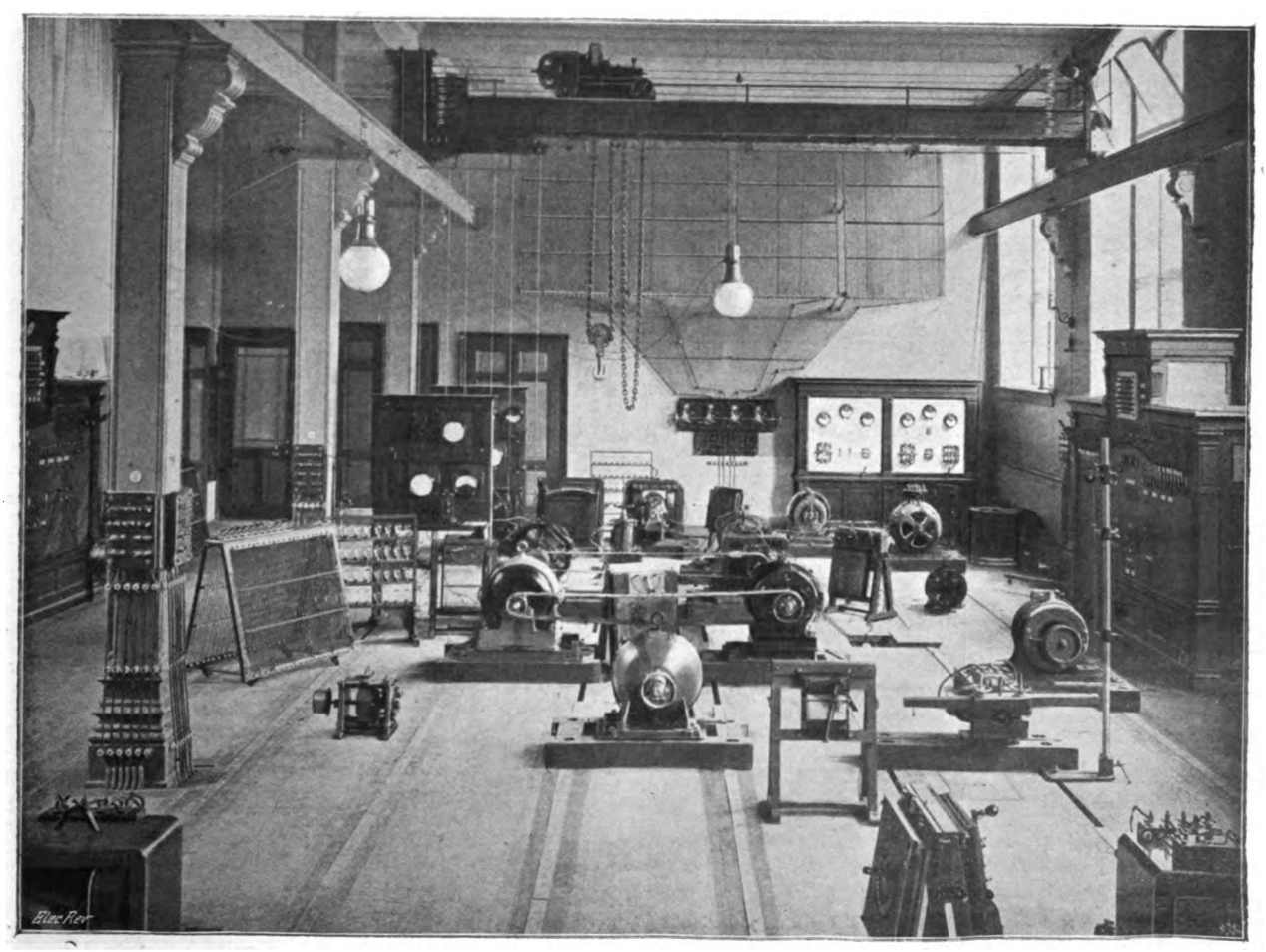
A GERMAN ELECTRO-TECHNICAL INSTITUTE.

Prof. E. Arnold has recently written a 60-page book describing the Electro-technical Institute at Karlsruhe, Germany. It is common knowledge that the technical institutes of Germany are better endowed and better equipped than our own, and their especial aim is to train men who have shown special promise in their earlier education. As Mr. Carnegie has pointed out, it is not the average men who are wanted nowadays, but men who can lead. In this country we appear to go out of our way to train and nurse mediocrities by the hundred, and dishearten and crush back to a dead level the more promising young men. Anybody who cares to inquire will find that all the best electrical work in America, or on the Continent, has been done by men not yet out of their thirties, and if this country is to recover its lost ground, or stop losing more, which is what we must now hope for, then we must give the best opportunities and positions of responsibility to the brightest of our young men.

The Electro-Technical Institute at Karlsruhe, Germany.

The illustrations herewith will give some idea of the thorough way in which the Germans equip their technical institutes. They are not patchwork affairs depending on the charity of certain guilds companies, or private individuals, but are properly endowed Government institutions, and, as such, are a standing monument to the common sense of the German nation.

It must be remembered that this Institute does not set out to teach *all* the trades and professions from the making of a suit of clothes, or a model engine, to shorthand and music. It is purely



Testing Room, Karlsruhe Institute.

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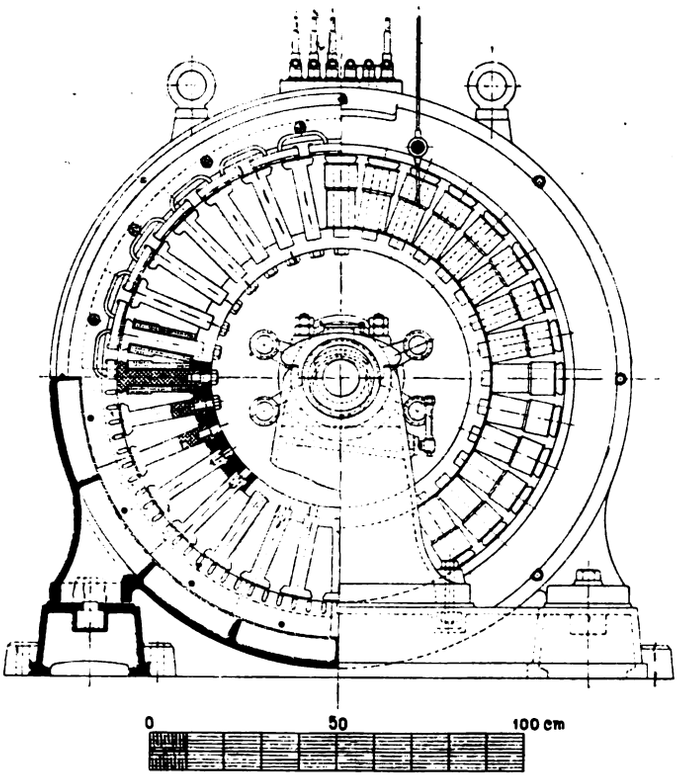
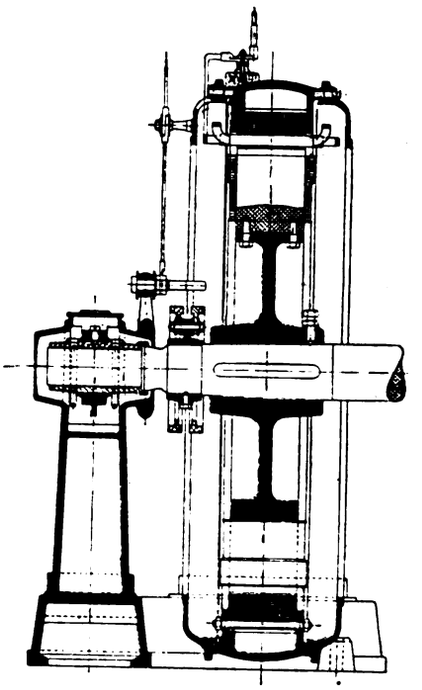
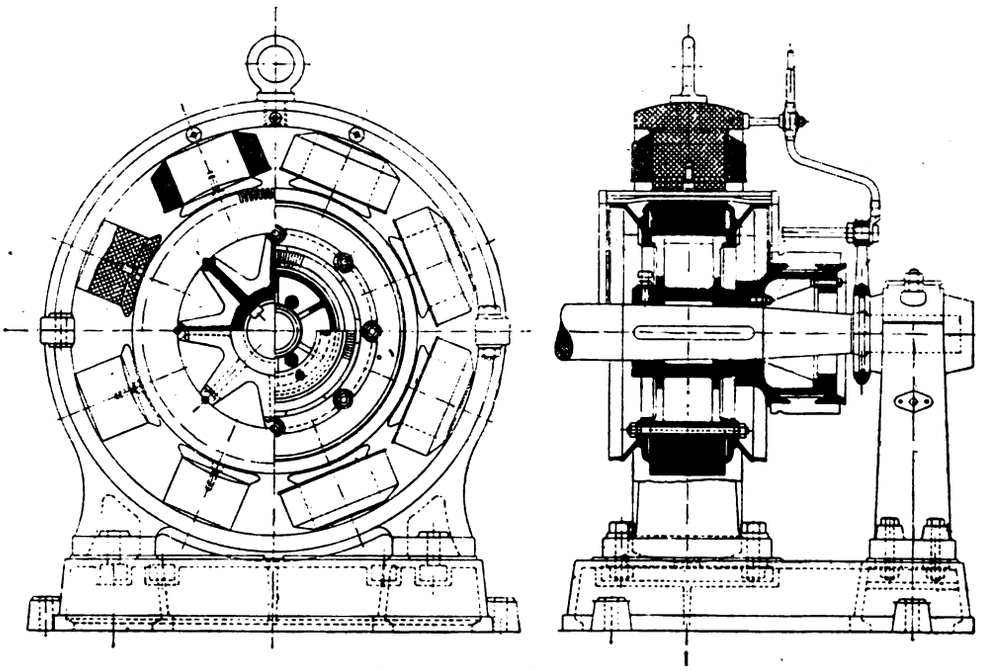




Experimental Alternator.



Experimental Dynamo.

Particulars of Experimental Motor-Alternator. Karlsruhe Institute.

Alternator. ·8 kw.

1,350 revolutions.
75 or 150 volts.
10 or 5 amperes.

Armature.

Bore, 200 mm.
Length of core, 140 mm.
Total depth of core, 60 mm.
Total number of turns, 2 × 72.
Area of conductor, 1·8 sq. mm.
Number of tunnels, 16
Diameter of tunnel, 22 mm.

Magnet.

Diameter, 195 mm.
Number of turns, 4 × 1,050.
Size of wire, ·7 mm. bare,
„ 1·1 mm. insulated.

Continuous current motor.

1,350 revolutions.
110 volts.
12 amperes.

Armature.

Diameter, 130 mm.
Length of core, 130 mm.
Total depth of core, 50 mm.
Number of conductors, 297 × 2.
Size of conductor, 1·1 sq. mm.
(two in parallel)
Number of slots, 33.
Depth of slot, 13 mm.
Breadth of slot, 6 mm.

Magnet.

Bore, 135 mm.
Number of turns, 2 × 3,200.
Size of wire, ·75 mm. bare.
„ 1·00 mm. insulated.

Particulars of Experimental Alternator and Dynamo. Karlsruhe Institute.

Multiphase alternator.

188 revolutions.
110 volts.
22 kw.

Armature.

Bore of armature, 120 cm
Length of armature core, 18 cm.
Total radial depth of armature core, 9 cm.
Number of tunnels, 96.
Number of hours per phase, 192
Wires per tunnel, 12.
Diameter of wire, 3·5 mm.

Magnets.

Diameter over magnets, 119·2 cm.
Face of pole, 8·5 cm.
Turns per pole, 200.
Diameter of wire, 3·7 mm.

8-pole continuous current dynamo.

188 revolutions.
110 or 170 volts.
22 kw.

Armature.

Diameter of armature, 76·2 cm.
Length of core, 20 cm.
Total depth of armature core, 12 cm.
Number of conductors, 346
Size of conductor, ·35 × 1·2 cm.
Number of slots, 173.
Depth of slot, 2·9 cm.
Width of slot, ·55 cm.
Number of commutator segments, [173.

Magnet.

Field bore, 77 cm.
Face of pole, 24 cm.
Width of pole, 19 cm.
Diam. of magnet pole, 19·5 cm.
Turns per pole, 700.
Diameter of wire, 2·5 mm.

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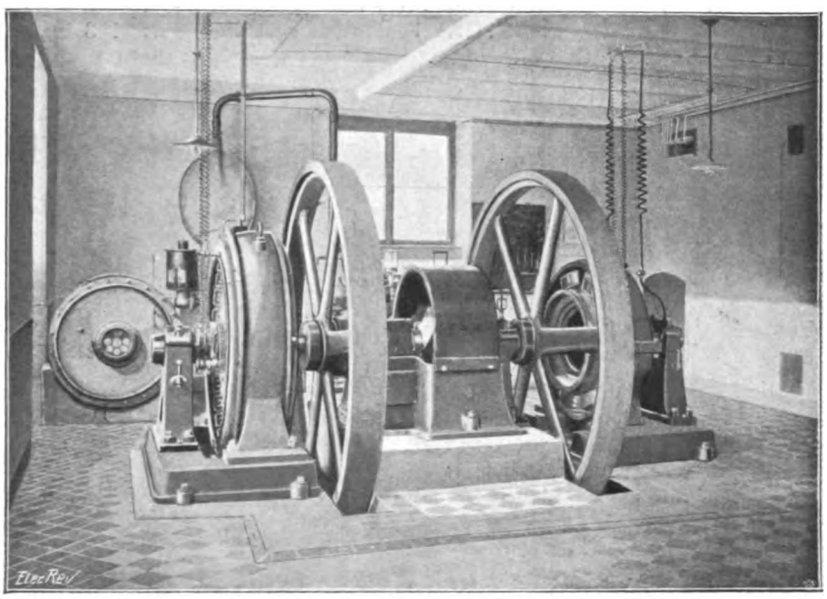
and simply an electro-technical institute, and to properly appreciate this fact, it is interesting to compare the size of the town of Karlsruhe with similar sized towns in this country. Karlsruhe is about 350 miles from Berlin as the crow flies, and has a population of about 74,000. Wolverhampton, 200 miles from London, has a population of 83,000; Middlesbrough has a population of 76,000; Greenock, 69,000; St. Helen's, 72,000; Walsall, 72,000; Rochdale, 72,000; Leith, 68,000; Cork, 75,000.

ENGINES FOR ELECTRIC TRACTION.

We are indebted to the *Engineer* for particulars of some large Allis engines, very similar in size to those called for by Glasgow, for they have cylinders 46 inches and 86 inches × 60 inches stroke, and thus compare approximately with the Glasgow engines —44 inches and 88 inches × 60 inches. The shaft of these engines is 34 inches diameter in the bearings, as compared with the 32 inches asked for by Mr. Parshall.

Mr. Parshall has made professions that he was anxious to let the Glasgow work to an English firm. To our simple minds there appear so many things inexplicable in print about the whole Glasgow business, that we would ask our readers to study the Allis engines as described in the *Engineer*, and Mr. Parshall's specification, and find their own way out of the maze.

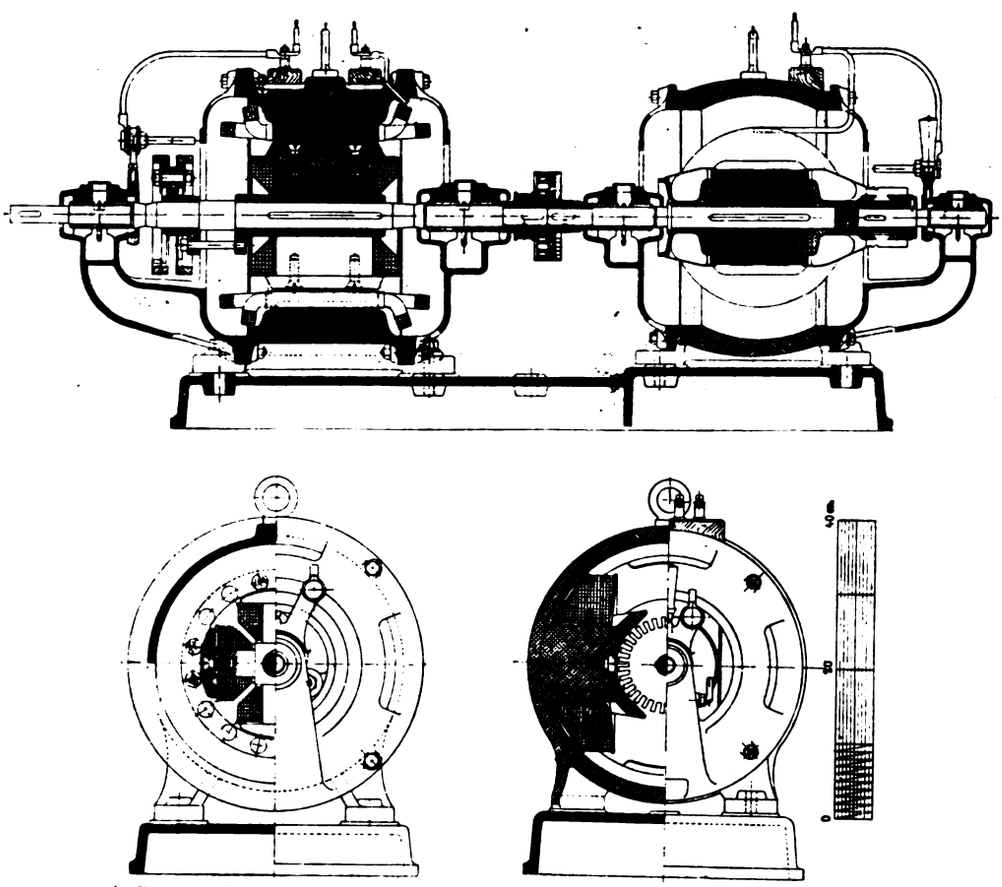
The *Engineer* returns to the question of the abnormal shaft diameters of the engines it illustrates, that are to be supplied to the Metropolitan Street Railway Company of New York.



A German Electro-technical Institute.—Experimental Alternator and Dynamo Coupled Direct to Gas Engine.

The shaft, as nearly as we can measure from the uneven scale of the illustration, is fully 14 feet between bearings, or, say, 19 feet from centre to centre of bearings. If we examine this by certain rules used in Lancashire for determining the middle diameter of a heavily loaded shaft, we find that this 37-inch shaft—it is 37 inches diameter at the wheel swell—works out at very different diameters for a load of 180 tons. The 180 tons is double the weight of the fly-wheel, to allow for the armature, which is hardly likely to be heavier than the wheel, nor do these two loads represent a central load in the sense that a single wheel does.

One rule for heavily loaded shafts is $D = \sqrt[4]{\frac{W l^2}{6}}$



A German Electro-technical Institute.—Experimental Motor-Alternator.

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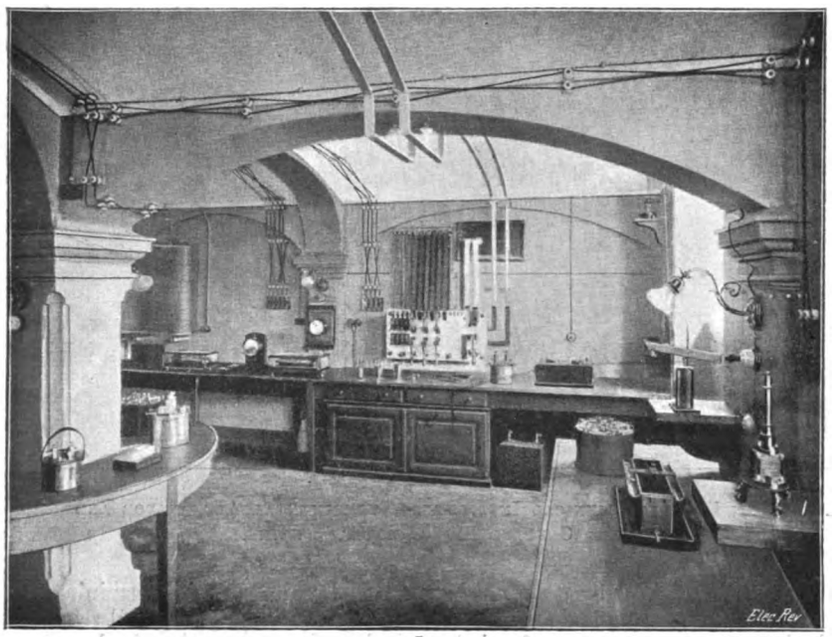
where D = central diameter in inches, and l is the span of the shaft in inches between centres of bearings, W being the load in tons. Then, with the above dimensions, D comes out as 35½ inches. There appears to be a fallacy in this rule, involved in the use of the fourth root, but this is not so, the shaft being treated as a beam. At 100 inches span the diameter would work out at 23½ inches.



A German Electro-Technical Institute.—The Standardising Room.

Taking the other rule, given in "Kempe's Year Book,"

$$D = 3\sqrt[3]{\frac{W\ L}{2}}$$

where L is the span in feet.

This rule gives D = 36 inches for a 19-foot span, and D = 27 inches for a span of 100 inches. Apparently the shaft is not enormously over-strong for such a huge span.

It is well recognised that trouble ensues where long span shafts are heavily loaded, and English practice has been to keep the span short, and we believe that the first of the above rules was found satisfactory for ordinary practice, the second rule having been worked out for general application. For the New York engines we cannot say that the dimensions are so very great, but we do consider this American design excessively faulty in having such an enormous span, demanding such a huge diameter of shaft.

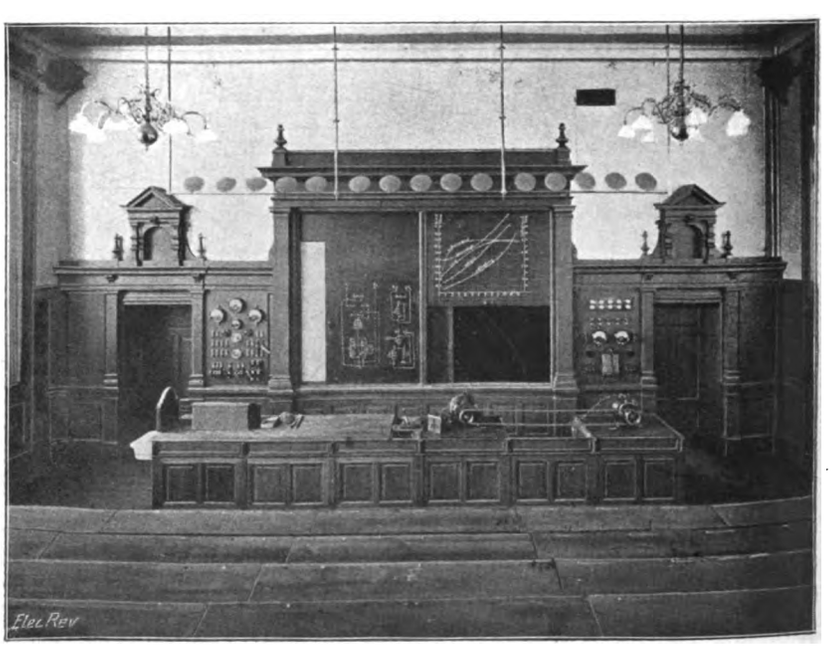
The cylinders are 28 feet 6 inches between centres, an altogether unnecessary span, and one which if employed in the past is quite sufficient to have led up to the excessive shaft diameters now in vogue.

But Mr. Parshall must be acquitted of this error until we see plans to the contrary. His design did not include a fly-wheel and a generator on the same piece of shaft. There was to be a bearing between of a length of 64 inches. The span for the fly-wheel length between centres does not appear to have been required to exceed 9 feet by the design for the engine as described, and for this span and only 105 tons of load, the central diameter works out by rule No. 2 at 24½ inches, and indicates that the Glasgow shaft is abnormally and excessively large. Mr. Parshall appears to have drawn his dimensions from one style of American practice and applied them to another type of engine, somewhat after the manner of the proverbial Chinaman and the patched new breeches. The illustration of the Allis engine for New York serves to confirm our opinion that the Glasgow dimensions, though almost identical, are excessive. We look upon the New York shaft as not too strong for the bad design as regards span.

We quite agree with the *Engineer* that the bearing surfaces are excessive. Our contemporary calculates them at 108 lbs. per square inch of projected area. We have observed that the heavy rope drums of Lancashire are carried on bearings having an area of about 1 inch for each 130 lbs. of load. The *Engineer* asks why American practice demands such enormous bearings to run cool enough when its own figure deduced from steamship practice is 224 lbs., while even 600 lbs. per square inch may be carried with care. For its figure of 224 lbs, a bearing 22½ × 40 would suffice. We think, however, that the *Engineer* is on the wrong tack here in this item of the New York engines, for we do not consider that their shaft diameter is at all a matter dependent on bearing stresses, but entirely, in this case, of weight and span.

It has been pointed out to us by an able and experienced engine maker in America, that Americans generally do not make a success of gun-metal bearings, and prefer to use white metal, and this may have some influence in determining bearing areas.

Brought to a brief summary, we may say that bearing stresses are, as a rule, easily provided for in any size of shaft that can sustain the load of its fly-wheel; that diameters must be calculated from spans between bearings. Long spans deflect so much under load that they require the bearings to be inclined to suit this. For traction work, the maximum reading of the ammeter is to be taken as indicating the tortional stress, and this must be doubled, to allow for sudden application. We believe these points practically embody the correct design of shafts, and it is useless fixing the sizes for one engine from those found suitable in another engine of the same power, but with different spacing of bearings, &c.



A German Electro-Technical Institute.—Lecture Table.

As a matter of economy in all large shafts, the time appears to have come for some different method of supporting such heavy fly-wheels as are now used. The friction of a large neck is very great. The friction of large mill engines is said to be 20 per cent. It is as much as is saved by condensing, or by the most efficient feed heating, and it is chiefly the product of the fly-shaft bearings. In a

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traction generator there is no side pull of belts in direct-connected sets, and the weight of the fly-wheel could be carried on friction wheels. It would not be insuperably difficult to so arrange these as to bear the heavy load, and transfer it to other bearings very much less in diameter, and very much slower in rubbing velocity.

It is not usual to calculate the slope of a loaded shaft. A formula for this is, however, $s = \frac{w\,l^2}{16\,E\,I}$ where s is the rate of slope, l the span in feet, w the load in pounds, E = the modulus of elasticity or 26 millions, and $I = \cdot 0491\,d^4$, d being the diameter in inches. For w in tons, $s = \frac{w\,l^2}{70\,d^4}$ where l is the span in feet. Thus, for a load of 100 tons on a 10-foot shaft of 20 inches diameter, we get $s = \frac{100 \times 100}{70 \times 20^4}$ or $s = 1$ in 1,120. The half length of the shaft bearing being, say, 30 inches, the slope of this will be about $\frac{1}{40}$th of an inch. Such a slope is too much; it implies far too serious a bending of the shaft. But the slope varies inversely as the fourth power of the diameter, and would be reduced to less than half by increasing this from 20 to 24 inches. The first of the rules given for central diameters was probably based on the fact that the rate of slope of a loaded beam is a function of the fourth power reciprocal of the diameter. Neglect to provide for such slopes by properly canting the bearings inwards has ruined many a new shaft.

It may be that the overheating of American shafts, due to this very fact, has been responsible for the present huge diameters, which might have been avoided had their bearings been made parallel with the necks they supported. That such has not been recognised by Americans is probable, or how else are we to account for the enormous spans they allow between bearings, and the fact that they permit such very small nominal bearing stresses?

Long span shafts gave trouble in Lancashire years ago, when made of the same diameter as had proved sufficient for toothed wheels before the wide rope drums were introduced. These soon brought about an increase of the middle diameter of the shaft, and promoted also an endeavour to minimise the span of the shaft as a girder, while the question of slope was dealt with by Hick-Hargreaves by the introduction of their swivelling bearings, a refinement that perhaps a careful erector might render unnecessary.

Shaft design and general arrangement is very much a question of compromise between antagonistic influences, and since the introduction of heavy wheels has had little to consider in respect of torsion, which is amply provided for when the other desiderata are taken into full account. There still remains, however, the question of a dead short circuit on the line resulting in an enormous current being taken from the generator more rapidly than the circuit breaker can cut the line out. On this assumption, which our correspondent, Mr. Taylor, seems inclined to make, but appears disinclined to put down plainly, but which other electrical engineers state is really the case, the circuit breaker does not protect the shaft from excessive torsion and the strongest shaft must fail. Obviously, therefore, the only correct system is to place a maximum slip coupling between the generator and the fly-wheel, or to design generators on the fly-wheel principle, avoiding entirely any transfer of fly-wheel energy through the shaft. We propose to return briefly to the question later.

CONTRACTS CLOSED.

(*Continued from page* 478.)

Colwyn Bay.—The District Council has accepted the tenders of Mr. B. Thomas, Cornbrook Telegraph Works, Manchester, for electric lighting plant as follows. About 30 firms tendered for the various contracts:—

Boiler and fittings	£466 0 0
Feed pump, heater, tank, &c.	236 13 8
Steam and exhaust pipes and fittings	150 0 0
Steam dynamo, balancer, and boosters	1,218 0 0
Switchboard and connections	291 15 0
Accumulators	775 0 0
Cables	542 0 0

Crewe.—The Town Council has given the contract for erection of electricity works buildings to Mr. J. Matthews, of Nantwich, at £6,000.

Darwen.—The Corporation is stated to have accepted the tender of the British Thomson-Houston Company and the Westinghouse Company for the supply of motor cars. The tenders submitted were:—

British Thomson-Houston Company	£6,145
Westinghouse Company	6,145
Brush Company	6,700
Dick, Kerr & Co.	6,980
Siemens Bros. & Co.	10,975

Leamington Spa.—The contract for an extension storage battery, 65 cells, 1,800 ampere-hours capacity, for the Midland Electric Light and Power Company, has been secured by the Hart Accumulator Company.

London.—The Bermondsey Vestry on Monday considered tenders received for the fittings, &c., required for the electric lighting of the Town Hall, the contract comprising the existing buildings, the proposed extensions, and the alteration of the existing gas fittings in lieu of providing new electroliers. The totals of the tenders, which were given in detail, may be summarised as follows:—

	£ s. d.
National Electric Wiring Company (recommended for acceptance)	485 6 0
A. H. Wood	491 0 0
Walsall Electric Lighting Company	1,039 5 0
Charles Peacock & Co.	916 17 0
The Concentric and General Contract Company	653 10 0
F. Troy & Co.	930 19 0
Sweet Bros.	675 16 0
Laing, Wharton & Down	914 5 0
W. Mackie	1,017 8 0
H. Beard & Co.	1,017 6 0
Simmonds Bros.	793 14 0
Magnet Electrical Engineering Company	823 17 0
Thorpe & Salter	914 0 0
W. J. Bishop & Co.	930 0 0
Newsome, Pinching & Walter	780 0 0
Peto & Radford	1,043 16 0
W. J. Fryer & Co.	862 15 0
C. J. Grist & Co.	1,094 1 4

This tender includes the cost of new electroliers.

At a late hour of the evening the members of the Vestry were still engaged in discussing whether or not the proposed extensions of the Town Hall should be carried out. In case these are abandoned the amount of the tender recommended for acceptance would be reduced by £76 12s.

London.—The Shoreditch Vestry, on Tuesday, considered the following tenders for the supply and laying of 1,082 yards of 1·5 low tension lead-covered cable from Worship Street to High Street:—

W. T. Glover & Co. (accepted)	£1,277 17 8
British Insulated Wire Company	1,313 18 9

North Wales Counties Lunatic Asylum.—The Committee of Visitors has accepted the following tenders:—For engines, dynamos, &c., Messrs. Donnison, Barlyn & Sillem, £2,111 10s.; for wiring, switchboards, &c., Messrs. Frank Suter & Co, London, £2,061.

Southport.—The contract for the supply of two 200 KW. tramway generators has been placed with Messrs. D. Bruce Peebles & Co., of Edinburgh, the price being £4,825.

Sunderland.—The Corporation has placed the order for four 215-KW. steam dynamos for the extensions of the electric light station, with the Sunderland Forge and Engineering Company, Limited.

Swansea.—The Tramways and Electric Lighting Committee last week considered a report presented by the sub-committee recommending the advertising for tenders for the supply of engines and dynamos, such to be sent in by October 9th; also the acceptance of the tender of Mr. David Jenkins, of Swansea, for the building of the electric lighting station. The amount of the tender was £17,242.

NOTES.

Institution of Electrical Engineers.—Prof. Silvanus P. Thompson, F.R.S., president, and Prof. W. E. Ayrton, F.R.S., past president, having been invited to take part in the Volta celebrations at Como, have been chosen by the Council to represent the Institution as delegates on this occasion.

Fatal Accidents.—According to the *Scientific American*, six firemen, while working at a fire in Omaha, made contact through an iron-bound ladder with a high pressure overhead wire. Four of the men were killed, and the other two severely injured.

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A New Single-Phase Alternating Current Motor.—We are given to understand that Mr. W. G. Rhodes, M.Sc., M.I.E.E, who is chief lecturer in Electrical Engineering at the Royal Technical Institute, Salford, has invented a new single-phase induction motor, which starts with a torque approximately equal to that exerted when running under full load. The principles involved in the construction of this motor have not yet been divulged, but we believe that Mr. Rhodes has constructed an experimental 1-H P. motor which gives a starting torque of about 21 lbs. on a 3-inch pulley. The full-load torque when running at a speed of 2,200 revolutions per minute is 20 lbs. The full load efficiency of the motor on a 100-volt 80 frequency circuit is stated to be 75 per cent., whilst the power factor is 0·70. The motor was constructed for experimental purposes, and it is expected that superior results will be obtained by improving its construction mechanically. As far as we know, this starting torque exceeds any hitherto obtained in induction motors. We hope to give full details of this machine in a later issue.

More American Works for England.—We cull the following interesting paragraph from the *Glasgow Herald*:—"Several large American companies will this autumn follow the example of the Westinghouse Engineering Company and appeal for British capital to inaugurate works on American lines in this country. While these will be for the most part connected with electrical work, the number will include some of the bridge builders of the States, as they believe that their methods of working will enable them to compete successfully for bridge work in this country and the colonies, with all the patriotic advantages associated with British labour, even although many of the workmen are imported from the States. Switzerland is also being looked to as a centre for the establishment of American works, and the Baldwin Locomotive Company, of America, and Siemens & Halske, of Berlin, with others, have joined for the establishment of works to turn out annually 600 locomotives, 1,000 steam railway passenger cars, 1,000 electric tramway cars, and 10,000 switches and signals with electrical motive power. The chief engineer, not yet appointed, is to have £5,000 a year, and his five assistants will have £1,500 per annum. There will be eight locomotive workshop foremen, four carriage shop foremen, and four signal shop foremen, each with salaries ranging from £1,250 to £500."

The Niclausse Water-Tube Boiler.—This boiler has been already described at some length in our columns, and it will be enough to recall here that it is of the double tube type, viz, its water tubes are fixed at one end only and free to move at their lower closed ends, while there is an internal Field tube for circulation. This boiler has thus some virtues not possessed by other boilers. We think the author of the paper read at the B.A. meeting last Friday was badly advised in comparing his boiler with the Belleville. This latter boiler has been approved by the Admiralty. Unfortunately the choice of the Admiralty is not associated with success in numerous cases, and a longitudinal section of a Belleville boiler does not reassure us. To compare another boiler with the Belleville does not say much for the other boiler, and we have a better opinion of the Niclausse boiler than to have used the Belleville as a datum of comparison. The removal of the tubes of the Niclausse boiler is done entirely from the front, the tubes being fixed by coned surfaces, the tightness of which is still a marvel to the English makers of the boiler, *i.e.*, to the author, though why it should be it is difficult to understand.

In the discussion which followed the reading of Mr. Mark Robinson's paper, one speaker asked whether any difficulty had been found in practice from the incrustation of the very small tubes. Incrustation was a very important matter in water-tube boilers. Another speaker asked whether the author could give an idea of the saving in ground space by adopting the Niclausse type in generating stations as compared with the Babcock boilers for the equivalent of power. Also, had Mr. Robinson at present at his works drawings showing the dimensions and form of the furnaces he would use for purposes where space was not of so much importance. What was the best system of baffling the heating gases generated, as they passed up through the heating tubes, so as to get the maximum effect of the heating surface?

Sir Frederick Bramwell contributed a few general remarks on water-tube boilers, and referred to the extremely admirable mode by which the tubes in the Niclausse boiler could be got at, one being easily taken out and another put in its place. He was always sorry to see economisers applied to boilers.

Prof. Hudson Beare had had Babcock boilers running at Edinburgh for two years. In regard to incrustation, he had had a boiler running constantly for two years for electric lighting work, and at the end of the time he withdrew some of the tubes and incrustation could hardly be detected. He referred to the fact that water-tube boilers are now being tried for locomotive work on the South-Western Railway.

Sir W. H. White, the sectional president, said there was another special point in the boiler beside the outer end of the tube, viz, the freeness of the inner. No doubt as regards tendency to bending that was a very great advantage. He had known cases where tubes had bent and the outer had come into contact with the inner, interfering with circulation. That, he thought, was the only serious allegation he had heard against the boiler. The amount of its seriousness was open to question. Looking at what had been done in France, that country had led the way in the modern application of the water-tube boiler. The French were boilering ships on three systems, and they had made about an equal allocation of orders for the various types of tube boilers. Mr. Robinson's point about the rapid withdrawal of tubes and making good defects was a matter of high importance in two ways. With most types, if anything went wrong in the tube the boiler had to be given up until the defective piece was found and made good. Obviously, if they could have a boiler which could be rapidly put back into order and the tubes changed, they could then afford without undue risk to have larger individual power in the boilers, and that must favour economy in weight in relation to power. The fact that the *Seagull* trials with the Niclausse boiler had been delayed so long was due to a series of almost accidental occurrences. The matter had had to stand back because of other things requiring the Admiralty's attention. The consumption of coal per I.H P. per hour was not conclusive, unless you had the efficiency of the engines. He saw in the newspaper that the *Seagull's* first trial had given 2 lbs. per I H P. per hour on a trial with the Babcock of 1·6 lbs. It would be far better if they had the two efficiencies given of the boiler and the engine.

Mr. Robinson, in a brief reply, said that in regard to incrustation there had been the usual experience with water-tube boilers. One recognised that a water-tube boiler required its own treatment. Incrustation gave very little trouble as a rule. It was purely a question of treatment. One used a water-tube boiler because it gave something different to what was obtained with the Lancashire boiler. By far the majority, or, at any rate, a large proportion of the electric lighting stations, now went in for water-tube boilers, so that their advantages were beginning to be recognised. As to baffling, you could put in baffles to taste almost. Regarding the bending of tubes, this was mainly a question of good circulation.

The Specific Heat of Water.—In continuation of a preliminary paper read by them at the Toronto meeting of the British Association in 1897, Prof. Hugh Callendar, of University College, London, and Mr. H. J. Barnes, of McGill College, Montreal, have described to the Physical Section of the Association at the Dover meeting the results of their experiments on the change with temperature of the specific heat of water. The method employed by them is to observe on a differential platinum thermometer the rise in the temperature of a small steady stream of water flowing through a tube and heated in its course by a wire carrying an electric current. In this experiment the capacities for heat of the different parts of the apparatus need not be determined, since the temperatures at all points remain continuously constant, and all the heat developed is carried away in the water. This removes one of the most difficult and uncertain parts of the work of Joule and others. The mode of heating the water as it flows through the tube by an electrical conductor carrying a current enables a large quantity of heat to be developed continuously in a small mass of water, and gives a considerable rise of temperature; while the amount of heat is easily and accurately measured. The differential platinum thermometer indicates, we are told, differences of one ten-thousandth of a degree, and is accurate within one-thousandth of a degree. The flow of heat through the walls of the tube is reduced to a very small amount by the use of vacuum and water jackets. A comparison of the details of this experiment with that of Joule shows in a striking way the advance of laboratory methods due to the establishment of the electrical standards, the potentiometer, and the platinum thermometer. The numerical result arrived at is as follows:—$s_t = S_{40}\{1 + 0{\cdot}0000045 (t - 40)^2\}$ where s_t S_{40} are the specific heats at $t°$ C. and 40° C. respectively; this holds for temperatures between 10° C. and 60° C. The determination corresponds very closely with the results of other good measurements, and the paper discusses at considerable length the probable mode of exactly reconciling them.

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Plymouth Electricity Works.—The official inauguration of the electricity works and the inauguration of the electric tramways, which have been already described in the ELECTRICAL REVIEW, take place to-day, Friday.

The official inspection of the Plymouth Corporation electric system was held on Tuesday, the 19th inst., by Mr. A. P. Trotter, M.A., electrical inspector to the Board of Trade. Mr. Trotter made a very careful and minute examination of the whole route from Theatre Royal to Princes Rock. He inspected the overhead construction, the details of the cars and motors, and the electrical arrangement at the generating station. At various points along the route trials were made of the brakes, both hand and electric. The inspector travelled on the car in both directions, both inside and outside. He was accompanied by Mr. J. H. Ellis (the town clerk), Alderman W. Bray (chairman of the Tramways Committee), and Mr. C. R. Everson (tramway manager); also Mr. J. H. Rider (borough electrical engineer) and Mr. W. A. Tester (resident engineer for the contractors for the line, who travelled on the platform with the inspector and drove the car). The inspector expressed himself extremely pleased and satisfied with everything he had seen, highly complimenting the borough electrical engineer on the first-class equipment of both the tramways and the lighting arrangement, and promised that the official permission to open the line should follow without delay. Continuous running for the general public is to take place immediately after the ceremony to-day.

The Copper Market.—According to Messrs. H. R. Merton and Co.'s mid-monthly circular, the stocks of copper on the 15th inst. were equal to 31,527 tons, as compared with 32,713 tons on August 15th, and 32,389 tons on August 31st. The fall since the latter date has therefore been = 862 tons. The shipments to European ports during the first half of the month have totalled 9,984 tons, while the deliveries have reached 10,846 tons. Of this latter total 1,326 tons is, however, accounted for by *shipments from Liverpool and Swansea to U.S.A.*, and had this buying on American account not occurred, stocks on this side would have risen and prices have fallen. It would be natural to assume that the agents of the New York Syndicate had been "operating" on this side, with a view to keeping up prices, were it not for the fact that during the first half of September the shipments of copper from North America to Europe were quite up to the average, having equalled 5,039 tons. To buy 1,326 tons copper on this side—for re-shipment to New York—while allowing 5,039 tons to come into the European market, is hardly good business for any but those Atlantic steamboat companies who carry the copper. The price of G.M.Bs. on September 15th was £77 per ton, as compared with £76 on August 15th, and £76 15s. on August 31st. The relative costs of copper and aluminium, when used for conducting purposes, are now expressed by—

$$\frac{8{\cdot}93 \times 8{\cdot}65 \times 59}{2{\cdot}68 \times 14{\cdot}5 \times 100} = \frac{4,557}{4,886} = \frac{117}{100}.$$

Copper, therefore, at present prices is considerably dearer than aluminium at 29 cents per lb.

Veritys, Limited.—Messrs. Veritys, Limited, announce a rather important departure in their business. In view of the rapid growth of electrical business in the North of England and Ireland and the present prosperous outlook, they have opened a central establishment at Hardman Street, Deansgate, Manchester, with a well-organised management. Manchester has been selected for headquarters on account of its convenient situation and good business centre. The new premises are said to be well adapted for the wholesale electrical business, containing five floors of 2,600 square feet each. Mr. M. B. Cotterell, who first joined the firm in 1887, and has for some time past held the position of assistant general manager at the works, will be responsible for the management. Mr. A. A. King, who has long been associated with the north county business, remains chief outside representative. The departments into which the business is divided are as follows:—Plant and machinery; wires, cables, bells, telephones, medical apparatus, &c.; switchboards and accessories; electric light fittings.

Accident at the Manchester Electricity Works.—The *Manchester Guardian* gives the following account of a somewhat serious accident which occurred at the electricity supply works of that town on Tuesday night. The accident led to injury to two members of the station staff, and a complete failure of the supply for the evening:—"The accident had apparently had its beginning in the breaking of a belt in the engine room. This room contains 15 steam engines, of an aggregate horse-power of 8,100, which are used in the generation of the current. It was the belt of one of these engines that broke, and the sudden throwing off of the load from the engine caused it to 'run away,' with the result that the fly-wheel was broken. The pieces that were sent flying from this wheel broke another fly-wheel. Two of the engines, together of 800 H.P., were thus disabled. Some portions of the fly-wheels also broke one or more of the steam and water pipes. These pipes, like the bulk of the plant at the station, are in duplicate, and the damage done to them would, in ordinary circumstances, have resulted in nothing more serious than a brief interruption of the supply of light; but the damage done to the engines was so great, that the steam and water had to be shut off from the whole range of steam and water pipes, and the work of the station was thus brought to a stand. Beyond the damage which has been described, and the smashing of a number of windows by pieces of the fly-wheels, and by the rush of steam, the building and its contents, as far as could be discovered in the darkness, were not injured to any extent. The engine driver, a man named Edward Tomlinson, was knocked down, and sustained a considerable number of bruises, and the greaser, named Chadwick, was injured about the arms. Chadwick was sent home. Tomlinson was taken to the Royal Infirmary, where it was found that his condition was not such as to cause any alarm. He was, however, detained as an in-patient. Mr. C. H. Wordingham, the chief electrical engineer to the Corporation, who had gone home, was telephoned for, and under his supervision the work of repairing the damage was at once entered upon, and it was hoped that it might be completed by midnight or by the small hours of the morning. Meanwhile, as has been stated, serious loss and inconvenience have been caused in many quarters by the stoppage of current for lighting and motive purposes. From this point of view the accident happened at the worst possible time, as Tuesday is market day in the city, and at six o'clock at night many of the shops are still very busy." No doubt in due course we shall have a true version of the affair from Mr. Wordingham.

Personal.—Mr. Lewis J. Steele, chief electrician to Messrs. Veritys, Limited, has returned to England after a lengthy visit to the United States, where he has visited most of the important electrical centres.

The Chatham Town Council has appointed Mr. H. R. Redman, teacher of magnetism and electricity to the technical education classes.

Mr. H. B. Knowles, M.A., physics and electrical engineering master at the Bradford Technical College, has been appointed (out of five candidates) principal of the Swindon and North Wiltshire Technical School.

Mr. A. Brooker, joint author of the well-known work "Electrical Engineering," by Slingo and Brooker, has resigned his position on the engineering staff of the General Post Office, after 22 years service in its various departments. Mr. Brooker has now joined the staff of the General Electric Company, Limited, and will proceed to Manchester, where he will act as manager of the company's bell and telephone department. We have known Mr. Brooker for many years, and we congratulate the General Electric Company on having secured the services of a gentleman of such proved ability. We feel sure that the appointment will prove mutually satisfactory to both parties, and we shall expect to see very shortly that the manufacture of their telephonic apparatus will favourably compare, both in finish and price, with anything in the market.

Marriage.—On Wednesday, 20th inst., the marriage of Mr. J. R. Garner (electrical engineer of the Clayton Engineering and Electrical Construction Company, Limited, Clayton, Manchester) with Alice, only daughter of Mr. James Whitehead, was solemnised.

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The Postmaster-General's Report.—The annual report of the Postmaster-General, which has recently been issued, states that as regards the telegraph department the number of telegrams of all descriptions forwarded during the year was 87,043,652, an increase over the previous year of 4,013,653, or 4·83 per cent. The ordinary inland telegrams, which increased in 1897 98 by as many as 3,248,969 over the previous year, show an equally large advance in 1898-99 over the total of 1897-98. The average value of the telegrams slightly declined from 7·43d. to 7 38d. Inland Press telegrams increased in number less rapidly than ordinary telegrams, but their length is indicated by the fact that the average weekly number of words so sent was 14,400,900. On the occasion of the final match at the Crystal Palace for the Football Association cup 3,509 Press telegrams were despatched, containing nearly 42,000 words. The number of foreign telegrams dealt with during the year was the highest on record, and exceeded by 7 59 per cent. the previous year's total.

The concessions made in 1897 in regard to the delivery of telegrams and guarantees for new telegraph offices have contributed in no small degree to the general increase of traffic. . . . .

The communication between coastguard and lifeboat stations around the coast for life-saving purposes has been further extended during the year. Alarm bells were fixed at various post offices for facilitating night calls, and about 43 new stations were added to the system. On the recommendation of the Royal Commission on Electric Communication with Lighthouses, &c., 10 additional shore lighthouses were connected with the postal telegraphic system, and at several of these arrangements have been made by the Board of Trade for the exhibition of storm-warning telegrams from the Meteorological Office. Two outlying lighthouses were also electrically connected with the mainland, but further development of arrangements for telegraphic communication with light-vessels has been deferred pending the question of the adoption of an aetheric system of telegraphy.

The number of post offices open for trunk telephone business on March 31st last was 286, an increase of 22 in the year. . . . . During the year the trunk system was extended to 22 towns, the extension in 16 cases being carried out under guarantee from the National Telephone Company. The total number of trunk wire transactions during the year was 7,066,069, or, reckoning each transaction as involving at least two spoken messages, a total number of 14,132,138 messages (an increase of 19·7 per cent. over the preceding year). The revenue was £167,505 (an increase of 25 per cent.), and the average value of each transaction was 5·68d., as against 5·45d. for the previous year. The reduction in the charges for Post Office telephone exchange wires and for short lines of private wire, which was made in October, 1897, has continued to lead to an increased demand for these facilities, the revenue for the year from this source being £142,600, against £130,100 in the previous year.

The telegraph revenue of the year, £3,260,145, shows an increase of £188,422, and the telegraph expenditure, £3,477,949, an increase of £99,108 upon the previous year.

The postal revenue of the year, including the value of services rendered to other departments, has been £13,049,317, an increase of £628,941 on that of the previous year. The postal expenditure has been £9,194,437, an increase of £511,120 on that of the previous year. Setting expenditure against revenue, the combined accounts show a profit of £3,637,076 on the year, or, if allowance be made for interest on the capital—£10,868,663—created for the purchase of the telegraphs, a profit of £3,338,188.

The number of postal packets delivered in the United Kingdom during the year is estimated as follows:—Letters, 2,186,800,000; post-cards, 382,200,000; book packets and circulars, 701,500,000; newspapers, 154,100,000; parcels (actual number), 71,913,000; total, 3,496,513,000. The rapid growth of telegraph money order business noted in last year's report had continued, the figures for 1898-99 being 25 per cent. in advance of those for 1897-98.

On March 31st last the total number of post offices open was 21,569, and the number of letter boxes was increased during the year to 31,441. The staff of the Post Office was increased during the year by 9,832—from 150,110 to 159,942 persons, of whom 127,779 were males and 32,163 females.

Death of M. Scheurer-Kestner.—In the death of M. Scheurer-Kestner France has lost one of her foremost scientific engineers. Like many other notable Frenchmen, Scheurer-Kestner was an Alsatian by birth, but always remained loyal to France, whose recent attitude to men of Alsatian birth has done so much to weaken any lingering remains of French feeling in younger generations in that former province. On the unpopular side in the recent deplorable events, Scheurer-Kestner has had much to worry him, and it is probable that the typhoid fever, which ended with his death, found a subject more or less prepared for its onslaught. He was well known for his researches, and was the author of a treatise on the calorific value of fuels, which is counted as one of the foremost of its kind. His death took place on the 18th inst.

Calcium Carbide.—A plant for the manufacture of calcium carbide, employed at Meran, in Austria, is driven by water-power. The turbines drive five three-phase alternators of 1,200 horse-power. According to some figures given by M. Carl Hering in *L'Eclairage Electrique*, and abstracted in the *Engineer*, theoretically it requires 1,900 lbs. of lime, and 1,230 lbs. of carbon to produce a ton of the carbide; in practice, however, 2,050 lbs. and 1,420 lbs. respectively are required. The cost of a ton of lime at this factory is about 16s., and of the carbon about 32s. One electrode will be sufficient for 10 tons of the carbide, and it costs £6 12s., or about 13s. per ton. The electrical energy per ton of the carbide is 6,400 horse-power-hours, which at £2 per electrical horse-power-year is equal to a little over £1 16s. per ton. The accessory machinery, the loss in the lines, &c., corresponds to about 200 horse-power, or about 4s. per ton, the production being about 6·5 tons per day. Labour, at 3s. to 3s. 4d. per day, amounts to about 15s. per ton. Amortisation amounts to about £1 per ton, and the general expenses to about £1 per ton; the maintenance of the plant is given at 6s. per ton. The total cost at the factory is £7 5s. per ton.

Fire.—The premises of the Incandescent Electric Lamp Company, Brook Green, Hammersmith, were attacked by fire the other day through the overheating of a boiler. Not much damage was done.

Electro-Harmonic Society.—Mr. C. E. Grove, the present honorary secretary of the above society, informs us that the first concert for the new season will be held on Friday next, 29th inst., at the International Hall, Café Monico, Regent Street.

Reduction of Telegraph Rates to India.—We have frequently pointed out that in view of the 4s. 9d. rate charged to Australia, a rate of 4s. per word to India was out of all reasonable proportion. We have been told that the low rate to Australia was charged owing to subsidies paid to the companies by the Australasian Colonies. These subsidies are on the point of lapsing, and we now read the following in the Australian Press:—"Details of the sliding scale of charges proposed by the Eastern Extension Cable Company as part of the scheme for constructing an all-British cable *viâ* Cape Colony and Glenelg give an early and definite promise of a uniform 2s. 6d. rate throughout Australia, without any cost to the Government."

University of Glasgow.—Lord Kelvin's Successor.—The following is a list of candidates who have sent in applications for the Chair of Natural Philosophy now vacant in the University. It is expected that the appointment will be made by the Court early in October:—

J. C. Beattie, D.Sc., F.R.S.E., Professor of Applied Mathematics and Physics, South African College, Cape Town.
Andrew Gray, LL.D., F.R.S., Professor of Physics, University College, North Wales.
Cargill Gilston Knott, D.Sc., F.R.S.E., F.G.S.E., Lecturer in Applied Mathematics, University of Edinburgh.
J. A. M'Clelland, M.A., Demonstrator, Cavendish Laboratory, Cambridge.
G. F. C. Searle, M.A., Demonstrator, Cavendish Laboratory, Cambridge.
John Sealy Townsend, M.A., Clerk Maxwell Student, Trinity College, Cambridge.
George W. Walker, A.R.C.Sc., B.A., Scholar of Trinity College, Cambridge.
C. T. R. Wilson, B.Sc., M.A., Demonstrator, Cavendish Laboratory, Cambridge.

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The Late Mr. Frank King.—At their board meeting on 20th inst., the first meeting since the death of Mr. Frank King, their late managing engineer, the directors of the Chelsea Electricity Supply Company passed a resolution expressing their keen sense of loss and their sympathy with his widow and family.

Appointment Vacant.—The Corporation of Newcastle-on-Tyne wants a resident electrical engineer to act under a chief engineer in the construction of the electric tramways. Salary £500 per annum. See "Official Notices" this week.

A New Cable Project.—The Central News telegraphs from New York to the effect that advices received at Victoria, Vancouver, from Japan, state that at the approaching Session of the Japanese Diet consideration will be given for a concession to a proposed cable from Victoria to the Philippines, *via* Japan. The promoters, who are sanguine of success, undertake to reduce by half the present cable rates to the Far East.

NEW COMPANIES REGISTERED.

Scottish Wireless Electric Syndicate, Limited (4,354).—This company was registered at Edinburgh on September 14th, with a capital of £3,000 in £1 shares, to manufacture and deal in scientific instruments, electric, automatic, and mechanical apparatus, machines and models, &c. The first subscribers (each with one share) are:—Arthur Govan, 15, Benfield Street, Glasgow, merchant; John Trotter, 28, Gordon Street, Glasgow, optician; Walter Jamieson, Orangefield, Greenock, science master; Archibald Barr, 250, Byres Road, Glasgow, engineer; A. B. Scott, 53, Bothwell Street, Glasgow, chartered accountant; James Glen, 139, St. Vincent Street, Glasgow, insurance manager; and James Haldane, 39, Cavendish Street, manufacturer. Table "A" mainly applies. Registered office, 53, Bothwell Street, Glasgow.

Edwards Electrical Company, Limited (63,567).—This company was registered on September 13th, with a capital of £10,000 in £1 shares, to take over as a going concern the business of Nathaniel P. Edwards (formerly Nalder & Hilton, Limited), carried on at Trafalgar Works, Bowcommon Lane, E., and to carry on the business of electrical and general engineers, manufacturers of and dealers in electrical apparatus and appliances, bicycle manufacturers, makers of cycle parts and accessories, hardwaremen, manufacturers of mathematical and scientific instruments, &c. The first subscribers (each with one share) are:—Nathaniel G. Edwards, 70, High Holborn, W.C., electrical engineer; John W. Edwards, 70, High Holborn, W.C., ironmonger; Julius Paschek, 44, Wellington Road, Charlton, S.E., electrical engineer; Arthur E. Darville, 5, Gilbey Road, Tooting, S.E., secretary; James Sykes, Suffolk House, Laurence Pountney Hill, E.C., solicitor; Frederick Brown, 43, Farrant Avenue, Noel Park, N., clerk; Edmund Coste, 2, Whitehall Place, Gravesend, gentleman. The number of directors is not to be less than three nor more than five; the first are John W. Edwards and Julius Paschek; remuneration as fixed by the company.

Electrical Maintenance and Accessories Syndicate, Limited (63,559).—This company was registered on September 11th, with a capital of £10,000 in £1 shares, to adopt an agreement with George Smith, and to carry on the business of electrical and general engineers, and manufacturers and dealers in cables, wire, accumulators, meters, generators, and all electric, magnetic, telegraphic, telephonic, and other appliances and apparatus, and to construct, repair and maintain any electric lighting, electric supply and other works. The first subscribers (each with one share) are:—E. Chevalier, 70, Derby Street, Hulme, Manchester, cashier; F. Rowbotham, 168, Hulton Street, Salford, manager; A. Seaton, 127, Ellesmere Street, Patricroft, manager; C. E. Longshaw, 435, Chester Road, Old Trafford, Manchester, manager; W. Huffey, Guywood Cottage, Romiley, Chester, manager; F. Hurst, 12, Peel Street, Eccles, Lancashire, printer; and G. Hardcastle, 117, West Park Street, Salford, printer. The number of directors is not to be less than three nor more than five; the first are George Smith (managing director with £300 per annum and a share in the profits) and others to be appointed by the subscribers; qualification, £50; remuneration of ordinary directors as fixed by the company. Registered office, 35, Bridge Street, Manchester.

Burmah Electric Works Syndicate, Limited (63,563).—This company was registered on September 12th, with a capital of £2,000 in £1 shares, to acquire any concessions, rights, and privileges in Burmah, and to carry on in Mandalay and elsewhere the business of electric and other tramway proprietors, electricians, producers and suppliers of electric power, &c. The first subscribers are:—E. H. Kindersley, Clyffe, Dorchester, J.P. (2 shares); M. F. Kindersley, Clyffe Cottage, Dorchester, gentleman (100 shares); E. R. Kindersley, Clyffe, Dorchester, gentleman (100 shares); H. R. Kindersley, 19, Ashley Place, London, barrister (100 shares); Miss K. Kindersley, Clyffe, Dorchester (1 share); A. F. Hendly, Clyffe, Dorchester, servant (1 share); and F. B. Fisher, West Walks, Dorchester, surgeon (2 shares). The number of directors is not to be less than three nor more than five; the first are M. F. Kindersley, H. R. Kindersley, and E. R. Kindersley; qualification, £100.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Electrical Power Storage Company, Limited (30,313).—This company's annual return was filed on August 11th, when 66 founders' and 18,592 ordinary shares were taken up out of a capital of £100,500 in 100 founders' and 20,000 ordinary shares, all of £5 each; £5 per share has been called up on 66 founders' and £3 per share on 3,132 ordinary; £10,200 5s. 1d. has been paid, including £474 5s. 1d. on 409 forfeited shares.

CITY NOTES.

Halifax Corporation Electricity Accounts. Public Lighting, Private Supply, and Tramways.

The accounts of the Halifax Corporation electricity undertaking are interesting owing to the inclusion therein for the first time of the supply of electrical power to the tramway system recently converted to electricity. The figures show a much more satisfactory state of things than the previous year, and no doubt when Mr. H. F. Street, the Borough Electrical Engineer, has completed the re-arrangement of the boiler house, the cost of production will be proportionately reduced. We understand that the same is anticipated regarding oil, waste, and engine room stores, &c., which, by present results, promise to be at least 50 per cent. less during the current year.

The present tariff is 5d. per unit for lighting, and 2½d. for other purposes, subject to a discount varying from 5 to 15 per cent., while the power supply to the tramways is charged at 2d. per unit. Motive power and other purposes apparently only brought in from private consumers a little over £30, and judging by the results of the past few years' working, there seems to be every reason to believe that the department would have done better to have adopted a differential scale of charges on the so-called rebate or Brighton system some time ago. The receipts were as follows for sale of current:—

Public lighting	£840	
Private supply	5,538	(including arrears.)
Tramway supply	2,332	(279,867 units)
	£8,710	

Upon the public lighting a discount of 15 per cent. is allowed, and the average discount upon the private supply is estimated at 6 per cent.

The general state and progress of the undertaking is shown by the following statement:—

	1897.	1898.	Increase.
Total capital expenditure	£56,322	£72,470	£16,148
Number of units sold	239,814	628,759	388,945
Number of lamps connected	20,800	32,020	11,220
Gross revenue	£4,846	£8,957	£4,111
Gross profit	£1,829	£4,566	£2,737
Average price per unit sold	4·62d.	3·33d.	−1·29d.

From this table it will be seen that the gross revenue from all sources has increased by £4,111, and that the gross profit, after paying engineering and management costs, has risen by £2,737. The following statement shows how the revenue is made up, and indicates that notwithstanding the large gross increases, the revenue per unit has suffered on each item; the receipts per unit for sale of current has fallen by a little over 1¼d., and the total receipts per unit by a sum just over 1½d.:—

REVENUE STATEMENT.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current	£4,667	4·62d.	£8,691	3·33d.	−1·29d.
Arrears	12		19		
Meter rents	175	·18d	222	·08d.	−·10d.
Supply of fittings	40	·04d	...	...	−·04d.
Sundry	112	·11d.	25	·01d.	−·10d.
Gross revenue	£4,946	4·95d.	£8,957	3·42d.	−1·53d.

The costs of production show decreases, with the exception of the item of repairs, which has slightly increased. The most important saving occurs on wages, as might be expected, but the reduction of nearly one-third of a penny on coal, already low, is a matter upon which Mr. Street may be congratulated. Nearly one-half of the oil, waste, and engine room stores' item is attributable to water for condensing purposes. Mr. T. P. Wilmshurst was engineer for about half the period under review, and upon his appointment to the engineership at Derby Mr. H. F. Street was promoted to the vacant post, and has the gratification of seeing satisfactory accounts issued at the end of his first six months' running. The details of the "costs" are set out as follows.—

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Costs of Production.

	1897. Gross.	Per unit.	1898. Gross.	Per unit.	Increase.
Coal	£837	·84d.	£1,449	·55d.	−·29d.
Oil, waste, water, and engine room stores.	306	·30d.	507	·20d.	−·10d.
Salaries and wages incurred in generation and distribution.	829	·83d.	961	·37d.	−·46d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	74	·08d.	247	·09d.	+·01d.
Works' cost	£2,046	2·05d.	£3,164	1·21d.	−·84d.
Rent, rates, and taxes	350	·35d.	358	·14d.	−·21d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	258	·26d.	367	·14d.	−·12d.
General establishment charges, stationery and printing, law charges and insurance.	183	·18d.	343	·13d.	−·05d.
Other expenses	180	·18d.	159	·06d.	−·12d.
Total costs	£3,017	3·02d.	£4,391	1·68d.	−1·34d.

Profit Statement.

	1897.	1898.
Interest on loans	£1,325	£1,693
Sinking fund for repayments	1,364	810
Net profit deficiency transferred to rates	− 842	...
„ carried to credit of general rate	...	1,862
Gross profit	£1,829	£4,565

Net loss on working, 1897 ... ... £842.
Net profit on working, 1898 ... ... £1,862.

Willans & Robinson, Limited.

The half-yearly report, to be submitted at the meeting to be held at the Victoria Works, Rugby, on Wednesday, October 4th, says that after writing off as depreciation from plant, patents, &c., the sum of £4,842 12s. 1d., and paying interest upon debenture stock, the balance to the credit of profit and loss account for the half-year (including £3,706 4s. 1d. brought forward) is £26,538 0s. 6d. Out of this the directors propose that dividends be paid at the rate of 6 per cent. per annum upon the preference shares, and at 10 per cent. per annum upon the ordinary shares, together amounting to £12,223 17s. The amount payable to the original directors, in accordance with the articles of association, is £3,870 1s. 0d., leaving a balance of £10,444 2s. 6d. From this the directors propose to carry £2,000 to the debenture redemption fund, and £3,500 to the reserve fund, leaving a balance of £4,944 2s. 6d. to be carried forward. The issue of new capital authorised by the last general meeting has been duly effected. The *pro rata* allotments were generally taken up by the shareholders, and the small balance of shares which remained unallotted were applied for many times over.

The Direct Spanish Telegraph Company, Limited.—The board has decided to pay, in addition to the dividend at the rate of 10 per cent. per annum on the preference shares, an interim dividend at the rate of 4 per cent., free of income-tax, on the ordinary shares, both for the half-year ended June 30th, 1899, and payable on October 2nd next.

Rockhampton Gas and Coke Company.—The directors' report to June 30th, 1899 (half-year), shows that the electrical operations have been carried on at a loss of £105 14s. 10d., but exceptionally large amounts have been debited to maintenance. The expenses were £1,058 14s. 11d., and the revenue £953 0s. 1d.

Evered & Co., Limited.—The directors have declared an interim dividend for the half-year ended June 30th, 1899, at the rate of 7½ per cent. per annum, warrants payable on and after September 30th. The transfer books are closed till October 2nd.

Edmundson's Electricity Corporation.—The whole of the shares issued a few weeks ago (£47,000) have been taken by the present shareholders in the company, who applied for more shares than the issue amounted to.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending September 16th, 1899, were £1,126 6s. 10d.; receipts for week ending September 16th, 1898, £996 17s. 9d.; aggregate for half-year to date, £15,984 9s. 5d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending September 15th, 1899, were £3,860 10s. 6d.; corresponding period 1898, £3,864 16s. 8d.; decrease, £24 6s. 2d.

The City and South London Railway Company.—The receipts for the week ending September 17th, 1899, were £368; week ending September 19th, 1898, £900; decrease, £32. Total receipts for half-year, 1899, £11,985; total receipts corresponding period, 1898, £11,886, decrease, £101. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending September 16th, 1899, were £308 1s. 9d.; week ending September 17th, 1898, £240 15s. 11d.; increase, £67 5s. 10d. Total receipts to date, 1899, £7,383 0s. 9d.; corresponding period, 1898, £5,990 17s. 2d.; increase, £1,392 3s. 7d. Miles of track open, 1899, 3; 1898, 3. Car miles run, 1899, 5,444 1898, 2,848. Number of cars, 1899, 13; 1898, 10.

The Dublin United Tramways Company.—The receipts for the week ending Friday, September 15th, 1899, were as follows:—D. U. T. Co., horse cars, £1,160 10s. 7d.; ditto, electric cars, £2,011 0s. 7d.; D. S. D. Co., electric cars, £691 18s. 10d.; total, £4,063 10s.; corresponding week last year—D. U. T. Co., horse cars, £3 464 15s.; ditto, electric cars, £469 16s.; D. S. D. Co., electric cars, £1,012 16s. 2d.; total, £3,947 7s. 2d.; increase, £116 3s. 10d. Aggregate to date, £51,347 5s. 7d.; aggregate to date last year, £49,786 15s. 1d.; increase to date, £1,560 10s. 6d. Worked:—The mileage open is 25 miles electrically, 19 miles by horses, as against 13 miles electrically, and 30 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending September 17th, 1899, were £688. Miles of track open, 10. Car miles run, 11,896. Number of cars, 21. The receipts for the week ending September 21st, 1898, were £295. Increase, £393. Miles of track open, 8½. Car miles run, 8,762. Number of cars, 10. Total receipts to date, 1899, from April 1st, 1899, £14,596; total receipts to date, 1898, from June 29th, 1898, £8,433.

The Liverpool Overhead Railway Company.—The receipts for the week ending September 17th, 1899, amounted to £1,484; corresponding week last year £1,495; decrease, £11.

The South Staffordshire Tramways Company.—The receipts for week ending September 15th, 1899, were £744 8s. 5d. aggregate receipts for 37 weeks, £24,584 19s. 3d.; week ending September 16th, 1898, £642 12s. 2d.; aggregate receipts for 37 weeks, £23,800 10s. 7d.

STOCKS AND SHARES.

Wednesday Evening.

Dulness is all that can be expected in such unquiet times as those now passing, but the electrical market holds its position with surprising strength considering all things. The general tendency of prices in any department of the Stock Exchange during bargainless days is, however, to sag away, as it were, of their own weight, and this disposition is not absent from the electrical supply shares. The greater part of the business done during the past week has been in the various metropolitan shares. Citys for the most part of their time have been weak, but strength is displayed by Metropolitan Electric Supply Ordinary. The company is taking rank among the "gilt-edged" list. We are inclined to regard "Mets" as one of the best shares to buy in the electrical market, more particularly because there is likely to be a steady advance in the value of the shares. The Charing Cross victory over the City Company has so far been productive of nothing, but we must warn impatient shareholders that the company's new powers require the most careful handling on the part of the directors, and in the present condition of the money market, Stock Exchange opinion is against any attempt to raise the fresh capital that will be required. Not that the company will have any difficulty in getting the cash; a firm of underwriters jauntily told us the other day that they were quite prepared to carry the business through by themselves, on certain terms.

The new Pacific cable should prove a grand chance for some of the telegraph construction companies to make money. The India-Rubber, Gutta-Percha and Telegraph Works Company is likely to get at least part of the contract, and a very good part, too. The present price of the shares is about 21½; the capital is half a million sterling, and there is a debenture issue of £300,000.

The Telegraph Construction Company has also some chance of participation in the new line, and the shares have already begun to move a little. The price is round about 40, but dealings are difficult, and almost a matter of negotiation.

We are afraid, however, that speculation with regard to the new cable is still premature, and it may be a long time before any of the actual work is put in hand.

Electric railway descriptions remain quiet as ever. It is interesting to notice that the Exploration Company—one of the largest holders of Central London shares—is taking a leading part in that electrifying of the Parisian tramway system to which we referred last week. The Exploration Company is one of the Rothschild's creations, and possesses interests all over the world.

Preliminary negotiations are on foot for covering the county of Durham with a network of electric trams. A small syndicate is in course of formation to furnish the capital necessary to meet the initial expenses, and the experiment will be watched with considerable attention. The enterprise of the British Electric Traction Company, and its activity in the Midlands, has been the means of pointing out how great a field exists for this class of business. Provincial tramways shares, however, are inclined to weakness at the moment, the result of the general uneasiness prevailing in the Stock Exchange.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years.			Closing Quotation, Sept. 18th.	Closing Quotation, Sept. 20th.	Business done during week ended Sept. 20th, 1899.	
			1896.	1897.	1898.			Highest.	Lowest
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	63 — 66	63 — 66	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	114½—115½	114 —115	115⅝	114
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	14½— 14⅝	14½— 14⅝	14⅞	14 7/16
205,151	Brasilian Submarine Telegraph	10	7 %	7 %	...	14⅝— 15¼	14⅝— 15¼	15	14⅞
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	106	...
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½%	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9⅞	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19⅛	18½— 19⅛	...	...
12,981	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	4	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	— 10½	9⅞	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	10 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½%	3½%	11⅜— 12¼	11⅜— 12¼	12⅛	11⅜
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	149 —154	145 —150	150	145½
1,795,000	Do. 8½% Pref. Stock	100	...	...	...	99 —102	99 —102	100⅛	99
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,482,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	116 —121	117 —122	120½	...
250,009	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14½— 14⅝	14½— 14⅝	14⅝	14½
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	115 —120	116 —121	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —105%	102	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	5½%	10⅜— 11¼	10⅜— 11¼	10⅝	10⅜
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15 — 15½	14⅜— 15¼	15½	15
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	...	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	49	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	107	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½%	6 %	6 %	5⅛— 5⅜	5⅛— 5⅜	5 5/16	5 1/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13⅝	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5⅜	5¼— 5⅜	5¼	...
1,339,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	100⅜	100¼
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅜— 1	⅜— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,889	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,881	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	4⅜— 5¼	4⅜	...
151,788£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	99 —102	99 —102	103	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛— 1	⅛— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	101 —104	101 —104	...	...
389,521	Western and Brasilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
68,321	West India and Panama Telegraph	10	1 %	2%	...	1⅜— 1⅝	1¼— 1½	...	...
84,568	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10¼— 10⅝	10¼— 10⅝	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8¾— 9⅛	8¾— 9⅛	...	...
30,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	104 —107	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	10 — 11	10⅞	10⅝
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6¼	6 — 6¼	6¼	6 1/16
84,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7⅛— 8⅛	7⅛— 8⅛	...	...
100,000	Do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	113 —115	113 —115	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11½— 12½	11 — 12	12	11½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13⅛	12½— 13⅛	13¼	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 12	11 — 11½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13½— 14½	13 — 14	13	...
220,000	Do. 4½% Deb. Stock, Prov. Certs (£30% to be paid) Rd.	...	...	...	...	82 — 85	83 — 85	83⅛	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5 — 5½	5 — 5½	...	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	8 — 9	8 — 9	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 7	6½— 6⅝	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	105 —107	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	14½— 15½	14½— 15⅝	15⅛	14⅜
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14 — 15	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	16½— 17½	16 — 17	17	16¾
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	9¼	...
65,000	South London Electricity Supply, Ord., £4 paid ...	5	...	...	...	3⅞— 4⅛	3⅞— 4⅛	3⅞	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	15 —16	15 — 16	15⅜	15 5/16

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Sept. 13th.	Closing Quotation Sept. 20th.	Business done during week ended Sept 20th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2⅜— 3¼	2⅜— 3¼	3	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	97 —102	97 —102	...	...
30,000	British Electric Traction	10	...	...	6 %	17½— 18½	17½— 18½	17⅜	...
10,000	Do. do. 6 % Cum. Pref. 30,001—40,000 (issued at £2 10s. prem. all pd.)	10	...	...	...	13¾— 14¼	13¾— 14¼	13 15/16	13⅞
20,000	Do. do. do. Nos. 40,001—60,000	10	...	...	...	...	...	...	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6¾	6½— 6¾	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	3 %	5 %	1⅞— 2⅛	1⅞— 2 xd	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅜— 2⅝	2⅜— 2⅝ xd	2 5/16	2 1/16
125,000*l*	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	108 —112	110 —114	111¾	111½
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	101 —104	103 —106	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13½— 14½	13½— 14½	...	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10¾	10¼— 10¾	10⅜	...
178,303	Do. do. do. £8 paid ...	10	...	...	...	..	...	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5¼	4⅜— 5¼	...	...
71,447	Do. do. Def. do.	5	...	...	...	5¼— 5⅜	5¼— 5⅜	5 1/16	...
630,000*l*	City and South London Railway	Stock	1 9/16 %	1⅞ %	2⅛ %	65 — 67	64 — 66	65½	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6¼— 6¾	6¼— 6¾	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	3⅝	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½ %	6 %	6 %	2 — 2½	2 — 2½	2 3/16	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½ %	6 %	6 %	4 — 5	4 — 5	4 1/16	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2¼	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	3¼	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	102 —105	103 —106	103½	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ⅞	⅝— ⅞	...	...
9,600*l*	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	110 —113	110 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21⅛	21⅜
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	102 —106	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅜ %	3¼ %	3¼ %	7⅞— 8⅛	8⅛— 8¼	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13¼— 13⅜	13¼— 13¾	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	39	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 .	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9¾	9¼— 9¾	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
540,000*l*	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	101 —104	103½	...

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

***Birmingham Electric Supply, Ordinary £5 (fully paid) 8¼—9¼.**
British Aluminium, Ordinary, 9½—10; 7 % Pref., 10—11.
House-to-House, 4½% Debentures of £100, 104—107.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 2—3.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7¼—7¾. Debentures, 103—106. Dividend, 1898, on Ordinary Shares 10%.
***T. Parker, £10 (fully paid), 19**

* From Birmingham Share List.

Bank rate of discount 3½ per cent. (July 13th, 1899).

MARKET QUOTATIONS, Wednesday, September 20th.

CHEMICALS, &c.		This week.	Last week.	Increase or Decrease.
Acid, Hydrochloric	per cwt.	5/-	5/-	..
„ Nitric	per cwt.	22/-	22/-	..
„ Oxalic	per cwt.	32/-	32/-	..
„ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	85/-	85/-	..
a Ammonia, Muriate (crystal) ..	per ton	£25	£25	..
a „ „	per ton	£23	£23	..
a Bleaching powder	per ton	£5 15	£5 15	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£16 10	£16 10	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£24	£24	..
a Lead, Nitrate	per ton	£23 10	£23 10	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks ..	per lb.	8½d.	8½d.	..
a „ Caustic (75/80 %) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£7 10	£7 10	..
a „ Crystals	per ton	£3	£3	..
a „ Bichromate, casks ..	per lb.	2¾d.	2¾d.	..
METALS, &c.				
Aluminium Wire, in ton lots ..	per ton	£224	£224	..
b „ Sheet, in ton lots ..	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis	per lb.	8½d.	8½d.	..
c „ Tube (brazed)	per lb.	10½d.	10½d.	..
c „ Wire, basis	per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).		This week.	Last week.	Inc. r Dec.
f Ebonite Rod	per lb.	8/-	8/-	..
f „ Sheet	per lb.	5/-	5/-	..
g Copper Bars	per ton	£88	£88	..
g „ Wire (basis price) ..	per lb.	10½d.	10½d.	..
g „ Sheet	per ton	£88	£88	..
g „ Rod	per ton	£88	£88	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha, fine	per lb.	6/-	6/-	..
h India-rubber, Para fine ..	per lb.	4/3 to 4/4	4/2 to 4/3½	1½d. inc.
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants)	per ton	67/11½	67/4½ to 69/7	..
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 ..	per ton	£14	£12 17 6	£1 2 6 inc.
g Lead, English Ingot	per ton	£15 5	£15 5	..
g „ Sheet	per ton	£15 7	£15 7 6	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bottle	£8 12	£8 12	..
d Mica (in original cases), small	per lb.	2d. to 6d.	2d. to 6d.	..
d „ „ „ medium	per lb.	1/9 to 2/6	1/9 to 2/6	..
d „ „ „ large	per lb.	3/6 to 7/-	3/6 to 7/-	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd strip & sheet	per lb.	From 1/2½	From 1/2½	..
o Platinum	per oz.	£3 10	£3 10	..
p Silicium Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n	p. ton	to £40	From £15	..
i Steel, Magnet, in bars		£58	£58	..
g Tin, block	per ton	£149 10	£149 10	..
g „ foil	per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16	per lb.	1/10	1/10	..
p White Anti-friction Metals—"White Ant" brand ..	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles	per lb	7½d.	7½d.	..
j „ Best Flax, 6 lea. ..	per lb.	4½d.	4½d.	..
j „ Hemp, 3 ply 10 lbs. ..	per lb.	3½d.	3½d.	..
j „ „ Russian, 10 lbs.	per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove ..	per ton	£13	£13	..
j „ Manila, 24 thread ..	per ton	£39 10	£36 10	£3 inc.
k Zinc, Sheet (Vielle Montagne bnd.)	p.t.	£27	£27	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yeo & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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BRITISH ASSOCIATION, DOVER, 1899.

SIGNALLING WITHOUT CONTACT.

A System of Railway Signalling specially suitable for Fog Signalling.

Paper read before Section G on Monday, September 18th, by Mr. W. S. Boult, Assoc.M.Inst.C.E.

The object of this paper is not to classify and compare the work that has been done in various directions in regard to railway signalling, but rather to deal with the question *de novo* in connection with successful practical work with apparatus described below.

The subject was originally approached by the author from the, in many respects, favourable position of the looker-on—who proverbially sees most of the game, his mind being perfectly open and uninfluenced in any direction by tradition or interest. He had, however, long held the opinion that the existing method of conducting railway signalling, especially during fogs, was far from satisfactory, for several reasons, and was capable of great improvement. It is surely a reflection on the present age, which justly prides itself on the advanced state of scientific knowledge and its application to practical purposes, that in a thick fog the only means of informing a driver of an approaching train that his next signal is against him should be to send out a man to put on the line something that will make a noise when the engine goes over it, and that, if no noise is heard, the driver is to assume that the line is clear, and he may go on—a method of working considered too dangerous to employ in regard to clear weather signals.

Independently of other objections, there is often great difficulty experienced in regard to having the men at their posts when wanted, notwithstanding all that has been done by the railway companies in preparation for emergencies, including the building of large numbers of cottages for the men, and the fitting up of electric call bells. It is not a very long time since an accident occurred directly after the foggers had been withdrawn, owing to a small unnoticed bank of fog and a train arriving together at a signal standing at danger, which, being invisible to the driver, was run past. In the case of fogs of exceptional duration another difficulty comes in owing to the men all being worn out with long hours and exposure to the weather. Fogging also is dangerous work for the men so employed, and has been the cause of numerous injuries and fatalities. Mr. W. M. Acworth, in "The Railways of England," says:—

"A long-continued fog seldom lifts without leaving one or two gaps in the army of platelayers."

As regards the cost of fogging, it is very difficult—probably impossible—to obtain detailed particulars, but the following extracts are not without interest:—

In "The Working and Management of an English Railway," the late Sir George Findlay, then general manager of the London and North-Western Railway, said:—

"There is one element which causes perhaps more difficulty, and entails more anxiety upon those engaged in the management of a railway than all others put together, and that is the prevalence of fogs in this country. . . . . Each man is provided with a hut to shelter him, a fire, and a thick, warm overcoat, which is supplied by the company for his use. As soon as he has been on duty three hours he is supplied with refreshments at the company's expense, and again six hours later, if the fog continues so long; and after 12 hours, if the fog still continues, he goes off duty, and his place is taken by a relief man. . . . . Inquiries have shown that during the week in question" (in January, 1888) "on the London and North-Western Railway alone, fogmen had to be provided at 2,462 signal posts; 2,375 men were employed, in addition to 1,377 relief men, making a total of 3,752 men."

It is only fair to add that Sir George writes in the highest praise of the results attained.

In "The Railways of England" Mr. W. M. Acworth says:—

"The men receive extra pay in addition to their ordinary wages, and are supplied with meals by the company as well. In a single one of the ten districts into which the North-Western is divided the food alone sometimes costs £100 in a single winter's month. The great fog of January, 1888, caused to a comparatively small company like the Sheffield a bill of £1,350, including as one item 360 gross of fog-signals. I have a return from a second-class station near London showing for that station alone an extra expenditure of over £80 per annum. . . . . It has been long felt by railway men that the present primitive system by which a man simply stands beside the distant signal, and if the arm goes up fastens a detonator on the line—or, rather, for greater precaution, two detonators, in case one should miss fire—and if the arm goes down, hastily pulls it off again, is a system that stands in need of radical reformation."

If further evidence is wanted as to the importance of the subject and the general desire for improvement, it may be found in the following letter received by the author from Mr. Francis Hopwood, secretary to the Board of Trade (Railway Department):—

"Board of Trade (Railway Department),
"7, Whitehall Gardens, London, S.W.,
"May 4th, 1896.

"Sir,—I am directed by the Board of Trade to advert to your letter of 27th ult. on the subject of your invention of an improvement in fog signalling, and in reply to the observations and request contained therein, to state that the Board would be glad to see some improvement in the present system of fog signalling, and to point out that the matter has, on occasion, been dealt with by the railway inspecting officers of this Department in their reports on certain railway accidents.

"I am further to observe that, if a mechanical system of this nature, perfect and reliable in all respects, can be found, the Board see no reason why it should not supersede the existing system.

"I am, Sir, your obedient Servant,
"(Signed) Francis J. S. Hopwood"

At the engineering conference last June the author introduced the subject of fog signalling, and in reference to this Sir Douglas Fox, chairman of the "Railways" section, remarked that the matter called loudly for reform, and that the general adoption of mechanical appliances would decrease the loss of life occurring with the methods now in use.

In *Fielden's Magazine* for August, Sir W. H Preece, K.C.B., President of the Institution of Civil Engineers, speaks of "the present barbarous, dangerous and irregular system of fog signalling."

As, owing to the interchange of traffic on the various companies' lines, any system of signalling, to be of extended practical utility, would have to be approved by railway engineers and managers in general, it appears highly advisable that the requirements to be demanded from any such system should be authoritatively discussed and settled, so that inventors and experimenters may have definite data to work upon.

In the hope of raising such a discussion the author has formulated these requirements as they present themselves to him, and submits the following as a comprehensive list:—

1. Certain action.
2. Simple construction.
3. Slow deterioration.
4. Good protection from accidental damage.
5. Easy replacement of damaged or worn out parts.
6. Minimum amount of cleaning and overhauling.
7. Moderate first cost.
8. Moderate maintenance and working expenses.
9. Signals must be given in the cab of the engine and in any vehicle fitted with receiving apparatus.
10. Action must be independent of speed or even movement of engine, and applicable as a starting signal.
11. Apparatus must work when engine is run either end first.
12. Two distinctive signals must be given—for "danger" and "line clear," respectively.
13. Distant and home signals must be clearly differentiated.
14. The signals must be capable of re-delivery at intervals as arranged.
15. Repeating in signal-box must be provided for.
16. A clearing signal should be given from the tail vehicle to the signal-box to show that the whole train has passed, and on which line, if more than one each way.
17. Commencing failure of action must be at once indicated while correct signals are being given.
18. It must be impossible for an engine-driver to mistake another signal for his own.
19. Failure of apparatus on the road must give the danger signal on the engine.
20. It must be impossible for the engine-driver by tardiness in stopping a bell, working a signal replacer, or otherwise, to prevent the receipt of a succeeding signal.
21. The whole apparatus must be unaffected by fog, frost, snow, rain, hail, wind, or changes of temperature.
22. Means must be provided for indicating which of several branch roads is made.
23. Each signalman should be able to veto "line clear" given by the signalman in advance.
24. The system must admit of "lock and block" and automatic block working.

Let us now more carefully consider these requirements and what they entail.

1. *Certainty of Action.*—The necessity of as near an approach to absolute certainty as may be attained by fallible humanity and apparatus need not be contended for. The best way of attaining this result is, first, by the utmost possible simplification and protection of apparatus—especially moving parts—and, second, by independent duplication of fundamental parts, as practised now in the case of detonators.

2. *Simplicity.*—As just pointed out, this conduces to reliability; it also has an important bearing on first cost and maintenance expenses. It is evident that complicated or delicate apparatus would be quite out of place for constant work on a locomotive.

3. *Slow Deterioration.*—This is important as affecting both reliability and cost of maintenance. It is absolutely necessary that there shall be no chance of anything working out of adjustment, bending, breaking, wearing away, or otherwise giving out, without ample notice through infrequent periodical examination.

4. *Good Protection.*—All parts of apparatus should be securely boxed in, or so strong as not to be liable to injury by accidental knocks from falling objects, &c.

5. *Quick Replacement of Worn or Damaged Parts by New Ones.*—This obviously is most important, not only as affecting the cost of repairs, but preventing the possibility of causing delays to traffic.

6. *Minimum Cleaning, &c.*—In view of the large number of apparatus that would be required, this is of great importance as seriously affecting maintenance expenses. To this end it is most desirable that all moving parts whatever that would be in any way liable to clogging or injury by dirt or weather should be *completely* boxed in.

7. *Moderate First Cost.*—This is chiefly important in view of the number of apparatus required. It is, however, not of such consequence as

8. *Moderate Maintenance and Working Expenses.*—Seeing that thick fogs occur only on a few days out of the 365, it is evident that to be successful fog-signal apparatus must require very little attention to keep it in operative condition.

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9. *Signal to be Given on Engine.*—The object of signals being to convey information to the engine driver, it certainly seems that the natural and best place in which to exhibit visible signals is right in front of the driver's face; audible signals also are to be received in the cab of the engine, and naturally should be given there. The best form of signal is a point requiring discussion; probably, at all events for danger signals, a miniature semaphore or equivalent signal and continuous action electric bell form the best combination, the bell continuing to ring so long as the signal remains on, or until the driver's attention is attracted. Many locomotive engineers do not view with favour the idea of applying to their engines apparatus which they deem to be dangerously fragile and liable to damage. It is for the designers of such apparatus to treat with all respect views founded on practical experience of locomotive working such as the majority of such designers do not possess, and to spare no pains to render their apparatus simple, strong, and well protected. There is another consideration often urged against giving signals on the locomotive, viz:—that all locomotives using any line worked by such signals must be fitted with receiving apparatus.

This difficulty is purely one of agreement amongst the various railway companies, and should be capable of settlement whenever any one system has proved itself thoroughly fitted for its work, and superior to all competitors. When once this state has been reached, and a system universally adopted, it will be just as much a matter of course to fit an engine with receiving apparatus as it is now to apply a safety valve or brake apparatus. The unnecessary loss of money incurred in fitting up rolling stock to suit two or even three systems of continuous brakes, should be taken as a warning not again to deal piecemeal with a subject better made a Clearing House matter.

10. *Action unaffected by Speed.*—This is clearly necessary, as not only may a signal have to be given to an engine travelling at any speed, but it should be possible by the same system to start an engine that has been stopped.

11. *Reverse Direction of Movement.*—Tank engines at least must be able to take signals when running either end first, and all engines must be able to pass up or down a line without doing damage. If any special movement has to be made to compensate for reversed running, this can probably be done by an attachment to the reversing lever.

12. *Distinctive Danger and Line-clear Signals.*—This, of course, would be a great improvement upon the present method of giving danger signals only, and greatly help the driver in determining his position, besides doing away with the necessity for treating no-signal as line-clear.

13. *Distant and Home Signals.*—Here, again, the driver will be assisted in determining his position.

14. *Re-delivery of Signal.*—By this means the driver may be as well informed as by seeing a semaphore from a distance. Requirements 12, 13, and 14 together ensure as great facility in signalling in fogs as is obtained by semaphores in clear weather.

15. *Repeating.*—It is obviously necessary that the signalman shall know definitely that he *has* set his apparatus as intended.

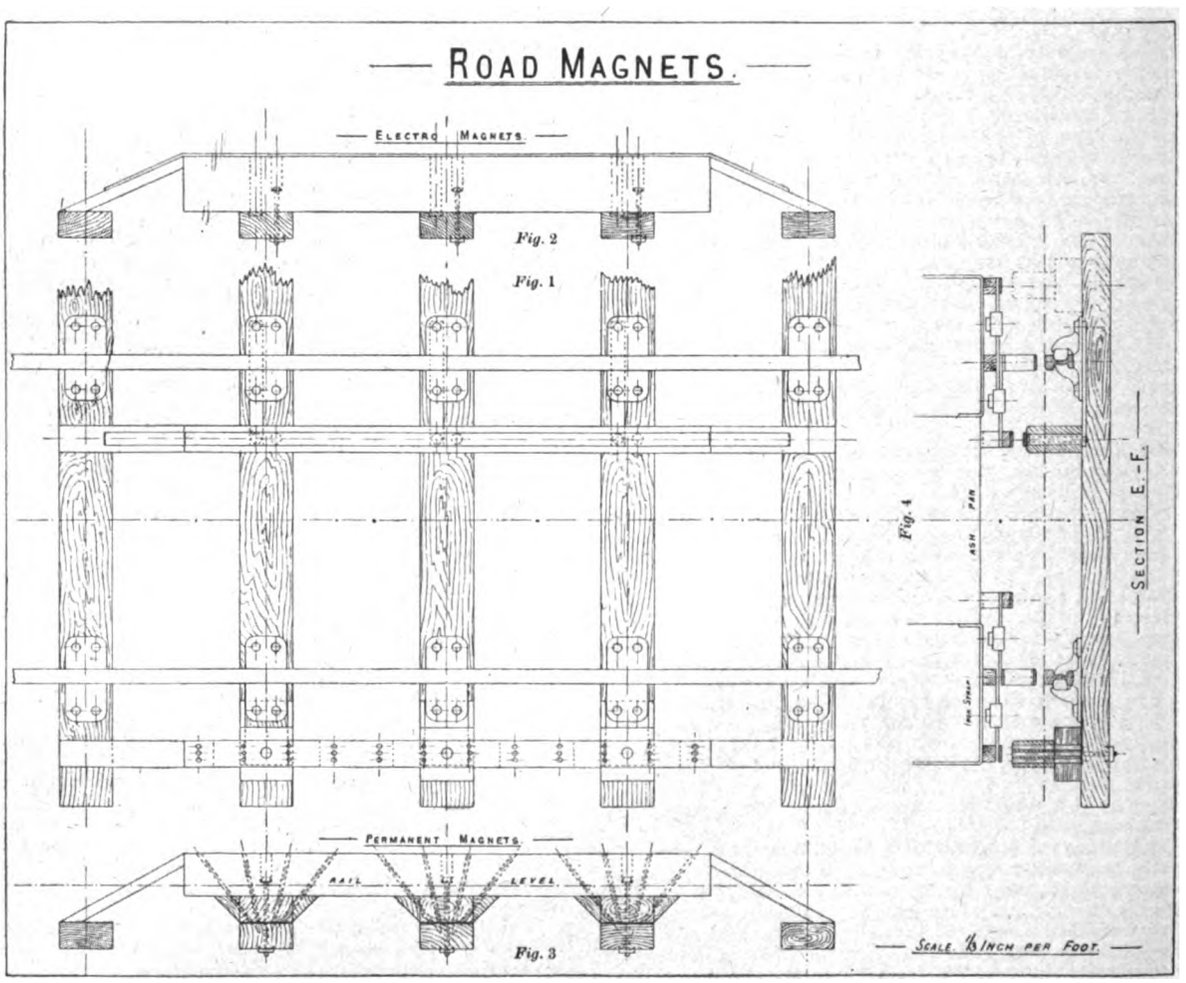
16. *Clearing Signal.*—This signal is especially wanted in thick fogs, when the tail lights of a train are visible only within a very short range, and it may not be easy for the signalman to see on which line a train is running.

17. *Commencing Failure Indicated.*—The best method of meeting this requirement is probably by independent duplication of fundamental parts and separate indication of their action. It may also be met by complete duplication of receiving apparatus. In either case the chance of two failures at the same instant is so remote, as to be negligible.

18. *Mistaking Signals.*—Any signal given in the cab of the engine prevents all possibility of a signal meant for one engine being acted on by another. This is another argument in favour of signalling on the engine, as emphasised by the collision at Crewe on October 4th, 1897, when four goods trains were wrecked in consequence of an engine driver acting on another man's signal.

19. *Failure on Road must Give Danger Signal on Engine.*—This is insisted on in the case of semaphores, which are weighted so as to take the danger position if a connection breaks; and surely it is doubly needful in foggy weather, though not attained with the present system.

20. *Late Replacing of Signal.*—Interference with a following signal by late replacement may be guarded against in different ways, but, at least in the case of danger signals, it is clear that it must be absolutely guarded against.



21. *Weather.*—It is, of course, a *sine quâ non* that the apparatus shall work equally well, and without special adjustment, at all possible temperatures and in all weathers.

22. *Route Indication.*—It is highly desirable that the engine driver should know that he is about to be sent on to the line he wants; but as the worst result of a mistake would be loss of time, this is essential only from a business point of view. Without such information it would be necessary, wherever there was a possibility of being turned on to the wrong road, not to go faster than would be safe on the worst road that could be given.

23. *Veto.*—This is the quickest way of stopping a train in which anything wrong was noticed as it passed.

24. *Block Working.*—The advantages of "lock and block" working are now generally admitted. For "light railways" and other purposes it is probable that automatic block working might be advantageously adopted.

Assuming the sufficiency of the above numerous and exacting requirements, the question comes:—How are they to be met? In answering this question, the first and all-important point is to find some medium or vehicle whereby some influence or movement may be conveyed from the stationary road to even the fastest running engine with practical certainty of action in all cases.

Apparatus actuated by mechanical contact between something on

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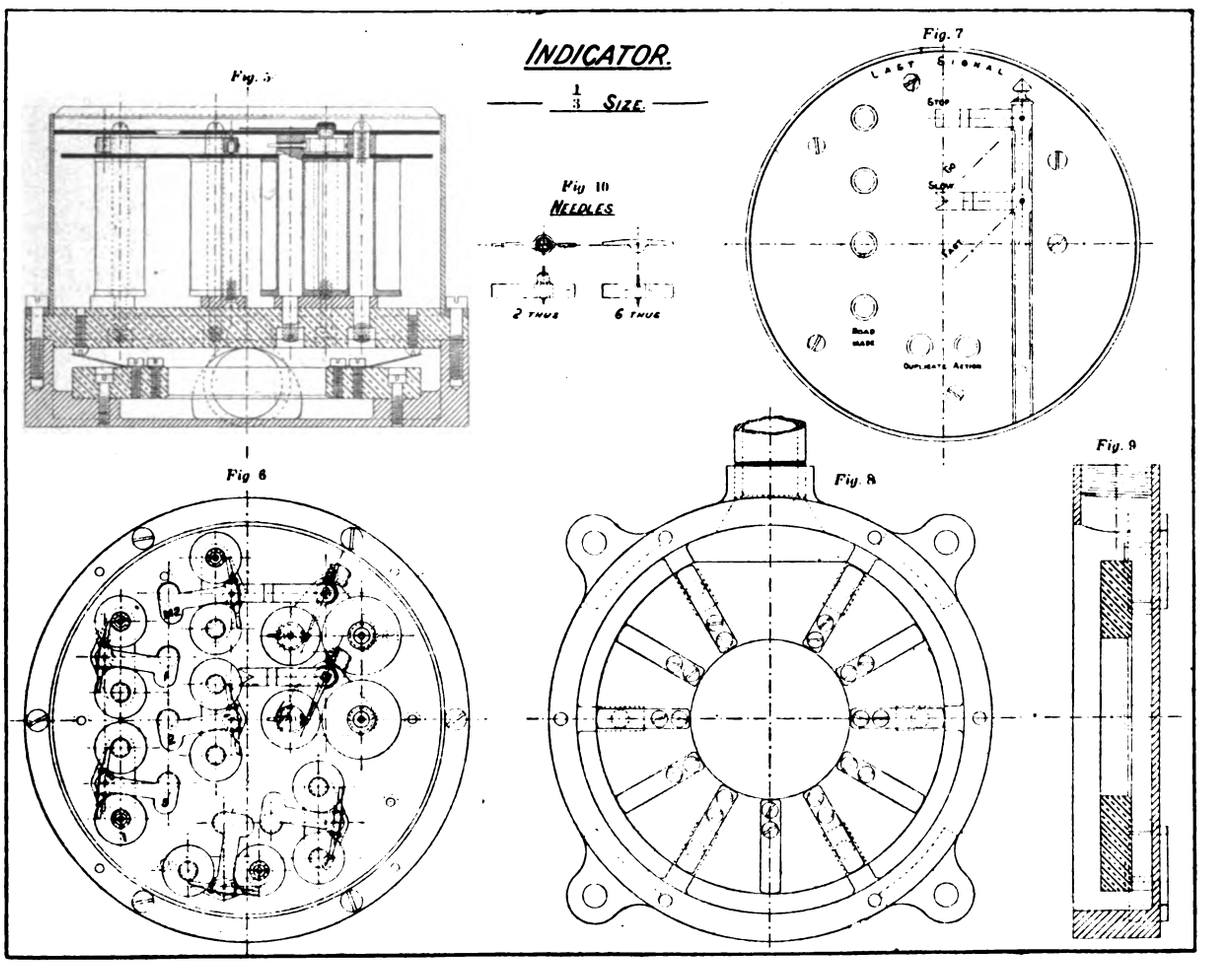
the road and something on the moving engine could, it is at once evident, never be satisfactory or inspire confidence, however often it worked all right; for blows given at a speed of 120 feet per second—the actual speed occasionally attained by some express trains—could not fail to quickly find out and develop any incipient flaws, however well proportioned, balanced, and aligned the apparatus might be. Moreover, wear of rails, tyres, and contact pieces, would necessitate perpetual overhauling and adjusting on both road and engines. Further, it is much to be desired that there should be no movement into and out of contact position of anything on the road, as all such movable parts would involve the expense of constant cleaning, oiling, and overhauling, even if required in actual use on only a small number of days in the whole year. Their action also must depend upon the proper compensation or adjustment of the already overloaded distant signal wire just at the time when the semaphore is invisible, so that *all* such moving parts would have to be repeated in the signal box. These objections apply more or less to all apparatus for placing detonators on the rails, many forms of which have been proposed, though at best only a danger signal is thus given, and the magazines have to be looked after and kept supplied with detonators which are used up at all sorts of varying rates—always supposing the machine remains in working order.



Another plan, adopted by numerous inventors, is the employment of electricity as the medium of communication with the engine, and at first sight this seems to offer great advantages. On consideration, however, many objections appear. Bare, insulated, and necessarily unprotected, conductors, must be laid on the road, and contact made therewith by a brush or contact piece on the engine. This, of course, may be in the form of a wire brush, or a plate spring, or be otherwise made more or less elastic, so as to reduce shocks, but, for all that, at high speeds, shocks there must be, as well as *wear* and *bending*, these last always tending towards want of alignment, so that, sooner or later, missed contacts between badly worn brushes and roadway conductors would be certain to occur, even if nothing got carried away. Dirt, snow and frost, would also be likely to prevent metallic contact. Again, with bare contact bars, the current might in various accidental ways be short circuited or cut off. But the fatal objection to purely electrical systems is, that failure of current in the roadway conductors or of contact therewith results simply in giving no signal, which, of course, might easily lead to most serious disaster. The author is aware that it has been proposed to guard against this contingency by causing the brush-holder, when the brush is raised by contact with the roadway conductor, to act as a switch to close a local circuit through a battery on the engine so as to show a fault signal if this is not held off by the main current. This, however, involves the use of two systems—electric contact and mechanical movement—and necessarily increases shocks, wear, and liability to damage; and, if failure of the main circuit is due to the brush having been carried away, or to its clearing the contact bar owing to banding or wear, is no safeguard whatever, as the cause of failure affects both circuits alike.

Sight, hearing, mechanical movement, and electric contacts, judged by the standard of requirements given, all fail to do all that is wanted. Appealing to the sense of smell also is, for obvious reasons, out of the question. There remains one means of transmission not yet mentioned, that is, magnetism, and consideration shows that magnetism is thoroughly well suited to the purpose in view. There are three ways in which magnetism can be employed to work across an air gap, such as is desired between the stationary and travelling parts, viz: (1) by direct pull on the travelling armature, mechanically transmitted thereby; (2) by inducing a current in a conductor on the moving vehicle; and (3) by actuating a pivoted needle or spring tongue, which may be incorporated with a rigidly held armature on the vehicle to be signalled.

The first two methods have previously been proposed, but clearly cannot do all that is wanted. No. 1 would need impossibly large magnets (at all events, except where dynamo currents were available), would actuate mechanism with great suddenness, and would give only one signal for each armature and set of magnets, and No. 2 would simply not work on a standing or slowly moving vehicle, and at best, like No. 1, would give only one signal. The third method, however, which appears never before to have been suggested, possesses none of these drawbacks.

Arriving at this conclusion in the manner above set forth, the author turned his attention to devising suitable magnetic apparatus, with results which he now has the honour to submit for criticism.

In brief outline his system consists in placing on the road magnets so arranged as to establish a long magnetic field of transverse polarity, and carrying on the engine through this field an iron armature, not itself to be moved by attraction to the magnets, but containing in a dividing gap or space therein a small pivoted needle on which magnetism collected by the armature is condensed or focussed so as to strongly act upon it and throw it over to one side. The polarity of the field from the road magnets is arranged to be from right to left, or left to right as required; and, as the direction in which the needle in the moving armature is thrown over depends upon the polarity of the magnetism collected by the armature, it is evident that the combination forms a simple means of determining the movement of the needle. The needle when thrown in one direction comes against an insulated contact post and thus closes one electric circuit on the engine, and when thrown in the opposite direction, similarly closes another circuit. When away from the influence of road magnets, it is magnetically, or otherwise, held in the middle of its travel, and clear of both contact posts. The action is that of the well-known polarised relay, the road-magnets and armature taking the place of the electro-magnets in the instrument used in telegraphy.

With the means of closing either of two independent local circuits

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(on the engine) thus provided, practically any signals preferred can be given and if desired recorded.

After the usual experiments, consideration, and alterations, incidental to the designing of new machines, the author's apparatus has now assumed the form shown in the drawings herewith.

Road Magnets.

The road magnets are by preference placed as shown in figs. 1 to 4. Permanent magnets, arranged in fan-shaped groups on iron plates over the sleeper ends, are placed in holes bored through a longitudinal timber, as shown in figs. 1, 3 and 4. The iron plates pass under the contiguous chairs, thus completing an iron connection to the upper surface of the rail, close to which travels a collecting pole plate on the engine armature. A similar pole plate on the other side of the armature passes just above the upper ends of the magnets. As will be seen from fig. 4, with the exception of the desired clearance between stationary and travelling parts, a complete iron circuit is provided for the magnetic flux.

On the inside of the other rail are shown three electro-magnets very similarly arranged, but with their upper ends connected to a common pole plate. In practice the permanent and electro-magnets would not be on the same sleepers, but, as explained below, it is proposed to have the permanent magnets in duplicate—one set to each rail.

Indicator.

Figs. 5 to 10 are views showing the construction of the indicator for complete signalling. The various indications are all given in the same way by a movement which may be explained in relation to the home semaphore. This semaphore is carried by a tongue or armature pivoted on a magnet and playing between the cores of two coils after the manner of a polarised relay; the cores and magnet all standing on a common iron base. The magnetic action, however, is not that of the telegraph relay, only one coil being energised to produce movement. For instance, if the semaphore, which is shown on, is to be thrown off, the right-hand coil will be energised with N. polarity at its outer end (the outer end of the magnet and tongue being S.), the effect being to strengthen the magnet, and, therefore, the tongue, and to reverse the polarity of the left-hand core, which then repels the tongue at the same time that the right-hand core is attracting it. Owing to the facts that the left-hand core is not too strongly magnetised, and that the magnetism of the tongue is simultaneously strengthened, seising is prevented, and the tongue may be thrown through a large angle.

Fig. 7 shows the dial of the indicator, with home and distant semaphores, duplicate action spots, and four number holes for indicating the road made at junctions. Figs. 5, 8 and 9 show the permanently wired base of the instrument, with radiating contact springs for connecting up the indicator coils.

(To be continued.)

SOME RECENT APPLICATIONS OF ELECTRO-METALLURGY TO MECHANICAL ENGINEERING.

By Sherard Cowper-Coles, Assoc.M.Inst.C.E., M.I.M.E., M.I.E.E.

(Read in Section G, September 18th.)

Abstract of Contents.

The paper commences by pointing out the prominent position electro-metallurgy is now taking in many workshops, and enumerates the uses to which electro-metallurgy is being applied. It then proceeds to give a description of an electro-galvanising plant for coating the tubes of water-tube boilers and the plates of torpedo boat destroyers, and also gives details of the anode and cathode bars for suspending the electrodes, and information as to the thickness of zinc applied, and the current density and voltage employed. Estimates are given as to the cost and output of various sized plants, and the advantages of electro-galvanising over hot galvanising are compared. The regenerative or recuperative process and methods of circulation are also described. Particulars are then given of various electro-chemical processes for cleaning iron and removing magnetic oxide and scale, and a description is given of a magnetic scale collector for collecting the scale from the acid solution after its removal from the iron or steel, so as to prevent the further unnecessary waste of acid. Experiments made in this direction tend to show that a considerable proportion of the acid is consumed by dissolving the scale after it has left the iron or steel.

An electrolytic process for the manufacture of reflectors is then described, suitable for making parabolic reflectors for search lights. The various steps of the process are given in detail. Briefly, the process consists in using a glass convex mould, on which is chemically deposited a coating of metallic silver, and then polished, so as to ensure the copper backing being adherent to the silver. The mould thus prepared is placed in a suitable ring and frame, and immersed in an electrolyte of copper sulphate, the mould being rotated in a horizontal position, the number of revolutions being about 15 per minute. The copper adheres firmly to the silver, and together they form the reflector, which is subsequently separated from the glass mould by placing the whole in cold or lukewarm water, and then gradually raising the temperature of the water to 120° F., when the metal reflector will leave the glass mould, due to the unequal expansion of the two.

The concave surface of the reflector obtained is an exact reproduction of the surface of the mould, and has the same brilliant polish, and requires no further treatment to answer all the purposes of a reflector, with the exception that it must be coated with a film of some suitable metal to prevent it tarnishing. Palladium is found to answer this purpose best, as a bright coating can be deposited rapidly to any desired thickness.

Electro-chemistry and metallurgy are beginning to play an important part in large engineering works; for instance, electricity is now being applied to galvanising, the removal of mill scale, the production of metallic reflectors, the manufacture of copper tubes and sheets, the recovery of tin from tin scrap, and for the coating of iron and steel with brass, for welding, brazing, soldering, and for sharpening files. It is also being introduced to allied industries, such as the manufacture of white lead. Time will not permit of my giving a description of more than the three first applications.

Galvanising.—Electro-galvanising is at the present time extensively used for coating the frames and plates of torpedo boat destroyers and for the galvanising of tubes for water-tube boilers, such as the Normand.

One feature that makes this process particularly suitable for this class of work is, that it does not cover up defects, nor does it reduce the tensile strength of iron and steel of small section, or distort it, as in the case of hot galvanising, but it shows up any defect in the steel, which means a considerable saving of time and money, as any flaw in the steel is detected at an early stage of manufacture, and not in the final testing, as, for instance, when all the parts of a boiler have been assembled. Another advantage of electro-galvanising is that the plant can be worked intermittently without loss, and varying thicknesses of zinc can be obtained at the will of the operator; the thickness of zinc usually applied to such work as boiler tubes is $\frac{3}{4}$ oz. to $1\frac{1}{4}$ ozs. per square foot.

The process of electro-galvanising consists of first removing the scale and rust from the work to be galvanised, either by immersing in an acid solution or by sand blasting. It is then placed direct in the galvanising bath, which is composed of a solution of zinc sulphate containing about 30 ozs. to the gallon of solution. The work to be galvanised is suspended by means of gun-metal carriers which rest on bars or girders running the length of the tank; the electric current is conducted into the solution by means of lead or zinc plates, the voltage at the terminals of the dynamo being six, the number of amperes per square foot of cathode surface 15 to 20.

The solution is rapidly circulated through the bath by means of a small centrifugal pump or air compressor, and is regenerated as the zinc is deposited by passing it over a filter bed composed of carbon, coke, or sand, mixed with zinc dust, which is obtained as a by-product during the distillation of zinc from its ores.

Figs. 1 and 2 illustrate a plant suitable for coating plates up to 7 feet in length, and is also applicable for coating tubes, such as those

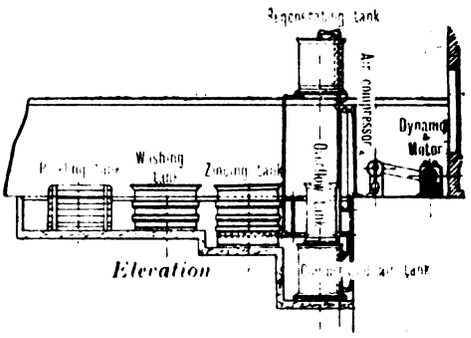

Fig. 1.

of the "Belleville" water-tube boilers. The plan and elevation both show the regenerating tanks and circulating arrangements. The regenerated electrolyte enters at the bottom of the zincing tank, the liquid which is returned to the regenerators being drawn off from the

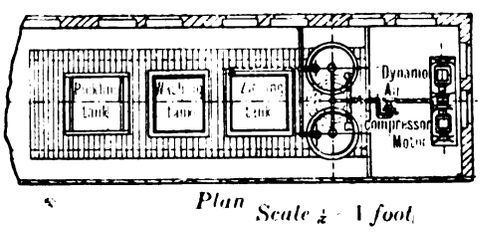

Fig. 2.

top of the solution over a wood sill placed in the corner of the zincing vat. Fig. 3 shows the carriers and compound anode and cathode bars which are used for carrying the anodes and cathodes. On the table are a number of specimens of electro-galvanised tubes, &c., also some interesting specimens of sheets which have been electro-galvanised under a pressure of about 1 ton to the inch.

Removal of Mill Scale.—The removal of mill scale is a matter of considerable moment with many large engineering firms. The ordinary pickling process is tedious and costly, and electricity is now being used to hasten the process. The removal of oxide and scale from forgings and plates has always been a matter of difficulty, the scale in many cases being over $\frac{1}{16}$th inch in thickness and very adherent. The usual practice is to place the iron in a solution containing one

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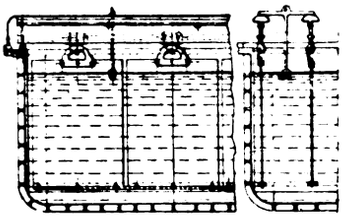
part of hydrochloric or sulphuric acid to 10 parts of water, for a period varying from half-an-hour to 24 hours—half-an-hour for close annealed sheets, 24 hours for plates and forgings, such as are employed for ship and bridge building.



Figs. 3 and 4.

Many experiments have been made to quicken the process and to reduce the cost. One of the first experiments was to make the iron to be pickled the anode in an acid bath, but this was found to pit the plates, as the iron which was not protected by the mill scale was more readily dissolved than that covered by the magnetic oxide. To overcome this difficulty, the current was reversed every few minutes, the iron being alternately made anode and cathode.

A device for catching the scale after it is removed from the iron so as to prevent the further unnecessary consumption of acid by dissolving the mill scale and oxide after removal, has been tried with satisfactory results. The pickling solution is circulated by means of a small pump or an externally heated lead coil, through a lead-lined box or chamber, behind which are placed electro-magnets as the solution flows past the poles of the magnets, the magnetic oxide in suspension is attracted and retained, and can be removed from time to time.

In America, another electrical pickling process has been tried, the solution being sulphate of soda or sulphuric acid. The plates to be cleansed from the negative electrode, and an iron plate the positive electrode; the hydrogen set free from the surface of the plate removes any grease that may be present, and reduces any oxides on the surface.

A voltaic method is said to do the work with more certainty and with less danger to the surface of the metal in the way of pitting. The articles to be cleansed are used as the positive pole of the battery, the negative pole being either carbon or wire gauze, electroplated with silver, and covered with amorphous platinum black. The bath consists of dilute sulphuric acid, containing a depolariser, such as nitric or chromic acid; the use of the latter agent, it is claimed, completely prevents the evolution of offensive gases.

Another process, which also depends on the use of electro-magnets, being a modification of the one I have already described, consists of an apparatus containing an electro-magnet encased in copper.

The scale collector (fig. 4) is placed in any convenient position in the tank, and connected by means of terminals to a depositing or electric lighting dynamo, the current required to work it being about 10 amperes when an E.M.F. of 6 volts is employed.

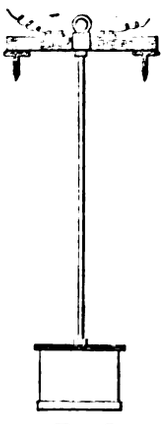


Fig. 5.

In the case of large pickling tanks two or more scale collectors can be employed, or only one may be used, this being moved about to different parts of the bath at suitable intervals. From time to time the scale collector is taken out, and the adhering scale removed, either by breaking the circuit or by means of a suitable brush or scraper.

On the table is a model of the apparatus, also a photo of the collector after it has been dipped in iron filings. It will be noticed that the electro-magnet has consequent poles, this method of connecting up having been adopted with the object of distributing the field as much as possible.

An Electrolytic Process for the Manufacture of Projectors.—Projectors are now extensively used for naval and military operations, every man-of-war, torpedo boat destroyer and fort being supplied with one or more, as the power of rendering visible distant objects is of great value.

During the American war with Spain, searchlights played a most important part in the blockade of the Cuban coast. The most essential part of the projector consists of optical means whereby the rays of some source of light are collected by reflection or refraction, or both, and projected in the form of a parallel beam towards the distant object which it is desired to illuminate. If the light emanated from a point, exactly the focus of a perfect parabolic mirror, the beam would be rendered absolutely parallel. In the case of the arc, however, the light comes from the crater of the positive carbon, which is of appreciable size, especially with large currents. Every point of the mirror is, therefore, struck with a cone of light, the angle of the cone depending on the size of the crater and the focal distance, consequently the whole beam after reflection disperses at the same angle. Light collected by a surface is inversely proportional to the square of the distance of the source of light, but after a certain limit has been reached, the amount of light received by the mirror does not continue to increase as the solid angle, on account of the obscuration effected by the walls of the crater. This obscuration begins to tell after a section of the solid angle has been reached of about 65°. The source of light of the point of a 1-foot mirror of 1-foot focus, would be as good as that of a 2-foot mirror with a 2-foot focus, both taking the same solid angle of light. The dispersion of a Manger mirror burning a 30 mm. positive carbon with 150 amperes is about 2°, that of a Schuckert is about the same, though the focal distance is less, the light collecting power is therefore greater.

Glass mirrors at the present time have been exclusively used for projectors for search lights and similar purposes. One advantage of a parabolic metal reflector is that the rays from the carbon points are collected into parallel beams by means of reflection only, and is not catadioptric, as most glass mirrors are. A perfect parabolic mirror, of exact mathematical curvature, ensures parabolism of the rays, especially if the source of illumination is of very small dimensions.

Great difficulties have been experienced in producing a true metallic reflector that will not readily tarnish when exposed to the heat of an arc light, and the influences of damp air and sea water. Spun reflectors are never true, as it is found in practice impossible to spin them quite true to the moulds. Experiments have been made with a view to substituting cast metal for glass, but the cost of grinding and polishing, and the unsatisfactory surface that is obtained, have resulted in the attempts being abandoned. Stamped reflectors have also been tried, but with no more satisfactory results.

The process now about to be described is electrolytic, one of the chief features being that the surface produced requires no after polishing or trueing up. When once a true mould has been produced, any number of reflectors can be taken from it at a small cost.

A glass mould is prepared, the convex side of which is accurately shaped and polished to form a true parabolic or other reflecting surface. As the mould only requires shaping and polishing on the convex side, it is comparatively cheap, as compared to a glass reflector, which has to be ground on both sides.

The glass moulds are prepared as follows:—First of all, a convex cast-iron mould is made to the approximate curve of the mirror. From this a concave mould is made of refractory material. Over this is laid a piece of flat glass about ⅜-inch thick, the whole being placed in a furnace and heated to such a temperature that the glass will adapt itself to the curvature of the mould without fusing. The roughly-shaped glass mould thus prepared, is then ground and polished on the convex side only. The mould is revolved slowly, the first breaking down operation being done by means of emery wheels, the desired curvature being given to the mechanical feed by means of a template or gearing. The glass is finally polished with pads and rouge, which are caused to move over the surface in different directions. This process is a very expensive and laborious one, two to three months being taken for the largest sized reflectors. The next step in the process, after having obtained a suitable glass mould, is to clean it, and then coat the convex surface with a coating of metallic silver, which is thrown down chemically on the glass and polished so as to ensure the copper backing being adherent to the silver. The mould thus prepared is placed in a suitable ring and frame, which is described later on, and immersed in an electrolyte of copper sulphate, the mould being revolved in a horizontal position, the number of revolutions being about 15 per minute. The copper adheres firmly to the silver, and together they form the reflector, which is subsequently separated from the glass mould by placing the whole in cold or lukewarm water, and then gradually raising the temperature of the water to 120° F., when the metal reflector will leave the glass mould, due to the unequal expansion of the two. The concave surface of the reflector obtained is an exact reproduction of the surface of the mould, and has the same brilliant polish, and requires no further treatment to answer all the purposes of a reflector, with the exception that it must be coated with a film of some suitable metal to prevent it tarnishing. Palladium is found to answer this purpose; a bright coating can be deposited rapidly to any desired thickness. Palladium resists tarnishing and the heat of an arc to an extraordinary degree. Palladium is a silver-white metal, and is sufficiently ductile to be rolled into thin sheets. Its specific gravity is 11·4, being about half that of platinum. The present price of palladium is about double that of platinum, but its weight being only one-half, the same area can be covered at the same cost. At the present time there is very little use for palladium, which accounts for its comparatively high price. The following table gives the comparative hardness of palladium as compared to other metals:—

Nickel electro-deposited	10·0
Sheffield plate	10·0
Antimony electro-deposited	9·0
Platinum deposited bright	9·0
Palladium deposited bright	8·0

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Chromium electro-deposited on copper	7·0
Cadmium deposited bright	4·5
Silver electro-deposited and burnished	4·0
Silver (deposited chemically)	2·0

The figures give the hardness as represented by the number of centigrammes weight on a diamond point required to produce a scratch. In carrying out the manufacture of reflectors by this process, it is essential that the glass mould should be perfectly clean and free from grease before the silver coating is applied. It has been found, however, that if the cleaning is solely effected by chemical means, there is a great liability of the silver adhering too firmly to the glass, whereby the mould is in danger of being broken during the removal of the reflector. This difficulty has been overcome by cleansing the mould with a suitable paste or powder, such as peroxide of iron, and then washing the glass in a 50 per cent. solution of ammonia. It is necessary that this cleansing operation be repeated prior to the production of each mirror. After the convex side of the mould has been properly cleaned, a thin coating of metallic silver is applied as follows, the process being that commonly employed for silvering reflectors for astronomical telescopes:—Two solutions are prepared, the first of which contains the silver salt; the second, the sugar preparation. Ammonia is added to a solution of nitrate of silver until the precipitate that is formed is dissolved, then re-precipitating with caustic soda again dissolving in ammonia; a solution of glucose is then added. Excellent results have been obtained with a silvering solution made up of equal parts of solution of the following strengths:—Silver nitrate 0·55 per cent., caustic potash 0·25 per cent. The author has found the weight of silver deposited from such a solution to be equal to about ·000588 per square inch, the thickness being ·0000034 inch.

The surface of the mould to be coated is immediately dipped into the solution face downwards. In from four to five minutes the silver begins to form on the glass mould, the solution changing from pink to dark brown and black; the film thickens quickly, and in from 30 to 35 minutes a good coating of silver is deposited. Dr. Common has found a good deposit of silver to be equal to a thickness of $\frac{1}{25000}$ inch. The silver is found to be clearer, thicker, and more uniform, if the glass mould is dipped into a proto-chloride solution of tin, and then washed before being placed in the silvering bath; the action is supposed to be catalytic. The silver coating is thoroughly washed and then allowed to dry, and the silver which has been deposited is burnished bright with a piece of cotton wool and peroxide of iron, freshly precipitated by ammonia from a dilute solution of ferrous sulphate. The cost of silvering is found to vary from 2d. to 4d. per inch diameter.

(*To be continued.*)

SMALL SCREW GAUGE.

Report of the Committee, consisting of Sir W. H. Preece (*Chairman*), Lord Kelvin, Sir F. T. Bramwell, Sir H. Trueman Wood, Major-Gen. Webber, Col. Watkin, Messrs. Conrad W. Cooke, R. E. Crompton, A. Stroh, A. Le Neve Foster, C. J. Hewitt, G. K. B. Elphinstone, T. Buckney, E. Rigg, C. V. Boys, and W. A. Price (*Secretary*), appointed to consider means by which Practical Effect can be given to the Introduction of the Screw Gauge, proposed by the Association in 1884.

In the year 1882 a Committee of this section was appointed to determine a gauge for the manufacture of the various small screws used in telegraphic and electrical apparatus, in clockwork, and for other analogous purposes. This Committee reported to the section in the succeeding years 1883, 1884, and proposed that a certain system of screw threads, since known as the British Association screw threads, should be recommended for adoption by users of small screws in this country. The system is identical except in one small point with that used in Switzerland and associated with the name of Prof. M. Thury. The series consists of 26 threads, numbered 0·25, having diameters from 6 mm. down to ·25 mm., and is so closely graduated that only in exceptional cases can any size be required intermediate between two of the set. The form of the thread has proved to be well adapted for practical purposes, and screws made on this system have come into extensive use among English manufacturers of small mechanical apparatus. It has been adopted by several Government Departments, who have imposed its use upon their contractors.

In the year 1895 representations were made to the section, and some correspondents of the technical papers urged, that the value of this system was prejudiced by the fact that purchasers of British Association screws and screwing tools could not rely on obtaining from manufacturers goods which were interchangeable with one another. This raised at once a question which had not been closely considered by the 1882 Committee—viz., the mode of determining whether any given screw of a particular number is or is not a fair representation of the form laid down by the British Association specification. The present Committee were appointed at the Ipswich meeting to deal with this point, and with some additional members have sat at intervals up to the present time.

In 1896 an interim report was presented to the section at the Liverpool meeting, in which the problem of the mode of gauging small screws was discussed at length. The principal conclusion reached at that time was that as no means exists of examining a nut or female screw, the efforts of the Committee should be directed to obtaining accurate plug or male screws for use as gauges, and combs or chasers.

During the three years that have elapsed since this report was made the Committee have been in communication with different firms, and principally with the Pratt & Whitney Company, of Hartford, U.S.A., a firm enjoying the very highest reputation for work of the kind the Committee desired to secure. Finding that this firm were prepared to undertake the production of gauges and tools for the British Association screw-threads on the same lines as they have adopted with the American and Whitworth threads, the Committee have been satisfied to leave the matter in the hands of the company till they should ascertain whether they could produce the desired result, and have given them all the information, specifications, &c., that were possible. Within the last two months the Pratt & Whitney Company have submitted to the Committee specimens in hard steel of male and female gauge pieces of threads Nos. 3, 7 and 13. The three male screws of these sets have been photographed by Colonel Watkin on a large scale, and have been measured by Mr. H. J. Chaney, Superintendent of the Standards Department of the Board of Trade. Their two reports are printed below.

The Committee believe these gauges to be sufficiently accurate for practical requirements. The material of which they are made—hardened steel—should enable them to stand much use without injury. Their finish and general workmanship are exceedingly good.

The Committee, through their secretary, have expressed to the Pratt & Whitney Company their satisfaction with the progress made with these gauges, and have been informed in reply that a higher degree of accuracy may be expected in the future. They are still in correspondence respecting the specifications of limits of error and other details concerning their production on the commercial scale. The manufacture and sale of these gauges by the Pratt & Whitney Company appear to realise the object set before themselves by the Committee, viz., to assist the extension of the use of the British Association system of screw threads by making generally available accurate means for their verification.

While recognising the excellence of the form of the British Association screw-thread for mechanical purposes, the Committee feel strongly that the difficulty of producing the form to the degree of accuracy desirable for the best class of work, and especially for gauge pieces, is a serious drawback to its value. Colonel Watkin's photographs show very clearly that the best appliances in the most experienced hands that the Committee could find have failed to produce even single specimens of first-rate accuracy. The letters addressed to the secretary of the Committee by Mr. George M. Bond, manager of the standards and gauge department of the Pratt and Whitney Company, as well as the high reputation of his firm, leave no room for doubt that very great care has been taken to secure accuracy in these specimens. A considerable number of gauges made by English firms of good standing have been examined by the Committee, and have in every case shown errors of the same character as, though usually to a much greater degree than, the specimens submitted by the American firm.

From several sources, and especially in Mr. Bond's letters, it has been urged on the Committee that although the difficulties of constructing these gauges of a very high degree of accuracy are practically insuperable, screw-threads of a flat-anded form can be produced with great exactness. A photograph taken by Colonel Watkin of a fine screw taken from an instrument made by Messrs. Brown & Sharpe shows that this is certainly the case.

The American, or flat-ended, form of thread appears to be rapidly establishing itself in France and Germany, judging from the reports we have received of the French and Zurich Conferences, and we understand that it is entirely employed by the French Admiralty and by several of the French railway companies. These reports refer, it is true, to screws of larger sizes than are included in the range of the British Association and Prof. Thury's systems. The conclusions of the recent Conference at Zurich, which adopted the flat-ended thread, were expressly limited to screws of more than 6 mm. diameter, the extreme upper limit of our system. But so far as the easy production of accurate form is concerned, arguments which apply to large screws apply with greater force to small screws; while a form which is suitable for all screws above 6 mm. cannot be wholly unsuitable for screws below that limit. The Committee, moreover, were informed by one of their number, that he has used screws of the American form in sizes corresponding with some of the smaller numbers of the British Association series, and has found them perfectly satisfactory.

Current conceptions of the possible and desirable limits of accuracy in mechanical construction are rapidly advancing, and while we recognise the value of the work of the Committee of 1882 in establishing a generally accepted thread, we are dissatisfied with a standard form for a piece so important as a screw which is open to the serious objection referred to above.

We recommend that this Committee shall be reappointed for the purpose of considering whether the British Association form of thread for small screws should be modified, and if so in what direction.

APPENDIX I.

Report by Colonel Watkin, R.A., C.B.

The Wilderness, Woolwich,
July 11th, 1899.

The Secretary British Association.
Screw Gauge Committee.

I have now taken photographs of the screws sent by the Pratt and Whitney Company for the Committee, prints of which I enclose.

I find the general forms of these screws are better than those we have obtained heretofore, which is satisfactory, taking into consideration the fact that they are constructed of hard steel.

As in former cases, the larger sizes conform more nearly to the British Association pattern thread, the rounding in the smaller sizes being not quite so satisfactory.

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The angle of the thread in the two large sizes is about 49°, but considerably more in the No. 13 size.

As regards linear dimensions, all the screws are nearly perfect, as will be seen by the measurements given on the back of the photographs.

The diagonal scale accompanying the photographs was constructed from the scale photographed at the same time as the screws.

The gauges may, I think, be accepted as sufficiently correct for all practical purposes as standard gauges for British Association pattern screws.

(Signed) W. Watkin.

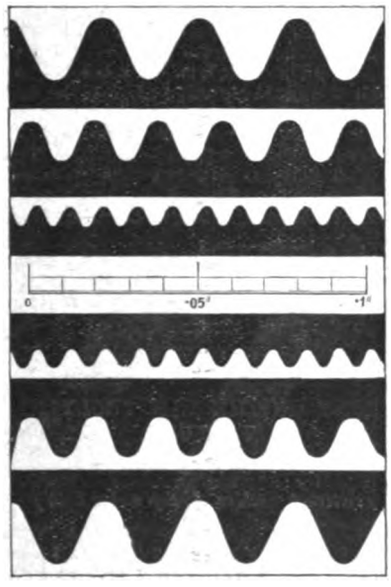

Fig. 1.—Reproduction of three Photographs referred to in Colonel Watkin's Report, superimposed on one another.

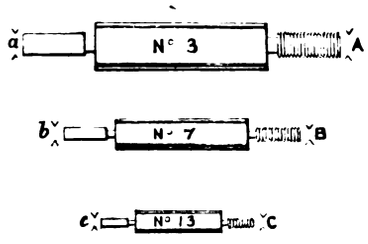

Fig. 2.

APPENDIX II.

Report from Mr. H. J. Chaney, Superintendent of the Standards Department of the Board of Trade.

Standards Department, Board of Trade,
July 10*th*, 1899.

My dear Sir,—I have now the pleasure to enclose, for the information of Sir William Preece, a statement showing the external dimensions of the three male screws which you forwarded to me on Thursday last, and which have been returned to-day by registered post. The dimensions were determined by contact comparisons (made by independent observers) of the screws with Board of Trade Standard cylindrical gauges, plane gauges, and wire gauges; and in the case of the smallest screw (c), by microscopic comparison with a linear standard.

Had time allowed, a more exhaustive examination of the three screws might have been made; but the present comparison may, I suggest, be relied on to ± 0·0001 inch. The dimensions given in the enclosed paper (4·1023 mm., 0·16151 inch, &c.) are in each case the mean external diameter of the whole length of the screw, and show that although A and C have perhaps appreciable errors, the required dimensions have generally been closely followed by Mr. Bond. The screw-threads are in fact, in our opinion, of excellent workmanship; but it is doubtful whether the screws are always perfectly cylindrical. For instance, the mean external diameter of the last eight threads of screw C (or the point of the screw) is 0·008 mm. greater than the external diameter of the 15 middle threads of C. The external diameter of the seven last threads (shoulder of the screw) of C agree in measurement with the diameter of the point of the screw.

I should much like to see a copy of Colonel Watkin's photographs.

Yours faithfully,

(Signed) H. J. Chaney.

W. A. Price, Esq.

Dimensions Specified.

A	...	...	4·1 mm.	= ·16141 inch.
a	...	...	3·224 „	= ·12693 „
B	...	...	2·5 „	= ·09842 „
b	...	...	1·924 „	= ·07575 „
C	...	...	1·2 „	= ·04724 „
c	...	...	·9 „	= ·03543 „

Screws Nos. 3, 7, 13.	Value in millimetres.			Value in inches.		
	Nominal.	Observed.	Difference	Nominal.	Observed.	Difference.
3 A ...	4·1	4·1023	+0 0·23	0·16142	0·16151	+0 00009
3 *a* ...	3·224	3·2304	+0 0064	0·12693	0·12718	+0 00025
7 B ...	2·5	2·5048	+0 0048	0 09843	0 09862	+0 00019
7 *b* ...	1·924	1·9273	+0 0033	0 07575	0 07588	+0 00013
13 C ...	1·2	1·2015	+0 0015	0·04724	0 04730	+0 00006
13 *c* ...	·9	9048	+0 0048	0 03543	0 03562	+0 00019

July 10*th*, 1899. (Signed) H. J. Chaney.

ELECTROLYSIS AND ELECTRO-CHEMISTRY.

Report of the Committee, consisting of Mr. W. A. Shaw (*Chairman*), Mr. E. H. Griffiths, Rev. T. C. Fitzpatrick, Mr. S. Skinner, and Mr. W. C. D. Whetham (*Secretary*), appointed to report on the Present State of our Knowledge in Electrolysis and Electro-Chemistry.

Section A.—September 15*th.*

The conductivity of a number of salts in very dilute aqueous solution at the freezing point of water has been determined by Mr. Whetham, while Mr. Griffiths has concurrently made observations of the freezing point for corresponding solutions. The observations of conductivity extend to solutions of sulphuric acid, potassium chloride, sodium chloride, barium chloride, copper sulphate, potassium permanganate, potassium bichromate, and potassium ferricyanide. The range of dilution is, speaking generally, from below the hundred-thousandth to about the twentieth part of a gramme equivalent per thousand grammes of solution.

The water used was specially distilled three times, and finally from a platinum still, and collected in platinum vessels. Its approximate conductivity was about $1·1 \times 10^{-15}$ at 18° C. in C.G.S. units. The best water obtained by Kohlrausch by distillation in vacuo had a conductivity of $0·2 \times 10^{-15}$ in the same units at the same temperature.

The results obtained this year, while confirming those described at the last meeting of the Association for solutions of moderate concentrations, show differences when great dilutions are reached, but the constancy of the present measurements shows that the water now used is good enough to enable trustworthy values to be obtained even at the lowest limits of dilution above mentioned.

Mr. Griffiths has remodelled his apparatus for determination of freezing points, and is now able to carry the measurements of temperature to a higher degree of accuracy than hitherto.

As soon as the observations are completed, it is intended to publish the results of both investigations together.

No further progress has been made with the rest of the report.

MUNICIPAL TRADING AND PROFITS.

By Robert Donald.

(*Read in the Economic Section, September* 15*th.*)

There should be no reason to object to municipal trading, from a commercial point of view, as the figures in a recent Government return show that an average annual profit on municipal water, gas, and electricity works, markets, tramways, and workmen's dwellings amounts to 4¼ per cent. on the capital invested.

The chief opposition to municipal trading last session of Parliament arose with electricity supply. It will be found that municipalities produce electricity at a lower cost and supply it at lower prices than do companies. A comparison between 21 municipal and 21 company undertakings, including in the latter the large London concerns and the companies of Birmingham, Leeds, and Sheffield, where the supply has been recently municipalised, gives the following result:—

Cost of production per unit—Municipalities, 1·87d.; companies, 2·71d. Average price per unit to consumer—Companies, 5½d.; municipalities, 4½d. Profit on mean capital—Companies, 7½ per cent; municipalities, 7¼ per cent.

Thus, municipalities produce electricity at ⅞d. less per unit than companies, sell it at 1d. less per unit, and earn only ¼ per cent. less profit.

Municipalities as a rule supply gas of a higher illuminating power than companies, and at a lower price. A comparison between a representative number of municipal and privately managed gas works shows that the average price of the municipal gas is less by 3d. per 1,000 cubic feet, the candle-power is higher, and the average profit on capital employed only 1 per cent. less than that obtained by companies.

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The direct operation of tramways by corporations has been done under easy conditions as regards capital expenditure, and has at once led to increased traffic. There has been a readier response to public demands, a reduction of fares, and better treatment of employés—all of which have combined to make municipal tramways very successful from a business point of view.

Municipal trading compares well with private enterprise. But it is not enough to show profits from municipal trading, as it is suggested that municipalities have no business to make profits. These are chiefly the people who would like the profits for themselves. But there are other reasons, based on economical grounds, why the aim of municipalities should be to provide the cheapest services at cost price rather than seek profit. The system of relieving general local taxation out of the surplus revenues of gas, water, tramway, and other undertakings has been necessary in order to demonstrate the business capacity of municipal bodies; but the policy is not one which best serves a community. When a town draws profit from gas, water, or electricity supplies, it is simply levying so much direct taxation on the users of these commodities for the benefit of the general community. The consumers might justly say that since the municipality became the sole providers of gas and electricity it deprived them of the advantages of competition, and should supply the cheapest possible article.

Whether municipalities should make a profit is left largely to their own discretion. It is becoming the practice not to make trading profits from water supply, and only a small margin of profit is sought on artisans' and labourers' dwellings and lodging houses. The practice of Parliament tends towards restricting profits. Profit from electricity supply works, for instance, is limited to 5 per cent. All surplus above that should be devoted to reducing charges. In Scotland, profit-making in connection with water or gas supplies is rendered impossible by the General Acts, which provide that surpluses go to reduce charges. No town has advanced so far in municipal organisation as Glasgow, and no town stands higher for the efficiency of its administration or the civic spirit of its citizens; and nowhere else, taken all round, are charges for municipal services so low; nor has any other town carried out so systematically the policy of little profit.

It will be found that in the towns where the civic spirit is the keenest and healthiest, where municipal institutions are most largely developed, there the profit sought is least and the administration is the best.

RADIATION FROM A SOURCE OF LIGHT IN A MAGNETIC FIELD.

Preliminary Report of the Committee, consisting of Prof. George Francis FitzGerald (*Chairman*), Thomas Preston (*Secretary*), Prof. A. Schuster, Prof. O. J. Lodge, Prof. S. P. Thompson, Dr. Gerald Molloy, and Dr. W. E. Adeney.

(*Section A—September 15th*)

The work undertaken by this committee has not yet terminated. This occurs partly from the difficulties which arose in obtaining a satisfactory supply of electric current with which to excite the powerful electro-magnet now in the hands of the committee, and partly from the circumstance that the secretary was not always free to work at such times as the staff of the Royal University found it convenient to permit research work in the Physical Laboratory.

Considerable advance has been made, however, during the past session, and the magnetic perturbations of the spectral lines of several substances have been observed and photographed from one end to the other of the spectrum. A considerable amount of work remains to be done in this direction still, and this we hope to complete in the near future.

The chief points of interest determined by the committee since its appointment are as follows:—

1. On Friday, September 9th, 1898, Prof. S. P. Thompson attracted the attention of the British Association (see "Brit. Assoc. Report, 1898," p. 789) to an elegant experiment devised by Prof. Righi for the purpose of illustrating the absorption of light in a magnetic field. This experiment was stated by Prof. Righi to succeed only when the light traversed the field along the lines of force, but it appeared to us from theoretical considerations that similar absorption should also take place when the light traverses the field across the lines of force. On trying the experiment on the following Tuesday (September 13th, 1898), it was found at once that the experiment was capable of demonstrating absorption across the lines of force * as markedly as that ascertained by Prof. Righi along the lines of force. This result was also ascertained subsequently, and independently, by M. Cotton.†

2. The next point of interest consisted in placing beyond doubt that the various modified forms of triplet, that is the quartets, octets, &c., are not produced by reversal or any other extraneous cause, but are true magnetic perturbations of the same kind as the normal triplet, which is to be expected from the simplest theoretical considerations. An account of the experiments by which this was determined will be found in the *Philosophical Magazine* for February, 1899, (*Phil. Mag.*, Vol. xlvii., p 165).

In pursuing this inquiry it was found that in a very strong magnetic field the quartets ultimately became resolved into sextets, the side lines of the quartets splitting up into pairs and separating as the strength of the field gradually increased.

These quartet forms, and various other types of perturbation, were observed by Mr. Preston in the beginning of November, 1897, and were shown at the following meeting of the Dublin University Experimental Science Association. Subsequently the quartet form (which we have now proved in the cases observed to be really a sextet) was independently observed by M. Cornu* and others.

3. Finally, from the various observations of the character and measurements of the amount of the magnetic effect experienced by the various spectral lines of several substances, a general law has been inferred concerning the effect, which may be stated as follows:—†

1. The spectral lines of a given substance may be divided into groups such that all the members of one group suffer the same kind of perturbation in the magnetic field, but the kind of perturbation of all the members of another group is different. Thus, for example, in the series of triplets of zinc, the first of one triplet is similarly affected to the first of each of the other triplets, while the second of one triplet is affected in the same way as the second in each of the other triplets, but in a different way from first and third of the triplet. Hence the series of firsts of each triplet constitute a group all the members of which are similarly affected, and the series of seconds and thirds are other such groups.

2. The character of the effect is the same in the corresponding lines of the spectra of chemically related elements. Thus, the triplets of cadmium are affected in the same way, both as regards the character and the magnitude of the effect, as are the triplets of zinc.

3. In any one group the magnitude of the effect is inversely as the wave-length of the line.

Further information will be found in this connection in the *Philosophical Magazine*, Vol. xlvii., p. 165, February, 1899, and the *Phil. Trans. Royal Dublin Society*, Vol. viii., Series II., p. 7, 1899.

* See *Nature*, lix, 228-9, January, 1899.
† *Comptes Rendus.*

ON THE THEORY OF THE ELECTROLYTIC SOLUTION PRESSURE.

By R. A. Lehfeldt.

(*Abstract, Section A, September 15th*)

According to Nernst's theory, when a metal is immersed in an electrolyte, a minute amount of it goes into solution in the ionic form, giving a positive charge to the liquid as compared with the metal, or ions from the solution are deposited in metallic form, giving the metal a positive charge according as the osmotic pressure of the ions in solution falls short of, or exceeds an amount known as the electrolytic solution pressure. This view has been generally adopted by physical chemists, it being supposed that the amount of metal to be deposited or dissolved is too small to measure. By combining the calculated value of the solution pressures with the known theorems of electrostatics on the tension exerted by electric charges, it may be shown, in the case of zinc at least, that the amount dissolved would be some centigrammes per square centimetre immersed, and could easily be weighed. Hence the theory seems to break down.

ON THE PRODUCTION, IN RAREFIED GASES, OF LUMINOUS RINGS IN ROTATION ABOUT LINES OF MAGNETIC FORCE.

By C. E. S. Phillips

(*Abstract, Section A, September 15th*)

The apparatus used in this investigation consisted of an approximately spherical glass bulb, the ends of which were left open for the purpose of inserting two soft iron electrodes, half an inch in diameter, through air-tight flanges which themselves were cemented to the glass. The bulb was about 2½ inches in diameter, and the electrodes were chosen of a sufficient length to enable them, while almost meeting at the centre of the bulb, to project outwards slightly beyond the rims of the flanges. A side tube was attached for the purpose of connecting the apparatus to a Sprengel air-pump and McLeod vacuum gauge. Two powerful electro-magnets were then adjusted, so as to strongly magnetise the electrode when necessary.

A low pressure having been produced in the bulb by the action of the air-pump, leading wires were attached to the iron electrodes to enable the discharge from the secondary of an induction coil to be passed through the rarefied gas. Under these conditions the effects produced in the usual glow-discharges by the magnetisation of the electrodes could be conveniently examined. It was seen that at a pressure represented by ·008 mm. of mercury, and with the discharge just able to pass in the bulb (the magnets meanwhile remaining unexcited), on shutting off the current from the induction coil and completing the magnet circuit, a luminous ring appeared within the bulb in a plane at right angles to the lines of force and in rotation about the magnetic axis. The number of such rings can be varied by special devices, and their brightness largely depends upon the electrostatic condition of the outer surface of the glass bulb. The circumferential speed of the ring or rings rapidly dies down, and the sense of the rotation reverses when the magnetic polarity of the electrodes is reversed. The rings, when once formed, usually last for many seconds, sometimes for a minute; and they momentarily brighten before disappearing, when the electrodes cease to be magnetised. The appearance of the rings is greatly affected by bringing charged bodies up to the outside of the bulb.

* *Comptes Rendus.*
† This law was published in *Nature*, lix., 248, January 12th, 1899.

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The effect also depends upon the manner of stimulation of the rarefied gas within the bulb. It is necessary to obtain a particular distribution of charged particles in order to get the best results when the magnet is excited. The shape of the magnetic field is also of importance. A single magnetic electrode projecting into the electrified gas shows the effect fairly well. Experiments with external magnetic electrodes have not given reliable results, the glow produced in such cases being generally irregular. An attempt will be made later on, when the experiments are more complete, to show that the formation of these luminous rings is associated with actions observed by the writer in connection with a separate research, the results of which were embodied in a note communicated to the Royal Society last June under the heading "Diselectrification produced by Magnetism."

DURBAN CORPORATION TRAMWAYS.

DURBAN is a little one-horse show in Natal. Its population is 40,000 and, at this, one half is native or coloured. Yet Durban is better placed than London, for it possesses apparently a City Council of infinitely greater intelligence, and it employs three men of decision to advise it as regards its electrical tramways. These three men are the borough engineer, Mr. J. Fletcher; his assistant, Mr. Crawford Lindesay; and the electrical engineer, Mr. John Roberts. The latter two were deputed to come home and examine tramways in England and America. They did so. They came and saw and went back to their one-horse little town, and they reported strongly in favour of an electrical system with overhead construction. Evidently Durban had instructed them that better tramways were wanted, and they were desired to go forth and find the best system.

They report like men. There is no evidence whatever that these men have acquired the professorial art of sitting on a fence. They don't say two things at once, so that in 10 years' time they can gracefully point to their report and say, "We told you so." But they study the question thoroughly and come to a firm decision and put this down like men in plain black and white, and their report jointly with that of the borough engineer—another man—makes over 100 pages of sound, healthy reading. They have seen innumerable electrical tramways and have got such a grip and insight of their subject as seems to show that their visit home was really intended as a means towards providing Durban at once with the best present system of tramways. If Durban does not follow the advice of its three engineers, no blame can attach to the engineers.

The authorities of Durban cannot go to the public and say "our engineers have advised us to adopt an impossible system." Now in this our City and County of London, our unfortunate County Council having first made up its mind to hinder all progress of a useful order, had no difficulty in getting an engineer to report to them on American tramways, and Prof. Kennedy, having acquired a thorough knowledge of that little country, the United States, during a prolonged visit of a fortnight, issued his report. We have published this report, and would refer our readers to it. We wish we could publish that of these Durban engineers, because there is something to learn from it. One particularly striking passage occurs. It is a reference to the obstructive action of English authorities. Clearly these travelling engineers are the servants of a more progressive municipality than most of our English towns possess. They condemn also the unnecessary ugliness of American poles and overhead work. They advise top seat cars which they have seen in England run on steeper gradients in Halifax and Bradford than the maximum grade which obtains for only a short distance in Durban, viz, 1 in 13.

We consider this report to be a masterly production, and one of the kind that ought to be submitted to the more or less non-technical councillor. There is not an overburden of argument, but sufficient to justify the very definite conclusions arrived at. The council has been provided, not with a dilettante discussion on vague generalities, but with plain straightforward advice from its advisers. Evidently, in South Africa, the use of an adviser in technical matters is to clear the ground and settle the minds of the authorities and pave the way for progress, not to throw a halo of fog round the subject and suggest possibilities, probabilities, and impossibles. The engineers might have advanced some pet scheme of their own, but they have advised what can be best bought in open market, and have not saddled their ratepayers with unnecessary expenses, to the ruin of all progress.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

17,815. "Improvements in direct acting electric generators and in directly driven electric compressors for air or other gases." J. ATKINSON. Dated September 4th.

17,846. "Improvements in or connected with electric motors and generators and other electric apparatus and instruments." V. A. FYNN. Dated September 4th.

17,857. "Improvements in galvanometers and electrical indicating and signalling apparatus." A. W. TOURNAY-HINDE. Dated September 4th.

17,877. "An improved composition of or from which may be manufactured tubes for various purposes, tyres and other articles requiring more or less flexibility, or as a non-conductor of electricity." G. BESTWICK. Dated September 5th.

17,878. "An improved composition of or from which may be manufactured billiard balls, handles for umbrellas or sticks, electric buttons and other articles of a like nature and general utility, and as a substitute for mica." G. BESTWICK. Dated September 5th.

17,924. "A new or improved process and apparatus for electrolytically precipitating metals in the cementation vats." A. ROVELLO. Dated September 5th. (Date applied for under Patents, &c., Act, 1883, Section 103, March 16th, being date of application in Italy.)

17,938. "Electro-medical batteries." C. J. MARIUS. Dated September 5th. (Complete.)

17,939. "Improvements in electric rock drills." G. BARKER. (S. Lescm. United States.) Dated September 5th. (Complete.)

17,953. "Improved means and appliances connected with air tight electric arc lamps." J. J. RATHBONE. Dated September 5th.

17,993. "Improvements in electrical switches." B. THOMAS. Dated September 6th.

18,005. "Improvements in secondary galvanic batteries or accumulators." R. N. LUCAS and E. S. NEW. Dated September 6th.

18,013. "Improvements in field magnet cores for electric motors or generators of enclosed type." H. W. WILSON. Dated September 6th.

18,014. "A new and improved apparatus for the intermittent lighting of electric lamps or groups of lamps for advertising purposes and the like." W. J. PARTRIDGE, F. T. LOVE and C. T. POUNSFORD. Dated September 6th.

18,028. "Improvements in electrical switches." G. W. HOLT and A. ATHERLEY. Dated September 6th.

18,040. "Improvements in or relating to telephone speaking tube and like receivers." H. A. CUTMORE. Dated September 6th.

18,064. "Improvements in electric trolley standards." C. W. G. LITTLE and A. J. IRELAND. Dated September 7th.

18,094. "A coin-freed electricity meter." G. A. MAQUAY. Dated September 7th.

18,100. "Improvements in electrical batteries." R. PEARSON. Dated September 7th.

18,124. "A new or improved method and means for electrically illuminating advertising signs and the like." F. M. STAUNTON. Dated September 7th.

18,181. "Improvements in electric arc lamps." P. MERSCH. Dated September 7th.

18,132. "Improvements in clocks, more particularly in electric winding mechanism therefor." F. I. GETTY. Dated September 7th.

18,138. "Improvements relating to electrical resistance boxes and like apparatus." T. E. GAMBRELL and C. T. GAMBRELL. Dated September 8th.

18,143. "An improved conical shaped collar reflector for the incandescent electric lamp by means of which the light is reflected and diffused and advertisements displayed." C. BUCKTON, G. E. FLETCHER and H. FLETCHER. Dated September 8th.

18,152. "Improvements in automatic telephone exchanges." W. AITKEN. Dated September 8th.

18,173. "Improvements in telephonic systems and in apparatus therefor." M. BYNG and F. G. BELL. Dated September 8th. (Complete.)

18,200. "Improvements in or connected with ships' telegraphs." D. KENNEDY. Dated September 8th.

18,254. "Improved construction of accumulator plates." E. T. A. POLZIN. Dated September 8th.

18,266. "Improvements in electrical resistance and heating apparatus." S. BRAMALL and J. T. ARMSTRONG. Dated September 9th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

2,108. "Improvements in and connected with electric arc lamps." J. O. Girdlestone and C. F. G. Thorkelin. Dated January 26th, 1898. Consists in a central tube passing into the body of the lamp and containing the upper carbon holder which slides on rollers in this tube. 4 claims.

3,316. "Improvements in a self-restoring annunciator more particularly suitable for employment in connection with telephone switchboards." J. E. Kingsbury and the Western Electric Company. Dated February 9th, 1898. Consists in combining an annunciator drop with perforated parallel plates supporting the drop at each end. 6 claims.

7,193. "Improvements in or relating to primary batteries for producing electric currents also applicable for the purification of water." A. J. Boult. (J. Corpaux and Wilbaux.) Dated March 24th, 1898. Relates to improvements in primary electric batteries. The polarising liquid is rain or salt water. Consists in a combination of a column of broken graphite in contact with conducting bodies and surrounded by a fabric jacket with a sectioned zinc cylinder, the column and the cylinder being maintained at the desired distance apart by two covers of non-conducting material. The covers have recesses to fit the fabric jacket. 8 claims.

7,575. "Improvements in electric furnaces for manufacturing calcium carbide." W. P. Thompson. (C. L. Wilson, C. Muma, J. W. Unger, H. Schneckloth, A. P. Brosius, and J. C. Kuchel.) Dated March 29th, 1898. Consists of a hollow electrode having at its upper end an insulator which is provided with openings to communicate with the openings in the electrode. Means are provided for raising or lowering the electrode and insulator so that it may be fed by hand. 2 claims.

7,725. "Improvements in holders for incandescent electric lamps." J. M. Huisman and H. C. Gover. Dated March 31st, 1898. Relates to holder for incandescent electric lamps. The holder is well insulated and has two spring push contacts. 1 claim.

9,047. "Hanger for trolley wires of electric railways." W. A. McCallum. Dated April 19th, 1898. Relates to hangers used to suspend the ears carrying the trolley wire from the cross wires. Consists in providing the hanger cap and the point of the insulated bolt with oppositely cut threads, also the inner surface of the hanger cap and the upper surface of the insulated bolt with suitable indentations and interposing between them compressible washers. 2 claims.

16,155. "Improvements in the globes of electric incandescent and similar lamps and lamp shades or chimneys." English Industrials Ltd., and G. E. H. Dia. Dated July 25th, 1898. Consists in moulding the inner surface of the glass object on the prismatic principle, i.e., with prisms arranged in hexagonal groups over the entire surface. 3 claims.

16,876. "Improvements in electricity meters." E. Schattner. Dated August 4th, 1898. Consists in the employment of a pivoted balanced lever in connection with a voltmeter of some suitable type, the passage of the current through the

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voltmeter being arranged to alter the weight upon one end of the lever so that the amount of current consumed may be found by obtaining by a moving weight a balancing point for the lever, such point being read off on a suitably situated scale. 3 claims.

17,289. "Improvements in electrically driven fans or ventilating devices." S. Bergmann. Dated August 10th, 1898. Relates to an electrically driven fan so constructed that the driving electromotor is rotated around a vertical axis by the reaction of the air whereby a second set of vanes is set in motion and a more active churning of the air is effected. 3 claims.

21,241. "Improvements in telephone switchboards." F. M. Richter. Dated October 8th, 1898. Relates to telephone switchboards. Consists in lifting or returning and re-engaging the annunciator flap. The flap falls down at a call and the operator inserts a plug in the sleeve and raises the flap by the thrust against a lug and it is held by the armature. Simultaneously a contact spring is lifted from another. After the conversation the subscribers make contact for energising the electro-magnet, thus again releasing the flap. The operator then pulls the plug out and the flap is raised in the same way as when the plug was inserted. 1 claim.

21,841. "Improvements in the armatures of multipolar dynamo-electric machines." Siemens Bros. & Co., Limited. (R. Dumas and G. S. Grimston.) Dated November 1st, 1898. Relates to construction of the armature and means in fixing the core plates in such a manner that they are held firmly in opposition to the centrifugal force when the armature revolves at high speed. The core plates are fixed to the arms of the armature by making the arms with laterally projecting dovetails radially dividing the arms engaging on them the dovetail notches of the core plates. The divided arms are widened out by driving wedge keys between the divided parts. 2 claims.

21,843. "Improvements in electrical contact breakers." R. Haddon. (Allgemeine Electricitäts Gesellschaft.) Dated October 18th, 1898. Relates to mercury contact breakers where the conductor is fixed and the mercury is given the required movement. The conductor has the form of a ring or cylinder and is provided with one or more slots at its lower edge. Against this part of the conductor a stream of mercury is excited rotating round within the ring. The mercury ejection is obtained by the rotation of a tube bent at right angles, one arm of which is vertical and lies in the centre of the ring and dips into the mercury, whilst the other, which is horizontal, rotates round and on the former. The slotted ring and this horizontal tube lie in an insulating liquid with which the mercury is covered. As soon as the speed of rotation has reached a certain point, the mercury is drawn up by the centrifugal force created, and is ejected through the horizontal arm. When the metal ring forms one pole and the mercury the other of a conduct, the circuit is alternately interrupted and closed. 4 claims.

22,086. "Improvements relating to conductors and collectors for electric railways." C. H. Myers. Dated October 20th, 1898. Relates to improvements in electric railways. In combination with the conductor rail is a sectional boxing arranged to partially enclose the rail and having its side movable away from said rail and means for locking the sides of the boxing in place. The boxing has a slot to allow the trolley traveller to have access to the conductor rail. 7 claims.

22,901. "Improvements in electric arc lamps." The British Thomson-Houston Company, Limited. (H. C. Spinney.) Dated October 27th, 1898. Relates to improvements in the construction of arc lamps. Consists of a combined cap support and floor for a clutch, also means for maintaining it at a fixed distance from the lamp mechanism, and means for permitting the support to have practically a universal motion for the purpose of adjustment. 15 claims.

22,983. "Improvements in couplings for electric conductors." The British Thomson-Houston Company, Limited. (F. E. Case.) Dated October 28th, 1898. Consists in making a half-lap joint of the two ends of the conductor, and fixing them together by screws in long holes or slots. 4 claims.

22,984. "Improvements in plug switches or wall contacts for electric circuits." A. Vandam and T. H. Marsh. Dated November 1st, 1898. Relates to plug switches having concentric terminals. Consists of an insulating piece composed of an inner tubular portion and an outer partially tubular portion provided with projections for supporting a fuse wire. 2 claims.

23,243. "Improvement in and relating to electric accumulators." P. Ribbe. Dated November 4th, 1898. Relates to a rib plate for accumulators. In the plate are cross ribs standing at an oblique angle to the surface of the plate and issuing on both sides, from a core plate which runs through it. 2 claims.

23,845. "Process for obtaining an electrolytic deposit of metallic films on aluminium." O. T. Hanhardt. Dated November 8th, 1898. Relates to a process for obtaining an electrolytic deposit of metallic films on aluminium, and the main object of it is to prevent the bath from attacking the aluminium, and thus to obtain a good and throughly adherent coating or film upon its surface. The baths employed have eliminated from them the caustic or acid properties which attack the aluminium by neutralising such baths by adding to them derivatives of phosphorus, and more particularly by a proportionate addition of ammonium phosphate. 1 claim.

23,718, "Improvements in or relating to secondary or storage batteries." R. Haddon. (C. J. Miller). Dated November 10th, 1898. The plates are stamped to form the recesses. Consists of an insulating cell containing two metallic electrodes each of which comprises an inner metallic core adapted to receive and retain the active material, perforated metallic envelopes surrounding said core piece. These envelopes have mechanical and electrical contacts with either respective cores, and a perforated insulating piece between the envelopes of respective electrodes. 18 claims.

24,171. "Improvements in voltaic cells having dry plates which may be regenerated." H. Schloss. Dated November 16th, 1898. Relates to voltaic cells the plates of which are saturated with sulphuric acid and then dried so as to form the electrolyte when water is added. Consists in applying a coating of water glass to the surface of the plates as a protection against damp. 1 claim.

1899.

88. "Improvements in supports or crossovers for overhead electric conductors." J. M. Anderson and A. Anderson. Dated January 3rd, 1899. Relates to electric conductor supports for overhead conductors. Comprises an insulating disc provided with a circular slot, a plurality of conducting arms extending from the disc and provided with projections to engage the slot and means for securing them to the disc. The arms are suitably insulated. 8 claims.

101. "Electrodes for storage batteries." T. A. Willard. Dated January 3rd, 1899. Relates to electrodes for accumulators. Consists in having a tubular electrode open at both ends and having leaves uniform in cross section and uniformly spaced from each other running spirally up it. 4 claims.

102. "Means for producing battery electrodes." T. A. Willard. Dated January 3rd, 1899. Relates to a machine which will make leaves from the surface of metal plates. Consists of a table and means to support and lock a flat plate to the table, a sharp edged cutter having its cutting edge at an angle to the plane of the plate and gradually deepening from front to rear and means to operate the cutter on the plate at varying distances apart at fixed intervals. 6 claims.

287. "Improvements in cooling appliances for alternating current and rotary phase current motors." Siemens Bros. & Co., Limited. (Siemens & Halske, Aktien-Gesellschaft.) Dated January 5th, 1899. Consists of combining with the end surfaces of the motor casing and guiding shields arranged to operate in conjunction with fan blades at the end surfaces of the rotor so as to produce air currents directed radially outward from the central air inlets which keep the whole apparatus cool. 2 claims.

826. "Improvements in or connected with telephonic instruments." A. L. Baird. (T. Barnet.) Dated January 10th, 1899. Relates to improvements in apparatus for recording the duration of time the telephone is used by the subscriber. The lever switch of the telephone is connected with a clock or other mechanism which will be inoperative when the telephone is in use. The up and down movement of the lever switch winds up the clockwork, thus making it automatic. 7 claims.

907. "Improvements in transmitting printed telegraphic messages." A. Silberman. Dated January 14th, 1899. Relates to printing telegraphic messages. Consists of apparatus comprising a system of toothed printing and stop wheels which on receipt of impulses of current of either kind the letter to be printed comes opposite an electro-magnet so that on a further impulse of current being sent, whilst the whole system is at rest, the letter is impressed, the system then automatically reassuming its original position. 6 claims.

925. "Rotary converters for single-phase alternating currents." M. Deri. Dated January 14th, 1899. Consists of a rotor like a continuous current dynamo armature connected on the one hand with a collector, on the other hand with contact rings, and rotating within an iron stator provided with short circuit winding and also with exciting windings to produce by means of continuous current a constant magnetic field, which by co-acting with the armature keeps the armature in synchronous rotation. 2 claims.

1,208. "Improved system of conduits for the underground conductors of electric railways." A. Sterze. Dated January 18th, 1899. Relates to the conductor for rail traction. Consists of a rail with an internal chamber containing the conductor, consisting of two parts; a simple rail having a wide basis with grooves and openings for the flowing out of water and the discharge of filth and a piece provided with ebonite bearings and binding screws to support the conductor. There is small opening between rail and piece to allow the passage of the rod connected to the motor. 2 claims.

1,282. "Process and means for transforming electric currents." H. P. J. J. Thomsen. Dated January 18th, 1899. Relates to improvements in transformers. Consists of an accumulator battery having groups of cells arranged in series is connected by shunt circuits from each group to a suitable commutator so that the elements come into action successively, either separately or in small numbers, and thus produce a current of correspondingly low tension obtained in succession from the whole set of batteries. 8 claims.

1,324. "Improvements in and in the manufacture of electrode plates for electric accumulators." W. P. Thompson. (The Accumulatoren und Elektricitäts-Werke, A. G. Verm, and W. A. Boese & Co.) Dated January 19th, 1899. Relates to electrode plates having as large a lead surface as possible and a very effective arrangement of the active mass and electrolyte. The plates are made with small flat formations of triangular shape placed alternately with their flat sides to one another in such a way that the points may in some cases be truncated, correspond to a similar position of the bases of the next layer, and when placed side by side present a latticed work or grid. 2 claims.

1,334. "Improvements relating to electrically illuminated signs or advertisements." W. L. Campbell. Dated January 19th, 1899. Consists of combining electrically illuminated signs or advertisements and the circuits thereof, and the automatically rotated snail cam or its equivalent, the peripheral contact it carries, and in constant electrical connection with the source of current, and a series of contact springs which illuminate the advertisements on the side of their particular box as the cam revolves. 5 claims.

1,883. "Improvements in and relating to arc lamps." J. Meixner, F. Haffner and M. Koch. Dated January 24th, 1899. The object of the invention is to provide a combined lamp and motor, the motor to drive a fan. Comprises lamp mechanism, a motor, an electric switch, electric connections for the motor and lamp, having in their circuits electric contacts and a switch lever provided with contacts so arranged that either the motor or lamp can be used alone or together. 20 claims.

2,174. "An improvement in commutator brushes for electrical machines." Siemens Bros. & Co., Limited, and A. Siemens. Dated January 31st, 1899. Relates to the construction of commutator brushes. The brush is made in one or more sections fitted in a suitable frame. Each section is pressed by an adjustable spring on the commutator and separately removable from the frame. 1 claim.

2,176. "Appliance for automatically regulating the frictional pressure on the rails of the driving wheels of electrically propelled vehicles." Siemens Brothers & Co., Ltd. (Siemens & Halske Aktien Gesellschaft.) Dated January 31st, 1899. The frictional pressure is obtained by means of an electro-magnet included in the circuit of the motor, so that the pressure is regulated by the strength of the current working the motor. 2 claims.

2,266. "Improvements in or relating to accumulator plates." P. F. Ribbi. Dated February 1st, 1899. Relates to an accumulator plate in which the active material is inserted in a perforated lead plate and is prevented from falling out by insulating plates covering the lead plates. 2 claims.

2,298. "Improvements in the manufacture of electric accumulators or secondary batteries." J. G. Hathaway. Dated February 1st, 1899. Consists in grouping two or more couples, each comprising a positive electrode active material arranged between them, and a porous support, a negative electrode and active material arranged between the same and a temporary support destructible by the acid and then rendering the negative active material self-supporting by "forming" the battery before the supports are destroyed. 6 claims.

2,825 "Improvements in electric switches." C. Furer, M.D. Dated February 2nd, 1899. Relates to contact making and breaking switches. The switch consists of a double lever of insulating solid material carrying at one end the connecting and at the other the disconnecting button and also a thin wedge-shape insulating tongue which in one action is pressed between the contact springs and in the other drawn out. The whole switch is covered with an elastic covering on which you press to actuate the switch. 3 claims.

2,368. "Improved arrangement for exciting the magnets of dynamo electric machines." M. Deri. Dated February 2nd, 1899. Relates to Specification 15,203, 1898. Consists in providing the periphery of the field magnets presented to the armature with compensation coils that are as uniformly arranged as the armature windings for the purpose of preventing sparking. 1 claim.

2,390 "Improvements in and relating to the fixing of insulators for carrying electric line wires." H. Fleischhacker. Dated February 2nd, 1899. Relates to the fixing of insulators for the purpose specified. Consists of improvements in the stem or holder of such insulators by means of which they may be fixed into stone, brick, or other walls with less likelihood of their becoming detached therefrom through oxidation of the stem. 1 claim.

2,654. "Improvements in electric switches." E. L. Joseph. Dated February 6th, 1899. Consists of a pivoted arm carrying a contact-piece adapted to make contact with two conductor terminals and acted upon by a spring in such manner that the contact piece is moved into and held in the open position at such a distance from the terminals as will effectually prevent sparking. 3 claims.

2,746. "Improvements in conduits for electric wires or cables." E. H. Callaway. Dated February 7th, 1899. Consists in making the conduits of baked clay joined by couplings of the hollow cylindrical type, and the whole is enclosed in a casing for protection. The conduits are exhausted of air. 4 claims.

2,826. "Signals to indicate the approaching exhaustion of the carbons in electric arc lamps." E. A. Clarement and F. H. Royce. Dated February 7th, 1899. When the carbons are nearly exhausted the machinery of the lamp makes an electrical contact which causes a visible signal to operate. 6 claims.

2,956. "An improvement in apparatus for controlling electric motors." Siemens Bros. & Co., Limited, and J. G. Wilson. Dated February 8th, 1899. Relates to Specification No. 12,088, 1897. Consists in combining with the revolving commutator controlling electric motors described in the above specification, sparking switches revolving with the commutator. 1 claim.

2,971. "Improvements in arc lamps." H. J. Bagley. Dated February 10th, 1899. Consists of an arc lamp produced in a vacuum or neutral gas which is produced in the same way as in incandescent globes. 1 claim.

2,994. "Improvements in and relating to electric arc lamps." P. Rzepka. Dated February 10th, 1899. Relates to a protection for the carbon holders against the arc when the carbons are consumed. Consists of a refractory ring or collar attached to one or both of the carbons. The rings are in two halves and are clipped together by a spring clip. 1 claim.

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THE

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ELECTRICITY IN H.M. NAVY.

WE suppose that to practical electrical engineers the paper by Mr. Alexander Siemens, and the subsequent discussion thereupon, were as interesting as anything electrical which came before the Dover meeting of the British Association. Both of these are printed in another column of this issue. The section was indebted to Mr. Siemens for bringing forward the subject of electrical machinery on board ship in the presence of the president, Sir Wm. H. White. If the paper had only been read expressly for the purpose of securing from the Admiralty's chief constructor a statement on the question in its bearing upon modern naval equipment, Mr. Siemens would deserve our gratitude. The author gave Sir W. White an opportunity to clear up certain doubts which have existed in some minds as to the wisdom of our Government construction policy of allowing electrical applications to take a secondary place on board our world-renowned battleships, and Sir William showed no reticence in disclosing what was the real policy adopted, nor did he hesitate to defend himself and his subordinate officials for the views which are held by them on this matter. The mistaken notion that Americans were first in the field with direct-driven generating sets was referred to. That this is far from being true is proved by merely mentioning the ridicule to which engineers who adopted direct coupling were subjected when they first placed several such sets on show at the Chicago Exhibition. One of Mr. Siemens's strong points in favour of the adoption of electricity for power purposes in marine vessels was the small amount of space occupied by electric transmission wires, as compared with hydraulic or steam pipes. These pipes might, or did, cause considerable trouble—leakage at the joints—a statement traversed both by Sir Frederick Bramwell and Sir W. H. White. Mr. Siemens's rejoinder on this point was particularly happy, and was fully appreciated by his hearers. If the pipes did not cause trouble by leaking, then they did by freezing. All precautions to prevent trouble occupy space, and no one will attempt to deny the extreme importance of space on modern vessels. Mr. Siemens exploded the suggestion that the Heilmann "central station on wheels" system could be applied to marine propulsion, and he dismissed the suggestion of accumulator propulsion by a calculation that a 6,000-ton vessel would require 40,000 tons weight of accumulators to take it across the Atlantic. This calculation was, of course, only made for the sake of introducing pleasantry. No one would have any doubt as to the sanity of any man who came forward at the present juncture with a proposal to employ accumulators in this way on the high seas.

We may not, perhaps, all agree exactly with the very slow progress which seems to have characterised the employment of electric motors on British naval vessels, and we must confess that the policy of caution, and slow but sure progress,

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which was defended by Sir William, is that which has held us back in many other directions, although it may perhaps have been beneficial in the long run.

Foreign countries may make their sweeping revolutions in the power employed for both heavy and light work on warships, but British Admiralty officials having found hydraulic power so very reliable are wedded to it, at least as regards heavier work and for the time being. Sir William was very enthusiastic in his praise of hydraulic power, because it has been well tried, and is considered absolutely reliable; but he desires it to be known that he does not overlook the extreme convenience and other advantages which will result from the adoption of electricity. Electricity is used in our Navy for various purposes at the present time, but only for the lighter duties—the heaviest gun handled by electric power is that of a 9·2-inch calibre, but Sir Wm. White bids us be encouraged by remarking that electrical power having proved its practicability and convenience for that size, will go on to be tried for larger sizes, so that in time the progress for which we are all hoping will be made. We cannot help, as Englishmen, having great respect for the national policy of caution, but we are inclined to think that the enormous advantages of convenience and economy of electric power have not been altogether appreciated by the Government department in which Sir W. White plays so important a part. A factory is not perhaps on all fours with a warship, but electrical transmission ought to acquit itself admirably under the circumstances to be met with in either sphere of action, although for marine service, as Sir Wm. White indicated, specially designed water-tight fittings are, of course, essential.

FIGURES RELATING TO ELECTRIC TRACTION.

For some reason or other there has been always more or less difficulty in obtaining actual details of cost relating to the operation of electric tramways, especially when they have been owned by English concerns. Even the actual cost of constructing a line is more or less shrouded in mystery. Probably more publicity prevails in America, and it can hardly be said that much harm has been done by the publication of financial statements; on the contrary, nothing but good could possibly result, and it is very much to be regretted that more information is not available. Electric tramways have been in operation in several English towns for some time, but it is hopeless to endeavour to ascertain the cost of working. It can hardly be said that the systems are in any sense a failure, because the receipts show the contrary. In no instance is it more regrettable than in the case of the Birmingham accumulator system, to which reference is made in another column. As far as we can learn, Continental authorities are as reticent as those at home, and consequently one is compelled to obtain information regarding operating cost from the United States. Some time ago a writer in one of our American contemporaries published some interesting figures, which were practically based on an analysis of nearly 50 power stations. In order to arrive at the real value of the figures of any good tramway system, the writer (Mr. R. W. Conant) made a standard of reference, and then compared the working of the various systems with that of a standard system operating under the most favourable conditions.

An equipment of a standard station is assumed to consist of three 1,200-KW. steam dynamos, and six 500-H.P. water-tube boilers with the usual accessories, the estimated costs being as follows :—

Building foundations for machinery, chimney, coal handling apparatus	£25,000
Engines and condensers, heaters, superheaters, and piping...	19,135
Feed pumps and economisers	3,750
Boilers and flues	12 700
Generators and switchboards	15,375
Land and docking facilities	3,540
Engineering sundries	1,040
	£80,540
Cost per kilowatt capacity	£22·4

On the basis of an annual output of 10,500,000 KW.-hours, with a load factor of 33·3 per cent., the working expenses are :—

Interest, depreciation, and taxes	0·20d.
Labour	0·08d.
Fuel, at 14s. per ton	0·16d.
General expenses	0·05d.
Total per kilowatt-hour	0·49d.

The usual fixed charges, cost of fuel, cost of labour, and general expenses are roughly in the ratio 4 : 4 : 2 : 1.

It is apparent that these figures are not likely to be achieved in actual practice on many occasions, because electric tramways are not often carried out under the most favourable conditions; but they ought to prove of interest in affording a standard. Moreover, in the inquiries made among the American stations, Mr. Conant found that at three existing stations the working cost per KW. hour is less than that given for the standard station.

It is not likely, with the growth of municipal tramways, that we shall very long suffer from a dearth of working costs, though whether we shall be able to obtain information as full as that provided by electric lighting returns remains to be seen.

While we are upon this subject of tramway operation costs, it will be opportune to make reference to the figures which have recently been issued by the Metropolitan Tramway Company, of New York, showing the comparative costs of horse, cable, and electric conduit lines in that city. Figures of a similar character were published by the same company for the previous year's working, and were referred to at length in the Electrical Review. It will also be remembered what a large amount of interest was excited in tramway quarters in this country by the free circulation of the figures on this side.

The Metropolitan Company, of New York, have under their care the three systems of traction above enunciated, and the *Street Railway Journal* gives a full table of the receipts and expenses of each system for the year ended June, 1899. Electricity earns most per car-mile, costs least in maintenance of way, is heaviest by a small amount only in equipment maintenance, and is by far the lowest in power cost. The total operating expenses by electricity are thus very much less than those for either rival system.

The three systems in the order named are operated on a track mileage of 25·3, 82·1, and 113·4. Since the previous financial year the car mileage on the same tracks had

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increased from 35 to 42 millions, and receipts had gone up 25 per cent., car-mile receipts springing from 29·7 to 30·7 cents. The whole Metropolitan system was operated at a cost of 15·18 cents per car-mile, and earned a net 15·5 cents against 13·87 cents the year before, and all the increase is due to electricity, for the other systems earned less per car-mile than they had done the previous year. The percentage of operating expenses was respectively 50·8, 38·3, and 69·8.

It appears that during the stormy part of last winter a new cable on the Broadway line would hardly last more than a week. The actual cost of electric motive power per car-mile was 1·57 cents, or, say, ·785d., against ·605d. the year before; but the new 70,000-H.P. station is not yet at work. It is expected to give better results than the numerous present temporary stations and storage batteries. The figures kindly published by this great New York company are of special interest. They show in bold type what electricity will enable to be done.

Engine Guarantees.

THE *Engineer* is evidently spurred on to write an article on this subject by the attention that has been called to the subject of guarantees through the Glasgow contract. Our contemporary rightly minimises the value of guarantees, pointing out that in traction work especially, the guarantee must be worked off under conditions which never obtain during the working life of the engines. It is easy to guarantee a steam consumption, because in very few cases can the conditions of the guarantee be supplied, and there are a score of influences at work to prevent the actual guarantee from being secured. The less scrupulous the contractor is, the more easily will he give impossible guarantees, *and rely on tactics of delay to prevent even the shadow of a test being even carried out.* The whole question of performance is, to our mind, beclouded by an imperfect realisation of what can be done to secure economy. Given steam of equal quality, a dozen engines from the same maker will give as many different results according to their finish. The economy of an engine may be varied by the material of its piston faces and cylinder ports, their roughness, &c. The fit of a deep cylinder cover is capable of making a very serious difference. We are inclined to think that in aiming at economy an engineer should secure from tenderers a drawing of the cylinder ends, valves and ports, and an agreement to give a certain finish to these parts. This done, and every effort made to secure economy, the rest is a mere matter of pressure and expansion, of suitability of an engine for its duty. In our contemporary's article too much mystery is made of the performance variations of engines of the same pattern, as though the cause was unfathomable. It is not usually very occult, but it is a fact that very small apparent faults will cause great losses. A slight fault that hardly shows itself to an ordinary observer on an indicator diagram may easily make a difference of 15 per cent. in steam consumption. We think, too, that few advantages are really got by means of a complex and expensive valve gear. True, we know some very complex valve gears, but we generally ascribe these to the overweening conceit of some fiend in mechanism who has let his ardour for mechanical movements get the better of his common sense. We think engine buyers should consider first the pressure they dare work at, the reputation for the firm they deal with for good workmanship, and the ability of their consultant to ask for details and demand a finish that is likely to make for economy. To turn an engine outside in as regards the polish of surfaces may bring at once an initial saving of money and a permanent saving of fuel. Yet how very little attention is paid either to the polish of inside surfaces or to the reduction of such surfaces to a minimum! These items have been preached upon by practical engineers for long years enough, but very little has yet been done towards carrying them out.

The Public and the Supply of Electricity.

THERE is little doubt that when the Public Electricity Works changed over their supply of electricity from 100 volts to 200 volts pressure, they did a good thing for themselves; but we are afraid the consumers have not always shared in these benefits, on the contrary, they have in some instances suffered materially from the change. Practically the supply systems, by adopting 200 volts, were able to quadruple the carrying capacity of their mains, and though it was little short of an engineering triumph, it is doubtful whether it will bring much advantage to the Electric Lighting Works until the disabilities of the consumers have been removed. The hardships that are placed upon a consumer by compelling him to accept a service at 200 volts pressure are sufficiently obvious: he is compelled to employ a better class of fitting, but most important of all, it is necessary for him to use 200-volt lamps, which are more expensive and less efficient than those made to burn at 100 volts. It is true that the supply companies, when introducing 200-volt supply reduce their charges, but the gain of a consumer is diminished if he is compelled to use more electricity. Under the circumstances it is not surprising that complaints from consumers should have been rife, and in more than one instance electric lighting has been abandoned for this reason alone. There are, however, methods by which the burden of the consumer may be lightened, and the bold policy of one municipality which gives lamps to all consumers has much to recommend it. The improvements that will be without question effected in 200-volt lamps will minimise the defects of the system; but in the meantime it is incumbent that the consumers should receive a little more consideration at the hands of the Electricity Supply authorities. The question has been raised as to whether a supply company can compel a consumer to accept a 200-volt supply; the companies have apparently acted on the assumption that they can, but we doubt whether their position could be maintained in a court of law. It is to no one's interests that any embitterment should be established between the suppliers and the consumers, and it is to be sincerely hoped that a *modus vivendi* may be found.

Electric Tramcar Mishaps.

THE frequency with which mishaps of one kind and another have recently been occurring on the Dublin electric tramways system is not calculated to benefit the cause of electric traction in towns where schemes are now under consideration. Some of the accidents may have been of extreme unimportance, but nevertheless they serve along with the more serious ones to cause alarm to the populace, which is by no means satisfactory. We therefore feel that the Board of Trade has been well advised in deciding to institute a complete investigation on the spot as to the cause of the recent occurrences. Mr. A. P. Trotter, whom everyone in electrical circles here is pleased to see back in this country, is conducting the inquiry, and we imagine that he will go very exhaustively into the matter. Several points occur to us as demanding attention, one of the principal being the necessity for efficient management of the cars. The human element is by no means an unimportant one, and there are, we believe, certain parts of the Dublin routes where great care is required in the manipulation of cars to prevent trouble arising with the other traffic. But we may trust to Mr. Trotter sifting the matter thoroughly, and we shall look forward to his report in the interests of electric traction.

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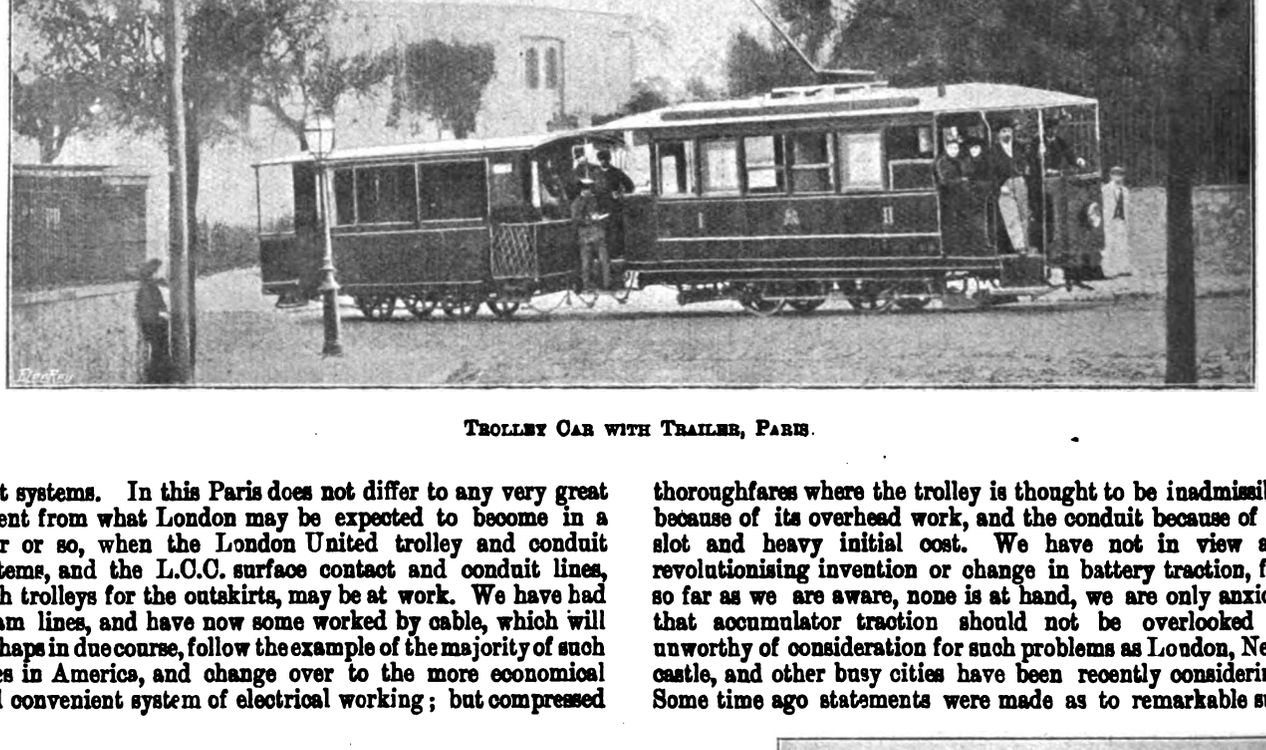
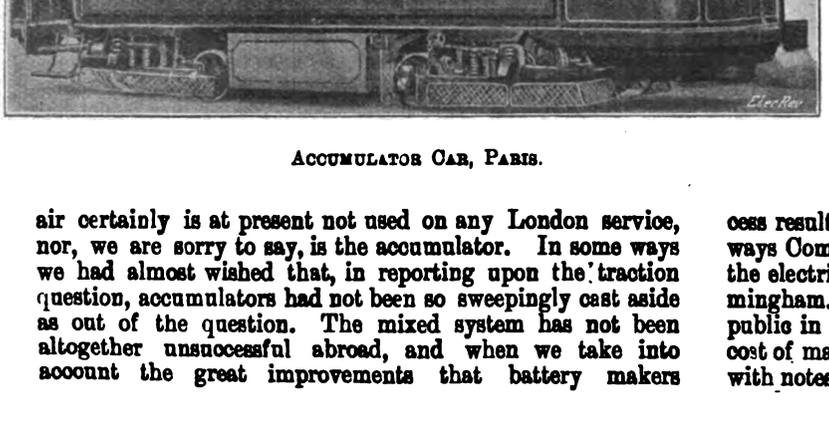
ELECTRIC TRACTION IN PARIS.

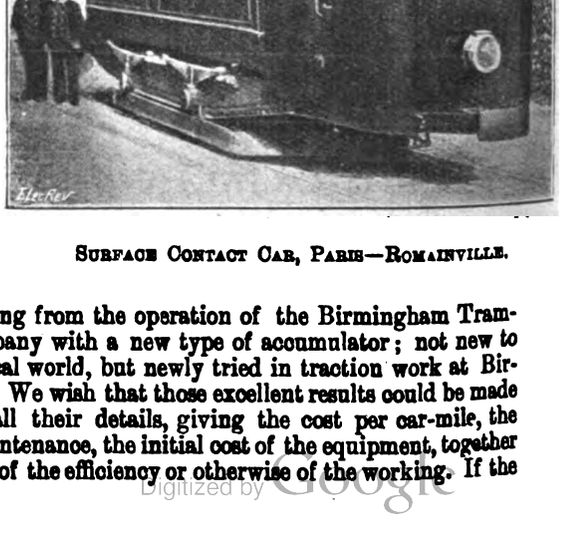
Paris has been the scene of a great variety of mechanical traction trials. Almost every conceivable method of electric tramway propulsion has been tried there during recent years, including cable, gas, compressed air, steam, electric trolley, surface contact, accumulator, and underground electric conduit systems. In this Paris does not differ to any very great extent from what London may be expected to become in a year or so, when the London United trolley and conduit systems, and the L.C.C. surface contact and conduit lines, with trolleys for the outskirts, may be at work. We have had steam lines, and have now some worked by cable, which will perhaps in due course, follow the example of the majority of such lines in America, and change over to the more economical and convenient system of electrical working; but compressed air certainly is at present not used on any London service, nor, we are sorry to say, is the accumulator. In some ways we had almost wished that, in reporting upon the traction question, accumulators had not been so sweepingly cast aside as out of the question. The mixed system has not been altogether unsuccessful abroad, and when we take into account the great improvements that battery makers have effected of recent years in their products, decreasing weight for a given capacity, increasing mechanical strength and reducing prices, and also the attention that has been devoted by those working accumulator lines to the easier handling of the batteries in their removal from the cars when discharged and subsequent replacement—when these things are looked at it certainly appears that things are gradually moving in the direction of accumulator traction for the crowded thoroughfares where the trolley is thought to be inadmissible because of its overhead work, and the conduit because of its slot and heavy initial cost. We have not in view any revolutionising invention or change in battery traction, for, so far as we are aware, none is at hand, we are only anxious that accumulator traction should not be overlooked as unworthy of consideration for such problems as London, Newcastle, and other busy cities have been recently considering. Some time ago statements were made as to remarkable success resulting from the operation of the Birmingham Tramways Company with a new type of accumulator; not new to the electrical world, but newly tried in traction work at Birmingham. We wish that those excellent results could be made public in all their details, giving the cost per car-mile, the cost of maintenance, the initial cost of the equipment, together with notes of the efficiency or otherwise of the working. If the



Trolley Car with Trailer, Paris.



Accumulator Car, Paris.



Surface Contact Car, Paris—Romainville.

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results were so good as we were led to believe, it seems difficult to understand why the figures should be suppressed or held back. It would be decidedly to the advantage of the maker of the particular battery if he could show results so vastly superior to the attempts of his predecessors, and it might have an effect upon the future of electric traction in towns.

We read in an American exchange of the extension of the Chicago and Englewood storage battery system. This fact alone points to success, and we think the present moment an opportune one for reproducing from the columns of our contemporary an illustrated description of the equipment. It appears on another page in this issue.

The *Street Railway Journal*, of Chicago, recently published an illustrated article noting what has been done in Paris in the way of electric tramways, and we are indebted to our contemporary for the notes and illustrations which follow:—

There are three companies which operate electric railways in the city of Paris—the Compagnie des Tramways de Paris et du Département de la Seine, the Compagnie Générale Parisienne de Tramways and the Compagnie du Tramway de Paris à Romainville. The principal line leaves from in front of the Madeleine, in the centre of Paris. The power station is situated on the line of the road at Asnières, and contains three engines, each connected to a Walker 200-KW. generator. Two types of cars are used, a single and double truck. The double-truck car, which is mounted on Brill maximum traction trucks, carries 58 passengers, and weighs, complete, 17,000 kg., made up as follows: weight of car body, 4,200 kg.; trucks and motors, 4,700 kg.; battery, 3,700 kg.; 58 passengers and two employés, 440 kg. The car operates on the mixed trolley and accumulator system.

The Compagnie du Tramway de Paris à Romainville operates cars from the Place de la Republique, at the centre of Paris, to the Port de Romainville, and thence to Coté de Noisy-le-Sec. The line was installed in 1896, is equipped with Claret-Vuilleumier surface contact system. The length in Paris is 4 km. of double track, and outside of Paris 3 km. of single track. The minimum curve radius is 25 metres, and the steepest grade is 5½ per cent. The power station is situated at Lilas, about two-thirds of the distance from the Paris terminal. It contains three boilers, four Corliss engines, four generators, and adjoining it is a car house for 30 cars. The cars are capable of carrying 52 passengers. They weigh 13,000 kg. loaded, and are operated by two 30-H.P. Walker motors.

The Compagnie Générale Parisienne de Tramways has a line 6 2 km. in length, part of which is operated by the trolley system and part by the underground conduit. There are 17 motor cars, each equipped with two General Electric motors. The power station contains three Thomson-Houston 200-KW. generators.

The Compagnie du Tramway Rainey à Montfermiel, while not in Paris, is not far from it, and it is proposed to extend the road into the city, by way of Romainville. It extends from Romainville to Montfermiel, has a length of 7 km, and is equipped with the trolley system. There are 10 motor cars, weighing 12,500 kg. each, equipped with two 25-H.P. Walker motors.

The *Revue des Transports Parisiens* recently summarised the Paris tramway companies as follows:—There are nine companies.

1. Compagnie Générale des Omnibus.—On January 1st this company had 184 7 km. of track laid with Marsillon rail, 9·3 km. laid with Broca rail, 15 km. laid with Vignole or T rail, and 23·3 km. laid with "American" or strap rail. The company has 14 Rowan (steam) cars, 54 Mekarski (compressed air) cars, 59 Serpollet (steam) cars. The company had 4,800 horses on July 1st, 1898.

2. Compagnie des Tramways de Paris et du Département de la Seine.—This company has 79 9 km. of track laid with Broca rail, and 29 7 km. of track laid with Vignole rail, all operated by mechanical power, viz:—Lamm Francq (fireless) locomotives, Serpollet (steam) locomotives, accumulator cars, and, for a short distance in the outskirts of the city, a trolley line. The company has 20 Lamm Francq locomotives, 22 Serpollet motor cars, which are being replaced with accumulator cars, 55 accumulator motor cars, 28 motor cars for a mixed trolley and accumulator service, and 5 trolley cars.

3. Tramway à Vapeur de Paris à Saint-Germain.—This company has 17 17-ton dummies.

4. Funiculaire de Belleville, the Belleville Cable Railway.—This road is 2 km. in length, laid with Broca rails, and has 21 cars.

5. Compagnie Générale Parisienne de Tramways.—This company has 111·9 km. of track, of which 60 9 km. is laid with Broca rails, 32·4 km. with strap rails, 9·8 km. with Marsillon rails, and 8·8 km. with Vignole rails. The company has 154 cars, all worked by horses, with the exception of a short electric line, most of which is trolley, but a short portion is underground conduit.

6. Compagnie du Chemin de Fer de Paris-Arpajon.—This company has five compressed air locomotives and 21 steam locomotives, but is proposing to instal an electric system on part of its line. The track is laid with Broca, Marsillon, and Vignole rails.

7. Compagnie des Chemins de Fer Nogentais.—This company has 17·3 km. of track, and owns 19 compressed air motor cars, and 10 trail cars.

8. Compagnie des Tramways de Saint-Maur.—This company has 12 km., and owns 10 compressed air motor cars and eight trail cars. The line will be equipped with the trolley system soon.

9. Compagnie du Tramway de Paris à Romainville.—This company has about 7 km. of track, and operates 20 electric motor cars on the Claret-Vuilleumier surface contact system.

In addition, an electric line will be started during the year by the North and South Tramway companies. The trolley system will be used outside of Paris, and the conduit system within the city limits.

THE INSTALLATION OF STEAM BOILERS.

VIII.

Having now reviewed the general arrangement of a boiler and its seatings, there remain to be considered its accessories, and it can hardly be said that these, in the aggregate, have less claim upon our care and attention than the boiler itself, for no matter how well a boiler may be made, or how strong it may be, these qualities will surely be endangered, or put to nought by failure in the accessories. A locked-down safety valve may burst any boiler, as recently happened at Barking, where the condition of the valve was either caused or obscured by the fault of the pressure gauge. In dealing with accessories, we may, perhaps, best commence with the feed inlet, finishing with the blow-out apparatus, thus following approximately the course of the water. At one time boilers were very commonly fed at their lowest points—even, at times, through a branch on the blow-out pipe. This method had two principal faults. The admission of cold or cool water to the bottom of the boiler caused very severe stresses in the shell bottom, and was a fruitful cause of seam rips. When anything went wrong with the pumps, or the feed check valve failed, or became leaky, and possibly, also, there was a leaking flange in the feed pipe, the pressure in the boiler was capable of emptying it of water through the feed inlet. A broken feed pipe and a check valve out of order would endanger the furnace crown very quickly. These faults combined brought about an alteration in the position of the feed inlet, which either fault alone was bad enough to demand. Although the feed inlet may be by a suitable block on the crown of the boiler, or through the back end plate, the modern approved position is on the left side of the front end plate, at a height of 5 inches or 6 inches above the level of the furnace crown, and at a distance from the centre line of the boiler equal to the furnace diameter. This position effectually prevents the reduction of the water level below the furnace crown, in case of accident to the feed pipes or valves. The feed valve, which serves as a check valve, also being loose on its spindle, is attached by a flange and studs to a faced block riveted to the front end plate. Studs screwed to the inside of this block serve to attach inside the boiler an internal distribution pipe, 15 to 20 feet in length, and perforated in the last length of 5 feet. It should be 2½ inches inside diameter, and it must be carried by a suspender each 5 feet, consisting of a hook of $\frac{1}{8}$ round iron, screwed and nutted, and attached to an angle bracket riveted by two rivets to the shell, as in fig. 23. Being in lengths of 5 feet, the pipes are easily removed for cleaning. The valve should be of the external nut and pillar type, and it should have a stop on the screwed spindle, to prevent too wide an opening being given, and danger of setting the valve free of its seating. Externally, the feed pipe should preferably come to the valve from above. It is bad practice to lay the feed pipes in the hearth pit, incommoding this, and rendering the pipes liable to corrosion.

The feed main should be suspended above the front of the boilers, and branches placed over each boiler, from which a down pipe is carried to each valve. As the opening to the valve is always from below, this down pipe terminates in a half-circle bend, and a good finish is given to the work, for

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this bend is of ⅛-inch solid drawn copper. These allow also for slight movements of expansion.

The feed mains may be hung by long suspension rods from the roof above attached to the pipe by a clip of 2 inches × ¼ inch iron, with a ⅝-inch bolt and an eye on the end of the

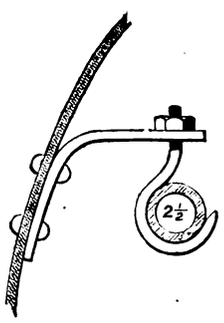

Fig. 23.

rod, which should be of ½ inch round rods, spaced two to each boiler, or of ⅝ rod if only one suspender is used for each boiler.

With pipes thus arranged, there is no invisible joint. The height of the feed main may conveniently be such that the straight down pipe is 5 feet long. Where not of copper, the feed pipes should be of wrought-iron or steel, but the internal distribution pipe may be of cast-iron. The feed main usually connects on to the outlet of the economiser, but it may also have a connection from the feed pump direct, and where it can be arranged the two valves for these two connections ought to be near together and painted red and blue respectively. Generally it is a good plan to distinguish connections of a duplicate order by colour.

As we are upon the subject of an attachment to the front end plate, the scum tap may be here named. It is attached to the opposite side of the front end plate to that occupied by the feed valve, and in the same relative position. Inside the boiler the scum pipes are similarly attached, and suspended by a hook, as in fig. 23. Their length is usually 15 feet in three 5-feet pieces, flanged together. They consist of 2-inch pipes, with

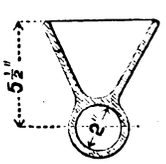

Fig. 24.

a trough 4 feet 6 inches in length cast upon each pipe, and the trough is about 5½ inches deep to the centre of the pipe from the upper edges of the trough. The sides of the trough incline from each other at an angle of 60°. At the bottom of each length are three slots of 1 inch × ½ inch. The trough for its full length is to be set perfectly horizontal with its edge half an inch below the water level pointer. It should be blown only when the water in the gauge glass is at the pointer level when the troughs will perform their duty of skimming off the surface of the water and any floating matter or froth. The pipes are connected by faced flanges. The scum tap itself may be of parallel slide valve type, or it may be a gun-metal cone tap discharging below. It is usual to take the waste pipe down into the hearth pipe and connect to the waste main by a band of copper for the sake of elasticity. The same remarks apply here as in the case of the bottom blow-out cock in respect of independent waste pipes. The single waste main has the merit of convenience, and in many cases is imperative, but when it can be avoided there are good reasons for doing so.

In reference to the remarks about the desirability of using specially moulded blocks for the contact surfaces of the front cross wall on the boiler shell, Messrs. Poulton and Co., of Reading, the patentees of curvilinear blocks, have written to say that they make these blocks as well as the seating blocks of their patented forms. They also make a seating block which serves equally well for either a seating block, or if turned through an angle of 90°, for side flue cover blocks. In fact, at every point of contact with the boiler of the external brickwork or the internal bridge work of the furnace, Messrs. Poulton & Co. provide a special form of brick to minimise the concealment of the plates.

ACCIDENT AT MANCHESTER CORPORATION ELECTRICITY WORKS.

We give below an authoritative version of the disaster of which we gave a brief account last week:—

At about 6 p.m. on Tuesday, the 19th inst., a belt broke on one of the 400 H.P. sets. There are 12 of these sets, comprising side by side compound condensing engines, running at a speed of about 80 revolutions per minute. They drive 240-KW. dynamo machines by means of leather link belts, the drive being shortened by means of jockey pulleys. Ten sets were running at the time of the accident; none of them were overloaded. The belt on one of the sets broke half-way across; the dynamo was switched out, and the steam shut off at the stop valve and the vacuum broken, but before the steam valve could be shut, the broken portion of the belt carried away the governor in its entirety, and the engine having full steam with no load immediately raced, attaining a very high speed. Simultaneously with the shutting off steam, the stress on the fly-wheel caused it to burst, and in so doing it wrecked the engine next to it, the fly-wheel of which was in the same plane as the first one which burst. The fragments of both fly-wheels were thrown to considerable distances, and owing to the great strength of the building they glanced off and damaged plant situated at some distance on either side of the engines, as well as what was directly in what might be expected to be the line of flight. Considerable damage was done to the building, the roof, and other plant; the two engines and the dynamos which they drive, together with their jockey pulleys, were completely wrecked.

The engines were fitted with automatic knock-off for excess speed, but owing to the carrying away of the governor, this was, of course, of no avail.

The supply was completely interrupted on account of the steam and condensing water pipes being disabled. The steam ranges are in complete duplicate, but the steam connections to the engines were smashed, one on each range, so that both were discharging live steam through a 7-inch pipe. The condensing water range, which comprises a 20-inch cast-iron pipe, not in duplicate, had a triangular hole about 4 inches across knocked in it, and a length of about 10 feet was completely shattered, though the pieces held together. Three of the engines only were arranged to work with atmospheric exhaust, and even this exhaust pipe was smashed so as not to be available.

Blank flanges were rapidly fixed on the branches to the engines, and the two steam pipes got under steam, but the supply could not be re-established owing to its being impossible to run the engines non-condensing. It was, therefore, necessary to in some manner temporarily repair the condensing water pipe; the means adopted may be of interest.

As already stated, the damaged pipe was a cast-iron one, some 20 inches in diameter. Some stout asbestos millboard was first laid over the hole and over the worst cracks, this was then bound round with the tape used for insulating electrical joints, then with canvas, and finally with spun yarn. The whole pipe and its wrappings was then entirely surrounded with a wooden box, having its ends cut to fit round the pipe. This box was then completely filled with the bitumen used in laying cables on the solid system. On turning on the water it was found that the means adopted were successful, and although the pipe leaked to a substantial extent, it was quite useable. The supply was re-established at 4.15 a.m. on the following morning, after having been interrupted for 10¼ hours.

Our first impression after reading the above is one of astonishment that such a slight incident as the breaking of a belt should lead to so serious a chapter of accidents—two engines wrecked, other plant damaged, steam and exhaust pipes and water pipe smashed, and the supply interrupted for 10 hours! Human foresight could hardly have been expected to anticipate all these items; and yet it ought not have been possible for them all to happen at once. It is easy to be wise after the event; but there are one or two questions which at once arise in one's mind. For instance, why were the engines wholly dependent upon the condenser, except in the case of three of their number? It seems somewhat absurd to duplicate the steam and feed pipes throughout, and yet to rely entirely upon a single water supply pipe for condensing, without even providing means for exhausting to the atmosphere! The latter provision, we should have thought, would under no circumstances have been omitted. Then again, in the case of those engines which were furnished with the alternative exhaust, why were not the pipes carried beneath the floor level? This is certainly the most convenient way of installing them, besides securing good drainage from the cylinders, and it is comparatively rare to find them carried overhead nowadays.

To criticise the archaic arrangement of belt-driving, with

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a short drive and a jockey pulley, is somewhat superfluous; the method was so freely criticised—and condemned—years ago, that we can add no new arguments to those already used. We cannot imagine any engineer carrying out extensions, still less new work, on that obsolete method. The fact remains, however, that several generating stations have been in past years equipped on this system; and it must be admitted that the belt was the prime cause of the whole series of disasters. We have often claimed for this country pioneer honours in direct coupling of engine and dynamo, while we have chaffed our American friends on their alleged habit of bursting fly-wheels; alas! what can we say now?

We are glad to think that the new 1,500 H.P. E.C.C. generator recently erected is direct-coupled to its engine, but it was apparently no better off as regards exhaust than the others. No doubt this error will be remedied before the large Siemens set is installed.

The ingenious method adopted for effecting a makeshift repair is noteworthy, and we must congratulate Mr. Wordingham and his assistants on their prompt restoration, under the circumstances, of the supply.

Since writing the above we hear that another interruption to the supply took place, on Sunday evening, due to a defect in the mains. The fault was made good in two hours' time and supply resumed.

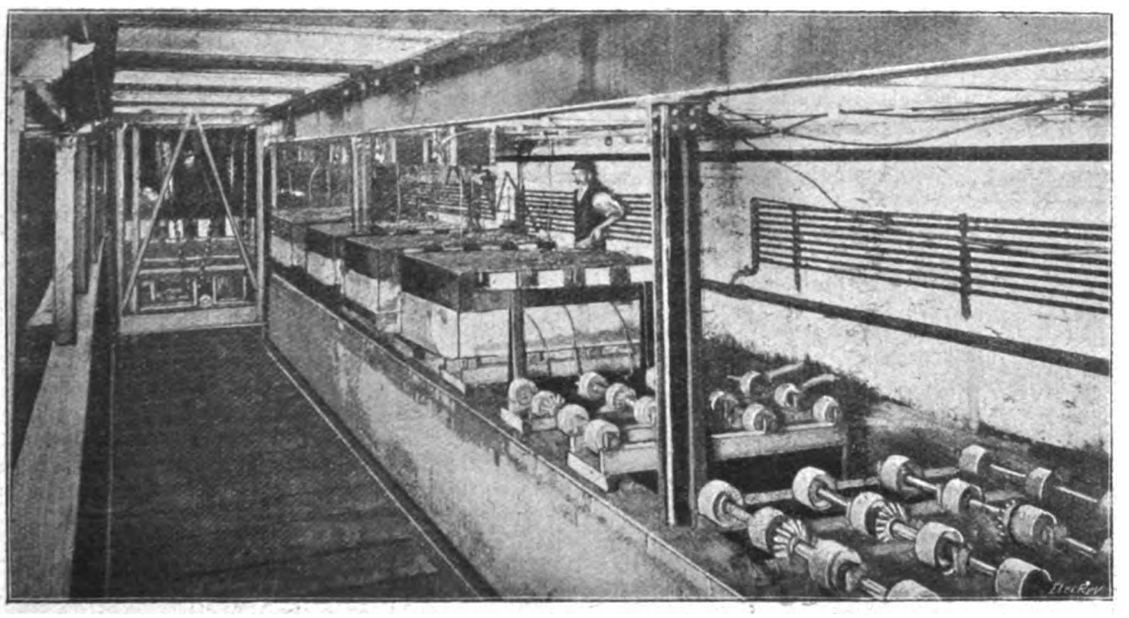
THE ENGLEWOOD AND CHICAGO STORAGE BATTERY LINE.

The storage battery cars on the line of the Chicago Electric Traction Company, formerly known as the Englewood and Chicago Street Railway Company, have now been running a little more than two years, and are said by the management to be handling the traffic in a satisfactory manner. It is not claimed, however, that cars can be operated more cheaply by the storage battery than by the overhead trolley system, but that for suburban lines of this character, or in cities where the overhead trolley is not allowed, the storage battery provides a very efficient and acceptable method of electric traction. The cost per car mile for operating the system in 1898 was 8·7 cents, and during the month of August it was as low as 7·2 cents. This year it is a little higher, owing to track repairs, which were not required during the first two years of service.

We are indebted to the *Street Railway Journal*, Chicago, for the following description and the accompanying pictures:—

The original equipment of the line embraced 24 miles. The main system extends in a south-westerly direction from Sixty-third Street and South Park Avenue to the village of Blue Island, with a branch running to Morgan Park. On this branch is a 9 per cent. grade, up which the cars are assisted by a balance weight system designed by M. H. Bronsdon, of Providence, R.I. The system has recently been extended as a single track line a distance of 5 miles to Harvey, and the cars are now running through to the latter place, where a small power station has been erected. The company has in regular operation 25 cars, for which 40 batteries are provided. The latter are of the Electric Storage Company's type, manufactured in Philadelphia, and what are known as the Manchester plates are employed.

Each battery is composed of 72 cells, arranged in a tray, by means of which it is shifted about or removed or replaced in the car. The weight of each battery, including the tray, is about three tons. The cars are mounted on Dupont trucks. The battery is carried in the middle of the truck between the axles, and is removed and replaced from beneath. A 525-lb. wheel and a 4-inch steel axle are employed. Each car is equipped with a 50-H.P. Walker motor, which is mounted outside the axle, and during the hours of excessive traffic each motor car hauls a trail car. The distance travelled by one charge of battery is 11 miles. A much longer distance can be run when necessary, but about this distance is regarded as the most economical. Each cell of the battery is charged to an E.M.F. of 2·18 volts. In the trip of 11 miles this is reduced to 2 volts, and it is seldom that the batteries are reduced below this rate. The life of the positive plates of the battery is sufficient for a distance of 23,000 miles, and the negative plates for about twice that mileage, or the negative plates will usually outlast two sets of positive plates. The plates are run until the surface is too much reduced by the dropping out of the active material from the grids. Worn plates are not repaired, but the waste material, in the form of fine powder, is sold to the junk dealers. In service the plates do not buckle, but it is found to be of advantage to thoroughly wash and clean them after making about 4,000 miles. The electrolyte is composed of distilled water with chemically pure sulphuric acid at a density of 12·25. This is found to be reduced by 15° on account of spilling and evaporation in about three weeks, when the cells of each battery are replenished and the fluid is brought up to the standard.



Storage Battery Pit and Shifting Car.

The main power station is located at Eighty-eight Street and Vincennes Road, about 5½ miles from the northern terminal of the line, and the most interesting feature of the station is the arrangement and location of the batteries, and the method employed for shifting and replacing. The battery pits occupy two long rooms in the basement, as illustrated on this page. These pits extend under the car-

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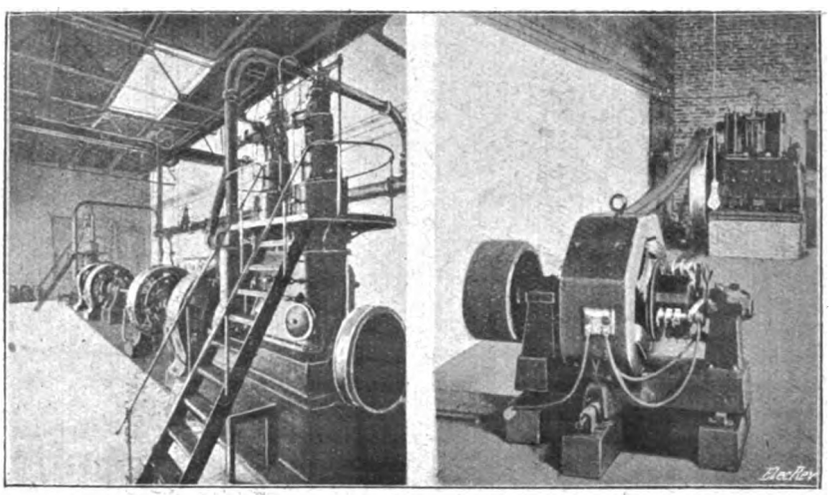
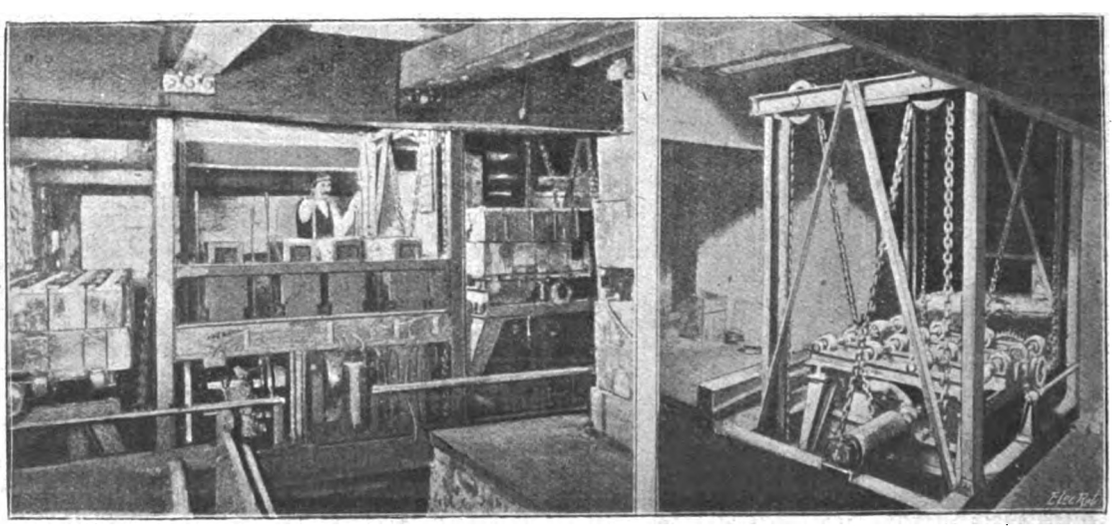
house in a line at right angles to the car tracks and the street tracks, which pass in under an alcove extending in front of the station. Each battery pit is provided with a sunken way, in which is a track over which a shifting car operates. There are two of these cars, one in each pit. Each tray of battery is located on a nest of rollers, as shown in the illustration, which are connected by a system of shafting and bevelled gear, the main shaft terminating in a clutch at right angles to the line of the tracks. The shifting car is constructed of a steel framework, is equipped with five motors, and is controlled by levers arranged at the middle section of the car, as shown. At each end of the car is a platform equipped with rollers, the same as those for supporting the batteries in position. This platform is fitted with an elevating apparatus, by means of which the exhausted battery is removed and a fresh battery substituted. For loading the battery on the platform, the car is run into position, when the shaft on the car platform is automatically coupled to that supporting the battery; the shaft is then revolved by the car motor and the battery rolls forward on to the car platform. The car is then run down the line directly under the shifting pit, when the vacant platform is raised, and the exhausted battery lowered from the car. The battery or shifting car is then moved forward, bringing the fresh battery directly under the shifting pit, when this in turn is elevated and automatically hooked into the truck, while at the same time the connections are automatically made by contact springs, located on the sides of the tray. The platform is then lowered, and the replenished car proceeds on its course. An expert in handling the shifting car has been able to remove and replace a battery in 28 seconds; ordinarily it requires about 1½ minutes. The exhausted battery is returned and shifted to the charging stand in the same manner as described for loading.

All the appliances for charging and shifting the batteries have been designed on very ingenious and economic lines, and it is hard to conceive how they can well be improved upon, as no hand labour whatever is required in shifting or in making connections for charging. In charging the batteries a current of only 160-volt pressure is first employed. Afterwards this is raised in stages to 170 volts, and finally to 180 volts. The motors are wound for operating normally under 135 volts pressure, but have never been injured by the ordinary voltage delivered from the battery. During more than two years of service no repairs whatever have been required on the motors. The manager would prefer to have two motors to the car, especially for winter travel, and it is the intention of the company to provide two motors on all new cars. As it is, only a little difficulty is experienced in keeping the cars operating during snowy weather. The snow ploughs and sweepers are equipped with three sets of batteries, and are as efficient as the trolley sweepers in keeping the tracks clear from snow and mud. The power equipment of the main station consists of two 250-H.P. Willans central valve high speed engines and four 250-KW. Walker generators. The engines are vertical, triple expansion, condensing, and run at 380 revolutions per minute. One is placed at each end of the engine room, and they are connected by a system of hollow shafting and clutches so that either one of the engines can be made to operate either or all of the four direct coupled generators, one engine and two generators being regarded as a unit, however. In charging the batteries three circuits are employed, as above described, so that one generator may be run at 160, the second at 170, and the third at 180 volts. When only two generators are run, the voltage is 166 and 178. During the time of light loads only one engine is run, but for heavy traffic both are employed.



Main Power Station. Harvey Sub-Station.



Battery Shifting Car. End of Shifting Car.

These engines were made by the M. C. Bullock Manufacturing Company, of Chicago, and are of the same type that this firm had running on exhibition at the World's Fair in 1893. They have been in constant service in this storage battery plant since it was installed in 1896, and are still working without any apparent depreciation. Each engine, as illustrated, is really a double vertical engine, and each half consists of three tandem cylinders, or is a tandem triple expansion single action engine, with central simple valve gear, with a fourth cylinder at the base, which acts as

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an air cushion. An important and particular feature of this type of engine is the drainage arrangement, which is accomplished by having the pistons dished downward in the centre, while the hollow piston rod has a ring of ports flush with the surface of the piston, being in the best possible place for drainage. This feature is claimed to make a saving of at least 15 per cent. in the steam consumption, as there is no water left in the cylinder to rob the incoming steam of its heat during the period of admission. Paradoxical as it may seem, the piston speed, 500 feet per minute, owing to the short stroke, only 8 inches, is slower than in so-called slow-running engines. In these engines the diameter of the three cylinders is as follows: Low pressure, 23⅝ inches; intermediate, 14 5/16 inches; high pressure, 10¼ inches. The engines run entirely noiseless, and the governing features are unusually sensitive and efficient. Among the claims for this type of machine are durability, economy, and safety.

The boiler equipment consists of three 200-H.P. Heine boilers, provided with Roney mechanical stokers. Jet condensers are employed, and there is a cooling tower, installed by the H. R. Worthington Company, which consists of a steel tank 30 feet high and 12 feet in diameter. This is partly filled with vitrified sewer pipe placed on end so that the water when pumped to the top of the tower trickles over the pipes to the tank below. The cooling blast is provided by a large fan operated by an electric motor, which serves to cool the water that it may be used over and over again for condensing purposes.

The new power station at Harvey is equipped with a 50-H P. Nash triple-cylinder gasoline engine, manufactured by the National Meter Company, of New York, run at 250 r.p.m. This is belted direct to a 40-KW. Eddy generator, manufactured by the Eddy Manufacturing Company, Windsor, Conn. This generator is operated in multiple with a stationary storage battery in the station so arranged that when the current is not being delivered to the car batteries it is charging the stationary battery. This battery consists of 95 cells of 320 ampere-hours' capacity. This station is provided with two extra car batteries, the same as those described above, and which are charged in connection with the stationary battery. The arrangement is such that a steady load is provided for the engine and car batteries are charged without an undue expenditure of power. The battery shifting device provided for the Harvey station differs somewhat from that described for the main station, as the trays are mounted on trucks and are rolled by hand-power by means of a windlass under the elevating platform, which is raised and lowered by means of a stationary motor. The Harvey power station is a one-storey plain brick building, 30 feet × 70 feet, and is divided lengthways into two sections. In one is located the track and pit on which the car is run for battery shifting. The other section houses the power equipment.

In connection with the operation of the line, a funeral car is operated when chartered, which serves to carry the attendance at funerals for the different cemeteries that are located along the line. This car is named Virginia, and is handsomely upholstered; in fact, it is finished very much like the private cars on other lines. End doors through the front vestibule provide for loading and unloading the box containing the body.

The system is now operated under the management of E. R. Gilbert, with A. E. Davis as superintendent.

PHOTOTHERAPEUTICS; OR, THE LIGHT CURE.

By W. S. HEDLEY, M.D.

In the pages of the Electrical Review and elsewhere the present writer has more than once drawn attention to the medical and biological effects of light. He has pointed out that some of these effects are demonstrable and accepted facts, and that light may now take rank among those other forms of radiant energy that have already rendered signal service to medicine. To those of us who have watched this development, and worked for its attainment, it is certainly satisfactory to have arrived at this point. Chief among the countries that have encouraged such researches is Denmark. An Institution founded three or four years ago by the benefactions of two individuals,* has now developed into a State-aided establishment, whose object it is to "carry on scientific researches concerning the action of light on the living organism, and chiefly with a view to its application in practical medicine." Its excellent work is already widely known throughout Europe, and our own country is amongst the first to profit by it; for, owing to the initiative of a benefactress, the apparatus used in this Institution is at this moment on its way to England, to be fully and fairly tried in a London hospital.

In the articles already referred to it was shown that the intensity or amplitude of the heat rays is increased as the light rays are added,† and the therapeutic effects of the luminous heat ray was in some measure dealt with. It was further explained that, ascending in the scale of refrangibility, when the blue, violet, and ultra-violet rays are reached, that is, when the calorific effect is least, and the chemical effect is greatest, a distinct and different set of physiological effects appear; and that one of the most striking of these is a destructive action upon certain micro-organisms; that the chemical rays are, in fact, bactericidal.

It is not proposed at present to deal with the general effects of light upon the organism. This has been already done in the above-named paper, and will be reverted to again. It is now intended to limit attention to the action of light when concentrated and localised upon a limited surface. It is this aspect of the question to which Dr. Finsen has contributed so much valuable work. In the first place, he points out that the effects of light as a purifying and disinfecting agent, a fact forcibly dwelt upon by Duclaux,‡ is due almost entirely to the chemical rays.§ The same is true of the bacillus of anthrax and the typhoid bacillus;‖ and d'Arsonval and Charrin,¶ experimenting with the pyocyanic bacillus have demonstrated that it is the chemical and not the calorific part of the spectrum that is the destructive agent. Charcot (1859) stated, and Widmark (1889) proved, that solar eczema (misnamed eczema caloricum) from which Alpine travellers suffer, is due to the most refrangible rays, and especially to the ultra-violet. With the thermometer marking a very low temperature, these effects occur, and they occur, perhaps most commonly, by reflection from the snow. In such cases it is, of course, the lower part of the nose and chin that is affected, the parts most directly struck by these reflected rays.

As a secondary result of the action of the light ray, there occur deposits of pigment, and this pigmentation is in its turn salutary—it appears to be Nature's way of preventing too deep a penetration of the chemical rays, and so protecting the animal against their injurious action. In such facts are also to be found (Unna. Finsen) an explanation of the colour of the negro, and the bronzing of the skin exposed to fierce and prolonged sunlight. Few of the readers of the Electrical Review are unacquainted with the effect upon the skin and eyes of a strong electric light. A Russian physician, Maklakow,** having been asked to report upon these injurious effects as occuring in a large electric welding establishment near Moscow, submitted himself to experiment for the purpose of his inquiry. He describes his condition after having "assisted" at an electric welding operation with an arc "produced by 250 to 500 accumulators;" and gives a description which must come forcibly home to very many of us; it certainly does so to the present writer, who has at times had to do with those conducting photometric experiments without due precautions. Following the exposure a few hours, the first symptom was a pricking sensation in the skin, which gradually increased, and shortly afterwards there was coryza and lachrymation, that is to say, symptoms of a bad cold in the head, and profuse watering of the eyes. Later, he was unable to open his eyes, and he felt a burning sensation on the left side of his face and neck. After

* M. G. A. Hagemann and M. Vilt-Jörgensen.
† Tyndall's well-known experiment.
‡ "Semaine Médicale, 1885," quoted by Finsen.
§ *Proceedings of the Royal Society of London*, 1878.
‖ "Arch. de med. exper. et d'Anat. Path, 1891," quoted by Finsen.
¶ "Sem. medicale, 1894," quoted by Finsen.
** "Maklakow—Arch d' ophthalmol., 1889," quoted by Finsen.

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a short sleep he awoke to find all the symptoms worse. In the evening there was redness and swelling of the face and that swollen condition of the ocular conjunctiva known as chemosis. He had a night of suffering, all the parts which had been exposed to the light having become inflamed; but it was remarked that the lining membrane of the eyelids was not swollen, although, as already stated, that covering the eyeball was so. On the following day the ocular pains diminished and a muco-purulent secretion in the eyes became established. The inflammation of the skin, however, continued to increase until night, when it somewhat abated. In a few days the skin desquamated in large flakes as if he had recently had scarlet fever; and there was some pigmentation of the skin. This, it is to be remembered, was an experimental case, and was allowed to run its course unchecked; it might have been materially alleviated by treatment. Such effects are undoubtedly due to the light, and not to the comparatively feeble heat rays. It may be remarked that in the case of a burn the pain is immediate; in such a case as that above related the pain only supervenes at the end of some hours.*

The injurious action of the chemical rays has been the means of introducing a new treatment of small pox, or, rather, a revival, based upon scientific grounds, of a treatment known and practised in that rather ill-defined period usually referred to as "the middle ages." This treatment seems to have survived even within the memory of persons living in the eighteenth century. It consisted in having the curtains and other surroundings of the patient's room exclusively red; in other words, in exclusion of the upper rays by means of filtration through red hangings. In recent years the action of light on the course of cases of small pox has been noticed by Picton (1832), by Black, Barlow, and Waters (1867 to 1871). In 1894 the subject was brought forward by Dr. Finsen, who proved that the injurious effect was due to the chemical rays, and that therefore red light was obviously the only kind admissible. This he elaborated into a system, and he states that it has been carried out by Dr. Lindholm (Norway), Swendsen Feilberg (Copenhagen), Strandgaard (Denmark), Benckert (Sweden), Moore (Dublin). The whole evidence leaves no doubt that the exclusion of the chemical rays by means of admitting only red light diminishes suppuration, prevents scarring, and shortens the fever. Such facts are of the deepest significance, but obviously lose some of their practical bearings in a country which trusts to prevention rather than cure.

In view of what has been proved of the microbicidal action of light, it is pointed out by Dr. Finsen in one of his instructive monographs that phototherapeutics must find a promising field of action in skin diseases of superficial kinds, caused by the presence of micro-organisms. Lupus is one of these.

It is, as everyone knows, a chronic disease of the skin, most frequent in the female sex, most commonly showing itself in childhood between the ages of 3 and 10, and, what is of interest in the present connection, it is caused by the tubercle bacillus. It is recorded that the "burning glass" has been empirically used in its treatment. Lehmann employed "a 12-ampere arc lamp," with the rays rendered parallel by a parabolic mirror. The subject has been energetically taken up by Dr. Finsen at the Institution already referred to, and with striking practical results. He shows that in order to get useful effects with light, it is necessary to concentrate it; and, therefore, in order to prevent burning of the tissues, to exclude calorific rays up to the yellow. It is quite certain, as already stated, that the bactericidal action lies in the most refrangible rays. The above objects are attained in more ways than one. If sunlight be used, a hollow plano-convex lens may be employed 20 to 40 cm. in diameter, filled with ammoniacal solution of sulphate of copper. Light from an electric source requires different treatment, the rays being divergent, not parallel, as in the case of the sun. The apparatus then consists of two telescoping cylinders, each of which contains two plano-convex lenses. The first pair are designed to make the divergent rays parallel and the second to converge the parallel rays; 10 litres of distilled water separate the latter pair. Beyond the fourth lens at the end of the apparatus comes the light-filter, consisting of a flattened glass cylinder containing the copper solution. More recently this apparatus has undergone modification, and rock crystal lenses are used, thus obviating the absorption of ultra-violet rays by the ordinary glass. It is not quite clear what amount of electrical energy is used for the arc lamps. It is given as 35 to 80 amperes, but the voltage of supply is not stated. The present writer for all phototherapeutic purposes uses from 15 to 50 amperes at 100 volts. It seems certain that to secure bactericidal action a concentration of chemical rays is required; and, further, Dr. Finsen is satisfied that the blood interferes to some extent with the penetration of light into the body, and he therefore uses pressure to exclude the blood as far as possible from the parts under treatment. He has designed a compress expressly for the face.

The procedure consists in subjecting a small surface at a time, say, 2 or 3 cm., to treatment. There is a daily exposure for two or three hours to the action of the rays, and treatment is continued for periods varying from "some days" to "many weeks," and even "three or four months." Dr. Finsen, who, as already stated, has elaborated this method, gives 59 cases, all improved but one, 23 being cured, and 30 remaining under treatment. Since then, he records 200 cases, 130 of which have been treated exclusively by the method in question.

Admitting the approved efficacy of the treatment by light in the case of lupus, it only remains to be asked, Is this method the quickest and the best? Even leaving out of sight other methods, and considering for the moment only the many successful results in lupus that have occurred by exposure to the X rays, it might be hazardous to venture a definite reply to this question. It may ultimately prove that what the ultra-violet rays do well, the ultra ultra-violet rays do better. But in the meantime, Phototherapeutics holds the field.

* This is in accordance with what has been observed of the action of those rays still higher in the scale, (?) the X and other rays that emanate from a focus tube, whose injurious effects sometimes take weeks to show themselves, and whose destructive action has been utilised under due regulation and control for the treatment of lupus, for epilation, and other purposes.

SOME NOTES ON SINGLE-PHASE MOTORS, WITH SPECIAL REFERENCE TO THE HEYLAND MOTORS.

By A. C. EBORALL.

The reference to the starting capabilities of single-phase motors in the Electrical Review of last week—namely, that up to the present it has been found impossible to build such motors to start against heavy loads—gives the writer an opportunity of bringing forward the capabilities in this direction of the Heyland single-phase motors, now being put on the English market by his firm. As far as concerns existing types of well-known motors, the statement in question is perfectly correct—not only will they not look at a load, but many of these motors require such heavy currents to start them *without* load that their use on lighting circuits (where alone single-phase motors are required) is discouraged in many places, and in others the demand for motive power is being met by laying down direct current power mains (for instance, Bristol, Clerkenwell, City of London, &c.)—a step which, though perfectly natural and the outcome of circumstances, cannot be regarded but with regret by all those who believe in the capabilities of the alternating current.

The single-phase motors patented by Mr. Heyland, which have been mostly built up to the present by the firm of Electricité and Hydraulique, Limited, of Charleroi, will not only start against full load, but they do this without complication or bother of any kind, and with moderate current consumptions. Moreover, if required, the starting torques can be made much greater than this, and a good single-phase traction motor is by no means such an impossibility as it appeared a year ago.

Before describing the fundamental principles and construction of these motors for heavy starting torques, it may not be out of place to discuss briefly, in general terms, what takes place in the commercial forms of single-phase motor during starting and running.

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At the outset, it may be stated that all commercially successful single-phase motors belong to the induction type. That is to say, the stationary inducing system, or stator, whose windings are connected to the line wires, causes currents to circulate in the windings of the running part, or rotor, and these currents, in conjunction with the driving flux of the motor, produce the torque. A characteristic of all induction motors is, that the rotor windings are always closed upon themselves after once the motor is running at normal speed, though they are frequently arranged to be opened at starting for the purpose of inserting a starting resistance.

The easiest way of considering what goes on in a single-phase induction motor is to think of a two-phase motor. Let, for instance, a motor of the latter type be running from two-phase mains, and without load. Neglecting (as may quite well be done) the trifling power current required to make up the motor losses (under these circumstances practically only iron, ventilation and friction), the current read on an amperemeter in each phase is the "magnetising current" of that phase of the motor, that is, it is the wattless current required for driving the magnetic flux through the magnetic circuits of the motor; further, the speed is synchronous. Now let one phase be switched out. The motor will go on running as a single-phaser at practically the same speed, but the amperemeter in the remaining phase will read approximately twice the current that it did before—that is, the magnetising current in this phase has doubled. What has happened is briefly as follows: The magnetic flux originally provided by the switched-out phase is now replaced by a flux of approximately the same value and relative position furnished by a magnetising current in the rotor. Magnetising currents are called into being in the rotor induced by the magnetic flux of the phase still connected to the mains, and in quadrature with this flux with regard to time, and these currents are carried round nearly 90° in space by the practically synchronous rotation before reaching their maximum. Thus the cross-flux produced by them has very nearly the same effect as that formerly produced by the switched-out phase. The magnetising current in the rotor has, of course, to be balanced by a corresponding stator current, so that the amperemeter reads the magnetising amperes of phase 1, plus the magnetising amperes of the rotor transferred to the winding of phase 1. Hence the magnetising current in the latter approximately doubles.

With this perfect motor running at synchronous speed, it would be found that a voltmeter connected to the terminals of the switched-out phase would give a reading equal to the pressure on the mains from which phase 1 is running. This E.M.F. is that induced by the cross-magnetisation of the rotor currents, and is in quadrature with the impressed E.M.F. of phase 1, as explained above. In commercial motors the E.M.F. of phase 2, measured in this way, is not quite equal to that of phase 1. The magnitude of the difference between the two voltages is a measure of the quality of the design of the motor.

It has been said above that the motor continued to run as a single-phaser at practically the same speed. In reality the speed is a trifle less (the difference being too small to detect on a counter) owing to the fact that the rotor currents cause a slight slip, so that even a perfect single-phase motor (unlike the polyphase motor) cannot run at a synchronous speed at no load.

Of course, as the motor is loaded, the slip increases, that is, the speed departs more and more from synchronism. Under these circumstances, the induced rotor magnetising currents are carried round in space less than 90°, the cross-magnetisation produced by them is correspondingly reduced, and the rotary field of the motor is therefore not only less, but gets much less uniform, until finally the increasing load causes the motor to break out of step. When the rotor is stationary, the cross-magnetisation is reduced to zero; there remains now only the one flux of the phase connected to the mains (phase 1), and this flux cannot possibly produce a torque—that is, the motor cannot start—because its axis (that is, the axis of the exciting coils of phase 1) is in the same direction as that of the rotor flux produced by it.

To sum up then, we see that in order to enable a single-phase induction motor to start at all, an auxiliary starting field must be created that will do exactly the same thing as the rotor currents do at synchronous speed, or that a second phase would do. That is, with regard to space, a magnetic flux must be established in quadrature with the principal flux inducing the rotor currents, and with regard to time, this auxiliary flux must be in phase with the rotor currents, or what is the same thing, must be in quadrature with the

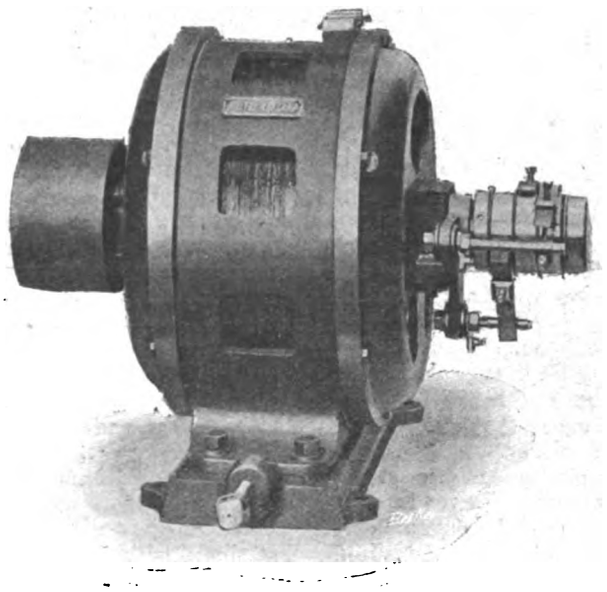

Fig. 1.

principal flux. Every single-phase motor must therefore not only have a starting device, but the amount of starting torque available will depend purely upon the effectiveness of this device with regard to fulfilling the conditions outlined above, and upon the value of the cross-flux produced by it.

Successful starting devices for single-phase induction motors have nearly all been arranged on the same general lines up to the present. The spaces between the running

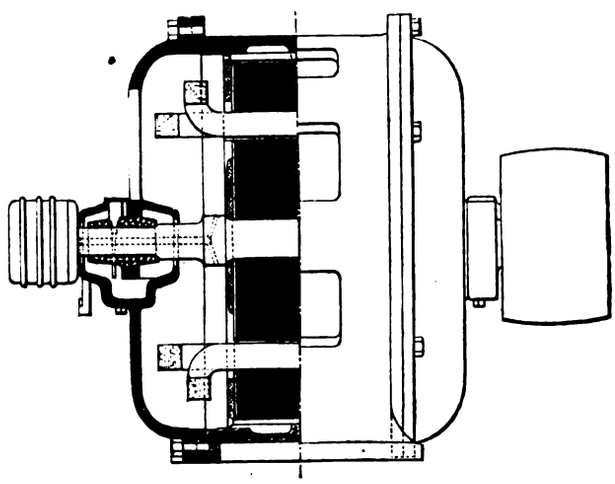

Fig. 2.

coils* on the stator are filled up with starting coils, and the two sets of coils are furnished at starting with distinct currents differing in phase from one another by means of an external phase-splitting device, assisted by suitable proportioning of the starting winding. The usual arrangement at starting is to switch the running coils on to the line either with or without a non-inductive resistance, and to put the starting coils in parallel with them through either a choking coil, condenser, or non-inductive resistance, depending upon the relative proportioning and arrangement of the two windings, the actual con-

* It is worse than useless to fill up all the slots of the stator with the running coils—that is, with the winding that is always in circuit, and which furnishes the principal flux of the motor. Two-thirds of the slots are usually taken up by the running coils, and the remaining one-third by the starting coils. Four to eight slots per pole per phase are generally allowed for the former.

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nections employed, and the particular maker's ideas. But none of these devices have proved particularly successful, especially when used with high frequency motors. The starting torque is always insignificant, frequently barely sufficient to get the motor under way with the load of the belt and loose pulley, while the starting currents are invariably excessive—for instance, it has been considered good if a motor can run up to full speed without load with a current consumption equal to 1½ times the full load current! These indifferent results are due to the fact that the phase differences of the two fields produced by all the above-mentioned devices are quite small, generally considerably under 30°, and moreover, the field produced by the starting coils does not reach a high value. Some makers have tried the effect of "staggering" the starting coils—that is, instead of winding these coils midway between the running coils, they have been displaced by the width of one or more teeth, thus giving a space displacement of less than 90°, in order to try and make up for the phase displacement of the current in the starting coils being so far from the correct amount. But no appreciable gain has resulted from this; moreover, useful winding space is lost.

Phase-splitting devices employing choking coils or condensers in the line circuits are in any case objectionable. The use of the former causes a low power factor at starting, large wattless currents, and consequently heavy C^2R losses. The employment of condensers is open to the objection that they frequently give a lot of trouble owing to the unmechanical nature of their construction.

The Heyland motors differ but little with regard to general design from other well designed motors of the induction type, but the principles underlying the action of the starting device, as also the method of applying them, are quite new in the alternate current motor field, while the results arrived at with these motors are far beyond anything hitherto obtainable.

The appearance and general design of the motors can be seen from figs. 1 and 2. The motor for sizes up to 100 H.P. is built either ironclad (as shown here) or else totally enclosed; a more open construction is used for larger outputs. The winding of the stator is shown diagrammatically in fig. 3, which illustrates that of a four-pole motor.

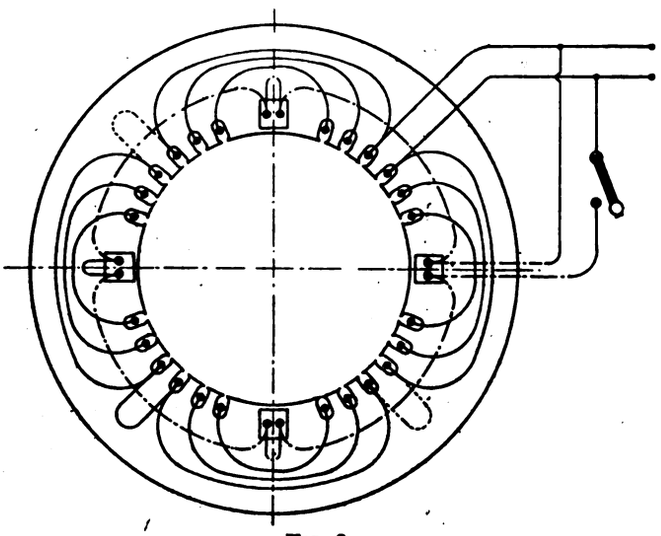

Fig. 3.

The running coils are wound drum fashion in the small half-closed slots, there being, of course, more than one wire per slot; these slots are insulated with micanite tubes. The starting coils are located in the large square holes, and it is the magnetic flux produced by these coils which produces the starting torque. The stator core discs are not built up in the motor case in the usual way, but each stator is finished complete with its winding and then put into the motor case. The depth of magnetic material in the stator can thus be conveniently varied within limits to correspond to small departures from standard outputs, &c. It will be noticed (fig. 2) that there is a considerable air space between the case and the stator core; this is arranged for in order to reduce magnetic leakage through the case, and, moreover, increased cooling facilities result.

The number of poles formed by the running coils, and the turns and section of the winding per pole are calculated out in the usual way; the number of turns of the starting winding is, however, always kept small, for the reason given later on.

The rotor is an ordinary three-phase rotor, that is, it has some form of barrel winding carried out in slots, and

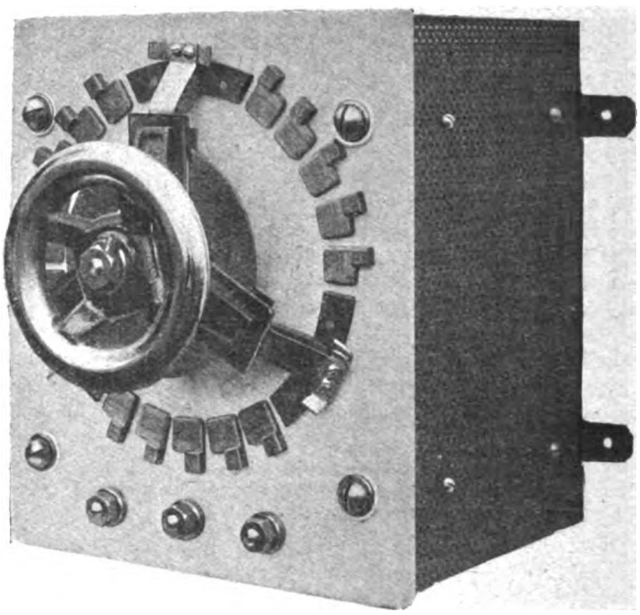

Fig. 4.

star-connected in three circuits. The ends of the three circuits are taken to three overhung slip-rings on the shaft, which are connected by means of suitable brushes to the star-connected non-inductive starting resistance shown in fig. 4. The insertion of this resistance at starting has two good effects, just as with polyphase motors—firstly, the starting current is limited in amount; and secondly, it is brought more into phase, thus improving the power-factor at starting, and also the values of current and watt consumption per unit of torque.

The starting of the motor is effected as follows:—All the rotor resistance being in, the single-pole switch (fig. 3) is first closed, and then the motor switch proper. The motor will immediately start up with great power, and the rotor resistance has now to be cut out, step by step, until the slip rings are short-circuited. The auxiliary switch can then be opened, when the motor will be running under normal conditions at full speed. For elevator and similar work, the single-pole switch and starting resistance are operated together by means of a suitable link coupling.

The displacement of phase obtained with the above simple starting device (which does not effect the running winding in any way, nor the general proportions of the motor) is very great, and can be made to approximate very closely to the ideal conditions. It is, of course, due to the relative unsymmetrical relations of the two windings with regard to the rotor, causing great magnetic displacement. The field produced by the starting coils can be made as great as desired, and the torque of the motor is limited only by the fact that after a certain point over-saturation of the iron comes in. For the standard motors with normal starting torques, the adjustment of this auxiliary field is made by adjusting the number of turns. As a definite back E.M.F. has to be produced in the starting coils, given by the supply E.M.F., it follows that the strength of the starting field is inversely proportional to the number of starting turns, and to nothing else. Hence, to get powerful fields, the turns must be small, and consequently in these motors, as stated above, the starting winding located in the square holes consists of but few turns, and the starting torque for different purposes is adjusted by the proportions of this winding.

The great differences existing between the Heyland starting device, and those which have preceded it will now readily be seen to be as follows:—

In all other phase-splitting devices, the fundamental idea is that a rotary field is to be generated, in order to enable

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the motor to start, and as pulsations of a rotary field mean loss, all the arrangements in use have been designed with a view to reducing these pulsations to a minimum—that is, a rotary field of constant strength has been aimed at. In accordance with this, it would be a great mistake to make the field of the one set of coils greater than that of the

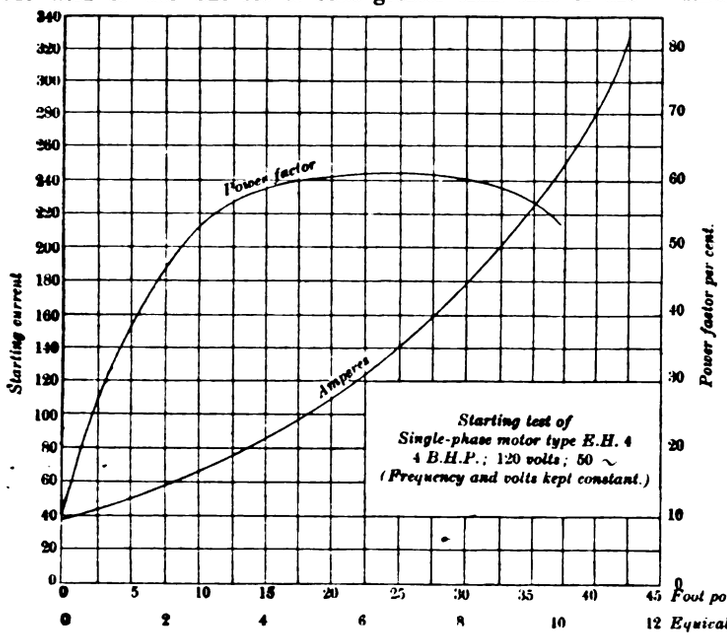

FIG. 5.

other. Moreover, in all these devices, in order to get a large phase difference, it has invariably been the practice to make the starting winding of large self-induction, as phase difference increases with the self-induction. But with increased self-induction the field producing the torque falls, so that the latter must always be small.

Now, Mr. Heyland's views are practically opposed to this. He does not trouble about the rotary field at all, but designs the starting coils to give simply an alternating field of large phase difference at right angles to the running coils, this

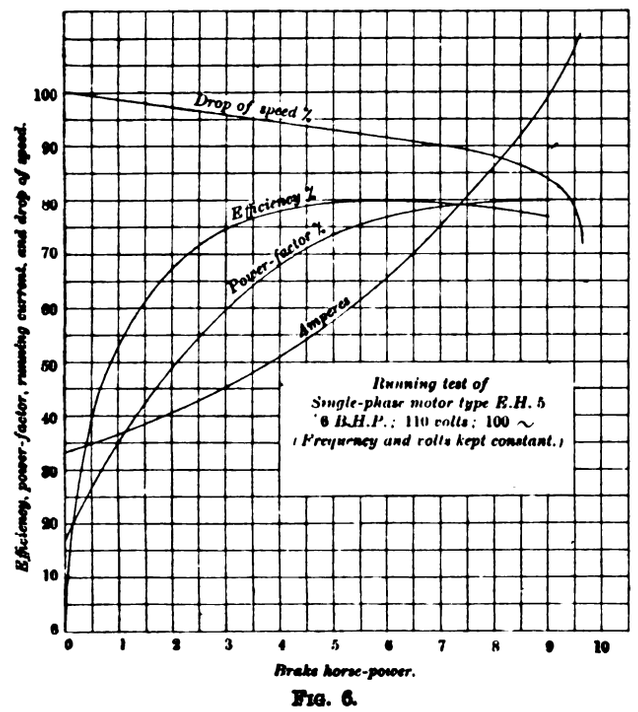

FIG. 6.

field having as great a value as possible, and always being larger than the field of the running coils, or coils carrying a current of small phase difference. The large phase difference of the magnetic flux of the starting coils is produced, not by designing the latter to have great self-induction, (which would have the effect of diminishing the flux required to produce the torque), but by displacing the flux magnetically in the manner shown. At the same time, this cross-flux has a high value, because the self-induction of the circuit producing it is quite small, owing to the small number of turns. To sum up, the design of the Heyland motors, with regard to the starting device, is along lines directly opposed to generally accepted practice, insomuch as the starting coils, causing the flux of great phase difference, have a much smaller self-induction than that of the running coils; moreover, the auxiliary flux of the starting coils is purposely arranged to be much greater than the flux of the running coils.

The actual performance of these motors, both when starting and running, is well shown by the typical test curves given (figs. 5 and 6). Fig. 5 shows the relation between torque and starting current and starting power factor for a 4-H.P. motor designed to give a specially large torque. The full load current of the motor is about 43 amperes at 120 volts, 50 cycles. From the curve of current and torque, it will be seen that the motor starts with a torque equal to that at full load with a current consumption of 84 amperes, or about double that at full load. At the same time, the starting power factor attains the remarkably high figure of 59 per cent. The maximum torque the motor will give at 120 volts is about three times that at full load. The slip of this motor at full load was 6 per cent., efficiency 74 per cent., and power factor 77 per cent.

Fig. 6 gives an idea of the performance of these motors when running. The motor in question (designed to run on a lighting circuit in the North of England) is nominally of 6 B.H.P., 110 volts, 100 cycles. From the curves it will be seen that the full load quantities are as follows: — Current, 66 amperes; efficiency, 80 per cent.; power-factor, 77 per cent.; and slip, 8½ per cent. The maximum power factor is 80 per cent., and the maximum load without falling out of step about 9 B.H.P. No special starting torque was asked for with this motor, but it was specified that the starting current should not exceed 100 amperes. At this current consumption the motor started with a torque equivalent to 3 H.P., thus half the full load torque with one and a half times the full load current.

From the commercial aspect it is always necessary to look to the weight of a machine when considering its efficiency, &c. The tabulation given below for the standard sizes of Heyland motors supplied by Messrs. Witting Bros., Limited, will show that they are not by any means unduly heavy for their output:—

STANDARD HEYLAND MOTORS.

For 50 cycles and 100 to 800 volts.

B.H.P.	Revs. per minute.	Power factor. Per cent.	Efficiency. Per cent.	Weight. Lbs.	B.H.P.	Revs. per minute.	Power factor. Per cent	Efficiency. Per cent.	Weight. Lbs.
⅛	1,500	55	50	66	15	1,000	80	83	1,100
¼	1,500	60	60	99	20	1,000	82	85	1,100
½	1,500	65	65	143	30	1,000	83	87	2,000
1	1,500	70	70	154	40	750	85	89	2,640
3	1,500	73	75	308	60	750	85	90	3,500
5	1,500	75	80	440	80	750	85	90	4,400
10	1,000	80	82	660	100	750	85	91	5,000

These motors, whose full load efficiency and power factor are given above, are designed on the following lines:—

1. Temperature rise after eight hours at full load will not exceed 40° C.

2. Drop of speed varies from 10 per cent. in the smallest size to 3 per cent. in the largest motor.

3. All motors have a loading limit of 1½ times the full load.

4. The motors are designed either to start up with a torque equal to full load, the current consumption being twice the full load current, or else to start with a torque equal to two-thirds of that at full load, the current being 1½ times the full load current.

NOTE.—In the writer's remarks on the starting of single-phase induction motors, all methods of bringing the motor

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up to speed involving the use of mechanical means, or of a commutator, were not considered, on account of such methods being unpractical, expensive, and hardly ever used in practice.—A. C. E.

CORRESPONDENCE.

Stresses in Engine Shafts.

I do not think anyone will question your contributor's statement that the capacity of a shaft to resist a suddenly applied twisting moment is one-half of that which it would be were the twisting moment gradually applied. In other words, the factor of safety must be doubled where the shaft has to resist suddenly applied twisting moments.

So long as we understand one another there is no point in haggling over definitions; my object is to get at the truth of the matter, and not to attack any statements your contributor may have made.

But perhaps I may be allowed to recapitulate, in the light of his subsequent correspondence, what I understand was really meant by the closing paragraph in your issue of September 1st (page 376):—

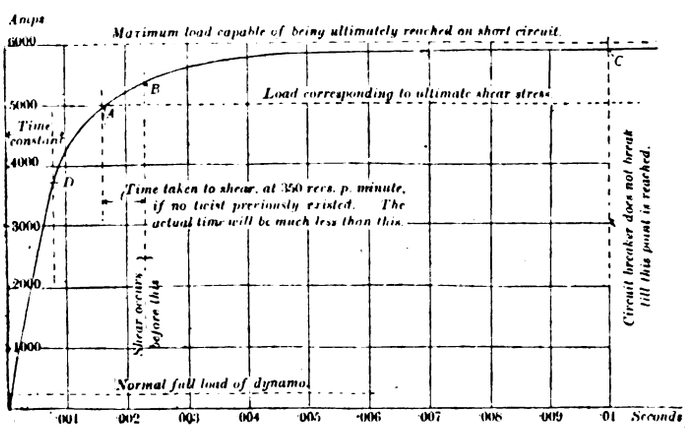
1. A suddenly applied stress is, in its effect on the shaft, equal to double that stress gradually applied.

2. The crankshaft on the engine side of fly-wheel has already been designed on this assumption; therefore, if we further assumed that the armature current never exceeded the "ordinary," we could put in a shaft on the dynamo side of the fly-wheel of the same diameter as on the other side. (To be logical, it seems to me that "ordinary" should be defined, *not* by the rated output of the engine, but by the maximum possible thrust on the crank pin at any period of the revolution; but let this stand.)

3. Your contributor says, in the article above referred to, "allow 50 per cent. excess stress," and he calculates the shaft on this basis. I submit that this is not strong enough, and that if the design he was then considering be adhered to (*i.e.*, the fly-wheel and armature separate) it should be made several fold stronger.

In an article in your issue of the 22nd inst., headed "Engines for Electric Traction," you mention incidentally that I seem to have come to the conclusion, but appear disinclined to put it down plainly, that the cut-outs will *not* act in time to save the great rush of current that tends to occur when there is a short circuit in the line. This is quite true; I had doubts whether the time lag of the generator was small enough, and the time lag of the cut-out large enough, to permit such a rush of current.

I have, however, now made an attempt to find the order of magnitude of the time lag in the generators of which the shafts were sheared off in the instance I gave, and as this, if correct, goes to show clearly that in some cases, if not in all, the dangerous rush of current is practically all over before the circuit-breaker acts, I have embodied the results in a diagram which I now send you to publish with this letter if you think it of sufficient general interest.



This diagram is based on the following assumptions:—

1. That the flux through the field magnets is not materially altered during a short circuit, due to the steadying effect of the shunt coils, &c.

2. That the flux through the armature core is also not materially altered; so that

3. We may regard the armature winding (considering the enormous rush of current which there tends to be on short circuit) as sensibly a coil of wire embedded in air; and the only path available for the lines of force (of its own making) as being in the confined space between the field and the armature, and the return path between the core discs.

We may then accept the solution for the establishment of a current in a solenoid under the application of a steady impressed E.M.F. as of the form given by Dr. Fleming on page 103 of his book, "The Alternating Current Transformer," Vol. I. Having calculated out the time-constant of the armature on the above assumptions, I draw a curve of the shape indicated by Dr. Fleming through a point (D) obtained by setting off the time-constant along the axis of abscissæ, the corresponding proportion (0·63) of the maximum short-circuit current along the axis of ordinates.

On the particular machine in question this occurs at about 3,700 amperes.

Assume that 5,000 amperes is the load at which the ultimate shear stress of the shaft would be reached, the ordinary working load of the shaft being only 250 amperes, a factor of safety of 20 being thus allowed (assuming load proportional to current, for the sake of simplicity).

We then see that the shaft would shear soon after the point (A) on the curve was reached; an interval of about ·0016 second from the commencement of the short circuit.

The automatic cut-out does not go till after the point (C) is reached, taking Mr. Dawson's statement of $\frac{1}{100}$th second for an "I.T.E." cut-out in preference to my own estimate of ·024 second.

It is evident that my calculation for the time-constant might be 1,000 per cent. wrong, and *yet* the circuit-breaker would hardly protect the generator.

If there is any external resistance (such as feeder or track) other than the dynamo, the time constant is *reduced*, and the circuit-breaker is still less a protection.

A. M. Taylor.

[We hope to show some diagrams which will throw some light on the question in an early issue.—Eds. Elec. Rev.]

Fly-wheels.

The ideal fly-wheel would probably vary its speed much more rapidly than the engine. A fly-wheel which would give up nearly all its energy when the engine slowed down, say, 10 per cent., would probably do its work very well and not be likely to do damage. It could also be made much lighter than the ordinary fly-wheel. These results could be obtained by running the fly-wheel by means of belting running on coned pulleys; the position on the coned pulleys being fixed by a governor. Or the fly-wheel might be made with heavy masses of metal arranged to slide on the arms. Normally these masses of metal would be constrained towards the centre by means of springs, but when the speed of the fly-wheel increased they would fly outwards and thus absorb energy owing to the increased velocity; when the speed of the fly-wheel decreased these masses would come towards the centre and so give up their energy.

Electrically the fly-wheel might be driven by a differentially wound motor in parallel with the main generator, the series coil being in opposition to the shunt. When the voltage of the main generator increased the series coil would weaken the field magnets of the motor and thus cause it to increase its speed. If the voltage of the main generator were to decrease then, owing to reversal of current, the series coils on the fly-wheel motor would tend to increase the strength of the magnets which would thus cause the motor to act as a generator and deliver energy to the mains.

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Most likely, however, the best solution of the difficulty will be to use accumulators as suggested in a recent number of *Cassier's Magazine*.

Charles Turnbull.

North Shields.

The Lancashire Electric Power Company as a Standby.

During the past few days the users of electric power in Manchester have had an experience to teach them the necessity of an independent source of supply in case of emergency.

It will be fresh in the minds of many people that a meeting of representatives of several municipal authorities was held at Manchester in January last to organise opposition to the above company's Bill; they did not wish anyone to supply electricity beyond their own municipal source of supply.

In a letter to several newspapers about that time, I contended that an independent source of supply was needed, and quote the following:—"This source of electric power may also be used as a standby, to be used in case of sudden emergency, or failure of the municipal source of supply."

Those who were opposed to the above scheme will perhaps see how convenient it would have been to have had some outside source of power as a standby to help the municipal source of supply out of a difficulty. The kind of accident that happened at Manchester last week is liable to occur in the best designed generating plant, with the same or even worse results. With a breakdown of gas generating plant it is possible to plod along for a time, but in the breakdown of an electric generating plant the stoppage is sudden, the only remedy being a large plant of storage batteries; so, even if a municipal authority has spent thousands of pounds in plant, it is not infallible, and I think those who opposed the above Bill will now see that there is something in having an independent source of electric power in their midst.

Thos. Winstanley.

Manchester, *September 26th*, 1899.

STANDARDS OF MEASUREMENT.*

The last report of this committee related to the redetermination of the electro-chemical equivalent of silver by Drs. Patterson and Guthe by means of a specially constructed electro-dynamometer. The result was 0·0011192 gramme per ampere per second. During the past year the same electro-dynamometer has been employed in making an absolute determination of the electromotive force of the Clark standard cell.

Two cells were made by the secretary of this committee in accordance with the specification which has been legalised in the United States. The two were made at an interval of a year, but at the same temperature they do not differ more than one part in 10,000.

The method adopted in measuring their electromotive force was to compare the electromotive force of the two in series with the fall of potential over the resistance of a coil of manganin wire immersed in paraffin oil, when the current through it balanced the torque of the phosphor-bronze wire of the electro-dynamometer when twisted through one complete turn. The comparison was made by applying the Poggendorff method to the cells and to the potential difference between the terminals of the manganin coil in succession. Since the resistance of the manganin coil is involved in the measurement, it must be known with accuracy; for this purpose two standard one-ohm coils were ordered from Wolf, of Berlin, with certificate from the Reichsanstalt. These coils arrived in June.

Three independent comparisons were made with the cells at 15° C. The temperature was measured by immersing the cells in a bath of petroleum, and taking the temperature by means of a thermometer made by Haak, of Jena, reading to fifths and calibrated at the Reichsanstalt. Its number is 11,021, and at 15° it reads 0·05° too low.

The result of the three measurements is 1·4333 volts at 15°. Glazebrook and Skinner, by the silver voltameter method, and assuming 0·001118 as the electro-chemical equivalent of silver, obtained 1·4342. Kahle found, by means of a Helmholtz electro-dynamometer, 1·4338. His value of the silver equivalent is 0·0011182. But Kahle says that silver nitrate neutralised by silver oxide gives a larger value for the electro-chemical equivalent by five parts in 10,000. Neither Kahle nor Glazebrook appears to have employed the neutralised silver nitrate solution. The value 0·0011192 was obtained by the use of the neutralised solution. Hence the silver equivalent for the solution used by Glazebrook equals 0·0011187. Assuming this value instead of 0·001118, Glazebrook's result is reduced from 1·4342 to 1·4332. This is practically identical with the value now reported by the secretary of this committee and Dr. Guthe, which is 1·4333.—Henry S. Carhart, *Secretary of Committee.*

* Report of the Committee on "Standards of Measurement," from *Proceedings American Association for the Advancement of Science.*

THAT BLESSED WORD "ELECTRICITY."

One of the greatest hindrances to the advancement of electrical knowledge in the popular sense is the facility with which unscrupulous individuals are enabled to trade upon the credulity of the uninitiated, by the cloak of mystery which shrouds all things electrical. One need only lay claim to the invention of some new and wonderful process or machine, making free use of the word electricity, but affording no actual details of the means employed, in order to become a hero in the eyes of the daily Press—and, therefore, of the public. This condition of things, has, unfortunately, been aggravated by the marvellous character of the genuine discoveries which have been made in recent years. When a man has been convinced by actual trial that he can see through substances which he has been accustomed to regard as opaque, and hear the voice of his friend beyond the sea, he is quite prepared to be told that his eyes are by no means indispensable to the faculty of seeing, or his ears to that of hearing, provided, of course, that the word "electricity" is employed.

Quite recently the non-technical papers have been deeply interested in an alleged discovery by a Mr. Stiens, who asserts that he can "make the blind to see." "My apparatus will," he says, "as in the camera, focus the rays of light from the object to the brain, and sight is given." . . . (We quote from a well-known morning paper.) The apparatus, of which absolutely no particulars are given, is said to be portable, and to be available for the ordinary practical purposes of life. A representative of the Press, who interviewed Mr. Stiens, was deeply impressed by a practical demonstration, but could obtain no explanation of the system. Mr. Stiens also claimed to give hearing to the deaf, even if the auditory nerve were deranged! Time will show how far these claims are justified.

Turning to another field of—*invention*, we learn that an American chemist and electrician has "solved the problem of robbing the air and its moisture of its power and storing it in a battery in the form of electrical energy."

To convert power into energy is a sufficiently colossal triumph; this, however, it is true, is frequently accomplished on paper by the non-technical press and by the engineer who ought to know better. "The cells collect the electrical energy directly from the atmosphere and give it up as power (*sic*) immediately." The use of steam is to be abandoned, &c., &c. As usual, the long-suffering and much misquoted Edison is dragged in to express an opinion in superlatives. We need not wait for time to deliver a verdict on this discovery. We have been used to hearing that electricity is in its infancy; truly, it is the electrical knowledge of the editors of non-technical, and of some technical, journals that is infantile.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending Sept. 27th, 1898.		Week ending Sept. 26th, 1899.	
Adelaide	Value £890	Antwerp. Elec. fuse	Value £246
Amsterdam	222	Barcelona. Teleg. mat.	100
Bombay	50	Bombay	21
Calcutta	98	Buenos Ayres. Teleg. mat.	295
Cape Town	138	Calcutta	982
Colombo	58	" Teleg. wire	112
Copenhagen	57	Cape Town	891
Durban	412	Channel Islands	8
Fremantle	53	Christiania. Teleg. wire	196
Hamburg	14	Colombo	208
Launceston	13	Durban	546
Madras	13	East London	73
Malta	24	Ghent	24
Melbourne	432	Gibraltar	12
Nagasaki	189	Gothenburg. Teleg. wire	29
Perth	306	Hong Kong	32
Port Elizabeth	44	Jamaica. Teleg. wire	78
Shanghai. Teleg. mat.	23	Launceston	117
Singapore. Teleph. mat.	108	Madeira	245
Stockholm. Teleg. wire	93	Madras	243
Sydney. Teleg. cable	210	Malta	87
Tientsin	108	Melbourne	120
Wellington	50	" Teleg. cable	514
		Montreal	25
		Ostend	76
		Penang	115
		Perth	73
		Port Elizabeth	98
		" " Elec. cable	150
		Rotterdam. Teleg. mat.	100
		St. Petersburg	45
		Stockholm. Teleg. wire	100
		Sydney	848
		" Teleg. cable	1,131
		" Teleg. mat.	197
Total	£5,618	Total	£8,047

Foreign Goods Transhipped.

Barbados. Teleph. mat. Value £106

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Ayr.—A new pipe organ, worked by electric motor, is to be erected at Cathcart Street Presbyterian Church.

Bankruptcy Proceedings.—A receiving order has been made in the case of F. G. W. Adams (of Downie & Adams, electrical engineers), 24, Newman Street, Oxford Street, W., on the petition of a creditor. The first meeting of creditors and the public examination are arranged for October 3rd and November 8th, respectively, at Bankruptcy Buildings, Carey Street, W.C.

A sitting for public examination was held under the bankruptcy of L. Lawrence, (trading as Lawrence and Butcher), electrical engineer, 5, Stafford Street, Old Bond Street, before Mr. Registrar Giffard at the London Bankruptcy Court on Tuesday last week, the statement of affairs showing liabilities £334 and assets £5. The debtor began business, without capital, at Stafford Street about four years ago. Six months later he was joined by Mr. Butcher, who found £200 for the business, and the partnership continued for 18 months, being dissolved in June, 1897, by mutual consent. He continued to trade until Christmas last as Lawrence & Butcher and then closed the shop and took offices at the same address, where he remained until June last, when the landlord distrained for rent. He had since been without occupation and dependent on relatives. About the beginning of December last negotiations were opened with a view to the formation of a limited company to take over his business. The capital of the company was to be £2,000, and he was to have received 1,000 fully paid up £1 shares, and his services were to be retained as managing director at a salary of £100 per annum. The company was duly registered on February 27th last as Lawrence and Butcher, Limited, but nothing definite came of the negotiations. He attributed his failure to bad debts, and to losses on contracts owing to ill health. The examination was concluded.

Liquidations.—The Western Counties Electric Light and Power Company, Limited, is winding up voluntarily for the purposes of reconstruction, Mr. H. Dyer, of Bank Chambers, Corn Street, Bristol, being appointed liquidator. He is authorised to register a new company (the Keynsham Electric Light and Power Company), and to sell and transfer all the assets, &c., of the old company to the new company under terms and conditions arranged in an agreement between the Western Company and G. J. T. J. Parfitt.

We are informed that the Phœbus Solder and Electric Soldering Fluid Company is in liquidation for the purpose of reconstruction.

"Beacon" Resistance Wire and Armature Binding Wire.—Messrs. W. N. Brunton & Son, Musselburgh, send us two samples of "Beacon" wire created to withstand damp and atmospheric influences. The first sample is of the wire as manufactured and supplied; the second is cut from a coil which has been exposed to weather for about seven months, close to their galvanising sheds where acid fumes and steam are the chief characteristics. This wire has lost almost nothing in diameter and is not by any means rusted, the only change apparent being a blackening of the surface. The firm is also manufacturing special tool steels of high quality and an armature binding wire to take the place of phosphor bronze or piano wire. They have already supplied a large quantity. It is easily soldered and has a high tensile strain. Our representative was recently shown through the works which are completely equipped for turning out the various specialties of the firm, one of which is a shaped wire, in various sections, for fine tools, and another a covered resistance wire for electrical instruments. All the work is carried on under the direct supervision of members of the firm, which is to a large extent a guarantee of thoroughness.

Books Received.—"Problems in Machine Design," by Charles H. Innes, M.A. Manchester: The Technical Publishing Company, Limited. 4s. 6d.

"Notes on the Construction of Cranes and Lifting Machinery," by Edward C. R. Marks, M.I.M.E. Manchester: The Technical Publishing Company, Limited. 3s. 6d.

"Terminal Index for Use with McNeill's Mining and General Telegraphic Code." London: Whitehead, Morris & Co., Limited. 7s. 6d.

"Electricity Simplified."—A popular treatise, by A. T. Stewart. Edinburgh: Bishop & Sons.

"Penrose's Pictorial Annual."—The Process year-book for 1899. London: Penrose & Co.

A British Ice Association.—The editor of *Cold Storage* writes to us as follows:—"In view of the increasing importance of the refrigerating, cold storage and ice industries, it has been resolved to form a British Ice Association to promote these trades, to benefit and safeguard the interests of members in all matters affecting their business welfare, to enable members to meet periodically and to correspond, to facilitate the interchange of ideas respecting improvements in the means of producing cold, and the applications thereof, and to publish and otherwise communicate information on such subjects. It is suggested that all British subjects having a real connection with the refrigerating industry, with the keeping of cold stores for the use of the public, and with the ice trade, should be eligible as members, and that provision should be made for associate and honorary members. The scheme has already gained strong support, but as some of your readers may not have heard of the proposal, I shall be obliged if you will permit me, through the columns of the Electrical Review, to invite any such to communicate with me at 19, Ludgate Hill, E.C.

British Fire Prevention Committee.—The arrangements for the Winter Session will again include a comprehensive series of fire tests, to which it has also been decided to invite distinguished guests from abroad, the almost international interest accorded to the work having led to a number of applications from foreign officials, architects and engineers to attend the experiments. In October there will be further investigations with doors of various materials, with floors, patented partitions, and non-inflammable materials. The operations of the testing station will then probably be extended to experiments with automatic fire alarms. Mr. G. E. Monckton has again taken up the duties of secretary, which ill-health compelled him to relinquish last February.

Catalogues.—The Edison & Swan United Electric Light Company has issued a new wire catalogue (Section V.), in which are included wires, cables, wiremen's tools and sundries, arc lamp carbons, dynamo brushes, jointing materials, casing and capping, wood blocks and sundries. In the opening pages there are some short notes on joint making which should be of service to the wireman, also on the selection of cables, the Ediswan "fall of potential" table, tables of sizes, weights, resistances and working currents of copper wires, a table of electric light wires and cables of various descriptions of insulation, &c., flexible wires and cords for incandescent lighting. Other tables are included of bell and telephone wires, telegraph and telephone trunk and aerial cables, soft binding wires, instrument wires, platinoid wires for instruments, resistances, &c. The list is as usual nicely arranged, and there are a good many illustrations of the various sundries described in the list.

From the Ward-Leonard Electric Company, of Bronxville, U.S.A., a list (997) comes to hand illustrating the principal types of rheostats and circuit breakers manufactured by them.

The British Electric Transformer Manufacturing Co., Limited, of Woodfield Road, W., have issued a well set out booklet of about 50 pages devoted to general notes on transformers, and especially to a description of the Berry type of transformer made by them. The relation of transformers to continuous current distribution, their application in tramway working, temperature rise, radiating power, ventilation, mechanical strength, ageing of iron, copper losses, overload, and various other matters, are commented upon, and a number of illustrations of Berry transformers are given, including one showing a bank of 250-kw. 11,000-volt transformers, built for the Metropolitan Electric Supply Company, and a 100 kw. three-phase transformer. There are several views of the company's works showing the several departments. Altogether the publication, which is well printed and illustrated, possesses considerable interest.

Messrs. Julius Harvey & Co., of Queen Victoria Street, E.C., send us a copy of their new catalogue of steam, oil, and electric motor vehicles. In each of the sections specimen motor cars of various kinds are shown, but the electrical section comes off badly with only one item, and that an expensive electrical victoria. We understand that Messrs. Harvey lay claim to being pioneers in this growing industry.

Correction.—In a recent issue we stated that Messrs. Philips & Co., of Eindhoven, Holland, have a daily output of incandescent electric lamps amounting to 15,000 c.p. The daily output is, however, 15,000 lamps, not c.p.

The D.P. Battery Company.—We are informed that the successful candidate for the appointment of works' manager at the company's new works, which are now in full operation, is Mr. W. S. Worthington, late of the Epstein Accumulator Company.

Educational Notices.—We have received from the Electrical Engineer Institute of Correspondence Instruction, New York, a catalogue of electrical engineering, mechanical engineering and other courses. The booklet is made the more interesting by photographs of about 20 past and present leaders in electrical science. The courses taught include all branches of electrical engineering, including electric lighting, electric railways, electric mining, telephony, telegraphy, mechanical engineering, mechanical drawing, &c. Mr. Joseph Wetzler, M.E., E.E., is the President of the Institute, and Mr. T. C. Martin, editor of the *Electrical World and Engineer*, is vice-president. The catalogue will be sent free on application to the main office, 120-122, Liberty Street, New York.

The Birkbeck Literary and Scientific Institution has just issued its calendar for the 1899—1900 session, giving syllabus of classes, schemes of work, results of examinations, &c. Illustrations are given of some of the departments, including the electrical and chemical rooms.

For the Northampton Institute electrical engineering department an instructor in electrical engineering design and calculations is wanted for evenings, also a junior technical assistant for full time. See "Official Notices" this week.

The Council of the North of England Institute of Mining and Mechanical Engineers, in collaboration with the Council of the Durham College of Science, have arranged a course of lectures for colliery engineers, enginewrights, apprentice mechanics, and others, to be delivered at the Durham College of Science, Newcastle-upon-Tyne. The course will extend over three winter sessions. The delivery of the course of lectures will commence on September 30th, 1899. Particulars on application to Mr. F. H. Pruen, Secretary, Durham College of Science, Newcastle-upon-Tyne, or Mr. M. Walton Brown, Secretary, North of England Institute of Mining and Mechanical Engineers, Neville Hall, Newcastle-upon-Tyne.

Enclosed Arcs for Illumination Purposes.—The British Thomson-Houston Company has issued another of its beautifully illustrated pamphlets. The present one is entitled "Artificial Illumination by Means of Enclosed Electric Arc Lamps." The good points in enclosed arcs for shop window illumination, interior works, and mill lighting, are emphasised, the advantages of an efficient lighting system, both from an advertisement point of view and on account of increased volume and efficiency of work executed, being stated. Considerable weight is given to these words by a number of photographic reproductions of shop showrooms and works interiors lighted by enclosed arcs, the benefits of electric lighting being still more distinctly shown in a view of a furniture

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establishment lighted by incandescent gas, the effect being such as to convey the impression that the mantles were quite ready to shuffle off this mortal coil.

Fire.—The Incandescent Electric Lamp Company notify that the fire which occurred in the Robertson Electric Lamp Works was rapidly overcome owing to the promptness of the firm's own fire brigade. No damage was done, and the supply of lamps will not be interfered with in any way.

For Sale.—From our advertisement pages particulars may be obtained of a proposed sale of goodwill, plant and machinery, stock-in-trade, patent rights, and book debts in the business of Sydney F. Walker (S. F. Walker & Co., Severn Road, Cardiff). The sale is to be conducted by Messrs. W. C. Clarke & Davey, of Cardiff.

Liner Lighting.—Messrs. W. C. Martin & Co., electrical engineers, Glasgow, have secured the contract to fit the large Cunard Liner *Ivernia*, launched at Wallsend on Thursday last week, with electrical plant for lighting and power. The electric lighting of the vessel is to be on a very extensive scale, the plant consisting of two compound engines coupled direct to two dynamos, each set capable of supplying power to light 1,500 8-c.p. lamps. A powerful search light giving 20,000 c.p., is to be fitted at the bow of the steamer for navigating purposes, and a thorough system of heating and ventilating all the rooms, machinery and cargo spaces will be installed. Ten 3-B.H.P. electric motors and 10 30 inch fans, direct driven, will be fitted. Five of the fans are to drive cold air through Stewart's patent thermo-tanks heated by steam, where the air will be heated to a certain temperature, and then carried into each room by ventilating trunks. The other five fans will exhaust the foul air from the holds at the rate of 12,000 cubic feet per minute. Electric motors will also be used for driving the hair brushes in the barber's shop, and for other purposes throughout the steamer.

New Book.—Messrs. Whittaker & Co. have just published "Electric Wiring, Fittings, Switches, and Lamps," by Mr. W. Perren Maycock, M.I.E.E.

Penistone Electrical Company.—This firm has now completed the transfer of the electrical department to its new works at Huddersfield, and in conveniently arranged premises and with up-to-date tools and machinery, is occupying itself with the manufacture of switches, switchboards, fuse and distribution boards, galvanometers, volt and amperemeters, railway instruments and bells, with Mr. V. J. Delebuque as works' manager. About 60 hands are now fully employed, and this number will be largely increased when further alterations are completed and more machinery is installed. The old premises at Penistone are being retained for the wood working department, employing 60 hands. Offices and clerical staff are at Huddersfield.

Portable Plant.—*Tenders and Contracts* says that in carrying out the repairs of the Torcenay tunnel on the Eastern Railway of France, a portable electric light plant is employed. A railway truck carries a petroleum engine driving a dynamo, which furnishes current, both for propelling the truck by means of a motor and for lighting the works in the tunnel with four to six arc lamps or 20 to 40 incandescent lamps.

Schuckert Tram Schemes.—The British Schuckert Electric Company, Limited, which is now developing its business within our borders, has just issued a list in which it gives in tabulated form the names of towns where electric tramways have been constructed or equipped by the Elektrizitäts-Aktiengesellschaft vormals Schuckert & Co., Nuremberg, in France, Germany, Spain, and other Continental countries. The total number of such lines running or under construction on January 1st, 1899, was 56, with a length of 476 miles and 1,121 motor cars. The table before us gives the year of opening, length of track, number of cars, H.P. of motors, station and accumulator K.W. capacity, and other notes.

Steam Lorry at Messrs. Johnson & Phillips.—Messrs. Johnson & Phillips have started a steam lorry in their cartage department. The lorry is built to carry 4½ tons and has been supplied by the Liquid Fuel Engineering Company. We understand that the firm are very well satisfied with the innovation. The heavy load which can be dealt with in a single journey has been found a specially valuable feature.

Trade Announcements.—The offices of the German Atlantic Telegraph Company have been established at Cologne, Stolkgasse 3—11.

Messrs. H. C. Yeo & Co., have removed from 34, Aldermanbury, E.C., to 38, Gracechurch Street, E.C.

The St. Helens Cable Company, Limited, notify that they have taken over the business carried on by Messrs. W. J. Glover & Co. for the past 80 years. The St. Helens Company will carry on the business of wire drawers, wire rope, electrical wire and cable manufacturers, rubber and insulating material, &c. The works will be under the direction of Mr. W. J. Glover and Mr. R. B. Glover. The electrical cable and rubber works at Warrington will be supervised by Mr. Heyl-Dia.

ELECTRIC LIGHTING NOTES.

Alderley Edge.—The supply of electricity has just been commenced by a company which has registered offices in Manchester. Works have been erected at Belmont, near Alderley Edge, and the company has secured the Board of Trade order from the Alderley Council, and has, therefore, full powers to supply in all parts of the district. The company has offered to supply the Wilmslow Council.

Bermondsey.—The Vestry will not offer objection, under certain conditions, to the proposal of the London Electric Supply Corporation to lay high and low tension distributing mains and to construct street boxes in Rothsay Street. The Electric Lighting Committee has sent a circular letter to the parishioners stating that the Vestry hopes to be shortly in a position to supply electricity. Inquiries from large firms have been received.

Birkenhead.—Colonel W. Langton Coke held a Local Government Board inquiry last week respecting an application by the Corporation to borrow £5,000 for supplying electricity to the outlying townships of Bidston and Noctorum.

Birr.—The question of lighting the town by electricity is to come before the next meeting of the Urban District Council.

Burton-upon-Trent.—Notice is given that the system adopted by the Corporation for the supply of energy under the Electric Lighting Order, 1890, approved by the Board of Trade on September 17th, 1892, has been revoked, and that the system henceforth to be adopted by the Corporation is that of a high pressure alternating current supply to sub-stations, distributing at low pressure to consumers and public lamps.

Cheltenham.—The accounts of the Corporation electric lighting department for the year ended March 31st, 1899, are as follows:—Number of customers, 302; 8 c.p. lamps, 18,980, say, 19,000; electric energy generated, 507,830 B.T.U.; used in street lamps, 192,712; sold to private customers, 183,122; used at electric works, 16,898; used at electric works, central offices, stores, &c., for lighting, and for testing and drying transformers, &c, 14,800; unaccounted for, 100,298 = 507,630. Number of public lamps:—Arcs, 134; incandescent, 13; maximum rate of supply, 360 K.W.; total capacity of plant (including spares), 800 K.W.

Coatbridge.—On the application of the Coatbridge Town Council, the Glasgow Corporation has agreed to allow its electrical engineer, Mr. Chamen, to advise that town as to the proposed taking over of the undertaking of the Coatbridge Electric Lighting Company. There was a small opposition—which proved unsuccessful—to the proposal in the Glasgow Corporation meeting, on the ground that it was against the usual principles at Glasgow, and further, Mr. Chamen's hands were already more than full of work.

Croydon.—At a meeting of the Croydon Corporation on Monday, the Lighting and Electricity Committee presented a report recommending that extensions be carried out to provide for the supply of electric light to the houses in course of erection on building estates which are being developed at Norbury. The cost of the necessary sub-stations, cables, distributors and other plant was estimated at £23,320. The Corporation adopted the committee's recommendation, and agreed to apply to the Local Government Board for leave to borrow the amount of the estimate.

Dawlish.—Messrs. Taylor & Field have been engaged to report on the subject of an electric lighting undertaking for Dawlish.

Dewsbury.—The Co-operative Society is sending a deputation to Barnsley to inquire *re* the working of the electric plant at the Barnsley Co-operative Society's establishment. Estimates have been got out for engine and boiler houses, and equipment, including two gas engines.

Diss.—The Urban Council's clerk has, in accordance with instructions, written to the Suffolk Electricity Supply Association, asking whether they are willing to light the whole or any part of the town with electricity, and has also advertised for tenders for lighting. He has received a reply from the company to the effect that it would not pay them to light the whole of the streets unless they could contract for a long term of years, on account of heavy expenses which would have to be incurred. They, however, recommended that the main streets, say, from the bottom of Mere Street to the top of Mount Street, and thence to Crown Hotel, should be lighted with six arc lamps, each of 650 c.p. These the company would be prepared to fix and light for eight months in the year for £65 per annum, and they would lessen the number of gas lamps in the town by about 15. The chairman remarked that if they accepted this offer they would largely increase the cost of lighting. An offer to light the existing gas lamps with oil was then discussed for 30s. per lamp on a two years' contract. This is to be further considered.

Epsom.—A Local Government Board inquiry was held last week into the application of the District Council to borrow £16,100 for electric lighting purposes. The only opposition offered was by two members of the Council. The Board has already sanctioned the borrowing of £2,500 for a site for the proposed works.

Forgan.—The Tayside Electric and Gas Light Company has the consent of the local committee to its application for a provisional order for electric lighting at Forgan.

Hastings.—A Local Government Board inquiry has been held into an application of the Town Council to borrow the sum of £38,613 in connection with the extension of the electric light works, which were recently acquired by the Corporation.

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Glossop.—With regard to the transferring of the electric lighting order to a company, the Town Council has been notified that the Edmundson Company is willing to reduce the previous quotation 1d. per unit, and is willing to afterwards sell the concern to the Corporation at a valuation. The estimate of the engineer was that the cost for lighting Glossop would be £15,000 in round figures, and £1,800 more if Hadfield were included. After discussion, it was decided not to carry out a municipal scheme, but to negotiate with a company which would, and to include the Hadfield district in the lighting area.

Hampstead.—The Vestry is to proceed with the extension of electricity supply mains in a number of thoroughfares as yet unsupplied.

Handsworth.—The General Purposes Committee of the District Council having obtained a provisional order for electric lighting, it only remains for the Council to give its sanction in order that the work may be put in hand. This will probably be settled at the next meeting.

Kirkcaldy.—The Electric Light and Tramway Committee has had before it several offers from companies for carrying out the electric lighting scheme, from which it appears that electricity can be supplied cheaper than gas costs at present. Other offers are yet to come in.

Leigh.—The District Council's electric lighting scheme (£10,500) is making progress. The whole of the mains have been laid, and the generating station is almost completed. Lighting is expected to be commenced in November. It was originally decided to light only the compulsory area, but already an extension is proposed, and the electrical engineer has under consideration proposals to lay mains in other roads.

Littleborough.—The Council has passed a resolution authorising an application to the Board of Trade, under the Electric Lighting Acts, for a provisional order to supply electricity for both public and private purposes within the district.

Llandudno.—Last week Colonel A. J. Hepper, R.E., held an inquiry on behalf of the Local Government Board into the application of the District Council for leave to borrow, amongst other items, the sum of £11,250 for electric lighting and motive power purposes. Part of this amount (£8,000) is intended to provide plant for the supply of power to the Llandudno-Colwyn Bay Light Railway.

The District Council has resolved that application be made to the Local Government Board for sanction to borrow a sum of £6,066 to cover expenditure over and above the amount already sanctioned in relation to the electric lighting and refuse destructor works, and including further expenditure estimated to be required to complete the work in hand.

London.—In regard to the matter mentioned under "Mile End" last week, the Vestry decided to apply to the Board of Trade to revoke the order and grant one to the Vestry. The Whitechapel District Board has now considered the matter, and has resolved to invite a conference of the local authorities in the Tower Hamlets, about to be merged in one municipality, with the view to thoroughly considering the question, so that only one centre of supply will be wanted.

We read that work is proceeding upon the erection of a central station for lighting the Embankment by electricity. The works will be close to Charing Cross Railway Station. Both sides of the Embankment are to be illuminated, 28 arc lamps being placed on the kerb on the land side and 29 on the river side.

The Vestry of St. Martin's have, according to the *Pall Mall Gazette*, entered into a contract with the Charing Cross and Strand Electricity Supply Corporation for the electric lighting of the principal thoroughfares in the parish, acting on the suggestions contained in a report prepared by their surveyor, Mr. George Green. Dealing with the question of combining the destruction of dust, with the supply of electric light, Mr. Green pointed out that such a scheme had been successfully worked in Shoreditch, where the steam generated from the furnaces used for the destruction of house refuse had been utilised for the production of electricity. But St. Martin's parish, for several reasons, was neither suitable for the generation of electricity nor for the destruction of house refuse. According to Mr. Green's plan, 28 important thoroughfares will be lighted by 92 lamps. The lamps in the Haymarket and near the other boundaries of adjoining parishes will be joint-lamps, the cost of erection and maintenance being shared equally by the parishes concerned. The extra cost of lighting the parish by electricity will be £1,362 per annum for the first seven years, and afterwards £561 per annum more than the present gas lighting, but the lighting power will be increased by 79,000 candles. The streets will be lighted by direct current arc lamps of not less than 1,000 C.P. The Charing Cross and Strand Company are now busy laying a cable in Charing Cross and Whitehall, as far as the Horse Guards, which forms the boundary of St. Martin's on the south, and it is expected that the installation will be completed before mid-winter. The Highway Committee of the Westminster Vestry has under consideration the question of lighting the parish by electricity.

Marylebone.—It is stated that the Vestry will this week consider whether to invite the vestries and public authorities whose districts are supplied with the electric light by the Metropolitan Electric Supply Company, to appoint representatives to attend a conference to consider the question of the purchase of the company's undertaking for the benefit of the consumers and the ratepayers. Although this scheme may not prove practicable, it is said that there is some serious intention on the part of the London County Council to promote a Bill or a clause in a general powers Bill, to empower the metropolitan local authorities to combine, with the object of purchasing electric light undertakings whose sphere of activity extends over several districts. As far as the business of the Metropolitan Electric Supply Company in Marylebone is concerned, the Vestry will shortly consider a report dealing with the question of purchasing that portion of the company's works, plant, and distributing mains situated in Marylebone alone. Two valuations have already been made with this object in view. On behalf of the company, Messrs. Deloitte, Dever, Griffiths & Co., put the capital expenditure on the Marylebone section at £319,735, and they estimate the goodwill at £613,476, or a total of £933,211. Messrs. Whamond, Williams and Co., for the local authority, agree as to the capital outlay, but they only allow £323,845 for goodwill and other items, making a total of £643,580.

Manchester.—Mr. C. H. Wordingham, the city electrical engineer, is circulating a list of the charges for energy. These are as follows:—

1. A charge of 5d. per Board of Trade unit consumed, with a minimum charge of 8s. 4d. per quarter.
2. A fixed charge of £7 per annum per kilowatt of maximum demand, plus 1½d. per Board of Trade unit consumed. This method of charge works out to a sliding scale, whereby the price per unit diminishes as the number of hours of user per annum increases.

This is shown by two tables showing the number of hours which a consumer must burn his lamps in order to obtain current at a certain rate, and showing the average price per Board of Trade unit when certain hours of burning are reached.

In the case of motive power two special rates are in use:—

(*a*) The first relates to consumers who guarantee to use their maximum demand for not less than 48 hours per week. To these consumers the fixed charge is remitted entirely, and they are charged only a 1½d. per Board of Trade unit consumed.

(*b*) The second rate applies to consumers who use their motors for less than 48 hours per week. These consumers have the option of paying either by the fixed charged method, or at the rate of 2½d. per Board of Trade unit consumed, without any fixed charge.

An explosion took place in a conduit on Tuesday morning. No great damage was done.

Nenagh.—The proposal to introduce an electricity supply is being supported with vigour, especially by Mr. T. M. Tobin, who originated the project. Messrs. Clayton, Weldon & Co., of Dublin, estimate that electricity could be supplied at about 5d. per unit with steam power, but, as ample water-power is available in the district, the price could probably be made still less. The scheme will be dealt with at the next meeting of the Town Commissioners.

Newport (Mon.).—Messrs. Baker & Co. having intimated to the Electricity Committee that the charge for electricity supplied in the June quarter was £126, and that they would have to discontinue the use of electricity unless a reduction could be made in the rate, the Committee decided that, as Messrs. Baker's enormous consumption was almost entirely a day load, the rate should be reduced from 4d. to 3d. per unit consumed in the daytime, for a minimum of 6,000 units.

Penzance.—The Town Council has resolved to obtain powers to carry out an electricity supply scheme.

Plymouth.—On Friday last the electric light and tramway undertaking was publicly inaugurated. Everything went off well. The Mayor performed the necessary ceremony, and the chairman of the Electric Lighting Committee in a brief speech referred to the history of the scheme and some of the difficulties which had had to be overcome. The large party of municipal Councillors and officials and friends then proceeded in five cars over the route, and luncheon at the Guildhall followed. Various toasts were gone through, and a presentation of a bronze figure bearing an incandescent lamp was made to the Mayor in commemoration of the occasion. Mr. J. H. Rider, the electrical engineer who has piloted the scheme through its difficult stages, delivered a speech in response to a toast, and gave some details of the work carried out. He predicted a profitable future for the undertakings both in private lighting and in tramway working. The power station started with a total load, besides the 8,000 private lamps, on tramways and arc lamps equivalent to 17,000 incandescent lamps. That was a record load for any station in this country to start with. Mr. Ferranti replied on behalf of his own firm and the others who had taken part in the equipment to "The Contractors" toast.

Queenstown.—The Urban Council has decided to have notice served on the gas company annulling the gas lighting contract, and the clerk is to advertise for tenders for the lighting of the compulsory area by electric light from January 1st next. It was also decided to advertise for the balance of the lighting of the town for same period.

Shildon.—A long report has been submitted to the District Council by Messrs. Handcock & Dykes on the question of electricity supply in connection with a refuse destructor. Their estimate states that the annual supply, 10,000 tons of refuse, is equivalent to 2,000 tons of coal (1·5 lbs. of steam per 1 lb. refuse), and they recommend that plant be laid down for the supply of 2,000 10-C.P. lamps and 80 public lamps, at a cost of £12,000. An innovation, or, rather, a return to primitive methods, is the suggestion that the lamps should be charged for at a fixed rate (probably 3½d. each per week) irrespective of the number of hours during which they are alight. The matter has been referred to a committee.

(*Continued on page* 523.)

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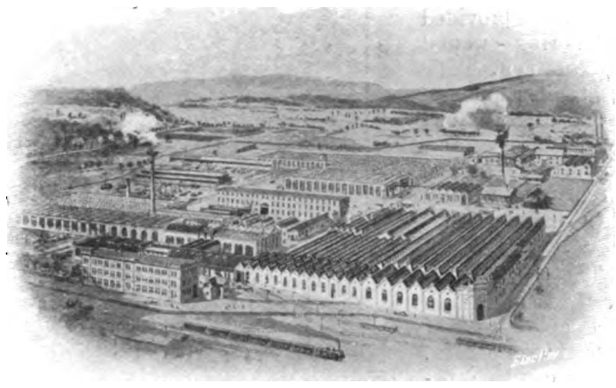
THE OERLIKON ENGINEERING WORKS.

By the courtesy of the management, we are enabled to give a number of illustrations of this famous factory, in which no less than 15,000 electric generators and motors have been

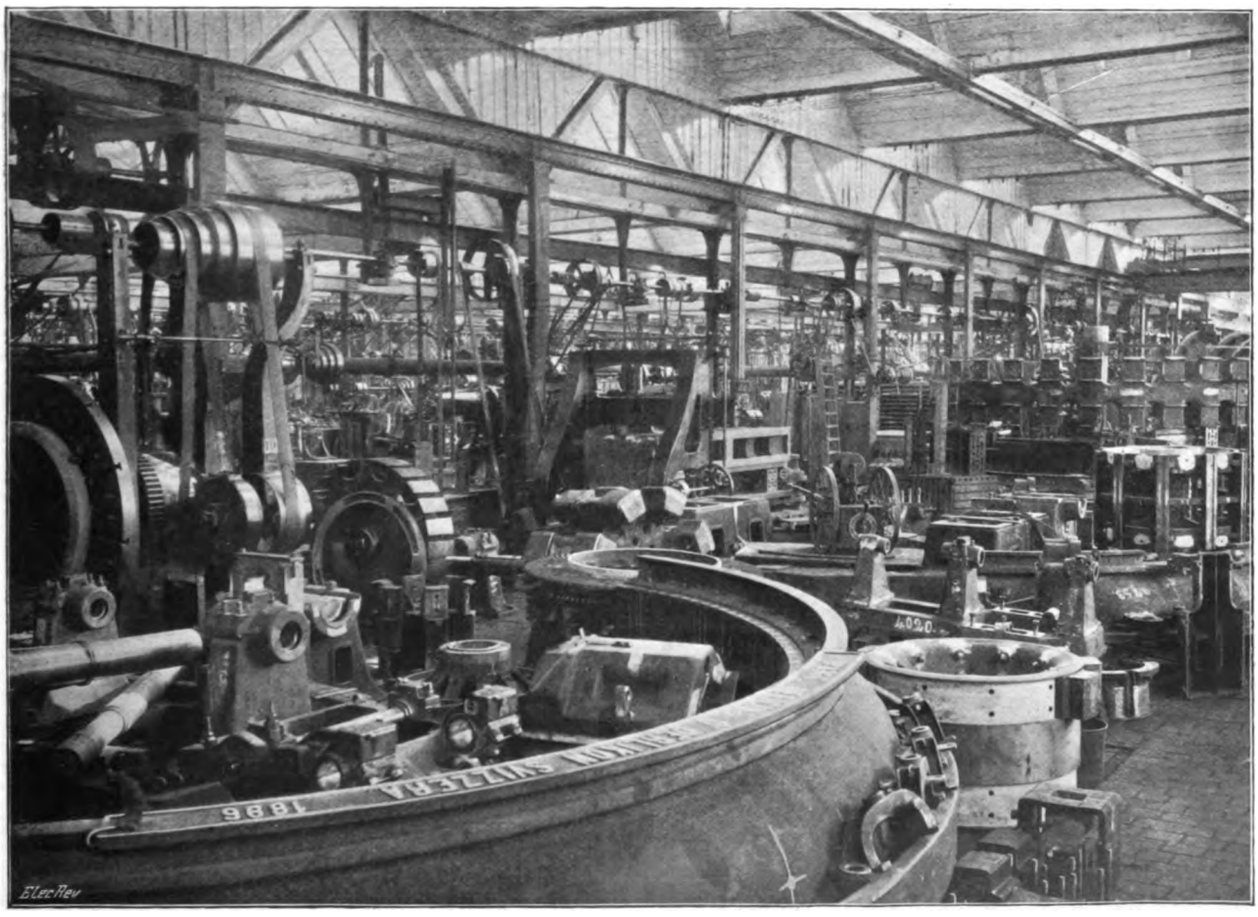
Oerlikon Tramcars, and Landes Museum, Zurich.



The Oerlikon Works.

built. The works was originally founded, in 1871, for the manufacture of steam engines and mechanical tools, and for general engineering business; a special feature from the first was the making of porcelain roller mills, of which over 14,000 have been turned out, and which are still an important part of the company's output. In 1880, however, the construction of electrical machinery was taken up with energy, and soon became the chief factor in the company's prosperity; as is well known, the Oerlikon works was among the first to make use of the applications of polyphase currents, and to push on the development of the induction motor.

The workshops, offices, &c., now cover an area of 8 acres. The number of workmen employed is about 1,800, under a staff of 250. Practically the whole of the machinery is driven by electromotors, mostly of the three-phase type. Part of the power is derived from a water-power plant at Hochfelden, 14 miles distant, where three turbines of 200 H.P. each drive three-phase generators. The current is transformed up to 13,000 volts for transmission to Oerlikon where it is reduced by oil transformers to 200 volts for distribution throughout the works. In addition, a 300-H.P. Sulzer engine and two large 10-pole steam dynamos with ring armatures are installed at the works, while a 600-H.P.



Mechanical Workshop.

Stator in foreground, rotor on vertical lathe in background, of 1,000 H.P. 8-phase generator for Genoa.

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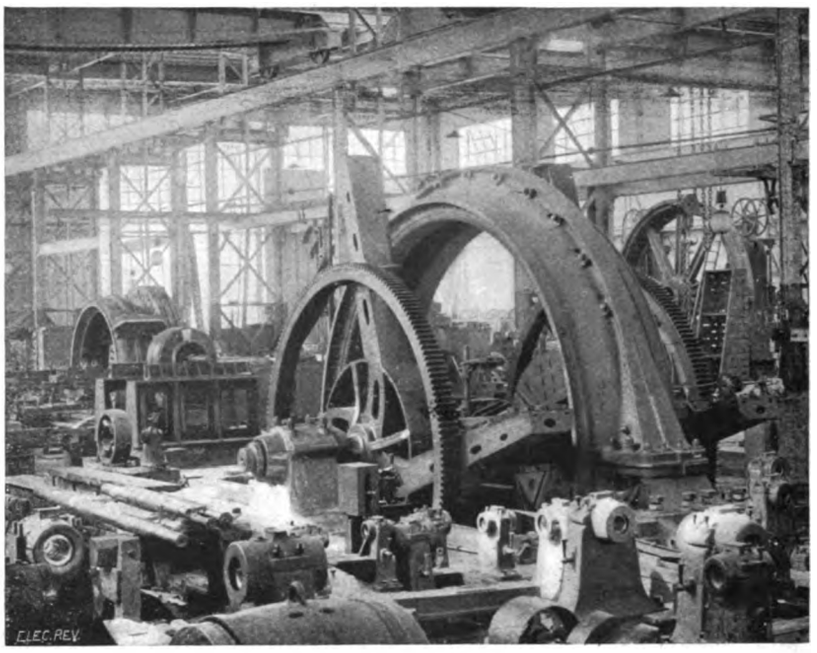
steam alternator with fly-wheel armature and laminated poles is being erected to run in parallel with the transformers. The works are lighted with direct current at 125 volts. On the occasion of our visit we were surprised to observe the large proportion of multipolar direct current machines which were provided with ring-wound armatures. The most important type of machine, however, was, of course, the three-phase alternator, usually with inductor fly-wheel.

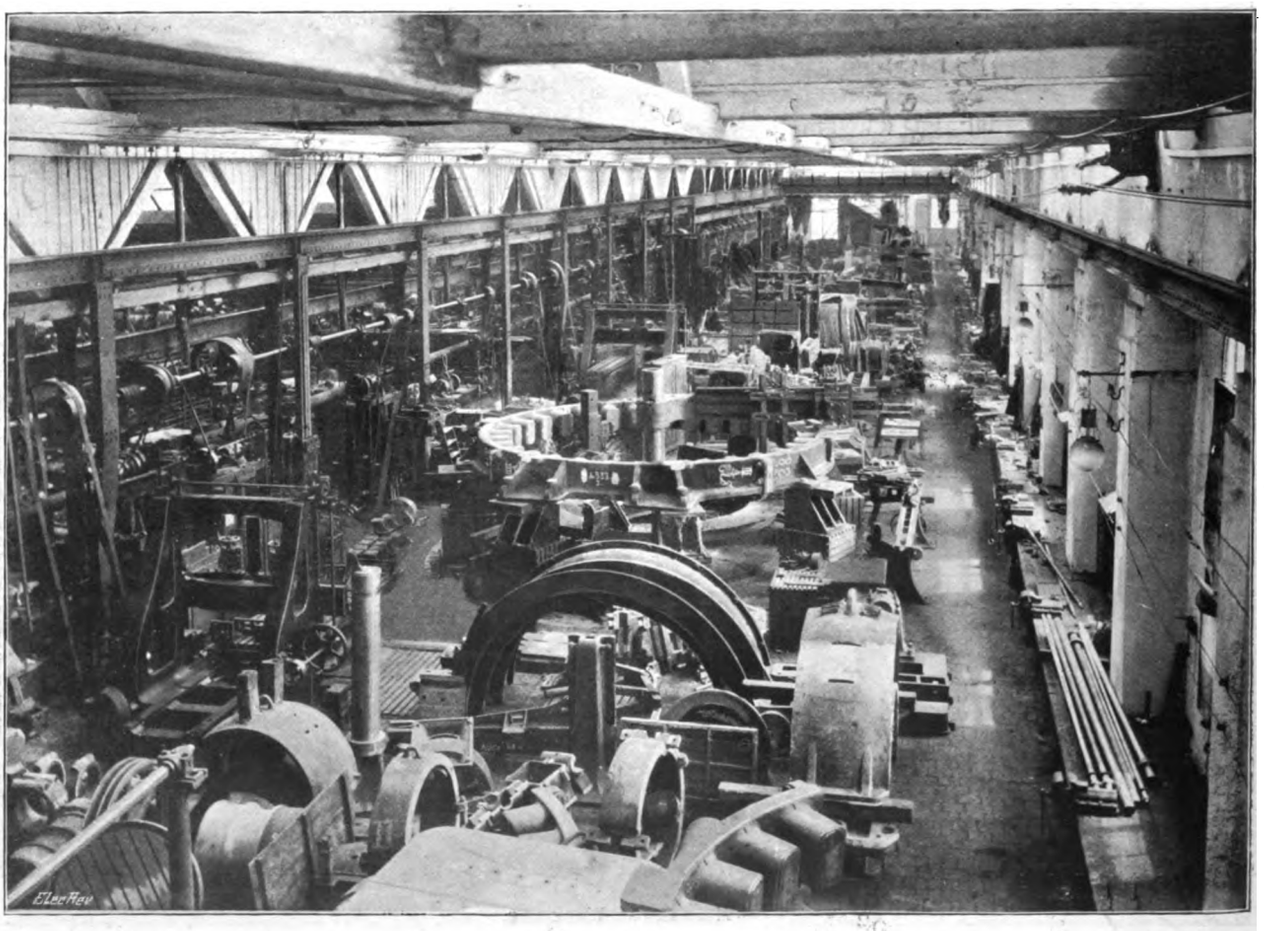


ELECTRICAL FITTING-SHOP.
Stator of generator for Letten Station, Zürich, on 21 feet boring lathe.

The Oerlikon inductor is built with a double set of armature coils, which can be separately removed without displacing either rotor or stator. Several induction motors were provided with a device, by means of which, after the motor had been run up to speed with external resistances, the rotor could be internally short-circuited, and the brushes raised. White metal is used almost universally for bearings. The cores of the stators of induction motors, which are always hole-wound, are bored out after assembly, until the roof of the tunnels is extremely thin; but it is not intentionally cut through. The radial clearance allowed is very small, usually about 0·6 or 0·8 mm. The travelling cranes, which are operated by three-phase motors, resemble the majority of those seen in the Swiss works, in having multiple flat-link chains for lifting. A simple device for avoiding eddy currents in cores due to burrs is seen in our view of the core-disc shop, in the shape of an automatic quick-stroke hammer with a large flat foot; the discs are moved about on the anvil until they are thoroughly flattened and the burrs beaten down.

A considerable amount of work has been done by the Oerlikon Company in laying down and equipping electric tramways, usually with direct current machinery; in some cases, however, the three-phase system is used, notably on the Jungfrau Railway, a locomotive for which was in the shops at the time of our visit.

There are 94 motors about the works, 860 lathes and other tools, and 18 electric cranes, with an average lifting power of 12 tons. The output of electrical generators, motors, &c., was 3,205 last year, and direct current machines have been built weighing up to 115 tons. It is remarkable that the



MECHANICAL WORKSHOP.
Field carcase of 810-H.P. dynamo for Rheinfelden, in 21 feet vertical boring lathe.

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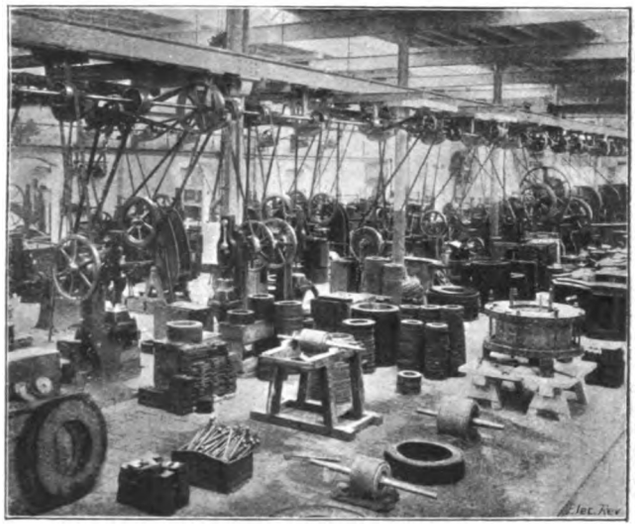
largest alternator ever built at Oerlikon was 96 tons in weight, so that direct current holds the record.

THE ELECTRICAL ENGINEERS' SWISS TOUR.

(*Continued from page* 468.)

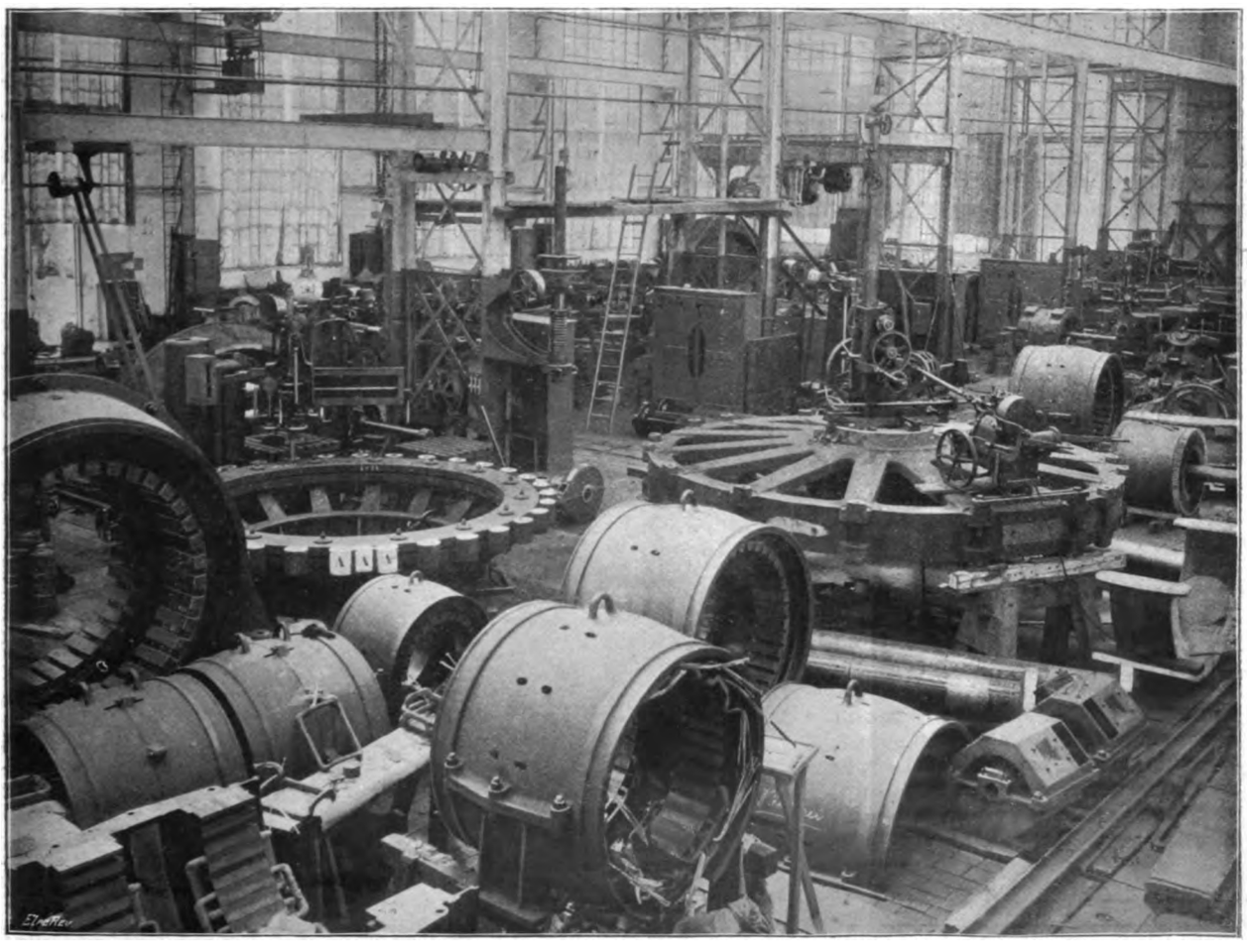
The first item on the programme for Monday, September 4th, was a visit to the world-famed Oerlikon Works, of which we give some photographs showing the work in progress.

The Oerlikon Engineering Works.—Iron Foundry.



The Oerlikon Engineering Works.—Punching Department.

Street Railway, a direct current overhead trolley line. There are three Oerlikon four-pole dynamos in the station, coupled direct to single-cylinder gas engines of 125 H.P. each, and running at 180 revolutions per minute. The engines are of the Deutz type, with hit-and-miss governors and electric ignition; each is provided with two heavy fly-wheels, and is insulated from the dynamo by the coupling, which is flexible, as appears to be usual in Switzerland. The dynamos have very wide commutators, with four sets of carbon brushes; they are provided with continuous ring lubrication, and are insulated by porcelain insulators from earth.



The Oerlikon Engineering Works.—Electrical Fitting-Shop.
1,000 H.P. 3-phase rotor for Schiffbauerdamm station, Berlin, with keyway shaping machine driven by 2½ H.P. portable motor. Stators of 250 H.P. 3-phase generators in foreground.

Before entering the works the party divided, and one section proceeded to the power station of the Zürich-Oerlikon

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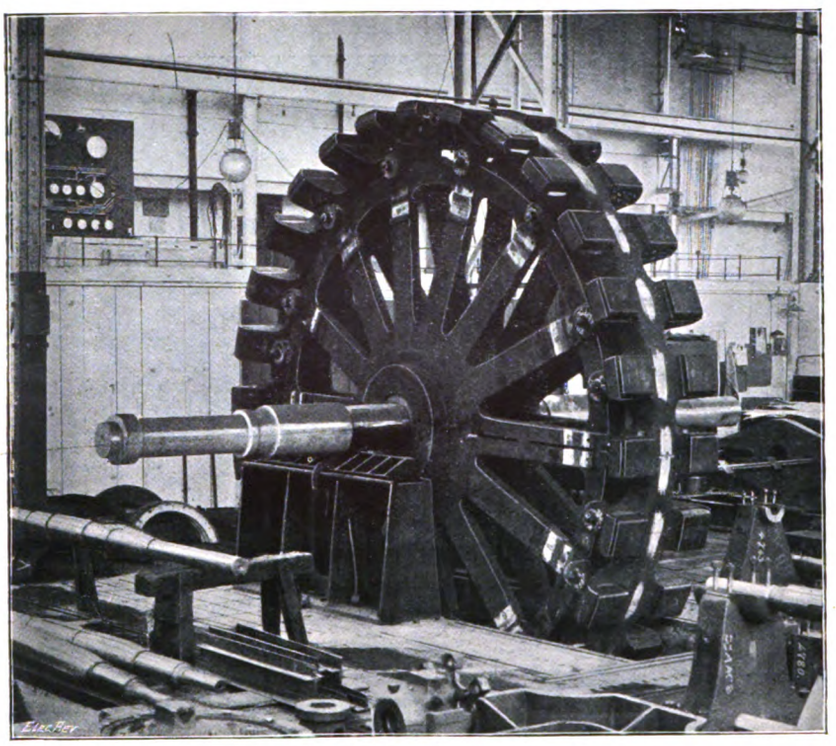
There is a large battery of Tudor accumulators, with an automatic regulating switch, and booster for charging. Dowson gas is used, the consumption of coal being 1·43 lbs. per B H P.-hour. We noticed that the current from one of the dynamos varied from 110 to 140 amperes at every stroke, while the current flowing to the battery varied from 15 to 40 amperes; the battery, therefore, practically annulled the irregularity as regards the feeders. The whole undertaking was carried out under the direction of the Oerlikon works, which was visited immediately after the power station; some notes about the works are given in the preceding article.



The Oerlikon Engineering Works.—Rotor of 1,000-h.p. Three-Phase Generator for Schiffbauerdamm Station.

The visitors returned to Zürich by tramway, and, having lunched, proceeded next to visit the works of Escher, Wyss & Co., where an unexpected variety of interesting features was met with. The operations of the firm are by no means confined to the manufacture of turbines; a large number of steam engines are also turned out. The respective figures are, since the foundation of the firm in 1805—2,800 turbines, of 250,000 H P., and 2,850 steam engines, of 195,000 H P.; while last year 103 turbines and 67 engines were built. The largest turbine was designed for 1,500 H P., and the largest engine for 1,200 H P.; it will be seen, therefore, that the work of the firm is of no small magnitude and importance.

Other products of this well-known factory are boilers, steamships, gas engines, paper-making machinery, &c. As might be expected, the works occupy a large area, about 25 acres; there is also a branch establishment at Ravensburg almost as large.

Amongst other interesting items we noted a neat automatic band saw sharpening machine, a pneumatic rivetter, hydraulic hammers, automatic shaping tools for wood and cast-iron bevel gear, and a lathe with revolving tools turning up a crank-pin. Casting has been elevated to a fine art; there is an immense foundry, and some of the castings were of great size and weight. One large fly-wheel, for 21 ropes, was 27·7 feet in diameter, and was cast in 12 segments.

The machines are electrically driven with three-phase current at 125 volts, power being transmitted at 5,000 volts from a turbine station at Bremgarten.

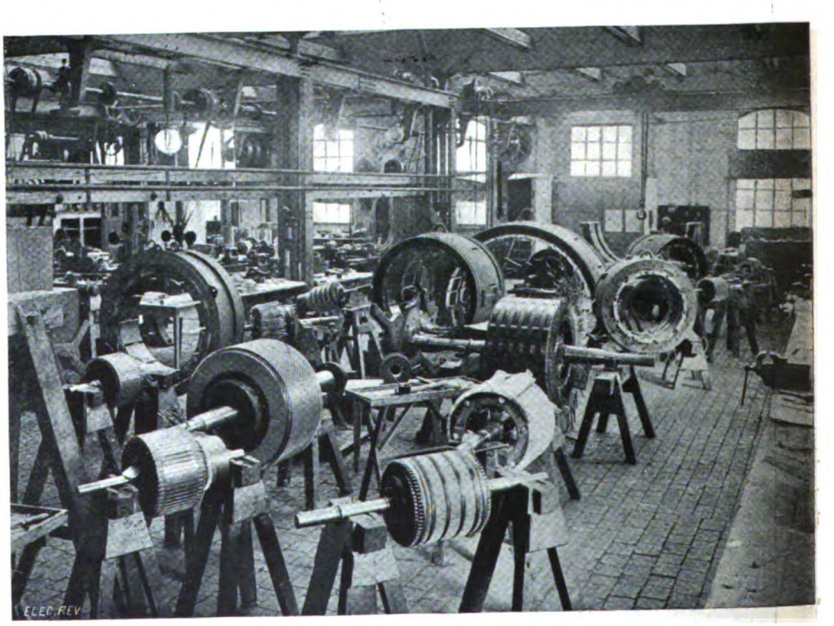
The next visit was to the Letten central station, which was especially interesting on account of the variety of the machinery employed. This station supplies electricity for lighting, traction, and industrial purposes to the town of Zürich, deriving the motive power from a number of turbines and three steam engines. The river Limmat is the source of power, the maximum available being 1,600 H.P.; Jonval turbines are used, with a fall of at most 10 feet. The electricity supply is carried out with single-phase current for lighting and power, three-phase for transmission to a tramway sub-station, and continuous current for direct supply to the tramway.

The single-phase machines have Kapp's ring armatures, while the three-phase generators are of the Oerlikon inductor type; the single-phase alternators are run in parallel with two phases in series of the three-phase machines. The conductors are laid entirely underground, and distribution is effected on the three-wire system at 100 volts. The steam engines are fine examples of Sulzer's work; two are rated at 1,000 H P. each, the third at 750. All are tandem compound condensing, with single crank, running at 100 revolutions per minute. A commercial efficiency of 94 per cent. at full load is claimed for the larger generators.

Many of the smaller sets are arranged in line, with clutches, so that the shafting can be coupled up or divided into sections at pleasure; the turbines have vertical shafts, and drive by bevel gearing.

The whole electrical output amounts to over 4,000 KW.; in addition, there is a large pumping installation in the station.

The sub-station at Selnau, mentioned above, was afterwards visited; here there were three motor-generator sets, supplying current to the tramway. Induction motors were used, receiving the three-phase supply at 2,000 volts, and driving the four-pole generators through flexible couplings.



The Oerlikon Engineering Works.—Armature Winding Department.

Each set had an output of 200 KW., at 370 revolutions per minute, with a commercial efficiency of 88 per cent. at full load; the efficiency of the motor itself was given as 95 per cent.

With this visit the day's work ended—a very creditable day's work, when the hot weather is taken into account, and

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the tiring effect of sight-seeing and trudging from place to place.

On Tuesday a start was made for Schaffhausen. This proved to be one of the most enjoyable excursions of the tour, including, as it did, a visit to the beautiful Falls of the Rhine. The Schaffhausen station itself is situated above the Falls. The machinery for the town supply consists of one three-phase and two single-phase generators, driven through bevel gear by turbines with vertical shafts. A noticeable feature of the latter is the fact that the shaft is hollow, and the weight of the moving parts is carried upon a fixed internal shaft, which stands higher than the bevel gear. The maximum output is 900 H.P., while two other sets, which are to transmit power to a spinning mill close by, will have an output of 600 H.P.

An older installation consists of two direct current rope-driven generators with six poles, running at 700 volts pressure. The original station for which Schaffhausen was once famous, is still at work, transmitting power by ropes across the river and along the right bank; but even here electricity has made good its footing, for we find a three-phase alternator driven by a turbine, and generating at 450 volts. The turbine was provided with a hit-and-miss relay governor, the working of which was highly interesting; it failed, however, to control the pressure with less variation than 10 per cent.

The members of the party now indulged in a respite from their labours. Proceeding to the Schloss Lauffen, which dominates the Falls, they descended through wooded paths to the ferry, enjoying magnificent views of the Falls at vantage-points on the way. A few were heard speculating on the amount of horse-power running to waste, but most were content to admire and take snap-shots. Crossing by the ferry just below the Falls, the visitors ascended the hillside to the Hotel Schweizerhof, where a perfect view of the river was obtained, and where much-needed refreshment was provided.

A visit was made in the course of the return journey to Zürich to the works of Messrs. Sulzer Bros., at Winterthur. Prof. Perry divided the party into four groups with his umbrella and scientific accuracy, and a somewhat hurried progress through the works was made. As is usual on these occasions, although the sections started off in diametrically opposite directions, it was not long ere they came into collision and entanglement; members lose their parties, or *vice versâ*, groups wane and wax, and no one knows which section he will be in when he winds up!

The work done by Messrs. Sulzer is fully as varied as that of Messrs. Escher, Wyss & Co., and to a great extent of similar character, but, of course, the manufacture of steam engines is the leading feature. Some we saw in course of construction were of powers up to 4,000 H.P. for electricity works. The output up to the present amounts to over 4,000 engines of 500,000 H.P.; as many boilers, and a large quantity of steam-heating plant, rock-drilling machinery, steamships, &c., &c. About 4,000 men are employed by the firm, 1,000 of whom work in the foundry. As usual, electric driving is used, although the whole of the motive power is derived from coal.

(To be continued.)

Discharge of Torpedoes.—In the course of a paper on "Discharge of Torpedoes below Water," read at the B.A. meeting, Captain Lloyd said:—"For firing the inner tube we prefer using only electric gear, whether for cordite discharge or air discharge. It is absolutely necessary that safety arrangements should be provided to render it impossible to fire unless the sluice valve be entirely open and the running-in screw out of gear. These safeties can be provided with much simplicity and assurance with electric firing, whereas with mechanical firing gear they become complicated. In designing the firing gear we have provided a simple system of galvanometers, sounders, and batteries, which combine to automatically inform the operator in the conning tower, first, when the sluice is opened; second, when all is in readiness for firing, as well as to give those in the torpedo room an automatic test of the circuit and of the electric primer."

ELECTRIC LIGHTING NOTES.

(*Continued from page* 518.)

Ramsgate.—The Gas, Water, and Electrical Committee has resolved in favour of an installation of electric light for private and public purposes. The Corporation own the gas and water works, and propose also to municipalise the electric lighting supply. The Committee advises application for a provisional order.

The estimate of cost for the scheme which was brought forward by the engineer, Mr. W. A. Valon, who has had the consultative advice of Mr. Colson, of the Leicester electricity works, was as follows:—

Two water-tube boilers	£1,000
Two steam dynamos, each 75 KW.	3,000
Fuel economiser, feed pumps, feed tank, exhaust and feed and drain pipes	750
Steam travelling crane	200
Switchboard	1,000
Meters for dynamo and cell circuits, connection between dynamos, cells, motor balancer, switchboard, &c.	250
Battery of accumulators and motor balancer and booster	2,250
Underground feeder and distributor cables, feeder and house boxes	9,600
Superheaters fitted to boilers	250
Meters and services, say	1,000
	£19,300
Contingencies, 10 per cent.	1,930
	£21,230
Engine house, boiler house, foundations and buildings	3,500
Trench work for cables	1,500
	£26,230

Room has been left in the buildings plan for additional boilers and dynamos when required, while the cables will have capacity sufficient to provide for the supply of 10,000 lamps.

Ross.—The Urban District Council met last week to consider the report of Mr. Hamilton Kilgour, electrical engineer, Cheltenham, on the proposed electric light scheme for Ross. In his report, Mr. Kilgour recommended the three-wire continuous current system (low pressure), and estimated the extent of the main required at 3,300 yards (Ross Town 1,760 yards, Ashfield district 1,540 yards), the estimated cost being £13,000. The estimated financial results show:—Debit: Works' cost, £517; management costs, £199; interest and sinking fund, 5½ per cent. on £13,000, £747; total, £1,463. The estimated income, £1,573, made up of the supply to private customers of 60,000 units, at 6d. per unit, £1,500; street lighting, 7,000 units at 2½d., £73. From these figures Mr. Kilgour considered an electric supply undertaking should prove successful at Ross, and be retained in the hands of the Council. Mr. Kilgour's plans provided 37 lamps for the streets. He considered it would be wise to include the Ashfield district in the area to be supplied. He explained three free wiring systems. It would take about 18 months to obtain the provisional order and the loan, if the application were made next November. It was pointed out that the present street gas lamps (14 C.P.) cost annually about 35s. each, and Mr. Kilgour said that if it was so low as that, it would not pay the Council to erect electric lights of 25 C.P.; they would have to come as low as 16 C.P. A meeting of the ratepayers will be called.

Scarborough.—An installation (400 lights) is to be put into the new Higher Grade School, Valley Bridge, for the School Board. Mr. G. F. Wells has the contract.

Sheffield.—The *Sheffield Telegraph* has an article calling for a more progressive policy in regard to the electricity supply scheme. The Electric Light Committee is said to be retarding the use of electricity in the city more than all other opponents, presumably by extreme caution or backwardness in carrying out extensions to new districts. It recommends a free extension of mains without waiting for a number of residents in each district to signify their intention to adopt the light. The article purports to contain the views of leading electrical engineers in the city, but whether that be the case or not, one has to bear in mind that the most successful electricity works in this country to-day are those which have been controlled in a progressive (we do not use the term politically) spirit by men who have shown no niggardliness in extending the mains into new districts. Edinburgh, Brighton, Manchester, and numbers of other towns might be cited as instances in support of this view. But in criticising the management of the Sheffield scheme, it is necessary to bear in mind all the local circumstances which have hindered progress. If we remember rightly, when the works were recently taken over from the company, the machinery was overloaded, and new plant of such a size as was necessary to cope with the increasing business could not be obtained at 24 hours' notice. When the Committee recently wanted to place an urgent contract for a large generating set with Messrs. Ferranti there was a storm in the Radical tea-cup, and among labour representatives generally at Sheffield because of the labour clauses which Messrs. Ferranti declined to accept. The facts of the case are perfectly familiar to our readers, and it is quite unnecessary to reiterate them again, but this is a point which attaches more blame to the Council itself than to the Committee. It would be anything but a wise policy on the part of the Committee to incur an enormous expenditure upon mains and main laying for new districts before there is a prospect of an approaching delivery of plant enough not only for the present area of supply, but for the demands of the proposed added areas as well. If there is to be a squabble at Sheffield every time a contract for generators is to be placed, then progress will indeed be slow, and the best thing the Committee could do would be to draw out a very big scheme, as some other towns have done, and place contracts—for alternators, or other generating plant which may be equal to the likely demand—for some years to come.

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But the Committee or the engineer seem to us hardly culpable of retardation, unless it can be proved that the contracts for generators might have been arranged at an earlier date, and upon that point we have our doubts.

South America.—We gather from the *South American Journal* that the Cordoba Electric Light and Power Company is negotiating for the installation of electric light and power at Rosario. The same company, which is stated to be successfully operating at Cordoba with a water-power plant, is also negotiating for a water-power scheme at Tucuman. At Rosario, no water-power being available, steam driving is proposed. The company has, through Mr. Chas. Bright, entered into negotiations with a London syndicate for finding the necessary capital.

South Brent.—The extensive water mills known as Millswood Mills, close to the town, have been secured by Mr. W. H. Hawke, who has decided to undertake the supply of electricity to the town.

Torquay.—Major-General Crozier, R.E., holds an inquiry on behalf of the Local Government Board to-day respecting the application of the Corporation to borrow an additional £10,000 for electric lighting purposes.

Tunbridge Wells.—A temporary hitch took place in the lighting arrangements last week, resulting in a lowered steam pressure, and necessitating the extinction of 23 street arcs until the difficulty was overcome; this was accomplished within an hour, and the normal lighting restored.

Walsall.—Complaints have been made about defective electric lighting of the streets during the night. The defect is now being remedied.

West Ham.—The accounts for the half-year ended March 25th last show that the capital outlay on electricity works, &c., amounted to £42,491 4s. 3d.; the revenue for the last quarter was £1,996 4s. 8d., resulting in a gross profit of £346 3s. The net revenue account for the last half of the year shows a loss of £1,124 5s. 11d., due to the lack of revenue in the quarter ending last December.

Wigan.—Private enterprise is already ahead of the Corporation. Several establishments are laying down their own plant for lighting. The two principal hotels (Victoria and "Dog and Partridge") are in a forward state, and only wait delivery of engines and dynamos.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Bedford.—A meeting is to be held in the Council Chamber on Friday, October 6th, to determine whether the Corporation shall apply to the Board of Trade for a provisional order authorising the Council to construct tramways, place and run carriages thereon, under the Tramways Act, within the borough and several parishes and districts adjoining.

Buenos Ayres.—The *Financial News* Buenos Ayres correspondent says that the City Council will shortly annul the clause in electric tram concessions making street lighting obligatory, and will impose a more equitable tax in its place. This clause has put a stop to all electric tram construction for the time being.

Cardiff.—The borough engineer (Mr. Harpur) has recently drawn up a plan showing the proposed extension of electric tramways. The plan has been approved by the Tramways Committee with minor alterations. The chairman of the Committee last week replying to certain newspaper charges of supineness in the matter of the tram scheme, said two years and three months must yet elapse before the Corporation could take over the company's lines, and until that time they could not run any cars on the proposed new lines. It would not be policy or in the interest of the ratepayers to lay out a large sum of money which would be lying idle for 12 months or so. The sub-committee which was appointed to visit various towns and prepare a report regarding the generating of power for tramway traction had already visited six or seven towns where electric traction was used, and had acquired a large amount of valuable information. They had two or three more towns to visit, and he hoped that their report would be ready in a month. The sub-committee were losing no time in making their inquiries, and there was very good reason why they should take no steps for the construction of the lines until they were thoroughly satisfied in regard to the stations for generating power. They believed that the whole of the work would be completed in 12 or 18 months, and they had two years and three months in which to make the tramways.

Croydon.—At the Corporation meeting on Monday, the question of the haulage system to be adopted for the tramways, which the Corporation had already decided to buy, came up for discussion on a motion proposed by Alderman Fors that a system of electric traction be adopted. The motion was promptly agreed to, but a further motion by the alderman that the overhead trolley system be adopted gave rise to some discussion. Most of the members were in favour of the overhead trolley, on the ground of cheapness and efficiency, and it was agreed to adopt that system, with the exception that the committee were directed to inquire as to some other system of electrical traction for one mile of the line in the centre of the town.

Driffield.—In regard to our note of last week respecting the Driffield Light Railway, Messrs. Bennett & Ward Thomas, consulting electrical engineers, of Manchester, inform us that the traction firm mentioned should be the English Industrials, and not the Drake & Gorham Electric Power and Traction Company.

Dublin.—The newspapers are giving considerable attention to the various mishaps which have been occurring in connection with the electric tramway system:—

On Tuesday evening last week an electric car, travelling from Nelson's Pillar to Terenure dashed into the Lord Mayor's carriage, which was waiting for his Lordship in front of the Mansion House. The coachman was thrown from his seat, and severely cut about the head. The shafts of the carriage were smashed. The horse fell, sustaining some injuries. The coachman had to be removed to hospital.

Another paper (we cannot vouch for the absolute accuracy of the report) says that—

On the 21st inst. an accident occurred to the electric tram system in Sackville Street, Dublin, and as a result traffic was suspended on several lines for almost an hour, causing considerable inconvenience to a large number of passengers. Shortly before 8 o'clock, p.m., a tram proceeding from Nelson's Pillar to Dalkey was passing the first post from the pillar in the centre of Sackville Street, when it suddenly came to a standstill. Almost simultaneously the gas lamp attached to the post mentioned flared up, and the flames extended several feet into the air. Whether this incident had anything to do with an accident to the arm of the post, or whether the trolley caught some portion of it, and the wrench that resulted caused the lamp to break, and the gas to flare up, are questions upon which there is considerable difference of opinion, but the electric wires were loosened from the arm, which appears to have been bent considerably, and the tram was brought to a standstill. The current was soon cut off, and as a consequence a serious stoppage of traffic on several lines took place. The service on the Donnybrook, Inchicore and Terenure lines was seriously disorganised for almost an hour, during which time the repairs to the wires and post were being executed; and the trams were also stopped to and from Blackrock and Nelson's Pillar. Rows of trams, all at a standstill, might have been seen in any of the principal streets from 8 o'clock till after the half-hour, and the passengers in the trams when the stoppage took place had perforce to finish their journey on foot. The escape of gas, consequent on the accident, was soon stopped; and shortly after 8.30, the breakdown gang having temporarily repaired the damage at the point where the accident happened, all the trams were again running.

Last week in the case of Caffrey *v.* United Tramways Company, heard at Dublin, defendants applied for an order remitting the action to the Recorder. The action was brought by a cabdriver for personal injuries received on August 15th through the alleged negligence of the defendants' servants.

The affidavit of Mr. Tresilian, secretary of the Tramway Company, set out that the plaintiff was on his car on August 15th in Lower O'Connell Street, when an accident occurred to an electric tramcar, and an interruption of the traffic was caused. It was believed that the trolley must have raised the trolley wire till it touched the guard wire, causing the latter to fall into the street. Plaintiff received no injuries from the wire, as it never touched him. He may have suffered from a small shock. An affidavit of Sir. Wm. Stokes set out that the plaintiff told him that he had been scorched in the arm, and had to remain in hospital until August 31st. Deponent found no trace of scorching on the plaintiff's arm, and no injury to his nervous system. The plaintiff, in his affidavit, stated that after the accident he lost consciousness till next morning. His head was not all right yet, and "pins and needles" continued to go through him, and he could not carry on his business as a cabdriver.

The affidavit of Dr. Louis Byrne, medical officer of the hospital, set out that the plaintiff was wholly unfit for work owing to shock and loss of power in the left arm.

Mr. Justice Kenny, without calling on the other side, refused the application, stating it was apparent that the plaintiff had suffered serious injury.

In another case (Ennis *v.* the same defendants) a similar application was made. The plaintiff sued for £500 damages for personal injuries sustained through the negligence of defendants' servants on June 20th, he being struck on the head by the trolley which, as defendants said, "left the wire inadvertently." Defendants said that if plaintiff had used proper diligence he would have avoided the accident. The following discussion occurred between judge and counsel:—

Mr. Justice Kenny: It seems to me that these trolleys are always inadvertently going off the wire. What does he mean by saying the defendants are not guilty of negligence?

Mr. O'Shaughnessy, Q.C. (for the plaintiff): Here is a passenger on the tramcar who gets his head broken in.

Mr. Justice Kenny: It is perfectly nonsensical.

Mr. Littledale (for defendants) said of course he was prepared for Mr. O'Shaughnessy's indignation.

Mr. Justice Kenny: No matter about Mr. O'Shaughnessy's indignation. It is apparent to anybody knowing anything about it. You will find very great difficulty, if it goes to a jury, to make them believe that passengers are always to dodge this thing.

Mr. Littledale read the affidavit at further length. It appeared that the plaintiff's life had been in danger. Mr. Justice Kenny refused the application.

It has since been announced that Mr. Trotter, Board of Trade inspector, has been appointed to hold an inquiry in Dublin as to the numerous electric tram accidents which have occurred in the city lately. The inquiry was to be held in the Arbitration Room, Four Courts, and was to commence yesterday.

Electric Omnibuses for Birmingham.—The *Birmingham Argus* says that it is the intention of the British Electric Traction Company to commence a service of motor omnibuses in Birmingham at no very distant date. The company are said to be simply waiting for an order of the Court to formally take over the Birmingham General Omnibus Company, and the work of constructing the vehicles will at once be proceeded with.

Electric Omnibuses in Berlin.—Trials were to be made this month in Berlin with four electric (accumulator) omnibuses. Four more are to be added later by the Berlin General Omnibus Company, which has the trials in hand.

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Gas Traction in Germany.—We understand that, in view of the opposition still encountered sometimes to the introduction of trolley wires, Messrs. Siemens & Halske, the Union Electricity Company, and other Berlin concerns, have formed the German Power Gas Company for the purpose of promoting gas traction where other systems are objected to. This is a new departure for electrical firms; the future progress of the syndicate will be watched with interest.

Huddersfield.—The Town Council last week adopted the minutes of the Tramways Committee which contained a proposal:—

That the town clerk should forthwith take the necessary steps for promoting a Bill in the ensuing session of Parliament for obtaining the borrowing powers required to carry out the borough engineer's scheme for electric traction, and for extending the tramways undertaking to the following districts:—Section A, Slaithwaite and Marsden; B, Honley, Thongsbridge, Holmfirth, and Holme Bridge; C, Honley, Brockholes, and New Mill; D, Mirfield to the boundary; E, Brighouse; F, Kirkburton.

There is also a proposal to extend the trams to Rastrick. The undertaking was stated to be a very large one, and the scheme will be discussed further in the Council before being carried out.

Ilfracombe.—A project is on foot for an electric tramway from Ilfracombe Pier to the railway station. It is suggested that, as the Council possesses an electric lighting order, it should with advantage take up the tram scheme, combining the two.

Isle of Man.—Workmen have lately been employed by the Isle of Man Tramway Company in constructing a weir and carrying out certain other works in Laxey Glen, in connection with a scheme for the production of electricity by means of water-power. At present it is intended to erect two powerful turbines on the site of the "old paper mill," on the Claddagh, to be driven by water obtained from the Laxey river at a point about 100 yards below Mr. Rydings' woollen mills. Later on it is contemplated to utilise, in a similar manner, the other streams in the neighbourhood. It is estimated that the scheme, when carried out, will dispense with the use of steam for about nine months out of the twelve, and will thus effect a material reduction in the working expenses of the company.

Italy.—The water-power of the River Adda is to be utilised in connection with the adoption of electric traction on the Lecco-Colico, Sondrio-Colico, and Chiavenna-Colico sections of the Adriatic Railway.

Leeds.—The Corporation Tramways Committee, on 25th inst., considered the question of the electrical equipment of the tramlines, and it was thought that it would be better and more economical to deal with the whole of the lines at one time, instead of adopting a patchwork policy. With this object in view, a report had been prepared by the consulting engineers (Messrs. Hopkinson and Talbot) giving estimates. The proposed new lines measure approximately 17 miles. The Corporation now has 75 cars, a further 50 are being advertised for, and another 75 will be wanted in connection with the present scheme.

The report says:—

The total output of the plant now installed, or on order, amounts to 1,920 KW.; allowing one-half of this as spare, this will suffice to run from 95 to 100 cars. The regular service of 146 cars will required about 1,460 KW., and the whole 186 cars about 1,860 KW. If you put down two additional sets of generating plant, each of 750 KW., practically a repetition of the two sets now on order, you will have a total of 3,400 KW., one-half of which will be capable of dealing with 170 cars, and would no doubt be capable of dealing with more for a short time. By running two sets of plant, each of 750 KW., leaving two similar sets and the original rope-driven plant as spare, you will be able to run the 146 cars required for the regular service very easily. In dealing with the number of cars the various combinations of plant will run, we have made no allowance for the use of trailers. If these are used, further power will be required. It may be as well at this point to consider whether it will not tend to economy of working if we instal a battery of such size at the power station, or a number of smaller batteries at sub-stations, as would be capable of dealing with such variations and gradual increments of load as will naturally occur during the time the various lines are being changed, and which will ultimately serve as a reserve of power when the changes are finally completed. If such were installed it would undoubtedly lead to better regulation of pressure, and would enable a smaller plant to deal with those temporary increases in the load which occur in every-day running, and if trailers were used at occasional times during the day would provide power to run them. We now come to the capital outlay required on the assumption that two additional sets, each of 750 KW., are put down, and a battery capable of giving 750 KW. for 1 hour, that is, a battery capable of running 75 cars for 1 hour. This battery would be placed at the generating station, as we understand that to place a number of batteries in sub-stations on the various lines will necessitate the employment of a number of attendants, and so add considerably to the running expenses. We have, however, this matter under our consideration, and hope to devise some apparatus which would not necessitate constant attendance at sub-stations. For the purpose of this estimate, however, we assume the above battery will be placed at the generating station.

ESTIMATE OF CAPITAL OUTLAY.—Two engines and dynamos, each of 750 KW., steam, water, and exhaust pipes; battery to give 750 KW. per one hour; boosters for charging battery, switchboards and instruments, addition to switchboard gallery; motor generators for Stanningley, with battery at Stanningley; underground feeders; overhead linework, including poles, brackets, &c., erected complete; getting out ground for feeders; 125 cars (this number includes the 50 cars now being advertised for; total estimated cost, £160,000. The above estimate is based upon the prices at which the work now in hand is being carried out. We have not included in the above any steam raising plant, nor any buildings or alterations to buildings, these matters having hitherto been dealt with by Mr. Hewson. It must be borne in mind that the space within the generating station is limited, and even to erect the two additional sets of generating plant above referred to would take up the whole of the unoccupied space at the end of the station, that is, assuming the present type of engine and generator is adopted. If the present rope-driven plant were removed, its space could be occupied by two generators, each of 750 KW., and a third of equal capacity could then be erected in part of the space now unoccupied, leaving the remainder to be used for the boosters and other plant. The ultimate arrangement of and the type of plant to be used in any contemplated extension is one which will demand very serious consideration, as although the space available is sufficient for the extensions herein considered, if it should prove ultimately that the present estimates are exceeded, the site may become too small for the requirements of the traffic.

The committee unanimously decided to request the Council to authorise them to take steps for equipping on the overhead electric system all the lines of tramway mentioned in this report, amounting to 34 miles of track.

Lees.—The District Council at their monthly meeting had under discussion a letter from the Hurst District Council stating that that Council was in communication with the Ashton, Oldham, and Hyde Tramways Company, which intended to go into other districts, with a view to the line being extended to Hurst and on to Lees. The matter was held over to the next meeting.

Manchester.—The City Council will meet specially on October 25th for the purpose of deciding whether to exercise its right to require the Manchester Carriage and Tramways Company to sell to the Corporation so much of the undertaking as the Corporation is entitled to purchase, and for the purpose of adopting, if so decided, a resolution to serve notice on the company to that effect. The Tramways Committee has refused to grant the Manchester Carriage and Tramway Company's application for a 10 years' extension of lease on very favourable terms, because the Council is already practically pledged to municipalisation.

Ormskirk and Southport.—An inquiry was held at Ormskirk on 25th inst. into the above electric tramway scheme, which is for passenger and agricultural traffic. The promoters are Messrs. Charles Birchall, Thomas Callender, and W. Winnard. Mr. R. H. Spotter, the engineer, described the scheme, which is to cost £42,000, the company having powers to raise £60,000 capital. Mr. T. O. Callender and Mr. Birchall also gave evidence, and Lord Jersey said that the Commissioners would have pleasure in recommending the Board of Trade to grant the order.

Sheffield.—A trial run was made on Thursday last week over the new line to Pitsmoor; this route is almost as steep as the Walkley route. Mr. Fell and his staff have been busily engaged on the Pitsmoor route for some days making preparations for the inspection of the track by the Board of Trade inspector (Mr. Alexander P. Trotter). The cables have been completed, and arrangements were made for the initiation of a service of cars on 27th inst. A portion of the new machinery needed to supply power for working an efficient service of trams on the Walkley and Pitsmoor routes has arrived at the electrical power station. It is hoped to have the whole of the additional plant working before the expiration of October, by which time a number of extra cars will have been delivered. At present the Tramways Committee are handicapped, both as regards the number of cars at their disposal, and the lack of machinery.

Spen Valley.—The opposition of the Dewsbury and Heckmondwike authorities to the British Electric Traction Company's projected light railway, which was about to take the form of a Bill promoted in Parliament, is likely to fall through, in consequence of the decision of the Cleckheaton District Council to confine its action to an appeal to the Board of Trade for the insertion of protective clauses in the order. The Thornhill, Liversedge, and Ravensthorpe District Councils have already entered into negotiations with the company. We hope, therefore, soon to see a liberal and homogeneous scheme carried out in this district.

Walsall.—The Town Council has unanimously carried the necessary resolutions for bringing about the municipalisation of the tramways undertaking of the borough now owned by companies.

Wycombe.—The electric lighting company has written to the Council asking whether it would approve of an electric tramline from West Wycombe to Loudwater, to be worked in conjunction with the electric light scheme. The Electric Light Committee considered the matter, and, owing to the narrowness of certain streets, was unable to recommend the approval of the scheme. The Council has referred the question back for further consideration.

TELEGRAPH AND TELEPHONE NOTES.

American Telephone Magnates for Europe.—A Massachusetts paper says that President John I. Sabin, of the Pacific coast telephone companies operating 60,000 subscribers in the States of Washington, Oregon and California, and President Charles J. Glidden, of the Erie Telephone System, operating 90,000 subscribers in the States of North Dakota, South Dakota, Minnesota, Wisconsin, Michigan, Arkansas, Texas, and Cuyahoga County in Ohio, which includes the city of Cleveland, were to sail on the *Lucania*, September 23rd, for Liverpool, their destination being Sweden and Germany. The paper mentioned, adds: "It is said the telephone development in Sweden and the City of Berlin exceeds that of any other country in the world. The telephone systems of Sweden, Germany, France and England will be inspected, and any features of value recommended for adoption in this country."

Cuban Cable.—The *Electrical World and Engineer* says that, with the aid of the United States Government lighthouse tenders, the Western Union Telegraph Company has completed the laying of the new cable between Miami, Fla., and Key West, more quickly than had been expected. The work of laying the line to Havana has been begun. The shore end will be landed at San Lazaro, on the north beach of Havana, to which point the old cable ends will be transferred from Cojemar.

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Post Office Telegraphs.—The St. Luke's Vestry has refused its consent to the application of the superintending engineer of the Post Office Telegraphs for the laying of conduits or cast-iron pipes in Finsbury Pavement and a number of other thoroughfares in the locality.

Post Office Telephone Service.—The Post Office authorities, writes a correspondent in the *Financial Times*, "are evidently determined to lose no time in endeavouring to put into force the powers conferred upon the Postmaster-General by the Telegraph (Telephonic) Communication Act, 1899, by which an expenditure of £1,000,000 was sanctioned for the establishment of an improved and cheaper system of telephonic communication in the metropolis. What the intentions of the Department may be in regard to the provision of telephone exchanges remains to be seen, but it is possible that arrangements in this direction may be made, perhaps as a temporary measure, at the central and principal district post offices. The establishment of exchanges is, however, an easy matter as compared with the difficulties likely to be encountered in the laying of cables to connect the exchanges together and to connect subscribers with the exchanges, since this opens up the delicate question of wayleaves, and the proposal to open the footpaths and carriageways is being resisted by some of the local authorities."

At Chiswick on the 22nd, a letter was read from the superintending engineer of postal telegraphs, giving notice of the intention to take up roadways and footways in Chiswick for the purpose of laying down a system. The proposals of the Postmaster-General were welcomed by the Council. Later, a deputation of Chiswick subscribers to the National Telephone Company, headed by Mr. Seymour Darlington, of the Bedford Park Stores, Chiswick, waited upon the Council with the view of inducing them to retire from the position they have taken up regarding the underground wayleaves, the telephone company having given notice to their subscribers that, unless the Council agrees to their terms, the service might be altogether withdrawn.

After the deputation had been heard, it was agreed that a special meeting of the Council should be held to discuss the matter with three subscribers and a representative of the telephone company.

On Tuesday a further deputation waited from the National Company upon the Chiswick Council. The Council agreed to consider fresh proposals from the company *re* wayleaves, and will not meanwhile insist upon the removal of the poles.

The Proposed Reduction of Rates to India.—The following letter, dated Calcutta, August 31st, has been addressed by the Acting Secretary to the Calcutta Import Trade Association to the Secretary to the Government of Bengal in the Public Works Department:—

Sir,—The attention of the Committee of this Association has been drawn to an important published letter recently addressed to the Government of the North-West Provinces and Oudh by the Upper India Chamber of Commerce in connection with the movement lately set on foot for a reduction in the telegraph rates between India and Great Britain. Reviewing the position, the Upper India Chamber asserts that "1s. per word rate, while constituting a great convenience to trade, the general public, and the Press, would yield to an independent line a volume of traffic sufficient to allow of the system being worked at a substantial profit." So far as regards the interests represented by this Association, the assertion that such a reduction would be a convenience to trade puts the case very mildly. The Committee have no hesitation, and there is certainly no exaggeration, in saying that a reduction from the present rate of R3 per word to the equivalent of 1s., *i.e.*, 12 annas per word, would prove not merely "convenient," but a powerful stimulus to trade. Having regard to the fact that the necessity of a reduction has been publicly admitted by the Viceroy and that sooner or latter the question will be dealt with both by Parliament and the Legislative Council of India, the Calcutta Import Trade Association, representing, as its name implies, a very large proportion of the trade of the port, most urgently desires to support the proposal of the Upper India Chamber of Commerce for 1s. per word rate, and the Committee trust that the Lieutenant-Governor will be pleased to communicate to the Government of India the views of this Association on this all-important question.—I have, &c., J. Taylor, Acting Secretary.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa...	April 4th, 1898 ...	...
Latakia-Cyprus	June 20th, 1899 ...	...
Otranto-Corfu	Sept. 16th, 1899 ...	Sept. 21st, 1899.
Corea-Japan	August 7th, 1899 ...	...
Jamaica-Colon	June 30th, 1899 ...	...
Landlines.		
Communication between Saloniki and Monastir ...	March 23rd, 1899...	...
Lines from Haiti to Gonaives, Gros Morne, Port de Paix Plaisance, Cape Haitien, Port au Prince to Miribalais and Jacmel	August 18th, 1899 ...	...
Siberian lines between Tschita and Nertschinsk...	Sept. 22nd, 1899 ...	Sept. 23rd, 1899.
Saigon-Bangkok	Sept. 25th, 1899 ...	Sept. 26th, 1899.

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking Town.—October 24th. The District Council wants tenders for boilers, pipe work, two 100-kw. steam dynamos, switchboard, motor and trailer cars, trucks and electrical equipment, overhead equipment, underground feeders, conduits, road work, &c., for the Barking and Beckton light railways. See "Official Notices" September 1st.

Belfast.—September 31st. The Electric Committee wants tenders for c.i. floor plates and w.i. rails for the electric light department. Specifications from the city electrical engineer on payment of one guinea, returnable as usual.

Bray.—October 2nd. The Urban District Council wants tenders for 12 months' electrical supplies. See "Official Notices" September 23rd.

France.—October 10th.—Tenders are being invited by the French Post and Telegraph Authorities, in Paris, for a quantity of telephone cable, and also of telephone insulated wire. Tenders to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris, whence particulars may be obtained.

Germany.—October 16th. Tenders are being invited by the municipal lighting and tramway authorities of Königsberg, Prussia, until October 16th, for the supply of six boilers required in connection with the extension of the electric power station, to supply steam to new engines aggregating 1,800 h.h.p. Tenders to be sent to Die Direction der Städt, Belenchtungswerke und der Electr. Strassenbahnen Kaiserstrasse 41, Königsberg, Prussia, whence particulars may be obtained for 1s.

Glasgow.—Tenders are being invited for electric lighting plant, and fitting up same, for the lighting of three large tenements of shops and dwelling houses at Uddingston, for Mr. Watson, builder.

Glasgow.—October 10th. In connection with the tramway scheme the Corporation wants tenders for switchboards, fuel economisers, two 50 and one 30-ton electric travellers, power station steel work, and cables. See "Official Notices" September 8th.

Glasgow.—October 10th. The Corporation wants tenders for the reconstruction of tramways according to specification. See "Official Notices" September 23rd.

Hampstead.—October 5th. The Vestry wants tenders for the supply of coal for the electricity works for one year. See "Official Notices" this week.

Huddersfield.—October 2nd. The Corporation wants tenders for five Lancashire boilers. See "Official Notices" September 15th.

Leeds.—October 18th. The Council wants tenders for 50 electric tramcars. See "Official Notices" September 23rd.

Leeds.—The Council requires tenders for 50 electric tramcars. Particulars, &c., may be had on application to Thomas Newson Esq., M.I.C.E., city engineer, Municipal Buildings, Leeds. Tenders must be to hand not later than noon, October 18th.

Rotherham.—October 9th. The Corporation is wanting tenders for Lancashire boilers, engines, dynamos, pumps, condensing plant, crane, economiser, battery, switchboard, boosters, feeders, mains, roadwork, &c., for electric lighting. Specifications from the Town Clerk on payment of £1 1s. for each of five specifications. The consulting engineer is Prof. A. B. W. Kennedy, at whose offices specifications may be seen. See "Official Notices" September 8th.

Spain.—November 7th. The Spanish Ministry of Public Works in Madrid is inviting tenders, until November 7th, for the concession for the construction and operation of an electric tramway in the town of Cadiz. Particulars may be obtained from, and tenders are to be sent to, La Direccion General des Obras Ribleas, Madrid.

Swansea.—October 9th. The Corporation wants tenders for medium speed vertical engines, continuous current generators, booster and balancer. See "Official Notices" September 23rd.

Sydney (N.S.W.).—November 8rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

Warrington.—September 30th. The Committee of Visitors of the Winwick Asylum, near Warrington, invites tenders for Contract No. 1.—Generating plant, including three sets of condensing engines or turbines, with directly coupled dynamos, each of 100 kw. output at 220 volts, booster set, motors, surface condensers, cooling tower, steam and exhaust pipes, &c. Contract No. 2.—Switchboard. The drawings can be inspected and specifications obtained of J. P. Muspratt, Clerk to the Committee of Visitors, County Offices, Preston, on payment of £2 2s for each specification, returnable. A separate tender must be sent in for the work included in each specification. See "Official Notices" September 8th.

Wigan.—October 25th. The Corporation wants tenders for feeders, mains, water-tube boilers, superheaters, stoneware conduits, steam dynamos, boosters, motor balancers, battery, inspection boxes. See "Official Notices" this week.

CLOSED.

Barnsley.—The Council has accepted the tender of Messrs. Venner & Co., to supply Chamberlain & Hookham meters, at £5 2s. 6d. each (all sizes); and of the Reason Manufacturing Company to supply Wright's demand indicators, as follows:—5, 10 and

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15-ampere instruments at £1 11s. 6d. each; 25 and 35-ampere instruments at £2 2s. each; 50-ampere instruments at £2 12s. 6d. each; 75-ampere instruments at £3 3s. each; 100-ampere instruments at £3 13s. 6d. each; 150-ampere instruments at £4 14s. 6d. each; and 200-ampere instruments at £5 15s. 6d. Councillor Brady said the lowest tender for meters was not accepted. Messrs. Ferranti were 2s. 6d. less than Venner & Co., but the former guaranteed to keep the meters in order for 7s. 6d. a year for 10 years, whilst the other, which had been accepted, guaranteed to keep them in order for 2s. a year for 10 years.

Chelmsford.—Mr. T. H. P. Dennis, of Chelmsford, has secured the contract to light the new railway station with electricity. There will be 190 lamps of various sizes and powers, and one arc light.

Dundee.—The *Contract Journal* says that the contract for the overhead line equipment and rail bonding of the following routes for the Town Council: (Section 1) Perth Road route, (2) Lochee route, has been given to Messrs. R. W. Blackwell & Co., Limited, Victoria Street, Westminster, London, S.W., (Section 1) £3,051 12s. 7d., (2) £2,879 17s. 7d.

Glasgow.—*The North British Daily Mail* says that the offer of the Barrowfield Ironworks, Limited, for the coal storage and water tanks for Pollokshaws Road electric lighting station is recommended to the Town Council for acceptance. The price is £5,838. The Sub-Committee on Corporation Works recommended the acceptance of the offer by Messrs. Cowan, Limited, Manchester, for four sets of switchboards, &c., for 1,100 H.P. engines and dynamo at Port Dundas Electric Lighting Station, the amount of the contract being £990; and also the offer of Mr. James White for four sets of switchboards and instruments for 400 H.P. and 200 H.P. engines and dynamos, the price in this case being £555 15s.

Hammersmith.—At the Vestry on Wednesday, tenders as under were accepted:—For main switchboard, Messrs. Ferranti, £1,180; Messrs. Cowan's tender was £1,420. For steam pipes, valves, &c., Messrs. John Spencer, Limited, of Wednesbury, estimated total £700, under a schedule of prices. For cast-iron exhaust pipes, Messrs. Rosser & Russell, Hammersmith, under a similar schedule, amounting to £200. For brickwork for boiler, Messrs. Babcock and Wilcox, £580. For concrete foundations, Messrs. Martin Wells and Co., £165. A letter had been received from Messrs. Babcock and Wilcox, stating that they had made an error of £120 in their tender. The matter being pressing, orders were given for the work to proceed on the lines of the original tender, and the question raised by Messrs. Babcock & Wilcox will be allowed to stand over until the completion of the work. For putting up a boundary wall along the east-iron side of the approach road to the electricity works, 7 feet high; stock bricks, Messrs. Martin Wells & Co., £375.

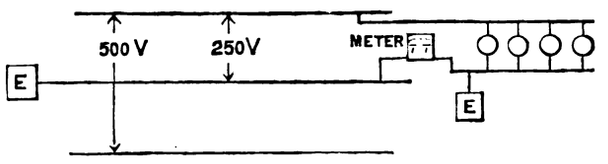
London.—The Battersea Vestry on Wednesday evening accepted the tender of the Edison & Swan United Electric Light Company, amounting to £3,588, for the supply and erection of switchboard and boosters at the electric lighting station.

NOTES.

The Electric Lighting (Clauses) Act, 1899.—In the article upon this Act which was published in our issue of September 15th, when referring to the provisions of Clause 7 of the schedule, the writer erroneously stated that "the limitation of profit to 5 per cent. will not afford any very strong inducement to private companies to undertake the supply of electricity." This clause, as a matter of fact, only applies to undertakings which are in the hands of the local authorities. Private companies are not in any way affected by it.

Windmills for Electric Lighting.—A correspondent of an American exchange recently asked for some information regarding windmills for electric lighting, as he had received various inquiries on the point from clients. In reply Prof. C. F. Brush, of Cleveland, Ohio, wrote, stating that his windmill storage battery plant for isolated lighting was still in successful operation after 11 years of use. During all this time he has not lost a single plate from the 408 cells of battery originally installed. This result is, he says, due to careful use. The plant is not, and was not, expected to be successful from an economical standpoint, because of its high first cost. The cost of any such plant, large enough to be of practical value, must always be large, and this feature, in connection with the skilled attention required, will, he thinks, prevent any extensive use of wind power for lighting purposes even in the country, where other sources of power are not available.

Connecting Up Meters on Multiple Wire Circuits.—A probable cause of the large proportion of "current unaccounted for" at some of the central electric light stations is the way in which the meters are coupled up on a multiple three or five-wire system, where the middle wire is earthed. Especially is this so when there is no fuse, or a comparatively large one, in the earthing circuit. No care is taken by



persons putting in the meters to see that it is put on the unearthed pole, and this should be done, since, if it is put on the earthed pole, and a substantial earth exists on that pole on the consumer's side of the meter, the latter becomes short-circuited as in the diagram, and does not register; this could not happen if the meters are put on the insulated pole.

"Allis, Where art Thou?"—An impossible reverie by a too partial chief:—

The switchboard man blinks drowsily,
The Pilot lamp gleams bright,
The peak is slowly falling,
And all's gone well to-night.
The ventilated armatures
Cooling my fevered brow,
Induce reflections o'er my mind,
Further extensions I must find—
But Allis, where art thou?

One year back this even
And thou wert by our side;
We thought the spec. would guard us, Allis,
Whatever might betide.
The load was slowly falling,
Just as it's falling now—and
The engine man slept gently.
. . . . . .
Oh, Allis! where *went* thou?

We sought thee in the boiler house
(The engine room was bare)
We 'phoned for news to Manchester,
You'd feel at home down there;
The wires, quivering, brought reply,
"We've high-speed sets in now;
Hundred-ton fly is all my eye."
So, Allis, where art thou?

In vain we sought through other towns,
We're going heavenward now;
Yoked to some star-wound dynamo,
Allis, we know art thou.

R. S. P.

Parsons Steam Turbo-Dynamos in Elberfeld.—The *Elek. Zeit.* recently stated that two Parsons steam turbo-dynamos, each of 1,000-KW., have just been completed, and will be started at the end of this year in the new central station in Elberfeld, Germany. The four-pole alternators have drum armatures, and make 1,500 revolutions per minute, the voltage at the poles being 4,000.—*Electrical World*, Digest.

Electrical Illuminations.—There have been great doings in the way of electrical displays at San Francisco. The principal thoroughfare was arched for a distance of 1¼ miles with strings of many thousands of incandescent lamps. Large search-lights were placed at intervals. The occasion was to celebrate the return of the 1st California Volunteers from the Philippine Islands, and the display lasted for three nights. The New York *Electrical Review* gives a photograph showing the effect.

Personal.—We hear that the Worcester Electricity Committee has appointed Mr. E. E. Hoadley, who is at present resident engineer to the Council at Barking, as *locum tenens* to Mr. C. J. Sutherland during his 12 months' leave. Before going to Barking Mr. Hoadley was chief assistant at Worcester for some 18 months, and he has also had experience at Islington and Eastbourne.

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200-Volt Supply.—An "expert correspondent" of the *Pall Mall* inveighs against the conversion from 100 to 200-volt supply, which is now going on in various parts of London, and urges consumers to refuse to allow the change. He maintains that the advantage is all to the company, and not to the consumer. We entirely disagree with this view of the matter. The benefit is mutual, as the consumer will eventually discover. It is as useless as it is ill-advised to attempt to stay the adoption of new ideas and better methods; one can merely cause delay, with its attendant inconvenience and expense. At present it is a fact, though it is often overlooked, that the mains item is one of the very heaviest factors in the capital outlay upon which dividends must be earned; it stands to reason that, if by doubling the pressure the number of lamps which can be fed with the same network is quadrupled, the capital cost of mains per lamp is reduced to one-fourth. In this way a reduction in the cost of supply, followed by a lower selling price, is certain to take place in time; while an immediate gain occurs from the fact that, with the present number of lamps connected, the losses in transmission are reduced to one-fourth, and the steadiness of the supply pressure greatly improved. It is admitted that the offer of new lamps is advantageous, but it is also alleged that the lower efficiency of the 200-volt lamps more than outweighs the reduction in price which is put forward as an inducement to make the change. This may be so in some cases; those consumers, however, who persist in standing out for the low pressure will find the difference in price grow wider and wider, until there is no question as to which is the cheaper system. While the price of high voltage supply is sure to be diminished, that of low voltage will just as certainly *increase!* *Verb. sat. sap.*

Fire at a Niagara Falls Railway Power Station.—The handsome station of the Niagara Falls Park and River Railway at Niagara Falls, Canadian side, illustrated on page 305 of the issue of the ELECTRICAL REVIEW of August 25th last, was destroyed by fire on the night of Monday, September 4th. The loss is estimated and placed at $90,000, and on this there was a total insurance of $38,000. Of this amount $30,000 was on the building and machinery of the Niagara Falls Park and River Railway, while $8,000 was on the generators of the Canadian Niagara Power Company, which company had a temporary installation of two 750-KW. generators in the station. The railway company had three 200-KW. generators, and a lot of necessary apparatus, &c. The fire started, it is supposed, from a short circuit on the alternating current line, and was first discovered in the basement by an attendant, who had barely time to shut down the station and throw the switches before escaping from the burning structure. The Niagara Falls Park and River Railway is among the possessions of the International Traction Company, and at the time of the fire President Ely happened to be in Niagara Falls. He at once set men to work stringing cables in order to make connection with the power service of the Niagara Falls Power Company on the American side of the river, and as these connections were promptly made there was little or no interruption to the service of the railway along the cliff on the top of the bank on the Canadian side. The generators of the Canadian Niagara Power Company supplied current to the Canadian branch of the Carborundum Company and other industries on the Canadian side; also to the Carmelite Monastry and for lighting the neighbourhood. Fortunately the old steam plant in the Niagara Falls, Ont., station had not been disposed of, and it was immediately brought into service. The Canadian Niagara Power Company and the Niagara Falls Park and River Railway are closely related, and it may be that in the construction of a new station the railway company will be governed by the plans of the power company, which is expected to soon commence a development on the Canadian side. The Niagara season is now about over, and the New York plant can supply a current service until a new station is brought into service.

Appointments Vacant.—The Barking Town Authorities are wanting a resident electrical engineer at £150 per annum, also a switchboard attendant, &c. See "Official Notices" this week.

The Electric Lighting of Tunnels.—Various attempts have been made to light the Batignolles Tunnel, near Paris, by electricity. As described in the *Revue de l'Electricité*, the first attempt was with arc lamps suspended from the tunnel arch, but the smoke and black walls allowed only a poor light to get to the interior of the trains, so that arc lighting in this way was impossible. Other trials were made, with the result that there is to be adopted an arrangement of 10 C.P. incandescent lamps placed a metre apart along the side of the tunnel. These lamps will be fixed at the height of the windows of the carriages, and will be automatically lighted and extinguished by the passage of the train. A number of pedals, which will be depressed by the rims of the wheels, work the switching gear. In this way any train stopping in the tunnel will be lighted fairly well from the outside, and much less electrical energy will be used than if the tunnel was continually lighted. The first installation will consist of 150 lamps only, but if successful, the full length of the tunnel will be lighted. While on this subject of tunnel lighting, we should like to add that some London railways would do well to give the matter attention, and more particularly the Great Eastern for its Bishopsgate tunnels. The G.E.R. is to be congratulated upon its efficient electric lighting at Liverpool Street, Bishopsgate, and Bethnal Green stations at night time, but the man who journeys cityward every morning sometimes says strong things about the inconvenience experienced in the tunnels and in Bishopsgate Street station when he wants to read the latest news from Paris and Johannesburg. It is bad enough to be suffocated with the fumes, &c., without enveloping the people in gross darkness at the same time. Why does not the G.E.R. adopt some system of train electric lighting so that the light can be automatically switched on as the trains enter the tunnels, and kept "on" until they leave at the other end? Or, failing this, the efficient lighting of the tunnels from end to end continously might be effected in some such way as is suggested for the Batignolles tunnel. Passengers would appreciate any improvement, and the cost would, we should think, be a comparatively small matter when one considers the vast proportions which the G.E.R. traffic has now assumed, and the enormous number of trains which have to pass through the tunnels every day. Some of our readers may remember the method of tunnel lighting in vogue on the Liverpool Overhead Electric Railway. The trains, on entering the tunnel (about half a mile long) are automatically lit up from copper conductors suspended from the roof of the tunnel, collectors being fixed on the roofs of the carriages. These lights are fed off accumulators, so that if a train should be stopped in the tunnel due to a "short" on the line, the carriages will not be in darkness.

Correction.—Messrs. Brown, Boveri & Co. call our attention to the fact that the majority of their alternators are of the ordinary fly-wheel type, and that they only construct inductor alternators in exceptional cases. We regret the obvious slip, which occurred in our notes on the Swiss Tour last week.

Electro-Harmonic Society.—The programme for this evening's Smoking Concert at the Society's new rendezvous, "The International Hall, at the Café Monico, Regent Street, W.," is a bright and cheerful one, the humorous element slightly preponderating. Recitations, violoncello and piano solos, ventriloquial sketches, ballads and humorous songs, ought to ensure an enjoyable evening for members and friends at the opening entertainment of the 1899-1900 season.

Chicago Prosperous.—Our New York namesake says that a careful canvass of the leading wholesale houses of Chicago shows that the increase in the volume of trade in electrical supplies for this year over the total figures for 1898 is estimated at $3,000,000.

Kashmir Railway.—We are informed that the whole of this project, of which we gave an outline in a recent issue, was carefully examined by Mr. R. E. Crompton during his recent visit to India, and that the decision to construct this, the longest electrical railway in the world, was not arrived at until after that gentleman had reported very favourably on the project.

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The British Association.—Next year's British Association meeting is to be held at Bradford. It will open on September 5th, and Sir Wm. Turner, of Edinburgh, will be the president. Glasgow will be the place of visitation for 1901, and it will be remembered that that is the year of the great international exhibition of that city. Belfast may be the town for 1902, while Cork is also seeking the patronage of the Association.

Utilising Waste Gases.—We hear that a company has just been formed in Berlin under the auspices of Messrs. Siemens & Halske and the Union Electrical Company with the title "Die Deutsche Kraftgas Gesellschaft," to put down plants to utilise the waste gases of blast furnaces in driving gas engines and dynamos, &c.

Manchester Association of Engineers.—In the syllabus of this association for the 1899-1900 session we observe the name of Mr. J. S. Raworth, who is to contribute a paper on October 28th on "The Generation and Electrical Distribution of Motive Power." The meetings open at the Grand Hotel on October 14th with a social gathering.

Marriage.—On 17th inst., Mr. F. A. B. Lord (representative of Messrs. W. F. Dennis & Co.), was married at West Hackney Church to Miss Constance Stapleton, of Stoke Newington.

Wanted, Competent Telephone Engineers.—The New York *Electrical Review* says:—"Nothwithstanding the fact that the telephone in its present state of development affords, in many instances, a perfectly satisfactory service to the subscriber, there are many important problems in telephone engineering yet unsolved. This leads naturally to the inquiry: Why are there so few really competent telephone engineers? It is a most attractive field of work and offers certain rewards to those who enter it with a proper knowledge of their profession."

Paris-Berlin Telephone.—It is reported from Paris that negotiations for the establishment of telephonic communication between Paris and Berlin have been successfully concluded. The laying of wires will commence immediately.

Lecture.—On Wednesday, Prof. J. Wertheimer inaugurated the evening class session at the Merchant Venturers' Technical College, Bristol, by a lecture (illustrated by lantern and experiments) on "Tesla's Experiments with High Frequency Currents."

Darwen Electricity Works.—The public inauguration of the municipal electricity works and dust destructor plant took place on Wednesday, 27th inst.

NEW COMPANIES REGISTERED.

Alliance Fire Apparatus Company, Limited (63,647).—This company was registered on September 22nd, with a capital of £5,000 in £1 shares, to acquire the agency business carried on at Goldhawk Works, Shepherd's Bush, and elsewhere, by J. E. Spagnoletti & Crookes, for the sale of American fire preventing and extinguishing apparatus, and to carry on the business of electrical and general engineers, &c. The number of directors is not to be less than three nor more than five; the first are H. S. Smith, J. E. Spagnoletti and G. L. Beasley; qualification, £500; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Aluminium Company, Limited (41,104).—This company's annual return was filed on August 9th, when the entire capital of £300,000, in 20,000 preference and 10,000 ordinary shares, all of £10 each, was taken up; £132,220 is considered as paid on 13,222 shares, and £10 per share has been called up on 16,770 preference and eight ordinary; £167,780 has been paid.

CITY NOTES.

Belfast Corporation Electricity Accounts.

Gas and Steam Driven Stations.

The accounts of the Belfast Corporation electricity undertaking show important changes, and the comparison of 1898 with 1897 is noteworthy in the history of the undertaking, as it covers the transition period between the old and the new order of things. Our readers will remember that Belfast originally started with a gas engine plant laid down upon the recommendation of Prof. Kennedy. A new station designed by the borough electrical engineer, Mr. Victor A. H. M'Cowen, containing steam plant, was started in July, 1898, and the increase in capital expenditure is, therefore, considerable, but is more than met by the extra output and rapidly rising gross profit.

The general state of the undertaking is shown by the following figures:—

	1897.	1898.	Increase.
Total capital expenditure	£52,066	£96,277	£44,211
Number of units sold	201,832	356,526	154,694
Number of lamps connected	21,000	38,500	17,500
Gross revenue	£5,266	£8,225	£2,959
Gross profit	£2,292	£3,882	£1,590
Average price per unit sold	6·04d.	5·41d.	−0·63d.

The revenue from sale of current has fallen nearly two-thirds of a penny; the other items of revenue common to both years under review show together a drop of the tenth of a penny, but a small item of "supply of lamps" in 1898 gives a plus value per unit of the hundredth of a penny. As a net result, the gross revenue per unit has gone down nearly ¾d.

Revenue Statement.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current ..	£5,076	6·04d.	£8·039	5·41d.	−·63d.
Meter rents	140	·16d.	171	·12d.	−·04d.
Supply of lamps ..	...	...	12	·01d.	+·01d.
Sundry	50	·06d.	3	·00d.	−·06d.
Gross revenue ..	£5,266	6·26d.	£8,225	5·54d.	−·72d.

In the "Costs" statement the item of "fuel" includes gas used in the old station and coal in the new works. Mr. M'Cowen has included in the item of coal all that used for running the new plant and testing same. Notwithstanding this the cost per unit for the fuel shows a reduction of nearly ¼d. on the 1897 figures. Also he states that the cost of coal used per unit sold for 1898 works out at 0·88d. against 1·22d. for gas fuel used in the same year, or a reduction of 0·34d. per unit. He further hopes to improve very considerably on the fuel figures this year.

Cost of Production.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal and Gas	£1,094	1·30d.	£1,583	1·07d.	−·23d.
Oil, waste, water, and engine room stores.	127	·15d.	213	·14d.	−·01d.
Salaries and wages incurred in generation and distribution.	656	·78d.	1,156	·78d.	·00d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	338	·40d.	291	·19d.	−·21d.
Works' cost	£2,215	2·63d.	£3,243	2·18d.	−·45d.
Rents, rates and taxes ..	283	·33d.	305	·20d.	−·13d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	339	·41d.	383	·26d.	−·15d.
General establishment charges, stationary and printing, law charges and insurance	137	·17d.	391	·26d.	+·09d.
Other expenses	...	...	21	·02d.	+·02d.
Total costs	£2,974	3·54d.	£4,343	2·92d.	−·62d.

The only increase shown in the costs' sheet are in the establishment charges and sundry expenses, notwithstanding the material rise in gross wages; the increased output kept this item at the same value per unit. The proportion of gas and coal may be indicated thus:—

	1897.	1898.
Units generated by gas ...	201,832 at 1·30d. per unit.	195,000 at 1·22d. per unit.
Units generated by coal ...	...	161,526 at ·88d. per unit.

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The following figures are interesting:—

	1895.	1896.	1897.	1898.
Total efficiency	91%	93·8%	89·2%	89·4%
Loss in batteries	6·7%	3·9%	5·4%	5·3%
Loss in mains	2·3%	2·3%	5·4%	5·3%

The profits were appropriated as follows:—

	1897.	1898.
Interest on loans	£1,105	£2,786
Sinking fund for repayments	127	175
Hire of gas engines	...	518
Net profit carried forward	1,060	402
Gross profit	£2,292	£3,881

British Electric Traction Company, Limited.

The directors' interim report states that considerable progress has been made in various directions by the company and by its subsidiary companies. Lines have been opened for traffic by the Potteries Electric Traction Company and the Oldham, Ashton, and Hyde Electric Tramways, and the Dudley, Stourbridge, and District Electric Traction Company's tramways, referred to in the last report as in course of conversion, were opened for traffic by electric traction on July 26th, and the receipts have materially improved. The light railways are in active course of construction. The order for extensions of the light railways has been granted by the Commissioners subject to the approval of the Board of Trade. Several other lines are nearing completion, and it is anticipated that they will be opened for traffic before the close of the year. During the past session various additional powers have been secured. A concession for the construction and operation of electric tramways in the City of Nelson, British Columbia, has been obtained by the company and others interested in the undertaking, and the work of construction has begun. The existing tramways in Auckland, New Zealand, now worked by horses, have been acquired, and a new company has been formed, called the Auckland Electric Tramways Company, to take over the same, and also a concession for the electrical equipment of the lines and extension of tenure. The financial year will not close until March 31st next, but the directors have decided to pay an interim dividend on the ordinary shares for the nine months ended September 30th at the rate of 6 per cent. per annum. Warrants will be posted on October 2nd.

The Direct United States Cable Company, Limited.—The board have resolved upon the payment of an interim dividend of 3s. per share, free of income-tax, being at the rate of 3 per cent. per annum for the quarter ending September 30th, 1899, such dividend to be payable on and after October 24th next.

City Meetings.—Yesterday (Thursday) afternoon, meetings of the Halifax and Bermudas Cable Company and the Direct West India Cable Company were held at 33, Old Broad Street. The proceedings were private.

Reuter's Telegram Company, Limited.—The directors have declared an interim dividend at the rate of 5 per cent. per annum, tax free, for the half-year ended June 30th.

Eastern Extension Telegraph Company.—An interim dividend of 2s. 6d. per share has been declared for the quarter ended June 30th last.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending September 23rd, 1899, were £333 8s. 11d.; receipts for week ending September 23rd, 1898, £370 17s. 9d.; aggregate for half-year to date, £16,767 18s. 4d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending September 22nd, 1899, were £3,420 0s. 4d.; corresponding period, 1898, £2,992 16s. 6d.; increase, £427 3s. 10d.

The City and South London Railway Company.—The receipts for the week ending September 24th, 1899, were £914; week ending September 25th, 1898, £926; decrease, £12. Total receipts for half-year, 1899, £12,901; total receipts corresponding period, 1898, £12,312, decrease, £111. Miles open, 8½.

The Dover Corporation Electric Tramways.—The receipts for the week ending September 23rd, 1899, were £279 0s. 3d.; week ending September 24th, 1898, £216 12s. 6d.; increase, £62 7s. 9d. Total receipts to date, 1899, £7,662 1s. 0d.; corresponding period, 1898, £6,207 9s. 8d.; increase, £1,454 11s. 4d. Miles of track open, 1899. 3; 1898, 3. Car miles run, 1899, 5,280 1898, 3,813. Number of cars, 1899, 12; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, September 22nd, 1899, were as follows:—D. U. T. Co., horse cars, £1,142 6s. 0d.; ditto, electric cars, £2,009 11s. 1d.; D. S. D. Co., electric cars, £849 18s. 11d.; total, £4,001 16s.; corresponding week last year—D. U. T. Co., horse cars, £2 486 16s. 7d.; ditto, electric cars, £469 13s. 2d.; D. S. D. Co., electric cars, £1,059 0s. 7d.; total, £3,965 10s. 4d.; increase, £36 5s. 8d. Aggregate to date, £55,349 1s. 7d.; aggregate to date last year, £53,752 5s. 5d.; increase to date, £1,596 16s. 2d. Worked:—The mileage open is 25 miles electrically, 19 miles by horses, as against 12 miles electrically, and 30 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways. —The receipts for the week ending September 24th, 1899, were £584. Miles of track open, 10. Car miles run, 11,371. Number of cars, 21. The receipts for the week ending September 28th, 1898, were £270. Increase, £314. Miles of track open, 3½. Car miles run, 8,675. Number of cars, 10. Total receipts to date, 1899, from April 1st, 1899, £15,180; total receipts to date, 1898, from June 29th, 1898, £3,703.

The Liverpool Overhead Railway Company.—The receipts for the week ending September 24th, 1899, amounted to £1,388: corresponding week last year £1,680 (visit of Channel fleet); decrease, £297.

The South Staffordshire Tramways Company.—The receipts for week ending September 22nd, 1899, were £667 15s. 8d.; aggregate receipts for 38 weeks, £25,252 14s. 6d.; week ending September 23rd, 1898, £645 17s. 11d.; aggregate receipts for 38 weeks, £23,916 8s. 6d.

STOCKS AND SHARES.

Wednesday Evening.

Another week of steady, depressing dullness has fallen to the lot of the electrical markets. The magnetic influence of flat prices all round the Stock Exchange crept even into the Traction department. In fact, it is difficult to discover one solitary spot of cheerfulness in any of the electricity sections. Business remains as dull as ever, orders are few and far between, and when they come they are nearly all to sell. Telegraph issues have tottered somewhat, but, curiously enough, it is among them that the single rise has occurred that saves our lists from presenting an unbroken series of falls.

Supply shares maintain their nominal quotations hardily, even City of Londons being scarcely altered from what they were a week ago. The making-up price, however, favoured the bears, being fixed at 11⅞ against 11¾, the making-up price on September 13th. Chelsea 4½ per cent. Debenture Stock has lost several points, but the company's shares are unchanged. Nor are Metropolitans altered, despite the talk of negotiations between the company and the Marylebone Vestry for the acquisition by the Vestry of the Metropolitan's work and plant in Marylebone. The market is looking on with languid interest, somewhat sceptical of the talk approaching a businesslike head. Definite information is not obtainable as to the date when the Charing Cross Company will make its new emission of capital, and the rumours afloat have no practical foundation. No quotable alteration has occurred in Nernst 7 per cent. Preference Shares, but the tone is easier in view of the special settlement on October 12th.

Eastern Telegraph stockholders are evincing grave anxiety at the outlook, and every day brings more and more stock into the already loaded market. Consequently, there has been another heavy relapse, and the price has given way ½ every day on an average during the last fortnight. Some selling has also taken place in Eastern Extension shares, the price of which has kept up remarkably well until the last few days. Anglo-American issues are weak, and the slump in Yankees is pointed to as the real cause of the fall. West Coast of America 4 per cent. Debentures furnish the one rise alluded to in our introductory paragraph, and the price has gone up 1 to 103½. African Trans-Continental Telegraph are worth keeping. The shares are, we believe, mostly in the hands of Mr. Cecil Rhodes, but a few were taken up by the public, and Mr. Stead's recent articles are likely to cause some demand for the shares as "long-shot" investments. Wireless Telegraphs are inanimate at 5½ – 6.

The railway market is chiefly notable for a fall in Waterloo and Citys to 101½, a price which seems quite high enough. Stock Exchange opinion leans to par as being a fair quotation for the stock, at any rate for another two or three years, until the line begins to stand on its own metals.

British Electric Traction Preference fell 5s. on a nervous holder attempting to realise his shares in a market that didn't want them. The Ordinary keep steady, and bargains are often arranged at the medium of the officially-quoted price. The interim report and dividend has no effect upon the price of the Ordinary. Tramway traffics continue good. Buenos Ayres and Belgrano reported an increase, up to August 27th, of £937, and the Ordinary shares hardened a trifle, to 3. Of all the electrified lines, this perhaps is the one most likely to produce the best results to a buyer of the shares to-day. The company is doing capital business, and the price of the Ordinary has every prospect of quietly advancing to par (£5). Anglo-Argentines are moving in the same direction, but their progress is very slow, and is likely to be until the electrifying work is completed, and the New Preferred stock can be issued. The traffic for last week showed an increase of £588, which is considered good. Tramways Union continue to dribble into the market, mostly in odd numbers, and the price is weak.

The telegraph and manufacturing department is steady to hard. Henley's new shares are 13. We understand that the certificates are on the eve of issue, and when they are ready the shares will be reinstated in the Official List. There is a small premium on the Preference of about 7s. 6d. Willans & Robinson are 10¾. Telegraph Construction and Telegraph Manufacturing exhibit no alteration.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Sept. 20th.	Closing Quotation, Sept. 27th.	Business done during week ended Sept. 27th, 1899. Highest.	Lowest
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	63 — 66	62 — 65	63½	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	114 —115	113½—114½	114½	113½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	14½— 14¾	14½— 14¾	14⅝	14⅜
206,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	14⅜— 15½	14⅜— 15½	15⅛	14⅛
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	188 —193	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	104 —106	105½	104½
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	4	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½ — 10½	9½— 10½	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½%	3½%	11⅜— 12¼	11⅜— 12¼	11 15/16	11⅜
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	145 —150	142 —147	146½	142
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	99 —102	99 —102	100⅛	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	117 —122	117 —122	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14¼— 14⅜	14 — 14½	14⅛	13 15/16
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,040, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	116 —121	116 —121	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —105%	104¼	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5½ %	10⅜— 11¼	10⅜— 11¼	11	10⅜
120,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	14⅜— 15½	14⅜— 15½	15½	14⅜
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	30½	...
39,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½%	6 %	6 %	5⅛— 5⅜	5⅛— 5⅜	5 5/16	5 5/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13 7/8	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5½	5¼— 5½	5 1/16	5⅛
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	100⅜	100½
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	¾— 1	¾— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,889	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5¼	4¾— 5¼	...	...
151,738£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	99 —102	99 —102	...	...
80,008	West Coast of America, Nos. 1—80,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	101 —104	102 —105	...	...
889,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph	10	1 %	2%	...	1¼— 1½	1¼— 1½	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10¼— 10⅜	10¼— 10⅜	10⅛	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	5 %	5 %	...	104 —107	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	10 — 11	10 11/16	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6¼	6 — 6¼	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8⅝	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	118 —115	110 —112	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11 — 12	11 — 12	...	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13½	13⅛	12 7/8
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 11½	11 — 11½	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	13½	...
220,000	Do. 4½ % Deb. Stock, Prov. Certs (£30% to be paid) Rd.	...	...	...	...	82 — 85	82 — 85	82¼	82
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5 — 5½	5 — 5½	...	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	8 — 9	8 — 9	8½	8
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	9 5/16	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6¼— 6⅜	6¼— 6⅜	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	105 —107	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	14½— 15½	14½— 15½	15⅛	...
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14 — 15	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	16 — 17	16 — 17	16⅝	16½
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid ...	5	...	...	...	3⅞— 4⅛	3⅞— 4⅛	3 15/16	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	15 — 16	15 —16	15⅝	15¼

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Sept. 20th.	Closing Quotation Sept. 27th.	Business done during week ended Sept. 27th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2⅜ — 3¼	2⅜ — 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	97 —102	97 —102	...	...
30,000	British Electric Traction	10	...	...	6 %	17⅛ — 18⅛	17⅛ — 18⅛	18	17⅞
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13⅞ — 14¼	13½ — 14	14⅛	13¾
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	127 —130	130	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½ — 6⅝	6½ — 6⅝	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅞ — 2 xd	1⅞ — 2	1 11/16	1⅞
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛ — 2⅜xd	2⅛ — 2⅜	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	110 —114	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	103 —106	102 —104	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13½ — 14½	13½ — 14½	14 3/16	13⅞
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼ — 10⅜	10¼ — 10⅜	10⅛	...
178,308	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	4⅜ — 5¼	4⅜ — 5¼	5 1/16	...
71,447	Do. do. Def. do.	5	...	...	...	5¼ — 5⅜	5¼ — 5⅜	...	...
630,000£	City and South London Railway	Stock	1 1/16 %	1⅞ %	2⅛ %	64 — 66	64 — 66	65½	64½
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6½ — 6⅝	6½ — 6⅝	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	8	...	...	...	3½ — 4	3½ — 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £8 pd. 1 to 99,261	5	5⅛ %	6 %	6 %	2 — 2⅛	2 — 2⅛	2	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛ %	6 %	6 %	4 — 5	4 — 5	4 7/16	4 3/16
344,028	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	97	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛ — 2⅜	2⅛ — 2⅜	2⅜	2 1/16
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3⅛	3 — 3⅛	3⅛	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝ — ⅞	⅝ — ⅞	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
8,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	110 —113	110 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21½	21
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	102 —106	100 —104 xd	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3½ %	3½ %	8⅛ — 8½	8⅜ — 8⅝	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½ — 13⅝	13½ — 13⅝	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	38	36½
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	103	...
18,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9½ — 9⅝	9½ — 9⅝	...	...
18,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅝ — 6¼	5⅝ — 6¼	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	100 —103	102	101

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8½—9½.
British Aluminium, Ordinary, 9½—10; 7 % Pref., 10—11.
House-to-House, 4½ % Debentures of £100, 103—106.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 2—3.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7½—7⅝. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 18¾.

* From Birmingham Share List.

Bank rate of discount 3½ per cent. (July 13th, 1899).

MARKET QUOTATIONS, Wednesday, September 27th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
" Nitric .. .. .. per cwt.	23/-	23/-	..
" Oxalic .. .. .. per cwt.	32/-	32/-	..
" Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	35/-	35/-	..
a Ammonia, Muriate (crystal).. per ton	£25	£25	..
a " " .. .. per ton	£23	£23	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a " (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£24	£24	..
a Lead, Nitrate .. .. .. per ton	£23 10	£23 10	..
a " White Sugar .. .. per ton	£31	£31	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 150° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	5½d.	5½d.	..
a " Caustic (75/80 %) .. per ton	£24	£24	..
a " Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a " Recovered .. .. per ton	£5 10	£5 10	..
a " Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a " Crystals .. .. .. per ton	£3	£3	..
a " Bichromate, casks .. per lb.	2½d.	2½d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£294	£294	..
b " Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 3" to 13") basis per lb.	8½d.	8½d.	..
c " Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c " Wire, basis .. .. per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. r Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f " Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g " Wire (basis price) .. per lb.	10½d.	10½d.	..
g " Sheet .. .. .. per ton	£88	£88	..
g " Rod .. .. .. per ton	£88	£88	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/2½ to 4/5	4/3 to 4/4	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i " Pig (Cleveland warrants) per ton	67/10½	67/11½	1d. dec.
i " Forgings, according to size per ton	From £11	From £11	..
i " Scrap, heavy .. per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8 .. per ton	£14 5	£14	5s. inc.
g Lead, English Ingot .. .. per ton	£15 5	£15 5	..
g " " Sheet .. .. per ton	£15 7 6	£15 7	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 12	£8 12	..
d Mica (in original cases), small per lb.	2d. to 6d.	2d. to 6d.	..
d " " " medium per lb.	1/9 to 2/6	1/9 to 2/6	..
d " " " large per lb.	3/6 to 7/-	3/6 to 7/-	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p " rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd str'p & sheet per lb.	From 1/3½	From 1/3½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£149 10	£149 10	..
g " foil .. .. per lb.	1/6	1/6	..
n " wire Nos. 1 to 16 .. .. per lb.	1/10	1/10	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
f Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	..
j " Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j " Hemp, 8 ply 10 lbs. .. per lb.	8½d.	8½d.	..
j " " Russian, 10 lbs. per lb.	4½d.	4½d.	..
j " Jute, 180 lbs. rove .. per ton	£18	£18	..
j " Manila, 24 thread .. per ton	£39 10	£39 10	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£27	£27	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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THE BRITISH ASSOCIATION.

ELECTRICAL MACHINERY ON BOARD SHIP.

By Alexander Siemens, M.I.C.E.

(Section G, September 20th.)

Everybody is familiar with the great advance in comfort on board ship following the substitution of electric lights for candle and oil lights, and it is only natural that ever since the first application of electricity, endeavours should have been made to extend its use on board ship. The first part of the electric system to be developed was the generating plant, as it was very soon apparent that belt driving, otherwise universally resorted to, was not reliable enough. The motion of the ship affects the working of the belts, and often caused the same to leave the pulleys. As a first improvement, Mr. J. S. Raworth constructed rope pulleys for an endless rope, which could be stretched while running by means of a movable guide pulley. This rope gear, although it avoided the danger due to the belt slipping off the pulleys, shared with the belt driving the serious disadvantage of occupying too much space, which, considering the limited accommodation in ship engine-rooms, was a fatal objection. About the same time, Brotherhood engines, running at a high speed, were first used coupled direct to dynamos, but their construction at that time was not very well understood, and the ships' engineers greatly preferred double-acting engines of simple construction. To meet their views, and to economise space, Mr. Raworth constructed a friction driving gear, which has been extensively used, and merits therefore a short description. The dynamo is bolted to a cradle, which can rock the dynamo about an axis at right angles to the direction of the armature spindle, and this carries a pulley of compressed paper, which is driven by the fly-wheel of the steam engine, against which it is pressed by adjustable springs. The cradle supporting the dynamo is placed between the steam engine and the fly-wheel, so that the whole arrangement is very compact. After this gear had been in use for some time, Mr. Charles Hall, the electrical engineer of the P. and O. Company, suggested driving the dynamo direct by a Tangye engine at the comparatively low speed of 180—200 revolutions per minute. This type of generating plant has practically been adopted for all modern ships, and it may be observed in passing that direct driving is nowadays recognised, even in places where there is no want of space, as superior to belt driving for all purposes.

In view of the contention that English practice is lagging behind that of other countries, it is as well to remember that at the Chicago Exhibition the two or three direct-driven sets were almost ridiculed by the American engineers, who confidently predicted that the old country would soon drop this practice and adopt the American method of belt driving. As a plant typical of the American practice of that time, the power plant of the Brooklyn tramways can be mentioned, where Corliss compound engines drove a fly-wheel from which a belt 5 feet wide drives two dynamos on the first floor of the building. It is needless to say that direct driving is now as much in use in the United States as it is here, and, in fact, everywhere. There can, therefore, be little doubt that the type of generating plant adopted on board ship has reached a stage in its development which, no doubt, will be improved, but will not be materially altered.

When electricity was introduced upon Her Majesty's ships, some inconvenience was caused by the magnetic field of the dynamos, affecting the ship's compasses in cases where iron bulkheads happened to be near the dynamos, and extended to the neighbourhood of the compasses. In order to guard against eventualities of that kind, it is now usual to employ ironclad dynamos on the men-of-war. For the same purpose the distribution of the electricity is in most cases effected by the double-wire system, the flow and return wires being laid side by side to all points of utilisation. These conductors form the most valuable part of the electric system, through being easily adapted to the scanty accommodation on board, readily repaired without danger arising from their being damaged when they are properly fitted up, and easily tested to ascertain that they are in working condition. Such qualities contributed not a little to the speedy introduction of the electric light, but they are still more appreciated for the distribution of power. The larger the ships are, the more it becomes necessary to supplement manual labour by mechanical power, and it is a trite saying that modern ships are nothing but machine shops. Until lately it was usual to drive all this auxiliary machinery by small steam engines, or by hydraulic power, and this necessitated a network of piping all over the ship, which is difficult to arrange neatly, and which gives endless trouble through leakage. In addition, there are waste products from all the auxiliary steam engines, and their disposal requires additional pipes and complications. All this inconvenience is avoided by employing electric motors, and for certain purposes, where the load on the motor does not vary much, they have been generally introduced. That their use has not been more extended is due to the difficulties which arise from variations in the load on the auxiliary machinery. Taking the case of a winch used to warp a ship, it frequently happens that the strain on a cable increases sufficiently to stop the movement of the winch altogether, and this would cause the current through the electric motor to rise to a dangerous extent. It is impracticable to protect the motor by a fuse, as the interruption of the circuit through the blowing of the fuses would allow the strain being taken off the winch, and in most nautical operations it is necessary to keep the strain on. There are two methods in use to overcome this difficulty—one is to employ shunt-wound motors, running continuously, and operating the winches, &c., through friction clutches; and the second is to employ special cut-outs in connection with series-wound motors. By these cut-outs the current through the motors is not interrupted altogether, but if the winch or other machinery is stopped so that the current becomes excessive, the main circuit is interrupted and a by-pass only left, in which sufficient resistance is inserted to allow only the maximum safe current to pass.

As an example of the first method, a steering gear and rudder indicator may be mentioned, which are constructed on similar lines, the indicator being, so to speak, a working model of the steering gear. A shunt-wound electric motor replaces the usual steam engine and turns the main shaft of the steering gear backward or forward by means of clutches, which are actuated by currents sent from the bridge. The current through the magnets actuating the clutches is interrupted automatically by the movement of the rudder-head, and a new impulse is wanted from the bridge before the steering gear will move again. For the convenience of the quartermaster, the contact-making apparatus on the bridge is designed in the usual shape of a small steering-wheel, so that it does not differ externally from the wheel used with steam steering apparatus. On the rudder-head a similar contact apparatus is fixed, which controls the solenoid clutches of the rudder indicator on the bridge, which is, as stated above, a working model of the steering gear, and shows the quartermaster the exact position of the rudder-head. Such an indicator has been in use on the ss. *Faraday* for some time, and has given complete satisfaction, so that it is contemplated to substitute the corresponding electric steering gear for present steam steering gear as soon as room can be found for larger generating plant. Here, again, appears an obstacle to the introduction of electric motors on board, and it can only be overcome by designing the engine room for the accommodation of powerful electric generating plant. There is every indication that this requirement is now being fully recognised, and that in future it will be possible to utilise electric motors in connection with all auxiliary machinery, and the absence of all pipework outside the engine room and boiler space will greatly increase the safety and convenience of working ships.

Sometimes it has been suggested that the main engines of a trans-Atlantic liner should also be worked by electricity, either on the plan adopted by Mr. Heilmann for locomotives or by means of accumulators. Although this may seem feasible at first sight, our present knowledge is not sufficiently advanced to make a practical test of either suggestion. Marine engines are the lightest per horse-power that are constructed. It would, therefore, not be possible to put smaller engines on board to generate electricity than those now used to drive the propellers direct. It is, therefore, self-evident that the Heilmann system cannot be economically applied for the main engines of ships. Equally impossible would it be to use accumulators for driving electric motors connected to the propeller shafts, as their weight would greatly exceed the capacity of the ship. This is easily shown by the consideration that a 6,000-ton ship propelled by 8,000 I.H.P. will take about 150 hours to cross the ocean, equal to 1,200,000 H.P.-hours. Fairly efficient accumulators give about 10 watt-hours per pound of their weight, so that a H.P.-hour can be obtained for 75 lbs. of accumulators. The ship in question would therefore have to load about 40,000 tons of accumulators for the trip across the Atlantic. No doubt there are further discoveries in store which will enable future electricians to attack the problem of propelling large ships electrically for long distances; for the present, it has only been proved to be an advantage to drive electrically the auxiliary machinery on board ship.

Discussion.

Sir Wm. White called upon Mr. Mark Robinson to open the discussion.

Mr. Robinson said he had very little knowledge of the subject of electrical machinery on board ship, but he knew something about direct-driving. He was glad Mr. Siemens had made allusion to the way in which England led in the matter of direct-driving, because he had seen accounts published of what had been done in America, in which it seemed that direct-driving had only taken its rise in America a few years ago. That was not the case. It had been suggested that they should drive liners across the Atlantic by accumulators, notwithstanding the difficulties. He felt pained that anyone had suggested that they should go across the Atlantic by that means. They might just as well have suggested the trolley wire; it was quite as practicable.

A speaker asked if it was easier in practice to repair the wires on board a ship than the pipes leading hydraulic pressure to the guns and different engines.

Sir Frederick Bramwell said he was inclined to doubt Mr. Siemens's assertion that the hydraulic pipes on board ship were subject to leakage. He had never heard that complaint, and he could not imagine that small joints like those could suffer. Steam pipes with an exceedingly high pressure did suffer, but he did not know it was so with hydraulic.

After a few further remarks from Sir Frederick regarding a method of operating winches sometimes employed for unloading the cargo from merchant ships,

Sir William H. White said that he had had a somewhat extended acquaintance with electrical machinery on board ship, it being one of the few responsibilities which he had to bear in connection with the Navy. He was inclined to think, although he was speaking from memory, that they began direct driving in the Navy at an earlier date than Mr. Siemens had mentioned, and he was certain they began the applications of electricity a good deal more than 20 years ago. The first application they made of internal lighting was in the *Inflexible*, which was designed in 1873, and was completed for sea about 1880. When leaving for the Mediterranean in 1880 or 1881, they got the first specimens of incandescent lamps on board for trial. The employment of electric power in warships gave, of course, the means of transmitting power for running motors with many obvious advantages. On the other hand, there could be no doubt that electric instal-

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lations on board ship were exposed to very special conditions of trial, and that those conditions might involve their breaking down to an extent that land installations would not. Their experience in the Navy showed that it was absolutely necessary to have special fittings of water-tight pattern for distributing boxes, and for many of the other electrical arrangements in the engine hold if they were to avoid accident and dislocation of the working of the machines. Of course, there could be no doubt that as to simplicity of leads, the smallness of space occupied by the wires transmitting the current and in many other ways in a warship, it was an enormous advantage to be able to use electricity. They could secure an amount of defence, and they could accept conditions, which were not possible with either steam or hydraulic power. On the other hand, up to date, those who had to do with the charge of electrical appliances upon board ship had been somewhat averse to its free and general extension, on the ground that they were not able to feel sure of continued efficiency and working, and of the apparatus holding good under all conditions met with on board ship. Therefore, the temporary policy had been to work up from the small end. There had been very great extensions of electrical power, much greater than people generally gave them credit for, as not merely was it the popular belief, as Mr. Siemens had said, that English electrical engineers lagged behind, but still more popular was the belief that they in the Admiralty lagged still further behind—in fact, that they were in the rear completely in this matter. That was not true. It might be said, speaking broadly, that the ships designed within the last three or four years contained very little steam-power outside the engine and boiler room departments. It was true, as Mr. Siemens had said, that the liberal use of long lengths of steam piping and of exhaust piping on board ship did not conduce to comfort or to coolness, but it was possible to do two things. It was possible to have your steam machinery within the engine room, to a very great extent, for example, by putting the steam steering engines in the engine room, and not right outside. It was possible to employ electricity for many purposes with perfect success. It could be employed, and with efficiency, for many purposes for which steam had hitherto been used. Take ships now building, the arrangement was of this nature:—All the ventilating fans (and there were a great many of them, outside the engine room department) were electrically driven; also the after capstan and some of the quick running coal hoisting machinery; in fact, he might say that the only steam pipes that were laid to any length in the ship were those that went to the cable working machinery forward. That in a warship was placed low down in the ship and there was no great inconvenience, but up to date they certainly did prefer steam machinery for cable and steering work. That was a matter of experience and choice. Coming to the working of heavy guns, there the feeling in the Royal Navy, amongst the individual officers in charge, was distinctly in favour of hydraulic power; but on the other hand, they were employing electrical power for the smaller kinds of guns that require power to be applied for working them, and they were employing electrical power in many of the operations for heavier guns, in the elevators of shot hoists, &c. They had electrical fittings in work for 24 to 28 tons weight. He was aware that foreign navies had gone so far as to employ nothing but electrical power for working guns. Those in charge of foreign ships had told him that they had been so worked with certain success, but in the English service electrical power had not been employed on guns above the 9·2-inch calibre. There was no doubt that, as they had reached the 9·2-inch size, so they would, in time, go on applying the same power to larger sizes. The Admiralty had other things to consider beside the mode of transmitting power. They had in hydraulic power a thoroughly successful system, which no claim ever made for electricity went beyond. They had no such difficulty in the leakage of hydraulic pipes as Mr. Siemens had mentioned. There had been cases in his experience where with pipes in the hot regions near boilers, and so on, the packing had suffered. They lived and learned, and took precautions, arranging the leads so as to get over the difficulty. With increase in steam pressure there was a good deal of heating and leakage from steam joints through very small effects, which with a slightly reduced pressure would be of practically no importance. Increase in steam pressure was in all its stages accompanied by difficulties, but experience enabled them to overcome them. Mr. Siemens had, of course, exploded the storage battery, in fact, he should say he had sunk it. Anyone who had made investigation had come to the same conclusion for himself. He well remembered when the first sample of "bottled" electricity was brought over here. He made his way to the people who had the best information on the subject. Their most sanguine expectations had made it clear that until there was a radically different storage battery introduced, it was not practical unless for special purposes, and largely for pleasure boats. There could be no doubt that in all those matters, that form of transmitting power which was on the whole best would establish itself. At the present time there were advocates for many kinds of power. Some favoured compressed air, some the universal use of electricity, some would have nothing but steam, and some, in their faith, hydraulics. He thought it might be said of the Royal Navy that they did not look upon any mode of transmitting power as of universal application, and they intended to adopt those powers which would lead to the best efficiency.

Mr. Siemens, in briefly replying, said that the Section had been very much obliged by the information which Sir W. White had given to them to complete that which he should have given in his paper but for the fact that in the several communications with which they were favoured from the Admiralty they occasionally received a copy of the Official Secrets Act. He was sorry he touched the hydraulic pipes. He had been duly squashed out in consequence. It could not be denied, however, that if the pipes did not leak, they occasionally froze. All precautions taken against freezing took up space. His principal objection to any pipe, whether steam or hydraulic, was that it took up space. He had stumbled over the various pipes himself. He had a great objection to them, and as soon as he was able to have all auxiliary machinery electrically driven he should do it simply for the convenience. Sir Frederick Bramwell said something about loading cargo. Mr. Siemens said that the electric winch would do the work in the same manner as the steam winch. The difficulty with the electric motor rose when the load on the winch or on the cable became so great as to stop the rotation. The danger then was burning out the motor, and they had to guard against that. As long as it could turn round it was all right. In regard to his statement about 20 years ago, that was approximate; he thought the first ship lighted by electricity was the *City of Berlin* with arc lights in 1877 or 1878, and he thought that the first ship of the Royal Navy lighted completely by electricity was the *Polyphemus*. He could only congratulate the section that Sir W. H. White had given a description as to how useful electricity was on board ship, and in spite of the great authority of Sir Frederick Bramwell, he thought that it would replace hydraulics in auxiliary machinery.

SOME RECENT APPLICATIONS OF ELECTRO-METALLURGY TO MECHANICAL ENGINEERING.

By Sherard Cowper-Coles, Assoc.M Inst.C.E, M.I.M.E., M.I.E.E.

(*Read in Section G, September 18th*)

(*Concluded from page* 496)

Referring to fig. 6, A is the mould accurately shaped on its convex side to a true parabolic or other curve, and formed with a bevelled edge B; D is a circular concave sucker formed by a disc of rubber or leather, backed with a metal plate, and attached to one end of a

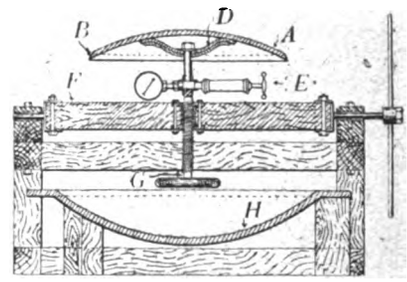

Fig. 6.

tube, which communicates with an exhaust pump E and vacuum gauge, and has its other end fixed to a screw rod G; F is a rotary wooden bar, having metal journals attached to its ends. These journals are mounted on plummer blocks fixed on the frame. A hole is bored through the centre of the bar F at right angles to the longitudinal axis, into which is fixed an internally screw-threaded metal bush. The screw rod, G, engages with this bush, and has a hand wheel attached to its free end. H is the tank containing the washing

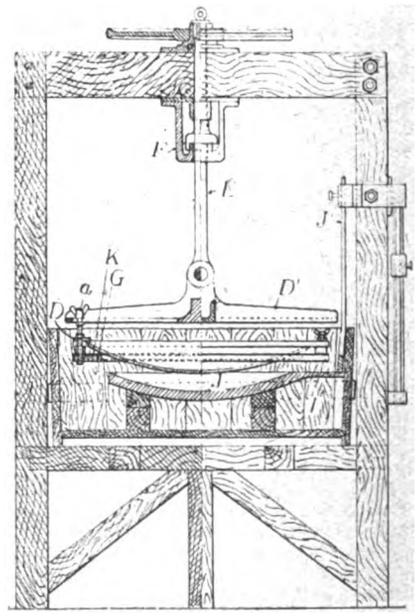

Fig. 7.

or silvering solution. When required for use, the bar F is rotated by means of the hand-wheel, until the sucker is turned up into the position shown. The concave side of the mould A is then placed on the sucker, and the air exhausted from between the mould

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and the sucker by means of the exhaust pump; the mould is thus securely attached to the apparatus. When the glass mould is in this position it is cleaned, as previously mentioned in this paper. It is then, by means of rotating the bar, F, turned down into the tank, H, when its concave surface is submerged in the silvering solution and coated with silver by the process already described, and finally washed and polished.

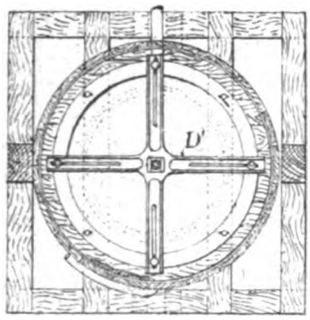


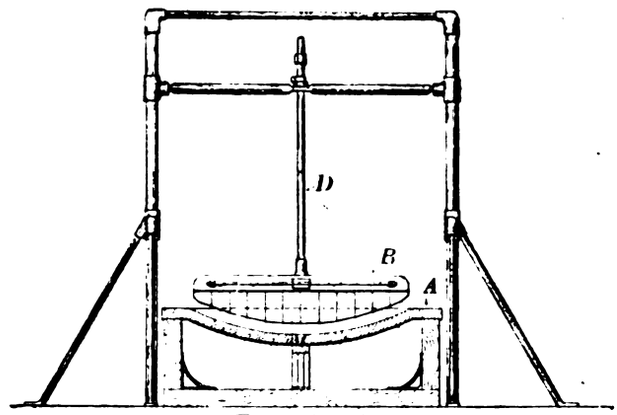
FIG. 8.

The mould is now removed from the sucker, and placed so that its bevelled edge fits accurately into the corresponding inner bevelled edge of the metal ring, D, figs. 7 and 8, which serves to support it in the depositing tank, while the metal backing of the reflector is being deposited.

The ring, D, is suspended by means of metal bolts from metal cross-bars, D^1. These cross-bars are connected by means of the metal bolts to a metal frame, which is hinged to the vertical shaft, E, by means of a pin, or pivot. This shaft passes through a box, F, and is carried on the main frame by means of a bearing, having balls, which support the shaft by a collar and allow it to rotate freely. A pulley is provided, through which the shaft and the mould may be rotated freely by a belt or cord. Attached to the ring, D, by means of small bolts are an annular baffle plate, G, and an annular stopping-off ring, K.

The distance of the plate, G, below the ring, K, is regulated by the thickness of the packing pieces. The object of the baffle plate is to prevent the formation of "trees," or "nodules," at the edge of the mirror, and the object of the stopping-off ring, or plate, is to determine the exact size of the mirror. Situated also in the tank is the anode, J, which (when a copper backing is being deposited on the mould) is of copper. This anode rests upon packing blocks, and has vertical rods attached to it, the free ends of which are adjustably secured in the metal brackets attached to the sides of the vat and one to the main frame. By means of adjusting these rods in the brackets, the distance between the anode and the mould or cathode, may be regulated. The tank is fitted with an inlet at the bottom of the vat, and outlet at the top, for the supply of the electrolyte; one terminal is connected to the mercury box, which is in electrical connection with the shaft, E, the cross arms, D', the bolts, *a*, and the mould forming the cathode, the positive terminal is connected to the anode by means of the copper strip, J'.

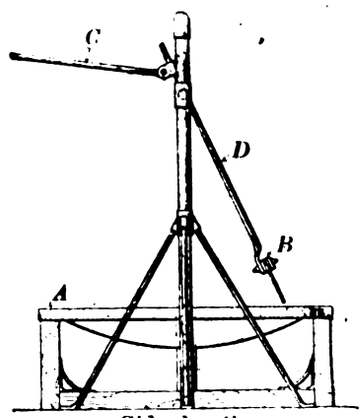
When first lowering the mould into the solution it is advisable to avoid throwing the work of carrying the whole electric current on the silver alone, so the shaft, E, is raised by means of pulley blocks to suspend the mould. The mould is then tilted and the shaft gradually lowered, bringing the edge of the mould in contact with the electrolyte, the circuit being thus established. A thin film of copper is deposited on the mould at the place of contact near the edge of the mould. The shaft is then lowered until it rests on the bearing, and at the same time the mould is allowed to resume its horizontal position. The operation I have just described occupies a very brief interval of time, and the current for a few minutes is worked at a pressure of about 9 volts, which is ultimately reduced. It is very important that the silver be flashed over with copper immediately on immersion in the copper sulphate solution. At this stage, the rings, K and G, are not applied, and the mould simply rests on the ring, D. The shaft is then rotated, and the operation of depositing the base metal continued with a current density of about 19 amperes per square foot, and is proceeded with until a sufficiently thick coating is obtained to act as a good conductor to the electric current. The copper solution generally used is of the following composition:—Copper sulphate 14 per cent., sulphuric acid 3 per cent., water 83 per cent. The ring, D, with the mould in it, is then lifted out of the bath and the rings, K and G, applied to determine the size of the reflector that is to be formed, after which the mould is again placed in the bath, and the operation of depositing the backing proceeds until the required thickness is obtained. During this stage the copper is deposited on the mould up to the inner edge of the ring, K, which thus determines the diameter of the reflector, and also ensures a clean even edge which requires no further treatment. After a sufficient thickness of metal has been deposited on the mould to form a suitable backing to the reflector it is removed from this tank, and the reflector backing separated by heating. The concave surface of the backing is now chemically cleaned, preferably with potassium cyanide or hydrate, and the backing, and then (referring to figs. 9 and 10) placed in an earthenware pan adapted to fit it, where a reflecting and protecting surface of platinum or palladium is deposited upon it. The tank, A, is supported on a wooden frame; its height being regulated by means of packing pieces. An anode is suspended from the main frame, and consists of carbon plates fixed in a holder, B, by means of lead strips. The carbon plates are arranged to form an approximate curve to the mould. The height of the anode can be adjusted by a vertical movement of the rod, D, which is attached to the holder, B. One end of a



Front elevation

FIG. 9.

connecting rod, C (fig. 10), is pivoted to the rod, D, and the other end is pivoted to a revolving disc. The disc is provided with a radial slot in which the pivot carrying the connecting rod is adjustable, so that by shortening or lengthening the distance between the pivot and centre of the disc, the throw of the connecting rod can be



Side elevation

FIG. 10.

regulated. The electric terminals are attached to the metal backing which forms the cathode and to the frame carrying the anode holder, B. If the reflector is to have a surface of platinum, the tank is filled to a sufficient depth with a solution of platinum composed of a freshly precipitated solution of double chloride of platinum and ammonium dissolved in a boiling concentrated solution of neutral citrate of sodium. If the reflecting surface is to be composed of palladium, a solution of palladium ammonium chloride is used. During this last process the anode is caused to swing backwards and forwards through the electrolyte by means of the revolving disc, in order to obtain an even deposit over the whole surface of the reflector and to keep the electrolyte agitated, and to prevent the deposition upon the reflecting surface of any foreign matter.

Seventy to eighty grains of palladium per superficial foot is found to afford a good protective coating. The silver-faced reflector previous to being placed in the palladium solution, is thoroughly washed with a hot, weak solution of caustic soda.

The back of the reflector is usually varnished before placing in the bath to prevent local action setting up between the copper, silver and palladium. When sufficient metal has been deposited the backing or reflector is removed from the bath and dipped in boiling water, and is then ready to be mounted in a suitable clamping ring such as shown in figs. 11 and 12; which is provided with a knife-edge, marked F, which holds the reflector against a ring of asbestos G, which is placed in a groove which retains it in position after the reflector has been carefully centred whilst resting on the asbestos ring.

Reflectors made by the process which has been described have been subjected to a number of tests, and have been found to withstand excessive heating without tarnishing. Salt water has been thrown on the reflectors when they have been too hot to touch, the result being that the water was driven off as steam, and the salt left behind as a white deposit upon the reflector, which was easily removed with a wet cloth. A reflector tested at Portsmouth had a number of rifle bullets passed through it when the parallelism of the rays was found to be but little affected. On the other hand the first shot fired at a glass reflector splintered it to pieces.

Some 3-foot mirrors made by this process for coast defence were placed in a projector case, in which was worked a 175-ampere lamp for six hours, during which time the temperature at the top of the reflector was found to be about 740° F. On removal the palladium-

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faced mirror was found to be quite bright, with the exception of a few small stains, which were easily removed with a chamois leather.

Although palladium does not reflect light as well as a silver surface which is perfectly clean and bright, silver is found to be quite unsuitable, as after being in close proximity to an arc light for a short

FIG. 11.

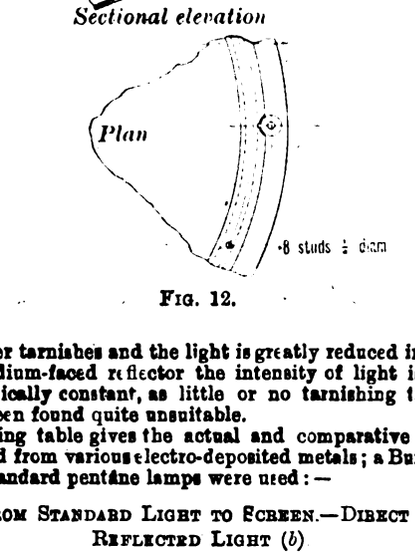

FIG. 12.

time the silver tarnishes and the light is greatly reduced in intensity. With a palladium-faced reflector the intensity of light is found to remain practically constant, as little or no tarnishing takes place. Nickel has been found quite unsuitable.

The following table gives the actual and comparative amount of light reflected from various electro-deposited metals; a Bunsen photometer and standard pentane lamps were used:—

DISTANCE FROM STANDARD LIGHT TO SCREEN.—DIRECT LIGHT (a), REFLECTED LIGHT (b)

ACTUAL REFLECTING POWER.

	cms.	cms.		$\frac{a}{b}$	$\left(\frac{a^2}{b}\right)$
Silver	69·5	71·5	...	·97	·94
Chromium	69·5	71·5	...	·97	·94
Platinum	69·5	97	...	·72	·52
Palladium	69·5	112	...	·62	·38

COMPARATIVE.

Silver ...	... 100 reflecting power $\left(\frac{a}{b}\right)$ taking Ag. as 100						
Chromium	.. 100	"	"	"	"	"	
Platinum	... 74	"	"	"	"	"	
Palladium	... 64	"	"	"	"	"	

The above tests were made on plates prepared by the same electrolytic method used for the manufacture of the reflectors.

Researches made by Prof. Potter give a loss of 31 to 35 per cent. for mirror metal, and Stephenson found for polished silver at an angle of 45° that the loss was about 44 per cent.

Platinum and palladium possess a reflecting power inferior to that of silver for visual rays, but superior for chemical rays, and for astrophotography.

Some experiments have been made to find out what effect the metallic surface directly under a reflecting surface of a thin film of an electro-deposited metal has on the reflecting power. A brass plate was polished, silver plated, and then thickly gilded and finished, and the amount of light reflected was then determined, after which the surface was coated with a very thin film of palladium, and the amount of light reflected determined again with the following result:—

Gold surface...	·77
Palladium surface	·63

The amount of palladium deposited on one side of the plate was so very thin that the gold could be distinctly seen through it; the measurement obtained from this was likewise ·63.

A metal reflector is lighter than a glass one. The weight of a 26-inch mirror is about 29 lbs., and the weight of the ring 132 lbs., making a total of 161 lbs., whereas the weight of a glass mirror is 165 lbs. without mounting.

Some of the reflectors have been tested optically by the process which has been extensively used by Tschikoliw. The method consists in photographing the image in a reflector of a white screen covered with a black square network, the lines being 0·2 inch thick and 0·2 inch apart. In the centre of the screen a square opening is left through which the photograph of the image of the network is taken through a pin-hole. The first step is to place the reflector at a distance of from 3 to 5 feet from the screen, which should exceed by at least 35 per cent. the height and breadth of the reflector, so as to ensure the image of the network covering the whole surface of the mirror. The test of the reflector is carried out as follows: The surface of the mirror in all planes is tried by a template to ensure that the exterior curves of the surface are not far distant from the parabola; the image on the screen is then photographed, and the irregularity of the lines indicates any serious errors of the parabolic surface.

Mirrors have also been tested by the Government test, that is, placing a number of annular rings of different diameters in front of the mirror, and reading on a scale the comparative focal length of the exposed portion of the mirror, an arc lamp being placed for this purpose at a distance of about 150 yards.

Messrs. Blondel and Rey have deduced from theoretical considerations that the brilliancy from any point of surface of the mirror, or of a mirror projector of the form due to Mangin, is practically constant, each point being considered as a source of light, and its brilliancy being measured in the direction of the optic axis of the mirror. They have recently tested this experimentally, and find that the brilliancy is constant, except at the mirror, and the central portion which is hidden by the negative carbon. To determine the brilliancy at any point of the surface, a sheet-iron screen was introduced at a short distance in front of the projector, so as to cut off all the rays except those coming from a small area surrounding the point. The rays were passed through a small hole in a sheet-iron screen, and formed an image of a crater on a photometer screen interposed at some distance. The illumination at the centre of this image was measured, and the brilliancy at a point of the mirror calculated. Finding the brilliancy at each zone of the mirror, the total candle-power of the projector is easily deduced.

On the table are some specimens and sections of parabolic reflectors made by the process I have just described; the specimens shown are faced with palladium, and one with platinum, there is also a section of a mirror showing the varying thicknesses of the metal.

I have here a parabolic reflector which has been fitted up as a sound locator for locating sound at sea. At night, or in a fog, it is very difficult to determine from what direction a sound comes, but by applying the flexible tube to the ear, which is attached to a small receiver and by moving the reflector in different directions, the direction of the sound can be readily determined; when the parabolic mirror is directly facing the source from which the sound emanates, the sound can be distinctly heard, and as soon as the reflector is moved away from the source of the sound, nothing can be heard through the receiver.

ON THE EXPANSION OF PORCELAIN WITH RISE OF TEMPERATURE.

BY T. G. BEDFORD, B.A., Cambridge.

(*Section A. Abstract.*)

In direct comparisons of the scales of temperature given by air and by platinum resistance thermometers at high temperatures, the expansion of the porcelain envelope enters as a small correction.

In the experiments described in this paper, a direct determination of the linear expansion of porcelain was made at temperatures from 0° C. to 830° C. The method used was essentially the same as that described by Callendar (*Phil. Trans.*, 1887, A. p. 167).

On a tube of Bayeux porcelain two fine transverse marks were made at a distance about 91·3 cm. apart. The tube was heated to as high a temperature as possible in a gas furnace, and was then slowly cooled by diminishing the gas supply. During cooling the variation in the distance between the marks was determined by a pair of reading microscopes, which were mounted on stone blocks and not touched except by the screw-head during an experiment. The readings of the microscopes for a standard length (glass tube kept in melting ice) were taken at intervals.

The temperatures corresponding to the length measurements were deduced from the resistance of a platinum wire running from mark to mark in the axis of the tube and supported on a plate of mica. The resistances in ice and steam were taken after exposure to a high temperature. The sample of platinum wire from which the piece used in these experiments was cut is known to have a value of δ, in Callendar's formula from 1·50 to 1·51. The value $\delta = 1{\cdot}505$ was used, and thus a direct determination of the resistance at the temperature of boiling sulphur was avoided. An error of ·01 in δ causes an error of less than 1° in the calculated value of t at 1,000° C.

Four main experiments were made; the results were plotted and are reproduced on the accompanying slide.

From 0° C. to 600° C. the results are represented fairly well by the formula

$$l_t = l_0(1 + 34\,25 \times 10^{-7} t + 10\,7 \times 10^{-10} t^2).$$

Above 600° C. the points are more erratic, but still do not depart far on either side from the curve given by the above formula.

A length of about 6 cm. at either end of the tube was not directly heated by the furnace. Hence there is an uncertainty due to the ends (greater at the higher temperatures), since the coefficient of expansion varies with the temperature.

For cubical expansion the above formula gives

$$v_t = v_0(1 + 102\,75 \times 10^{-7} t + 32\,4 \times 10^{-10} t^2).$$

SIGNALLING WITHOUT CONTACT.

A SYSTEM OF RAILWAY SIGNALLING SPECIALLY SUITABLE FOR FOG SIGNALLING.

Paper read before Section G on Monday, September 18th, by Mr. W. S. BOULT, Assoc.M Inst.C.E.

(*Continued from page* 494.)

ARMATURE RELAY.

The construction of the armature relay is shown in figs. 11 to 15. The ends of the whole structure or bridge-piece shown, are attached to the longitudinal pole plates above referred to as shown in fig. 4.

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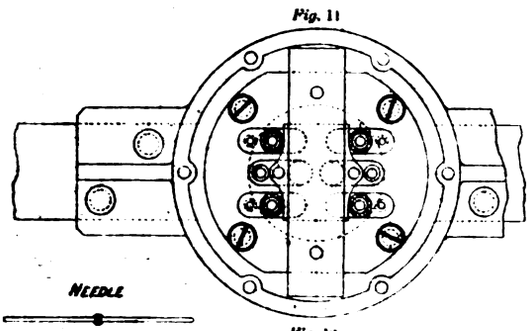
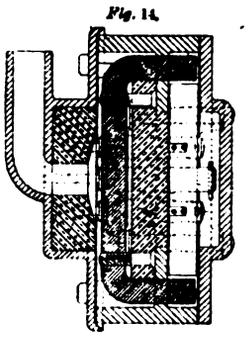
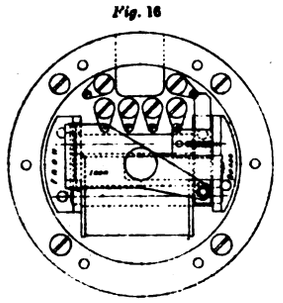
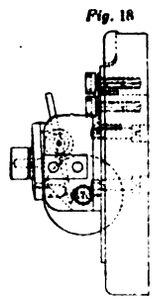
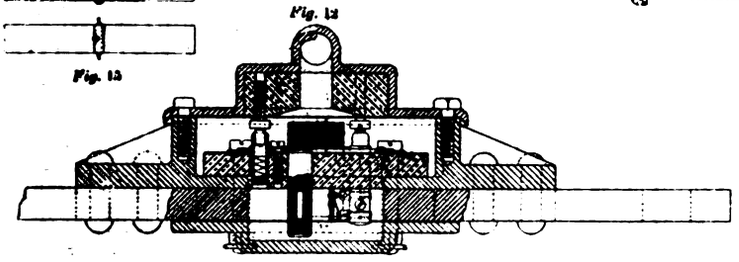
Both the iron needles 3 inches long (see fig. 13, a view of the under side with cover removed), are both polarised and controlled (or held in the central position) by a single horse-shoe magnet, which, as its ends do not reach quite so low as the bottom edge of the needles (see fig. 14), to a large extent relieves the pivots of their weight. It will be noticed that the control of the needles is due to repulsion from the horns of the iron bridge bars near their ends which are similarly polarised by the magnet. This repulsion control allows a far wider play of the needles than an attraction control does, while at the same time simplifying construction. The needles may be thrown into absolute contact with the horns and not stick. There are four contact posts, against each of which a needle when thrown over by road magnets makes duplicate contact, so that for each signal there are four contacts, any one of which suffices for working. Connections with the circuit wires are made at the back or upper side of the ebonite slab on which the movement is mounted, by means of plungers such as are used in lamp-holders and insulated screws in the cover. Everything is enclosed in a jointed brass box.

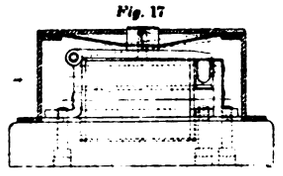


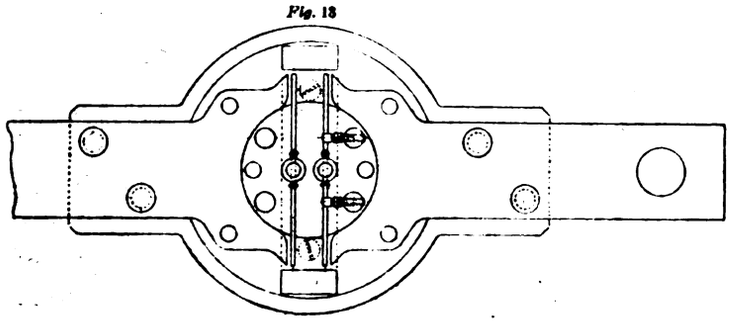












Relay Push.

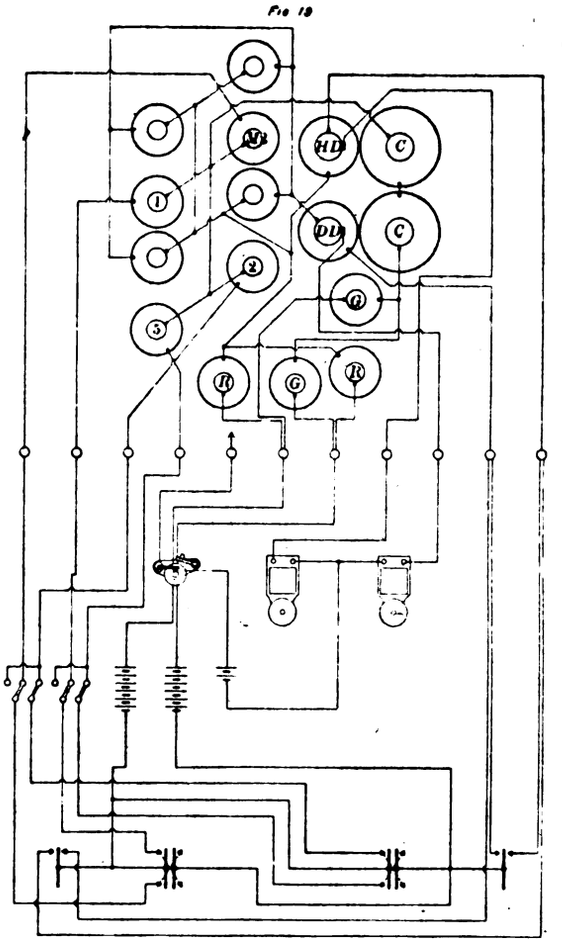
Figs. 16 to 18 show an apparatus for breaking a bell circuit at a relay or switch closed by the signalling current, and doing this in such a manner that the signalling current has always controlling power over the manual movement. For want of a better name it is referred to as a "relay push." It is constructed on a similar plan to the indicator movement above described, but has only one core and bobbin (with two independent coils in connection respectively with two separate batteries); a hinged flat iron bar taking the place of the second core. The polarised tongue acts as a switch in the bell circuit, being closed by signalling current passing through either or both of the coils on the bobbin. To open the relay, and thus stop the bells, the hinged iron arm is pressed down against the action of a spring till an iron stud on its end touches the tongue (which is not in contact with the iron of the core). It is then allowed to spring up, dragging the tongue with it. At any instant throughout, or after this operation, signalling current will re-make the contact.

Engine Circuits.

The working of the whole apparatus will be best understood by a reference to fig. 19, which is a diagram showing the connection of all the parts on the engine.

The upper half of the figure shows the indicator coils connected with their terminals—a row of small circles extending across the diagram. At the bottom of the diagram are shown four armature relays carried underneath the engine, as shown in fig. 4. The two outside ones have single needles only, and work in duplicate to give the danger signals. The circuits from these needles will be right whichever end first the engine is running. The other two armatures have duplicate needles, and give the line-clear signal (both semaphores off) in conjunction with one road number. These circuits require reverse connecting for reverse running, switches for this purpose (which may be worked by the reversing lever of the engine) being indicated.

There are two batteries with their positive poles connected through the two coils of the "relay push" to the two "duplicate action" or spot movements, and their negative poles connected to the armature needles, so that for each signal one needle in connection with each battery is operated. Failure of one needle contact, one battery, or one connecting wire, is immediately shown by the "duplicate" spots showing different colours and thereafter remaining fixed, a green spot showing for the defective circuit and a red spot for the working one. The running signals will still be properly operated by the remaining circuit.



As this partial failure ought *never* to occur, it might be made a strict rule to run slowly in such a case.

Separate distant and home danger bells are shown, as well as the "relay push" for stopping them when the engine is standing, and doing this without interfering with the signal.

The numbers, M2, 1, 2, 5, indicate the respective coils for showing these numbers on the dial. H D and D D are the home and distant danger coils; C C, working together, give the clear signal; R R show red spots, and G G green ones.

(To be concluded.)

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MOTOR CONTROLLERS.

In the early use of electric motors for power distribution, says the *American Electrician*, the motor itself was simply called upon to revolve and give power at a fixed speed. The adaptation of this power to the machines driven was effected by belts, cone pulleys, friction clutches, &c. Now that motors are direct coupled, or direct

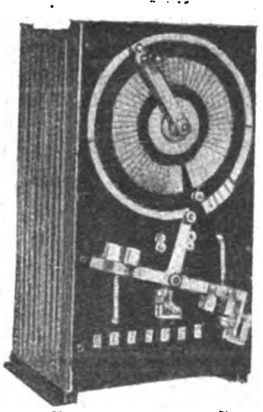

Fig 1.—A Printing Press Controller.

geared to machines, the speed or torque control, starting, stopping, &c., must be arranged for in electric circuits instead of in the mechanical connections. Different types of machines involve different requirements, necessitating a larger number of different controllers. Of these the Cutler-Hammer Manufacturing Company, of Chicago, Ill., makes a remarkably complete line, some of the newest instruments of which are illustrated here with.

Fig. 1 shows what is called a compound controller for large printing presses. The rheostat arm is fitted for controlling the speed of the motor by three different methods. In starting it first cuts out the armature resistance, then cuts out the series coils of the motor field, and finally inserts resistance in the shunt field circuit. Below this rotating arm on the controller is the main switch, consisting of a horizontal arm pivoted at its centre, the two ends constituting the two knives of a double-pole switch. This is closed by hand, by means of the upwardly extending handle, and is constantly pulled toward the open position by coiled springs. When closed it is latched by the

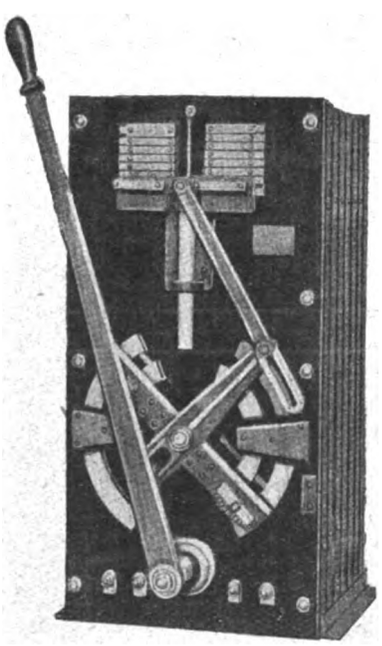

Fig. 2.—A Reversible Controller.

armature of a small magnet connected up with a number of switch buttons and contacts arranged to be automatically closed by broken paper or other mishap. The operation of this magnet releases the arm, which is pulled into the open position by the springs. A small overload magnet also acts as a relay to operate the same releasing magnet in case the motor is overloaded.

Fig. 2 shows what is termed a reversible controller, which is designed for cranes or hoists, and consists of a long arm linked with a four-arm dial switch, which serves in the usual way to reverse the armature connections. Pinned to the end of one of these four arms is a connecting rod, which serves to push upwardly a cross-head carrying carbon contacts on the rheostat connections at the top of the controller. The connecting rod is slotted, so that the rotating switch arm can only push the cross-head up, but cannot pull it down. It falls by gravity, and its speed is controlled by a dash pot. When, therefore, the controller is reversed, it pushes the cross-head up quickly to the top position, in which all resistance is inserted, and leaves it free to fall of its own weight against the dash pot, so that the operator is unable to quickly cut out the resistance and thereby

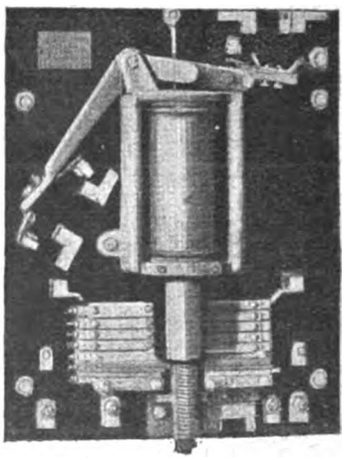

Fig. 3.—The Self-Starter.

overstrain the motor. The resistance is thus cut out automatically at a speed dependent on the weight and resistance of the dash pot, starting the motor smoothly at the proper rate of acceleration.

Fig. 3 shows an ingenious instrument applicable to many various uses, and termed a self-starter. It consists of a solenoid designed to attract a vertical plunger, which is connected with an L-shaped pivoted casting. The two arms of the L constitute the two poles of

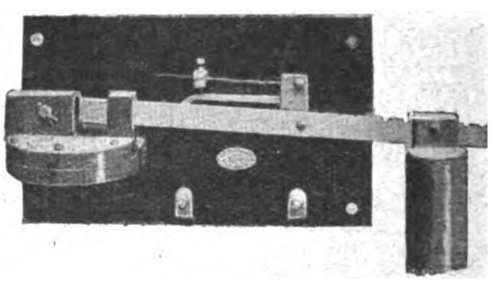

Fig. 4.—An Automatic Pressure Regulator.

a double pole main switch, with laminated copper contacts and secondary or following breaks of carbon. This is operated with a quick snap whenever the circuit of the solenoid coil is made or broken. The armature of the solenoid is also connected through a coiled spring with a cross-head at the bottom of the controller, carrying the contacts on the rheostat segments. When the armature rises suddenly, closing the main switch described above, it compresses this spring, gradually forcing up the rheostat cross-head, which is fitted with a retarding device so that the resistance cannot be cut

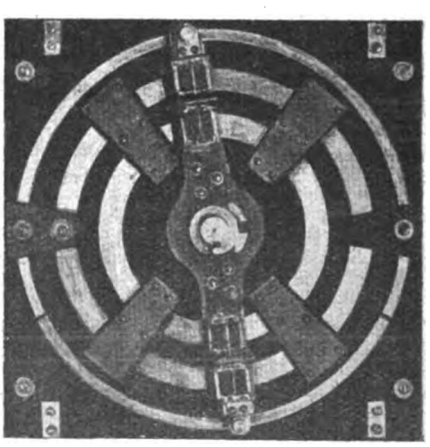

Fig. 5.—A Reversing Switch for Elevators.

out too rapidly. The circuit of the solenoid windings is necessarily closed while the motor is running, but the moving parts are fitted with contacts whereby—when the armature has risen and the magnetism need only be maintained at sufficient strength to hold it in the upper position—the current is greatly reduced, thus cutting down the waste of energy to a negligible quantity.

This instrument is applicable to elevators, motor-driven pumps or

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other apparatus where it is desirable to start and stop a motor automatically. For pump service it may be combined with any float switch whose contacts need only control the small current taken by the solenoid windings, instead of the main current of the motor. For motors used in obtaining a constant pressure, either hydraulic or pneumatic, the pressure regulator shown in fig. 4 may be used on the same self-starter. This consists of a diaphragm forcing upwardly a weighted lever and operating a small snap switch on the circuit of the solenoid of the self-starter. For elevator service the same self-starter may be used with a reversing switch, such as is shown in fig. 5. Here the two inner rings operate to reverse the armature connections in the ordinary way, while the outer rings send current to the solenoid of the self-starter when the reversing switch is in either the up or down running position.

ELECTRIC LIGHTING OF WORKHOUSE COTTAGE HOMES.

The Shoreditch Vestry on Tuesday last week considered a letter read by Dr. Mansfield Robinson, vestry clerk, from the Shoreditch Board of Guardians (of which Mr. H. E. Kershaw is a prominent member) asking that the Vestry would grant permission to Mr. Newton Russell, the electrical engineer, to prepare a specification and estimate of the cost of installing the electric light in the Hornchurch Cottage Homes. The Board would then apply to the Local Government Board for sanction to borrow the necessary money, the expenditure being estimated at £4,000.

Mr. H. E. Kershaw moved, and Mr. Hall seconded, that the permission should be granted.

Mr. Moss, Chairman of the Electric Lighting Committee, hoped that the Vestry would consider before acceding to the request. It was not fair to the committee that the Guardians should ask for one of the Vestry's officers to be employed upon such work, and he personally considered that Mr. Russell had quite sufficient to do to look after the electric light station. The proposed expenditure would be a waste of the ratepayers' money, and as an amendment he moved that the Vestry should decline to grant the application, and that they should strongly protest against the extravagance proposed by the Guardians.

Mr. Kershaw asked for permission to withdraw his motion, but this was refused.

Mr. Winkler having seconded the amendment, a long, acrimonious and somewhat personal discussion took place. On a division the amendment was carried by 41 to 30 votes, and it was then adopted as a substantive motion.

We have been enabled to obtain a copy of the scheme proposed for the electric lighting of the cottage homes as elaborated by the Visiting Committee of the Guardians. As the document is of an exceedingly original character, we make no apology for presenting it to our readers. The reasons adduced by the committee in favour of an electric light installation are as follows:—

The Scheme.

1. The engine house, boilers, and plant would form an excellent training school of a very useful and practical kind for the boys electing to go as engineers. Any intelligent lad having served two years in a small station would be capable of earning a commencing salary of £1 per week in a London or country electric light station.
2. Our present engineer with the assistance of the boys, is competent and able to undertake the running of the plant.
3. The cost of the whole installation computing the money borrowed at 3 per cent. for 30 years would be repaid with interest for £50 to £100 per year only in excess of that paid annually for gas (gas at 4s. 2d. per 1,000).
4. A saving would be effected by using the exhaust steam for heating the bath, stores, and schools; the surplus live steam we could find uses for, such as pumping, heating schools, &c.
5. An anticipated saving may be expected in the present consumption of coal, for the three existing boilers could be dispensed with.
6. No extra labour need be entailed, for by the provision of a battery it will only be necessary to run the station of an evening in the winter and two or three days a week in the summer.
7. The plant is provided for in duplicate, so that in event of breakdown the Homes will not be put in darkness. If, however, your Board think one engine and one boiler with the battery sufficient, a large portion of the cost would be reduced, say, £1,000.
8. It has been often considered a source of danger, the grounds being in comparative darkness during the winter; this will be obviated by the proposed erection of eight arc lamps, as now in Shoreditch.
9. Saving in decorations, more light in the Cottages, double the light in Infirmary and Schools and Grounds.

The Cottages are at present lighted by—

18 8-c.p. gas jets on ground floor.	Now proposed,	7 16-c.p., 11 8-c.p.) in each
15 8-c.p. " " upper "	"	15 8-c.p.) cottage.
Schools, 60 12-c.p.	"	60 16-c.p.
Workshop and stores, 100 8-c.p.	"	50 16-c.p.
Infirmary, 50 8-c.p.	"	50 16-c.p.
Official residence, 30 12-c.p.	"	30 16-c.p., 10 8 c.p.
Grounds, 8 arc lamps, each giving a light equal to about 1,000 c.p.		

These figures show 769 points total, and as nothing like half this total would ever be alight all at one time we are safe in assuming a maximum load of 400 16-c.p. lamps, which electrically would give a total possible load of 42 kw., with an average maximum of 30 kw., and the cost would be:—

	£	s.	d.
Two 20-kw. sets, engines and dynamos	900	0	0
One 350-ampere-hour battery	120	0	0
Two meters	12	0	0
Two boilers and setting	500	0	0
One main switchboard	150	0	0
Cost of wiring Cottages, &c., arc lamp posts, &c.	910	0	0
Mains, conduit pipes, road boxes and covers	344	10	0
Laying cable	176	0	0
Buildings and contingencies	887	10	0
	£4,000	0	0

These figures allow very fully in every case, and ample margin is allowed in arriving at these costs. The prices are based upon the contracts now being carried out for the Vestry.

An estimate of Maintenance Account is as follows:—

	£	s.	d.
Two boilers, consuming 100 tons of coal per annum, costing, say	100	0	0
Water	10	0	0
£4,000 repayment, interest and capital	253	6	8
	£363	6	8

Present gas account, £257 per annum.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

18,312. "Improvement in electromotors." M. O. Schmeidel. Dated September 11th.

18,324. "Improved method and means of constructing electric circuits for inter-communication." C. Adams-Randall. Dated September 11th.

18,335. "Improvements in electrodes for arc lamps." H. Bremer. Dated September 11th.

18,350. "Improvements in or relating to electrolytes." Q. Marino. Dated September 11th.

18,365. "Improvements in central battery telephone exchange systems." W. Aitken. Dated September 12th.

18,380. "Improvements in ventilating fans of that class which is employed in connection with electric motors." P. M. Justice. (The Emerson Electric Manufacturing Company, United States.) Dated September 12th. (Complete.)

18,414. "Improvements in or relating to electric contacts or current taking devices." E. Greil and E. Audigé. Dated September 12th.

18,438. "Improvements in or relating to the electrolytic deposition of metals." C. V. Burton. Dated September 12th.

18,440. "Improved means of flash signalling by electric light." Sir W. G. Armstrong, Whitworth & Co., Limited, and J. Honner. Dated September 12th.

18,454. "Improvements in electric lighters for pipes, cigars and the like." J. J. Robson. Dated September 13th.

18,457. "Improvements in guards for electric tramcars and other tramway vehicles." J. Tidswell. Dated September 13th.

18,468. "Improvements in electricity meters." Chamberlain & Hookham, Limited, and S. H. Holden. Dated September 13th.

18,489. "Process for forming a conducting connection between electrical incandescence bodies of second class conductors with conductors of the first class." Siemens Bros. & Co., Ltd. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated September 13th. (Complete.)

18,502. "Improvements in safety devices for electrically operated hoisting apparatus." Hans von Kramer. Dated September 13th. (Complete.)

18,531. "Improvements in or connected with overhead trolleys for electric railway vehicles." H. H. Hall and R. J. Urquhart. Dated September 14th.

18,537. "Improvements in or relating to appliances for raising and lowering suspended incandescent electric lamps and the like." J. B. McIndoe. Dated September 14th.

18,539. "The Leach-Prince electrical cable guard for overhead trolley system of electrical tramways." J. Leach, G. Prince and W. Prince. Dated September 14th.

18,547. "Improvements in continuous current electric motors or generators of enclosed type." H. W. Wilson. Dated September 14th.

18,550. "Improvements in armoured insulating conduits and the method of treating same." A. G. Brookes. (A. M. Lougee, United States.) Dated September 14th.

18,555. "Improvements in splicing ears and terminals for overhead electric trolley wires employed on electric tramways." J. Slack. Dated September 14th.

18,564. "Improvements in incandescent electric lamps." H. D. Goatley. Dated September 14th.

18,574. "Improvements in apparatus for wireless telegraphy." F. J. Jervis-Smith. Dated September 14th.

18,576. "An apparatus for ascertaining the direction of electrical waves." A. Polumordvinoff. Dated September 14th.

18,589. "Improvements in the decomposition of alkaline salts by electrolysis, and in apparatus therefor." J. Greenwood. Dated September 14th.

18,598. "Improvements in the manufacture of incandescent filaments for electrical incandescent lamps." R. Haddan. (M. Boehm, Germany.) Dated September 14th.

18,612. "Improvements in the means of attaching shades, globes, reflectors, and the like, to electric incandescent lamp-holders." E. Duckenfield. Dated September 15th.

18,624. "Improvements in and relating to electroliers." S. Ball. Dated September 15th.

18,627. "Jude's single leaf electroscope." R. H. Jude. Dated September 15th.

18,628. "Jude's multiplex connector." R. H. Jude. Dated September 15th.

18,629. "Jude's double leaf electroscope." R. H. Jude. Dated September 15th.

18,630. "Jude's galvanometer or galvanoscope." R. H. Jude. Dated September 15th.

18,643. "Improvements relating to the amalgamation and coating of metals or alloys of metals with metals or alloys of metals by the aid of electricity, and to apparatus therefor." F. H. Snyder. Dated September 15th.

18,664. "Improvements in and relating to electric railways." W. B. Purvis. Dated September 15th. (Complete.)

18,695. "Improvements in or connected with incandescent electric lamps." G. J. Thomson and E. Lee. Dated September 16th.

18,705. "Improvements in or connected with incandescent electric lamps." G. J. Thomson and E. Lee. Dated September 16th.

18,728. "Improvements relating to electrical switches." A. G. W. Baxter. Dated September 16th.

18,741. "Improvements in electric tramways." B. P. Stockman. Dated September 16th.

18,743. "An improvement in separators for the plates of secondary batteries." H. Leitner. Dated September 16th.

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18,754. "Improvements in galvanic batteries." P. Meyer. Dated September 16th.

18,756. "Apparatus for generating and utilising electric energy." W. S. Simpson. Dated September 16th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1899.

387. "Improvements in and connected with the manufacture of iron wall carriers for electric insulators and other objects." F. Unterberg. Dated January 7th, 1899. Consists in making the bed-plate and feet in one piece by cutting, stamping and pressing the iron for use with electric insulators. 4 claims.

427. "Improvements in electric igniters for gas engines." W. H. Cotton. Dated January 7th, 1899. The energy for the igniter is provided by means of electro-magnets mounted on the cylinder head in combination with an armature. Only one electro-magnet need be used. 7 claims.

580. "Improvements in telephone apparatus." D. H. Wilson. Dated January 10th, 1899. Relates to telephone and transmitter systems. Comprises an induction coil, including a primary and secondary coil; one coil provided with a core having opposed pole pieces, the other coil interposed between such pole pieces, so as to be in the path of the magnetic circuit between the pieces and a transmitter and receiver, connected respectively with the primary and secondary coils. 6 claims.

764. "Hollow or recessed punches used in connection with Wheatstone's automatic telegraphy or other systems of automatic transmission." J. W. Willmot. Dated January 12th, 1899. The heads of the punches are hollow, and thereby a flatter cutting surface is obtained, and compressed air forces out the punched out pieces of paper from the punch. 1 claim.

1,001. "Improvements in and relating to electric heaters." E. F. Porter. Dated January 16th, 1899. Relates to Specification 5,595, of 1891. Consists in mounting the heat generating parts on the blades of a fan. The motor is in circuit with the conductor. 5 claims.

1,027. "Improvements in insulators for fastening electric wires." J. Treleaven. Dated January 24th, 1899. Relates to improvements in wire fastening for insulators. Consists of an insulator having a groove passing half way round near its top, a groove on the opposite side curved downwards and intersecting the opposite ends of the groove, the intersections being angling obliquely to the plane of the groove and means for preventing the insulator from turning when fastened. 1 claim.

1,035. "Improvements in switches for starting and controlling electric motors." H. Hirst and W. Mead. Dated January 26th, 1899. Relates to switches for starting and controlling electric motors, and has reference to the regulation of rheostats. Consists of a spring, box, wheel and pinion, and an electro-magnet, the armature of which acts upon a pinion. 5 claims.

2,610. "Improvements in the manufacture of insulating material for electric cables." G. E. Hoyl-Dia. Dated February 6th, 1899. Consists in using as an insulator paper pulp, to which is added non-hygroscopic oils instead of cellulose. 2 claims.

2,780. "Improvement in cut-outs applicable both in the case of fuses and of switches." J. W. Manley. Dated February 7th, 1899. Relates to that type of cut-out in which the metallic strip is affixed to a part detachable from the base and constituting a handle of insulating material. The contact springs are sunk and the tongues are abnormally long. The handle is perforated in a direction normal to the plane of the base. 5 claims.

2,834. "Improvements in or relating to induction coils." M. E. Field. Dated February 9th, 1899. Relates to improvements in medical induction coils. Consists in inserting between the core of the coil and the primary and secondary coils sheet metal which is a good conductor of magnetic lines of force. 8 claims.

3,051. "Electric illuminating apparatus." S. Baner. Dated February 10th, 1899. The spring motor which drives the dynamo is arranged in a small box which is capable of receiving the dynamo, the motion transmitting parts, and an accumulator, and which is enclosed in the foot or in the upper part of the amp. 4 claims.

3,182. "Charging stand and contact for storage batteries." G. H. Condict. Dated February 13th, 1899. (Date claimed for patent under Section 103 of Act, being date of first application in United States, July 18th, 1898.) The table or stand is provided with a number of rocking contact levers which have two arms, one of which carries a yielding or elastic contact at its outer end, the end of the other being upturned. These contacts work automatically and charge the batteries in trays, by making contact with the contact pieces on the tray. 6 claims.

3,188. "Improvements in electric insulators." F. H. Withycombe. Dated February 13th, 1899. Has for its object to lessen the likelihood of insulators being broken. Consists in replacing the smooth outer surfaces of a small protuberance ridges which will break and cushion the force of contact of missiles, &c. 11 claims.

3,367. "Improvements in trolley apparatus for use in connection with electric traction." J. E. Winslow. Dated February 15th, 1899. The object is to provide improved trolley apparatus for use in connection with overhead conductors of electric railways. Consists in combining with the pivoted trolley arm, two or more springs in tandem, and so as to act in multiple. The springs are provided with a case. 5 claims.

3,734. "Improved process for electric smelting or reducing." W. Borchers. Dated February 20th, 1899. Consists in inserting the whole of the carbon intended for the reaction as the resistance into an electric furnace, and packing the substance to be acted on round the carbon without mixing the two, and then passing a strong electric current through the carbon. 2 claims.

3,735. "An improved method of and apparatus for utilising the waste gases and heat from electric furnaces." W. Borchers. Dated February 20th, 1899. Consists in effecting the electric smelting or reduction in the interior of a steam generator in the presence of an excess of the charge which remains undecomposed, freeing the gases generated in the furnace from dust particles by passing them through a filtering medium and then allowing the molten product to cool down in the surface. 7 claims.

3,736. "Improvements in secondary batteries." J. Skwirsky. Dated February 20th, 1899. Consists in the use of electrodes of cylindrical form inserted one within the other around a central electrode, the cylindrical vessel containing all the electrodes of one cell, and being likewise utilised as an electrode. 4 claims.

3,754. "An improvement in electrical wall plugs." P. F. W. Simon and H. P. Berry and C. Rayner. Dated February 20th, 1899. Relates to a wall plug for high tension currents. The plug is suitably insulated and screws on to the wall head connections. 1 claim.

3,774. "Improvements in galvanometers and the like." L. H. Newton, R. R. F. Neville, S. P. Newton and E. Tew. Dated February 20th, 1899. Relates to improvements in a galvanometer. The indicator needle is balanced horizontally, and kept in its normal position by a permanent magnet. Only one coil is used, which is in a horizontal position. 2 claims.

4,119. "Improvements in the mode and means for operating the poles or masts of electrical cars or vehicles for tramways." W. Rutherford. Dated February 24th. Consists of a gravitating carriage or its equivalent attached to the mast and holding a cord in suspension so as to allow an easier transfer from one cable to another. 2 claims.

4,176. "Improvement in the distribution of electricity over electric railways on the series system." M. Cattori. Dated February 19th, 1899. Relates to Specifications Nos. 6,212, 1894, and 20,629, 1895. Consists in an electric railway provided with two parallel sectional conductors, switches by which two adjacent sections may be joined and terminal switches connected to the respective poles of the generator and each arranged to connect one of said poles with the terminal section of either conductor. 5 claims.

4,231. "Improvements in arc lamps." W. C. Johnson and A. Wunderlich. Dated February 25th, 1899. The resistance coil of the circuit consists of a thin band of metal wound round a number of radially arranged insulating bars so that it is exposed to the atmosphere. 7 claims.

4,442. "Improvements in the manufacture of accumulator plates." Dr. W. Majert and F. Berg. Dated March 1st, 1899. Relates to the manufacture of accumulator plates as described in Specification 991, 1897. Consists in giving the tool there described an oscillating motion. 4 claims.

4,699. "An improved ceiling rose for electric lights and the like." H. F. Clayton. Dated March 3rd, 1899. The base of the rose is provided with a passage or channel of zig-zag form for the reception of wires, so that the likelihood of fracture is reduced to a minimum. 2 claims.

4,878. "An improved case for electrical transformer connections, also applicable to street electric light standards." G. Wilkinson. Dated March 6th, 1899. Consists of a box with a hinged and locking door adapted to a transformer, and holding enclosed all high tension connections, in combination with a metal covering having internal attachments, and carrying a concentric cable with or without a metallic tamping for sealing and earthing. 4 claims.

4,957. "Improved electric devices for controlling the power supply of meters and the like." M. K. Bowen and G. W. Knox. Dated March 7th, 1899. Relates to devices for controlling the power supply of motors. Consists of a movable part having suitable contacts, and provided with a retarding device independent of the current and of variations in the force applied in operating the controller. 4 claims.

5,030. "Improvements in control apparatus for electric hoists and elevators." O. Imray. (A. E. Macoomn, United States.) Dated March 7th, 1899. Relates to means for automatically slowing down the car of an electric hoist near each end of its travel, and stopping the car always at the same point. Mechanism actuated by the movement of the hoist introduces resistance when the car nears the end of its travel. A hand-worked cut-out switch is connected to the hoist drum, and automatically breaks the main current when the car reaches the limit of its travel. 5 claims.

5,255. "Improvements in electrical switches." R. T. Hall. Dated March 10th 1899. Consists in interposing between the poles, simultaneous with the breaking of the circuit, a diaphragm of insulating material. 4 claims.

5,518. "Improvements in electric break apparatus." T. B. Kharaide. Dated March 14th, 1899. Comprises a rotating member, an electro-magnet, a break device, and means driven by the rotating member for interrupting said break device. 11 claims.

5,545. "Improvements in induction motors for alternating electric current circuits." The British Thomson-Houston Company, Limited. (E. W. Rice, jun., and C. P. Steinmetz, United States.) Dated March 14th, 1899. Relates to alternating current motor. Consists in arranging a field magnet coil which may or may not be wound on the moving member, and in inductive relation thereto, at such an angle as to produce a rotary effect, a second coil is provided, which may be closed on itself by a switch inserting an adjustable resistance. 13 claims.

5,546. "Improvements in induction motors for alternating electric current circuits." The British Thomson-Houston Company, Limited. (E. W. Rice, jun., and C. P. Steinmetz, United States. Dated March 14th, 1899. Instead of constructing the phase-splitting motors with poles displaced from each other by one quarter of the polar pitch, and exciting one set of the said poles from the single-phase mains, and the other by dephased currents, one main inducing coil and two auxiliary inducing coils are used. 9 claims.

5,547. "Improvements in devices for changing the frequency of alternating currents in systems of electrical distribution." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated March 14th, 1899. Consists of a frequency changer composed of two dynamo-electric machines being of the rotary induction type so connected as to supply energy from a system of distribution, connections of one of the machines to a secondary system and means whereby one of the machines is so modified by the action of the other that the current induced in its secondary member and fed therefrom to the secondary system is of a frequency different from the frequency of the current which would normally be induced in it. 6 claims.

5,550. "Improvements in self-starting alternating electric current motors." British Thomson-Houston Company, Limited. (C. P. Steinmetz and E. J. Berg, United States.) Dated March 14th, 1899. Consists of a single-phase alternating current system of electrical distribution, an alternating current motor having exciting windings connected directly to the supply mains of the system, phase modifying devices connected across the said mains and in parallel with exciting windings and other exciting windings connected through phase modifying devices to supply main. 12 claims.

5,551. "Improvements in devices for starting alternating electric current motors." The British Thomson-Houston Co., Ltd. (C. P. Steinmetz and E. J. Berg, United States.) Dated March 14th, 1899. Consists mainly of an alternating current motor having main and supplemental induced windings, the main windings being directly connected to the supply lines of the system phase modifying devices connected to the lines in parallel with the main induced winding and connecting the supplemental windings to the supply lines. 6 claims.

5,570. "Improvements in closed conduits for electric railways and trolleys therefor." A. M. Clark. (The Campbell Electric Traction Company, Incorporated.) Dated March 14th, 1899. Consists in a conduit containing a continuous conductor, and having a non-conducting cover grooved in its under side metal plates in the groove, and insulated from each other, and outside sectional conductors each connected with one of the metal plates. 8 claims.

5,576. "Improvement in automatic systems of preventing collisions on electric railways." C. F. Bancroft and P. F. Sullivan. Dated March 14th, 1899. Relates to automatic systems of preventing collisions on railways specially applicable to single line track provided with turnouts. Consists of means whereby the passing of a car along a section of line will shut off the power from another section of the same. 5 claims.

5,619. "Improvements in or applicable to galvanic batteries." F. E. Singer. Dated March 15th, 1899. Relates to an improved method of preparing the carbons of galvanic batteries. Consists in preventing a deposit on the electrodes through chemical action by coating the carbon with a thin layer of cement. 2 claims.

5,868. "Improvements in connection with the sheathing or casing of thermo-electric elements." J. Y. Johnston. (Hartmann & Braun, Germany.) Dated March 17th, 1899. Consists of a protecting sheathing for thermo-electric elements consisting of fire-resisting material with a longitudinal hole therethrough traversed by a rod or tube capable of resisting high temperatures. 8 claims.

6,087. "An improved electrical drying apparatus for treating textile fabrics." J. M. J. E. Vignon-Dante. Dated March 20th, 1899. The heat necessary is obtained through electric energy transferred to caloric. The heating apparatus is enclosed by the drying apparatus. 3 claims.

6,260. "Improvements in electric lampholders." R. F. Hall. Dated March 23rd, 1899. Consists in the employment of metallic nipples to which the ends of the circuit or lead wires are secured, and which carry attached spring plungers adapted to contact with the filament terminals of the lamp. 2 claims.

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THE

ELECTRICAL REVIEW.

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MUNICIPAL AMENITIES.

IT is very nice to theorise upon the advantages of municipal industry, and to think how much better off we are when electric light, gas, water supply, and tramways, are all in the hands of the local authorities; but, although there is much to be said in favour of such municipal development, yet a danger also exists of painting these local industries in colours of too bright a hue. Disillusionment is certain to follow, and a consequent set-back to any progress in this direction—whether such progress be really advisable and wise or not.

The financial aspect of municipal electric traction will not disturb the bigger towns and cities, but it may well do so with the smaller ones; and the question of intercommunication between adjacent towns or centres will prove even more important, for the only possible means of municipal working in such a case, viz., that of a joint committee, is beset in practical daily working with such enormous difficulties that the operation of electric tramways by local authorities (unless with systems or networks absolutely isolated in single areas) is likely to utterly fail for this very reason.

Endless jealousy of one another is always felt by neighbouring authorities, and too often the big one tries to override the smaller, or play the big boy and the fag.

Take, for instance, certain authorities in the North, one of which, the larger "A," has already electric tramways at work. The smaller district, "B," sends a deputation to ask whether "A's" lines can be extended into "B's" district far as the Town Hall. "A" replies: "They cannot enter into a partnership with 'B,' nor give 'B' the option of purchasing the lines and cables, but would obtain electric energy from 'B' if they ('A') found it advantageous to do so."

This stands out as a cheeky piece of monumental bluff, if truly reported, and the small authority, "B," has only to wait until such time as "A" wants to come outside its district and asks Parliament for powers. "B" will then find that a Parliamentary Committee will support it ("B"), even preferably to the bigger authority, and give it permission to purchase such tramways on more favourable terms than are even mentioned in the iniquitous Tramways Act of 1870.

But how truly absurd it is for one authority to so attempt to override a smaller one! Every additional branch line reaching out like the one sought for by the small authority, is a feeder to the trade of the big town, and deserves every possible encouragement; and for the town to pose as the benefactor instead of the one who profits, is as ridiculous as it is shortsighted.

The same tendency has been noted in other places; and one city in particular has sufficient self-conceit to lay down, as a condition of taking the tramways outside the municipal boundary, that it shall be given control of, or a right of, tramway, over the neighbouring districts, roads and streets, *for ever*.

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We cannot believe that this assignment in perpetuity of any rights there may be of running electric tramways along the roads, has received the full consideration by Parliament that it should require before approval. The confiscation of roads for traction purposes in this way by local authorities is quite as unjustifiable as if it were done by an individual; and if a right of way is limited in period for private interests, there seems no reason why, inherently, the same kind of monopoly should be granted to a public body for ever.

Our Industrial Supremacy.

It is gratifying at times to read in some of the more reasonable American trade journals appreciative notices of the splendid performances which are written down in the history of English engineering work. In several recent issues from across the ocean we have observed that journals of this class have administered sharp rebukes to some of their lower class contemporaries, which are for ever shrieking about the declining supremacy of poor old England. The object of these shrieks is, of course, to enable them to bring into greater relief the very wonderful things which are being achieved on their own territory. No one is more ready than ourselves to give due credit to America or Continental countries whose progress during recent years has taken a quicker pace than our own, but the scare has been absurdly overdone. We have frequently admitted, with candour, that we are behind our trans-Atlantic rivals in some things, but in following the comments of some of these irresponsible critics whose opinions unfortunately obtain currency bearing the appearance of authoritative views, the casual reader is persuaded that this poor old country's industrial constitution is in a state of rapid decay, in fact, almost beyond hope. Of course, those who are acquainted with the facts of the case know how to treat these ridiculous fabrications. We know that, generally speaking, English factories and works never were so busy as they are to-day, our colonial and foreign trade never was so large, and our reputation for good, substantial and thorough work never was better; all over the country new works are springing up and old ones are being extended —in short, everywhere there are signs of increasing prosperity. Some of our foreign rivals are, we willingly concede, rapidly adding to their reputation for quick, and perhaps, cheap, work. There appears to be a fair field for construction of this class, in spite of the fact that some of the cheap and quick work turns out to be very dear and very slow in the long run. But taking a general purview of the situation, where does the blame lie for our apparent backwardness? We have on several occasions brought it home to the handicapping influence of labour. In the praiseworthy endeavours which have been put forth to improve the condition of what are called the "working classes," they have been given an inch and they have taken the proverbial ell. It has been frequently asked of late to what extent American manufacturers who establish works on English soil will be troubled by the many phases of the labour problem as it exists to-day. When these Jonathan-Bull works have been running for a time it will be an interesting occupation to compare the experiences of the works in England and America respectively, with a view to calculating the effect of labour upon these new factories and their outputs. At the moment of writing there is before us a note of the views of a leading United States fiscal expert and statistician—the Hon. Robert T. Porter—who has been interviewed by some enterprising pressman anxious to obtain his opinions on trade matters. The Hon. Porter is reputed to have expressed the opinion that England has not lost ground in the World's markets, and that with the aid of technical education we are making efforts to keep pace with the increasing skill of our rivals. But like anyone else who reads the outlook aright, he apprehends the possibility of evil consequences, if the excessive interference of trade unions is permitted to continue. While advocating, as we ourselves have also done, organisation, of a kind, among the working classes for certain purposes, he deprecates the tendency to dominate the master in the conduct of his business. One of the largest electrical appliance manufacturers in the States is reported to have stated that he could not possibly carry on his establishment, if he had to submit to the dominance of British trade union regulations. Mr. Porter attaches great importance to the use of automatic machinery as a means for enabling the employer to once more gain complete command of the reins.

From these few brief notes it is apparent that Mr. Porter's views are quite in keeping with those of common sense practical men in this country. He has at once placed his finger upon the weak spot in our industrial life. The pity of it is that those who are responsible for the evil are apparently blind to their own interests.

Gas v. Electricity.

The *Gas World* says that notwithstanding all the pushing of electricity in Edinburgh, the consumption of gas increases at a remarkable rate, and the writer quotes figures for the month of August giving support to the statement. The concurrent advance of gas and electricity in various towns is a matter of common knowledge, but what we cannot understand is why gas interests should so obstinately and obstreperously do all in their power, by means both fair and foul, to keep electricity schemes in abeyance. Upon their own showing, where electricity is introduced the gas supply increases. Why, then, oppose it? Gas suppliers have a splendid field at present in the rapidly extending use of gas for domestic heating purposes, a business for which electricity is not yet able to cater at a reasonable price, at any rate with a view to meeting the requirements of the average consumer. Where electricity is to reveal its advantages and to reap big profits in the future, is in the extension of areas supplied with energy for lighting and motive power purposes. The small gas engine has done, among other things, a useful work in educating the small manufacturer up to the benefits following a cheap supply of motive power, but it is being rapidly supplanted by the more convenient electric motor wherever a public supply of power is available. The great future for gas engines, so far as the electrical world is concerned, seems to be in the driving of large electric generators, but as we have often said, the electric motor is proving itself a remarkable boon to the small man for his thousand and one operations for which power is needed on a limited scale, and what it now does is but a small indication of the great proportions which the power supply business will assume in due course if proper attention is bestowed upon its development by a policy of wise encouragement. We suppose there must come a time when the consumption of gas for purely lighting purposes will have reached its highest point—even if that time has not already arrived—but in domestic heating it may hold its own for a long time to come, unless some of these revolutionising inventions of which one hears at varying periods are going to improve the chances of electric heating.

Black Lists.—Our municipal contemporary *London* warns "negligent and unscrupulous contractors" that certain municipal authorities are now keeping a "black list" of those who "fail to carry out their contracts to the satisfaction of the Council." We do not deny that there may be contractors who are either negligent or unscrupulous, or even both, but perhaps it is as well to mention that there are certain reputable firms who keep their own black list of Councils which fail to exhibit any fairness in dealing when placing contracts. The Employers' Federation has a very long and very black list, showing pretty clearly the density of the municipal authorities throughout the kingdom. We have already drawn attention to this on several occasions for the benefit of electrical manufacturers.

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NOTES ON ELECTRICAL SPECIFICATIONS.

By ERNEST KILBURN SCOTT.

Specifications are absolutely necessary in expediting large business transactions, and can generally be used with advantage on comparatively small contracts. It is true that when there is no specification, goods can often be bought cheaper, but the reasons for high quotations are:—

(*a*) The specification is not clearly drawn.
(*b*) The tests are too numerous or unnecessarily severe.
(*c*) The payments are too long deferred.

All reliable manufacturers are accustomed to making suitable tests, the severity of which is graduated in accordance with the importance of the article in case of failure. When, however, a number of special tests (which partake more or less of the nature of experiments) are asked for, it is only natural that a good round sum should be added to cover the extra work and risk. Specifications drawn up by professors are frequently troublesome in this respect.

Deferred payment, in which the final 10 per cent. is paid nine months after the plant is running (or at a time even more remote), is a favourite method with municipalities, who as they come by their money so easily ought to be the first to hand it over. It is an axiom in business, at any rate between individuals, that he who pays promptly gets best served. The 10 per cent. generally represents all the profit on the transaction, and it is no wonder, therefore, that the principal firms have one price for municipalities who dribble the payments over months and months of time, and another price for companies, shippers, and private individuals who pay up properly. If anyone doubts this let him ask a leading high-speed engine maker, who stocks the parts of standard sizes, for the price of a certain sized engine *with* and *without* the deferred payment clauses as they usually appear in municipal contracts.

A specification need not aim at being either a legal (the less the average town clerk has to do with it the better) or a literary production. Schedules, and plenty of them, are what contractors want nowadays, not wordy clauses.

Drawings.—Drawings are sometimes submitted with specifications, in fact an arrangement drawing forms a specification in itself. It is a mistake, however, to show too much detail, or at any rate to dimension such details. Nine times out of ten the dimensions will not fit the standard designs of the tenderer, or if they do, he may, from further experience, be able to suggest improvements.

Some engineers prefer to make original designs of various parts of the plant, as, for example, the switchboards, and this is all right in its way, but as it does not pay engineering firms to get out patterns and special jigs, &c., for work which they may never get another order for, the result is that few tenders are offered, and the work has to be put out at a fancy price. The cost of tendering for electrical work is a very considerable item of the establishment charges, and with plenty of work in their shops electrical firms are breaking off their old habit of sending in tenders for every job advertised.

Workmanship.—However lengthy or elaborate a description may be, it cannot be made to represent the character of the workmanship, and other ways have to be found of safeguarding this. If the contract is a large one it will probably pay for an inspector to sit over the work to see that a certain standard of workmanship is kept up. In the majority of cases, however, the makers' guarantee is accepted, such a guarantee taking the form of a written offer to keep the apparatus or machine, &c., in working order, allowing for fair wear and tear, over a definite period of time.

Steam Piping.—Steam piping is one of the most awkward things to estimate for, and an alteration to any part of the plant, as, for example, a different type of feed pump, may make a considerable difference in price. Many firms have regretted taking pipe contracts because of the large amount of expense to which they have been put in erection, and the writer's opinion is that the erection should always be done by day work. If, however, those who employ the engineer insist, as municipalities usually do, on having a complete tender, they must in future be prepared to pay through the nose to cover a very large contingency item. The actual amount which the contractor may think it advisable to add on for contingencies will depend on how detailed the consulting engineer makes his specification and drawing. By detailed the writer does not mean giving the exact thickness of the flanges, the number and diameter of bolts and that sort of thing, but indicating clearly the pipe chases, the number and exact position of bends, the connections of the feed and drain piping, approximate positions of relief valves, steam-traps, water meter, feed pumps, water heater and exhaust to atmosphere. This is the information the contractor requires, but which is seldom given properly. It is common knowledge that even the best consulting engineers' specifications go thoroughly into trivial details, and omit or only casually refer to what is really important, and this is especially the case with the piping.

Vague Specification of Output.—Specifying two or three voltages for dynamos which have to be used for charging accumulators as well as lighting direct, is especially troublesome. In a recent specification three voltages were given, the difference between the highest and the lowest being about 40 per cent. There appears to be a sort of hazy idea abroad that a dynamo will not be any larger or more expensive if two voltages are specified. This is, of course, wrong, as the designer simply works by the maximum voltage and the maximum current, making the field to suit the former, and the section of the armature conductors to suit the latter. To cut down the field current and work the machine at an inefficient and unstable point most of the time (when not charging batteries) is a poor sort of makeshift for a central station, but in case it is preferred to having a booster, then the charging current at the higher voltage should be distinctly specified as well as the maximum current at the lower voltage. If the charging current is very small, say one-third of the maximum current, then something may be gained on account of the drop in voltage of a shunt machine, and if the engine will allow of it advantage may also be taken of an increase in the speed. This information is, however, seldom given, and in its absence the dynamo maker can only be safe by quoting a machine which will give the maximum current and maximum voltage at constant speed.

Temperature Rise at "Full Load."—The words "full load" are frequently used in a loose sort of way. What, for example, is the full load of a dynamo specified to have several voltages as mentioned above? At the high voltage the field will get hot, while at the low voltage the field will be cool and the armature hot. Although not always wanted, the writer thinks it would be an advantage if, when specifying the temperature rise after a certain number of hours' run, consulting engineers and others would distinctly state the *load in amperes and volts* instead of simply saying "at full load."

Speed Variation.—The variation of speed of direct coupled sets has been a stumbling block in one or two cases. For example, in a recent contract, the specification required an alteration of speed of 10 per cent. above or 10 per cent. below the normal. Now, although governors are capable of some wonderful things, this is outside their powers. It should be remembered that when altering speed by screwing up or unscrewing springs the sensitiveness of the governor is increased or diminished respectively, and either hunting is caused by increased sensitiveness, or, on the other hand, too great a range of speed is permitted through decreased sensitiveness. If a long range in the variation of speed is required for synchronising or other purposes, it can only be attained at the expense of the governing properties.

Short Circuiting Test on Alternators.—In some specifications alternators are required to withstand a short circuiting test through a seven strand cable (whatever that may be). Now, most iron-cored alternators will stand short circuiting, but why should the risk be taken at all? When a railway superintendent orders a new locomotive he does not insist that it shall be put to the test of a collision to see if it is strong enough.

Parallel Running.—Where alternators without iron in the armature already exist, a clause is inserted that the new alternators must run perfectly in parallel with the old machines, and although an iron-cored machine would apparently be preferred, the supplier of the new alternator is practically asked to indemnify the customer against any breakdown of the old machines. This, of course, cuts out the makers of ironclad types, as it is very certain which alternator would go in case of accident. Engineers who

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have machines without iron in the armature must therefore go on using them to the end of the chapter or else withdraw this objectionable clause.

Transformer.—There appears to have been a good deal of reckless guaranteeing of late, with the result that figures are given in specifications which are simply unattainable by any transformer in the world. This is especially the case with the voltage drop and the magnetising watts. Contractors are asked what the latter will be in 12 months' time when, as a matter of fact, it is pure guess work, and it cannot be known what work the transformers will be put to in the interval.

Temperature rises of the larger transformers are more often than not specified at utterly ridiculous figures. The fact that the larger the transformer the less is the proportion of cooling surface to the watts lost, is overlooked.

Flashing or Insulation Test. — Flashing or testing the insulation by applying a high pressure for some time is often specified at an absurdly high voltage. The other day, for example, some dynamos which ordinarily worked at 440 were specified to withstand 5,000 volts or over 10 times the working pressure. The writer can understand that for the field coils of a tramcar motor a test at, say, 1,000 volts, is useful because of the great amount of self-induction from the magnetic blow-out, but for an ordinary central station dynamo such a high voltage as 5,000 is unreasonable. 5,000 volts is quite high enough for the primary coils of transformers which ordinarily have to work at 2,000 volts.

The high pressure stress is undoubtedly the one to make (plugging for megohms on a bridge is waste of time except as a rough guide, when the stress test can be taken), but the writer would suggest that the stress test should be specified to be taken when the apparatus to be tested is cold.

Water Consumption Bonuses. — Bonuses for the steam consumption of direct coupled sets are an excellent idea, but some consulting engineers show themselves distinctly one-sided in specifying for same. To start with, a steam consumption is given which leaves very little chance for any contractor to escape being fined, and yet to make doubly sure that he shall not benefit, the figure under which the bonus can be earned is set much lower than the guarantee. Surely it would be only fair to fix one value with a bonus above and a fine below. As a rule where the engines are high speed, these tests can be best made at the engine makers' works, but when a test on site is insisted on, the contractors should be allowed preliminary runs to ensure that the plant has fairly settled down on its foundations and the bearings are properly in line. Where a very high efficiency is asked for it may take several weeks' running before the plant will give it. For high speed engines the steam consumption test might be specified per B.H.P.-hour, and be taken at the makers' works, whilst the combined efficiency of the engine and alternator or dynamo could be taken after several weeks' running on site. With the large slow running sets there is nothing for it but to erect on site straight away and test per KW.-hour by measuring the water into the boiler.

Delivery on Site.—With reference to the erection of the machinery, it would be an advantage to add a clause such as the following, to make it quite clear that the contractors are to have facilities for getting the plant on to its foundations:—It is understood that the railway company's wagon can bring the machinery directly under the overhead crane in the engine house, and that this crane will be available for lifting the plant on to its foundations. In case any extra work is required in preparing a road for the wagon, or getting the machinery under the traveller, or in case the crane is not ready the customer will either undertake the extra work or make an allowance to the contractor for doing it, at day work prices.

Insurance.—As it often happens that a good deal of valuable machinery is lying about at the generating station, it would be as well if the conditions specified exactly how far the contractor is liable in case of fire. He is, of course, entirely liable for the fire risks while the plant is in his own works, whilst the railway company takes over the liability during transit; it appears to the writer, therefore, that it would be only fair that the customer or corporation and the contractor should share the fire risk equally whilst the plant is in the customers' station or premises until such time as it is handed over. It has been specified that the policy is to be taken out in the joint names of the corporation and the contractor, and to be retained by the corporation. Surely the corporation should share in the risk.

Liquidated Damages.—It is now generally conceded that the maximum amount of damages on any contract should not exceed 1 per cent. per week of the contract sum, but cases still occur, as in the Glasgow traction contract, in which exceptionally severe penalties are imposed. As the contractor stands to lose orders if he gets the reputation of giving bad deliveries, the customer is well protected by 1 per cent. per week. It would, however, be better to make it clear in future specifications, that the 1 per cent. only applies to total contract sum when the whole of the plant is behind time. Thus, suppose 20 transformers were ordered for the sum of £2,000, and the first 10 delivered to time, and the second 10 one week late. Then, obviously, the 1 per cent. should only apply to the value of the second 10 transformers, *i.e.*, £1,000. This is a matter on which most specifications are particularly vague.

In the building trade these questions of damages have gone into the Law Courts many times, and the result has generally been that the contractor has won for the simple reason that he has easily been able to prove some deviation from the specification. A slight alteration will apparently nullify the most accurately worded clause. Even where the contractor has lost the case he has only paid an amount which covered the actual damage sustained by the customer, and in assessing such damages the wording of the penalty clause has been ignored. As a matter of fact, there is in legal circles a strong feeling against consulting engineers, architects, and others taking upon themselves the specifying of the damages in case of non-compliance with conditions. The words which have been added in recent specifications to the effect that the "penalty shall be claimed as ascertained liquidated and agreed damages" is supposed to put the matter right legally.

Fair Wages Clause.—This promises to be the cause of trouble in the future. In some clauses it is not clear whether the specified wages are to be paid to men employed on a particular contract or to all the men in the factory.

The latest form of clause reads somewhat as follows, and refers only to the contract in question:—

"That all workmen employed in carrying out *the contract* shall be paid at a rate of wages and observe the hours and conditions of labour as recognised by the Masters' Federation and the representatives of the men's trades unions for the district. These conditions shall also apply to sub-contractors."

"The contractors agree that the engineer for the Corporation shall, at all reasonable times during the progress of the works, have free access to the workmen of the contractors, and to the wage books of the contractors, and to the factories or other places which shall for the time being be in the occupation of the contractors for the purpose of this contract, and shall, on behalf of the Corporation, be entitled to make full inquiry with the object of ascertaining that the stipulations in respect of the rates of wages, and the conditions of labour are being duly observed by the contractors."

It would be rather difficult to say what men are and are not employed on the contract; thus the shop sweeper, or the stoker of a boiler in another part of the works where the packing cases were made, would be indirectly employed on the contract. The phrase that all unskilled labour is to be paid at the rate of 7d. an hour opens up questions of which it is difficult to see the end.

PROGRESS IN THE ACETYLENE GAS INDUSTRY.

By JOHN B. C. KERSHAW, F.I.C.

I.—Generation.

The genus—Inventor—still continues to find in the generation of acetylene gas from calcium carbide a fruitful field for the display of his abilities. The following figures show the numbers of patent applications relating to calcium carbide and acetylene *granted* during the last three and a half years:—

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1896	159	1897	172
1898	177	1899, first half ...	101

The proportion of these totals which relate to furnaces for carbide production is very small, and by far the greater number of patents relate to generators and lamps.

The value of the majority of these patents is absolutely nil, the novel (?) methods of bringing the carbide and water into contact having been in use for years for the laboratory generation of such gases as sulphuretted hydrogen and carbonic acid.

This fact, however, does not in the least lessen the activity of the hosts of inventors engaged in elaborating apparatus for acetylene generation; in fact, it rather seems to stimulate them since it renders invention more easy. The writer has more than once referred to this subject, and he is pleased to note that his opinion as to the valueless nature of most of the patent acetylene generators is endorsed by others.*

However, a British patent, though lacking in novelty and of no intrinsic value, is often quite sufficient basis for a company promotion, when a "boom" in the special branch of industry with which it is connected is in progress, and acetylene patents have formed no exception to this rule.

During the last 12 months the following companies have been registered in this country alone:—

Name of company.	Authorised capital.
Buffington Acetylene Gas Light Company	£100,000
Freis Calcium Carbide Company	60,000
Carbides, Limited	50,000
Electroid Gas Company	50,000
Imperial S. C. Acetylene Gas Company	40,000
Carbides Development Syndicate	30,000
Read-Holliday Acetylene Company	30,000
Turr's Acetylene Gas Syndicate	25,000
Tyne Acetylene and Carbide Company	10,000
Home and Colonial Acetylene Syndicate	10,000
Acetylite, Limited	10,000
Carbide and Acetylene Trust, Limited	8,100
Patents Development Syndicate	5,000
Acetylene Purifying Company	5,000
Acetylene Manufacturing Company	3,000
Total	£436,100

Some of these companies are, no doubt, at present doing a profitable business by the sale and installation of their generators, but this fact does not prove that the patents they hold are worth the sums paid for them. The attention of investors in acetylene gas companies might with advantage be given to a recent article in the journal devoted to the industry, in which it is stated that some of the companies floated during the "boom" are already in the hands of the debenture holders.† The number of patents granted for acetylene generators, which the writer now estimates at over 600, ought to convince investors of the folly of paying large sums for such inventions. Patent acetylene generators promise to become as plentiful as blackberries in August, and therefore ought to be equally cheap.

II.—Purification.

The purification of acetylene gas is now receiving considerable attention from scientific investigators, and some valuable contributions to the literature of this subject have recently been published.‡ It was formerly supposed that the acetylene gas might be safely burnt as it came from the generator without purification, but it is now recognised that for domestic lighting and for public halls it is absolutely essential that some process of purification should be adopted. The chemicals that have been recommended and tried for this purpose are:—

(*a*) Lime water, by Lundstroem.
(*b*) Bleaching powder, by Lunge and Cedercreus.
(*c*) Bleaching powder and lead chromate, by Wolff.
(*d*) Acid cuprous chloride solution, by Franks.
(*e*) Chromic acid, by Ullmann.

The first removes all impurities with the exception of the phosphoretted hydrogen, the most dangerous to health; it is therefore useless alone. The use of bleaching powder is condemned by Caro,* on account of the possible formation of nitrogen tri-chloride, and therefore only the methods of Franks and of Ullmann can be considered of practical value. The absorbents adopted in these two methods may be used in conjunction with powdered quartz, and these mixtures have been patented under the names of "Frankolin" and "Heratol" respectively. It is stated that 5½ grammes of chromic acid suffice to purify 1 cm. acetylene gas; but it is evident that the amount required must depend upon the percentage of impurities present. Caro recommends that the purified gas should be subjected to a final scrubbing action with paraffin oil, in order to remove any impurities picked up from the chemical re-agents.

In relation to this question of purification, Liebetanz, in his report upon the exhibition of acetylene generating and purifying apparatus at Buda-Pesth in the early part of this year, makes the following remark:—"It is to be urgently recommended that makers of acetylene generators should entrust the design of the purifying apparatus to those who have a special knowledge of the subject, for the purifying apparatus exhibited showed in many cases a complete ignorance of chemical knowledge on the part of the designer, and often formed a dangerous addition to the complete apparatus."† The ignorant inventor is therefore not unknown outside the limits of the British Isles.

III.—Utilisation.

The attention which has been paid to the scientific aspects of the generation and purification of acetylene has improved the practical value of the gas as an illuminant, and its use for this purpose has undergone considerable extension during the last 12 months.

The high price of carbide in certain districts remote from a producing factory, is, however, a considerable hindrance to the further extension of acetylene lighting, and there is no doubt that in many places where it has already been adopted, at the present price of carbide, it will be found a very costly illuminant. It is customary for those engaged in pushing the sale of acetylene apparatus, to urge the use of acetylene, because it is cheaper than coal-gas or oil, in the particular locality where they may chance to be operating. In numerous instances this is absolutely false, and such tactics will not conduce to the permanent gain of the carbide or acetylene industries. The *Progressive Age*, one of the American papers favourable to the acetylene gas industry, has recently‡ been commenting on this tendency to underrate the cost of the gas when dealing with prospective buyers of generating apparatus, and has referred to the distribution of pamphlets and leaflets, in which the ratio of cost between illumination by coal-gas and by acetylene is stated to be 4·2 : 1·0. The lowest ratio found in any of these circulars is stated to be 1·0 : 1·0, while the actual ratio calculated on the prices then current in New York was ·5 : 1·0, acetylene being twice as costly as coal-gas for equal illuminating power.

The dissemination of false information of this character has led to the discarding of acetylene in some cases—after actual trial. Thus the Canadian Electrical Association has recently made an inquiry concerning the position and prospects of acetylene lighting in Canada.§ It found that there had been 90 installations of acetylene apparatus, involving the operation of 217 generators; but that 62 generators, or over one-fourth of the total number, after a few months' trial, had been put out of use.

An anonymous writer in the *Engineer*‖ recently discussed this question of relative costs of acetylene and coal-gas, in a singularly fair and temperate article, and summed up by urging the general adoption of acetylene as an illuminant, on grounds—not of economy—but of health. Though in favour of the new illuminant, this writer was obliged to admit that as compared with coal-gas or oil, it was, in most places, *at present much more costly, and was likely to remain so.*

That there are localities where acetylene is cheaper than coal-gas is, of course, true, and the correct policy of the Carbide and Acetylene Companies is to seek out these, rather than to direct their attention to districts where coal gas or

* The *Engineer*, August 25th, 1899. *Journal Acetylene Gas Lighting*, May, 1899.
† *Journal Acetylene Gas Lighting*, January, 1899.
‡ *Journal f. Gas Beleuchtung*, 1899, p. 198.

* *Zeit. f. Angew Chemie*, July 11th, 1899.
† *Ding'er's Polyt. Journal*, June 10th, 1899.
‡ *Progressive Age*, April 1st, 1899.
§ *Lightning*, August 31st, 1899.
‖ The *Engineer*, March 31st, 1899.

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electricity are in the stronger position. In such localities, oil is the only real competitor, and though acetylene can never hope to compete with oil on the ground of cost, yet it may do so with some success on the grounds of convenience and health.

As regards actual progress in this country, the Manchester Acetylene Gas and Carbide Company is stated to have installed Kay's patent generator in over 100 county residences, in nine churches, in a few manufacturing establishments, and also to have supplied special portable apparatus for lighting portion of the Salford Docks of the Manchester Ship Canal. Messrs. Read, Holliday & Sons, of Leeds, have supplied their generator to a large number of factories and hotels, among which the following may be mentioned :—Wyke Valley Print Works, Bradford; Raven's Hall Hotel, Scarborough; Messrs. Wood Bros., Tockwith, York; Meal Bank Works, Kendal; and Toulston Lodge, Tadcaster.

The Thornton-Scarth apparatus is in use at Lord Pirbright's residence, Brookwood, Surrey, and at the Clifton Hotel, Liverpool. The remarks made above will explain why the writer considers the latter installation a mistake. Messrs. Thorn & Hoddle are supplying an installation of 80 25-c.p. lights to the village of St. Michael's, in Kent.*

In France the most noteworthy sign of progress is the decision of the General Omnibus Company, of Paris, to use acetylene for lighting the trams on the Louvre-St. Cloud section. The carbide is to be specially treated by the Serpollet process in order to obtain a coating of glucose upon it. On bringing into contact with water, a sucrate of lime is formed, which, being a soluble salt, facilitates the use of comparatively small generators. Details of the apparatus to be used will be found in the paper named below.†

At Bayonne, acetylene is being used for the lighting of several establishments, and owing to its proximity to several projected carbide factories, the innovation may be a permanent success.‡

In Germany a large-scale acetylene installation is reported at the town of Olivia, near Dantzig, where a 2,000 light generator on the Wolff system has been erected; cast-iron pipes are used for distributing the gas. The streets of Schonsee, West Prussia, are stated to be now lighted by acetylene. Lundstroem, in the article already referred to, states that there are already 6,000 !! installations for acetylene lighting in Germany. The writer is of opinion that two stray cyphers have been mixed up with this estimate, and that 60 would be nearer the correct total. The railway stations at Luchan, at Hildesheim, and at Altenstein, are now lighted by acetylene; while the communes of Bretrenheim, of Grunmen, and of Elberbech, have arranged for acetylene installations. The editor of the *Revue Industrielle* estimates the present consumption of carbide in Germany as between 5,000 and 10,000 tons per annum,§ while Liebetanz has more recently estimated the consumption in 1898 to be at the rate of 14,000 tons per annum.‖ The value he places on the carbide, namely, £500,000, is certainly excessive, and is equal to a price to the consumer of £35 14s. per ton. With carbide at this price, acetylene illumination will not prove economical.

Outside France and Germany the principal progress appears to be occurring in South-Eastern Europe, where coal-gas and electricity are hitherto comparatively unknown.

Thus, at Syra, in Greece, an installation of acetylene gas for public uses is being carried out, oil being the only competing illuminant. The carbide is to be imported from Belgium, and the acetylene is to be charged at the rate of 4dr. 50l. per 1,000 cubic feet. This is equivalent to 3s. 7d. per 1,000 cubic feet, and the estimate is evidently erroneous.¶

The use of acetylene, in conjunction with other gases, is considered by many to be the most promising field of exploitation, and mixtures of acetylene and oil-gas are being used upon some branches of the German State Railways. Wedding, of Berlin, has recently published details of experiments made with mixtures of acetylene and air, and with mixtures of acetylene and coal gas,* while Guilbert at the recent Buda-Pesth Congress read a paper on the use of mixtures of acetylene and oil-gas.† Mixtures of these two gases in the proportions 25 : 75 gave double the lighting value of oil-gas alone (not *treble* the intensity, as sometimes stated); but the most favourable results were obtained with mixtures containing 40 to 50 per cent. acetylene.

Taking carbide at £26 per ton in Paris, the cost of 1 cm. (35·3 c.-feet) acetylene gas will be 1s. 11½d., including 2·87d. for generating costs. The same volume of oil-gas costs 7·69d. Using these costs as the basis of calculation, the costs per c.-metre of various mixtures of acetylene and oil-gas work out as follows :—

75 % oil-gas 25 % acetylene	} 13·7d.	60 % oil-gas 40 % acetylene	} 12·38d.
50 % oil-gas 50 % acetylene	} 14·58d.		

The first mixture (25 per cent. acetylene) is that known as the Pintsch mixture, and is used under compression for railway carriage lighting on the German State Railway, as mentioned above.

IV.—Conclusion.

This review of recent progress in acetylene generation and utilisation shows that advancement is occurring, and that in certain directions the acetylene gas industry may undergo permanent and successful expansion.

This expansion is unlikely to occur, however, in districts where coal-gas and electricity are already established, or where they can be favourably installed as illuminants; and those who desire the establishment of the carbide and acetylene gas industries upon a sound basis, should recognise this limitation to their field of operations, and should, above all, discourage the circulation of false information concerning the relative costs of acetylene, coal-gas and oil, when used for illuminating purposes.

THE ELECTRIC DRIVING OF PRINTING MACHINERY.

We suppose there is hardly any class of motor work more "wrop in mystery" than the driving of printing machinery. Printing establishments rigorously bar their doors to the stranger, and electrical firms who have gained experience of such work, not unnaturally keep their information to themselves. Yet there is nothing very wonderful in being able to successfully drive a "Wharfedale," a rotary cylinder machine, or a two-centure revolution press, and the character of the work ought not to vary very greatly from other machine work that is more or less intermittent in character. It is, however, the occasional nature of the printing press that renders it peculiarly adapted to an electric drive, and one would imagine that printers have only to become acquainted with the advantages of electric motors to become convinced of their fitness for the printing office. But the members of the great guild of the printing press are conservative, and doubtless this, combined with the apparent initial expense of electrical machinery, has been the cause of the comparative slowness to adopt newer methods. We are quite aware that many of the large printing establishments in the metropolis have been long converted to the claims of the electric motor, but when one reflects upon the enormous number of printing presses in London alone, it is apparent that the conversion has been a very partial one. Yet, of some of the printing offices we have seen equipped with electrical machinery, we are not filled with a consuming admiration.

While one ought not to be surprised at printers being disinclined to adopt electrical methods in old offices, there is little excuse for not adopting them when starting new works,

* Most of these installation notes are based upon paragraphs in recent issues of the *Journal of Acetylene Gas Lighting*.
† *Le Genie Civil*, July 1st, 1899.
‡ "Foreign Office Report," 2,250, May, 1899.
§ *Revue Industrielle*, June 24th, 1899.
‖ "Das Acetylen."
¶ "Foreign Office Report," 2,252, May, 1899.

* *Dingler's Polyt Journal*, May 13th, 1899.
† *Zeits. f. Angew. Chemie*, July 11th, 1899.

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for it is under such conditions that electric driving proves itself to be immeasurably superior to all other methods. It not only means an economy in working the presses, but it actually affects the cost of buildings, for when shafting is dispensed with, a much lighter wall may be employed. In the methods adopted of applying motors to printing presses, the motors are very frequently applied direct to the shaft of a machine, in spite of the fact that it means a very large slow speed motor in many cases. If, say, the main driving shaft of a press makes five revolutions to every impression, a press operating at 1,440 impressions per hour would require a direct connected motor running at 120 revolutions per minute, which clearly means an unnecessarily large and expensive machine. Moreover, such a motor could hardly be of a standard character, and the replacement of any part would take a good deal longer than in the case of a standard type running at 600 or more revolutions per minute. This may be an extreme instance, but it shows that direct connection is not always desirable. Besides, the many improvements effected in gearing, almost render the direct-connected motor unnecessary; the raw hide pinion makes a gear noiseless, and although raw hide is dearer than gun-metal, it is, barring accidents, probably not less durable than a metal pinion. It is true that the low speed motor possesses the merit of a probable longer life, but few people care to spend money on a prospective advantage.

The introduction of the electric motor into the printing office has not entirely eliminated shafting, and though this may be regretted, it must be admitted that the individual motor is not always justified. For paper-cutting machines, for binders, and similar machines, the usual practice is to group them and drive them through the medium of a short length of shafting; such a proceeding rather neutralises the special claims of electric driving, but if a series of machines only require $\frac{1}{6}$-H.P. each, it may be seen that it would be hardly an economical arrangement to employ separate motors. It would mean increased capital expenditure and increased maintenance charges. Perhaps the most objectionable method of driving a printing press is by a motor and a belt. True, it is simple and economical in first cost, but the arrangement is distinctly unsightly; moreover, the machine takes up more room. An electric motor ought to form an integral portion of the machine it drives.

The experience of some printers, after using electric driving, is interesting and worthy of being put on record. Not long ago a contemporary devoted to printing interests referred to the introduction of electrical driving in a well-known printing establishment in London and said, "A very powerful argument in favour of the new method of driving is afforded by noting that the same gas engine, which only sufficed for driving half the machinery at the older premises, now does all the work of driving at the new works, and in addition to this, gives force for some 260 lights." Such a statement ought not to be without its effect, and even the figures put forward occasionally by electrical contractors are worth remembering. Two typical instances may be mentioned. A well-known printing house, before it adopted electric driving, spent £9 per day for fuel alone: after adopting a much larger plant (electrical) and with added cost of light, heat, and elevator service, the cost averaged 85s., a saving of £7 5s. per day. The American Lithographic Company reported that electricity for driving purposes saved 44 per cent. over previous methods. There is more reticence in this country, for reasons which we have already advanced, but, in spite of that, it is possible to give some information as to the power usually required by various printing machines. Mr. Alfred Gibbings some time ago made a series of tests on the power required by different machines, and obtained the following approximate figures:—

Letterpress, Wharfedale, Bremner and Cylinder Machines.

Demy, to print a sheet	24 × 18 inches	...	...	1 H.P.
Double crown	30 × 20 "	...	...	1 "
Double demy	36 × 24 "	...	...	1½ "
Quad crown	42 × 30 "	...	...	1½ "

Golding Jobber, Minerva, Arab, Universal, &c., Platen Machines.

Foolscap folio, 7 × 11 inches inside chase	...	...	½ to 1 H.P.
Crown folio, 10 × 15½ " "	...	...	¾ to 1 "
Demy folio, 13 × 9 " "	...	...	¾ to 1 "
Linotype machines	...	...	¾ H.P.

Lithographic, Bremner, &c., Machines.

Demy, to print a sheet	24 × 18 inches	...	...	1 H.P.
Double demy	" 36 × 24 "	...	...	2 "
Quad royal	" 50 × 40 "	...	...	4 "

Guillotine Cutting Machines.

26 to 32 inches wide	...	...	...	...	...	¾ H.P.
38 to 44 "	...	...	...	...	...	1 "

Paper Glazing Machines.

To roll 27 inches wide	...	...	...	...	3 H.P.
" 33 "		...	...	...	4 "
" 36 "		...	...	...	5 "

Ink Grinding Mills.

Rolls 12 × 8 inches	...	...	...	...	3 H.P.
" 18 × 10 "	...	...	...	...	4 "
" 24 × 12 "	...	...	...	...	5 "

From careful investigations that were made at the publishing offices of *McLure's Magazine* (New York) it was found that automatic cylinder presses required a motor of about 4 or 5 H.P., and with that could turn out impressions up to 1,200 per hour, according to the nature of the work to be done; rotary presses capable of turning out 2,000 sheets per hour required 15 H.P. motors. Some other interesting tests have been made in America, and were published some time ago by a writer whose name we have forgotten, taking a series of printing presses and the power required for certain sizes of sheets:—

Size of sheets.	Sheets per minute.	Character of forme.	H.P.
42 × 60	21	Light	2·36
42 × 60	22	Medium	2·781
16 × 22	22	Light	2·40¦
31 × 40	26	Heavy	2·50

The variation in these figures rather suggests different types of printing machine. It is curious how the production of different machines varies with the manner in which the motors are connected, though no definite conclusions ought to be drawn from them.

Type of machine.	Size of motor.	Average sheets per H.P.-hour.
Michle No. 0000 ...	5-H.P. geared	500
" No. 00 ...	2 or 3-H.P. geared	663
" No. 00 ...	3-H.P. direct connected	720
" No. 000 ...	4-H.P. direct connected	640
Hoe No. 8	7·5-H.P. geared	360
" No. 7	3-H.P. geared	527
" No. 7	4-H.P. direct connected	395
Cottrell	7·5-H.P. geared	570

As was pointed out by the author of these tests, the number of printed sheets per H.P.-hour by any combination of press and motor will depend largely upon the forme, the size of the sheets printed, and the viscosity of the ink, so that it would be always difficult to obtain definite data unless one knew these.

ELECTRICITY v. STEAM FOR BRANCH RAILROAD LINES.

The summer conventions of the Institution of Civil Engineers should be exceedingly valuable, inasmuch as the topics presented for discussion are short, and the informal discussion can be carried on at length. The ready interchange of experience and ideas between members ought to result in an all-round acquisition of useful and practical knowledge which one can hardly expect to imbibe at the formal Tuesday evening meetings held during the winter session.

Some specially interesting topics were presented this summer on traction by means of gas, steam and electricity, but, as we remarked at the time, the discussion gave rise to a feeling of disappointment. We are not quite sure in our own minds whether the chairmen of the various sections are always in the best position to know the best men in any given branch of engineering, especially of electrical engineering, to call upon to take part in the debate, but, be this as it may,

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the information then given to members on electric traction was meagre and indefinite to a painful degree.

A subject of considerable magnitude, and of first-rate importance to this country, is that indicated by the title under which we pen our comments, for we know of several districts where influential residents are anxiously awaiting the advent of electric traction, in some shape or form, to open up communication between important centres of industry, and between inland towns and rapidly rising seaside resorts.

By a lucky coincidence, we have at our disposal some valuable opinions on the subject from engineers who, in their own land, are classed as a similar body to our own Institution of Civil Engineers; and just three months ago, at the Annual Convention of the American Society of Civil Engineers, an informal discussion took place on "What are the Economic Conditions under which Electricity may be profitably Substituted for Steam in the Operation of Branch Railroad Lines, and what are the Engineering Requirements to be Considered in such Substitution." Over a dozen gentlemen, members of the Society, took part in an animated debate which, in a concise and abbreviated form, we have culled from the *Proceedings of the American Society of Civil Engineers*, and give below. It will be noticed that traction by means of accumulators mounted on locomotives is not touched upon, although in a place where water-power is available, this system ought, with the improved batteries now obtainable, to turn out commercially successful for light traffic with frequent trips. If such well-known and experienced electric traction advocates as Mr. Crompton, Mr. Dawson, Mr. Parshall, Mr. Sellon, Mr. Quin, Mr. Rider, Mr. Charles Hopkinson, Mr. Manville, Mr. Clifton Robinson, Mr. Dickinson, Mr. Garcke, Dr. E. Hopkinson, Mr. Raworth, Mr. Clirehugh, Mr. Baldwin, Prof. Carus-Wilson, Mr. A. Siemens, Mr. Thomas Parker, and others, would warmly take up the matter here and continue the discussion, a mutual benefit would be conferred upon both English and American engineers, and we should be only too pleased to make the ELECTRICAL REVIEW the medium for such an interchange of opinion.

The topic to which we have alluded was brought forward by—

Mr. H. S. HAINES, who said as he was responsible for the submission of this subject for discussion, he would undertake to state the purpose he had in view in suggesting it. Electricity has been gradually introduced as a motive power on railroads, first as a substitute for horse-car lines in cities, then into continually widening areas, with the extension of such lines into suburban districts; all the time offering more formidable competition to steam railroads, until it has become a question as to its substitution for steam on some of these very lines. The profitable substitution of electricity for steam in a railroad motor probably varies with its application, whether to the traffic on a strictly suburban branch, or to a branch in a rural or manufacturing district. There is also to be considered the advisability of its application alternately with steam on the same line. The conclusion seems to have been reached that this substitution can be more profitably made where it is desired to move single cars frequently, rather than where it is required to move heavy trains at infrequent intervals. In planning quite a long main line, Mr. Haines had occasion to provide for several branch lines to reach factory sites or manufacturing villages, at varying distances from the main line, where a mixed train, making one or two round trips per day, might meet all the requirements, at least for a year or two after the branch lines were opened. In one case it would be practicable to obtain current from a factory where it was generated by water-power. In this way his mind was directed to the subject, but he was not sufficiently familiar with the economic conditions affecting the transmission of an electric current, and its use as a motive power, to determine the question satisfactorily to himself, and hence its reference to the Society for discussion. It is distinctly as an engineering problem that Mr. Haines asks for a solution. There is an apparent disinclination on the part of civil engineers to consider, as appertaining to their domain, the application of electricity in connection with engineering works, in the same way that they accept and discuss questions involving the use of water or steam-power. As a help to himself, and to others similarly interested, he would like to have a discussion of the conditions under which it would be advisable to operate by electricity a branch line to a steam railroad, whether in a suburban, a manufacturing, or a rural district; the conditions including the length of the branch, the character and frequency of the traffic, the generation of the electric current by water-power or by steam, &c. The subject should be considered, not only with reference to lines with a large traffic, but also as applied to branch lines operated only by one locomotive with a single train crew, making one or two round trips daily. If these conditions can be determined with approximate accuracy, the field for the application of electricity will be accordingly extended, and perhaps it will thereby become more feasible to provide traffic facilities for communities, to which they cannot be profitably extended with steam as a motive power.

Mr. HENRY G. PROUT said the question is pre-eminently one of traffic conditions rather than of strictly engineering conditions; although engineering covers traffic conditions. Under such requirements as Mr. Haines has suggested, *i.e.*, branch lines with infrequent trains, it would not be advisable to try to substitute electricity for steam locomotives; and it is quite likely that during the next few years light steam motors for such work will be developed. The costly installation of the New York, New Haven and Hartford Railroad at Hartford and Berlin, Conn., will probably be found to be a very expensive and unremunerative experiment. It is said that about half of the machinery in the power house is lying idle, and that one-car trains are run at intervals of 20 or 25 minutes. Under such conditions it is impossible to pay the interest on the cost of the installation. In other words, if the traffic is in units of considerable size at infrequent intervals, the work can be done more cheaply by steam locomotives than by electricity. A locomotive which will develop, say, 1,000 H.P., will cost (we will assume) $10,000, and a power house and plant to develop 1,000 H.P. will cost, perhaps, $80,000. Thus it will be seen that the interest on $70,000 has to be earned, or accounted for in some way by the superior economies of the electric installation. It may be said that there will be a great saving in the fuel account, but careful analysis, made within the last three years, has shown that the fuel will cost as much per horse-power delivered at the rim of the driving wheel for electricity as for a steam locomotive. Although in a fixed plant cheaper fuel can be used, and with all the appliances of automatic stoking, &c., can be burned more cheaply than in the steam locomotive, yet the losses in efficiency of the generator, in transmission, and in the motor, are sufficient to overcome that saving, and by the time the power is delivered at the rail it will have cost as much in coal as by the locomotive. This seems to be a safe general proposition, although Mr. Baker, general superintendent of the Manhattan Elevated Railroad, has lately said that many improvements have been made within the last year or two, and greater efficiency is obtained from the generators and motors. But even if a saving in coal of, say, 50 per cent. can be made, yet, after all, the fuel item in the operation of a railroad is comparatively small. Assuming the fuel element to be about 13 per cent. of the total operating expenses, then, even if the saving in this item is 50 per cent., it is evident that little has been saved toward paying the interest on the expensive electric installation. If the traffic is such that its efficiency, or commercial development, requires a minute sub-division of the units, that is, a division into very small units running very frequently, in order to induce traffic to move, then, of course, electricity will win, not because it is cheaper than steam, but because it is adapted to such minute subdivision.

Mr. OBERLIN SMITH said that within the last 10 years the ordinary street trolley line has grown from a mere experiment into a great industry. The time for the universal use of motors on railroads has not yet arrived, but he believed that it would come eventually, in consequence of discoveries which will cheapen the use of fuel and simplify electrical machinery; and also because such a method will result in greater convenience to travellers, by reason of more smoothness of motion, freedom from dust, smoke, cinders, &c., and facility for running single cars (or short trains) at much more frequent intervals than now. It therefore follows that the use of electricity on roads which are at present run by steam will largely increase travel—and the habit of travelling. Such improvements make car riding a pleasure rather than the duty that it now often is. The foregoing remarks apply to travel on surface roads, at speeds much the same as now practised. The change in method has already begun, and its adoption by all railroads is simply a matter of relative cost—in construction, maintenance, and operation. It would seem probable, however, that in the next generation, if not in this, an entirely new type of high-speed railroad will be developed. Mechanically the world is ready to begin it; financially, not yet, for its cost would be great. Upon some special type of track, confining the cars absolutely against derailment, a speed of 120 to 150 miles per hour, and possibly more can doubtless be obtained; and it would not seem to be a very wonderful feat to cover the 90 miles between New York and Philadelphia in half or three-quarters of an hour. There are no physical or mechanical obstacles which cannot be overcome with our present knowledge and some experimenting with details. The danger of collision with other objects can be avoided by the use of an elevated roadway with absolutely no crossing, turn-tables, or switches, and with the trains run upon a positive electric block system, in one direction, on one track. The question of derailment and collision being obliterated, the speed of trains will be limited only by air resistance and by the strength of the wheels to resist centrifugal force—if wheels are used. If the cars are made long, narrow, pointed, very smooth and properly jointed together when in trains of more than one, they can probably be run at high speed without encountering such great air resistance as would make the cost of power too great. Such cost, however, must not be based upon present train weights in relation to live load. It has been demonstrated that a heavy steam locomotive and train can travel upwards of 100 miles an hour, with all the disadvantages of a tremendous load not on the drivers, and a degree of uncertainty as to whether or not the train will stay on the rails. If, however, such a train could be made safe upon a surface road, at the speeds under consideration, and did it not cost too much for power, yet there are limitations of speed in respect to getting steam through the ports quickly enough, and in working reciprocating members—as pistons, connecting rods, &c. These limitations do not exist with rotating electric motors. One reason why electricity works better upon steep grades is that, with the best modern systems, every wheel in the train can be made a driving wheel. A train can be comparatively light, without the dead weight of a locomotive, and yet have sufficient traction. With a steam train we not only have the cars very heavy, especially Pullman

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cars, but we have the big locomotive itself to drag up grades, with only the adhesion due to the weight of part of the locomotive, such as happens to be on the drivers. This is evidently very different from being able to have a very light train and making every wheel a driver, with every pound of the train and load contributing its share of adhesion.

Mr. W. B. Reed said the discussion, up to this point, has referred mainly to passengers. The question of carrying freight in combination with passengers, upon electric lines, should also be discussed. Generally speaking, it has been found that for short distances passengers can be carried more comfortably and more cheaply by electricity than by steam, but in the carrying of freight little has been done by electricity as yet. When freight is to be carried over passenger lines by electricity it will have to be taken through city streets, or at least over highways, and the rails should be designed to meet the conditions of electric cars which have shallow flanges; freight cars with deeper flanges, and which vary more or less in gauge, requiring not only a deep groove but a wide flangeway; and the ordinary vehicle traffic.

Mr. G. S. Davison said about eight or nine years ago he was in charge of the construction of a small branch line near Pittsburg, which was required to connect a small manufacturing town with the Pittsburg and Lake Erie Railroad and the Pennsylvania lines. It was an independent corporation, controlled by manufacturers in the town, and it was equipped at first with steam-power. The president of the company conceived the idea that with such cheap fuel as is to be had in that neighbourhood, and in view of a proposed change in the future from steam to water-power, it would be proper to operate this branch by electricity instead of steam. He experimented slowly, and equipped the line as a trolley road, but separated the passenger and freight traffic, and carried the former by electricity, and the latter by steam locomotives. He did not know the results of the operations of this company, but judging from later occurrences, he believed that the separation of the passenger and freight service was found to be a mistake. In this case the company had ideal conditions for cheap fuel, and had also its own electric power plant. It was not necessary to instal a new plant, but simply to add to the old. The road was afterwards purchased by the Pittsburg and Lake Erie Railroad Company, and is now being operated as a branch of that road. The company, on acquiring this branch line, studied its operation to determine whether it should be conducted as an electric line in part or as a whole, or whether it should be operated as a steam road. As the electrical equipment was discarded and as the road is now being operated by steam, it may be assumed that electricity was found to be uneconomical. The causes which led to this change are not known to the speaker, but he suggests that possibly the trolley equipment might have been found very inconvenient when operating the road by steam as a freight line. The third-rail system may prove to be more practicable than the trolley in such cases, but the latter must be excluded on account of its inconvenience. In the vicinity of Pittsburg there is a large mine which is operated for some seven miles back from the point where the coal is brought to the tipple; the means of bringing the coal to the opening being virtually a small branch railroad. This branch passes through several tunnels and has been operated as a steam railroad for a number of years. At the present time the first five miles of the road is being operated as an electric line, using the trolley system, and on the remainder of the line, next to where the coal is brought out to the tipple, steam locomotives are used. The owners stated that the operation had been planned in that way, and that they had been justified in hauling the coal the first distance by electricity, because the use of steam locomotives in the mines was detrimental to the health of the men. But, taking full account of the cost of installation, power, &c., they had not found that it would be cheaper or better to continue the use of the trolley to the tipple. The fuel of this power station is delivered directly from the mine into the boiler house, and yet, on the five miles operated by electricity, the saving on fuel is so small that the expense of an electric equipment for the remaining two miles would not be justified.

Mr. Walter L. Webb said the relation of grades to the question of steam or electric operation has not yet been touched upon in this discussion. On a steam railroad, a grade of 2 per cent. is considered steep, while 4 per cent. marks almost the limit of working on such roads; yet on many of the electric railroads in the United States there are grades of 10 per cent., and even steeper. On steam roads which are steep in some places and flat in others there is a great waste of power. This occurs, not on the heavy grades where the engines are hard worked, but on the light grades, where the great reserve power—at those points doing practically no work—has to be maintained for service on the heavy grades. On an electric road, the amount of power used is almost proportional to the work to be done, and this is an important element in its economy. Assuming a fair amount of traffic, so distributed as to keep the road in uniform operation, electricity will, in many cases, prove more desirable than steam locomotives, taking into consideration the interest on the cost of the construction and installation, and the expense of operation, and this will be true for these reasons alone, to say nothing of the possible economies consequent on a utilisation of water-power.

Mr. J. James R. Croes said the economical generation of power, either steam or electric, implies a constant and continuous operation of the generating plant. When variable power is needed, the generating plant must be constantly operated at its maximum efficiency. When the work to be accomplished can be distributed over a continuous period of 10 to 24 hours, the power can be more economically generated by an indirect application through a stationary plant than by a direct application of the fuel to the motor, as in the steam locomotive. Where, however, the work involves a spasmodic application, occupying only a limited amount of time, at irregular periods during the day, the generation of power by an independent motor, capable of producing in itself the power needed, is more convenient and more economical than its production by a central plant. Steam-power at the present day can be generated spasmodically more efficiently than electric power. The requirements of railroad service on a line of limited traffic are spasmodic, reaching a maximum at certain hours; and until a storage battery has been devised in which the power produced continuously can be stored and used for spasmodic application, which application shall satisfy a maximum call greater than the average efficiency required of the generating plant, electricity cannot be applied more economically than steam. At present, it seemed to him that where the work is spasmodic, steam power is, and must be, more economical than electric power, for branch railroads.

Prof. D. C. Jackson said there is no mystery about this matter, and Mr. Croes has well stated the case. It is more economical—not more efficient—to generate power for operating a railroad or a group of manufacturing establishments at a central station only when the power can be used continuously over long hours, for the reason that when the traffic on the railroad or the load on the motors at the manufacturing establishment is continuous, the demand on the central station for power is continuous, and the cost for interest and labour per horse-power-hour developed by the station is brought to a reasonable figure. Where traffic requirements are intermittent, it is more economical to operate a railroad by steam locomotives. If a plant of 1,000 H.P., installed to operate a branch railroad with freight traffic, is called on for its output for only three hours of the day, 24 hours of interest charges lie against the three hours of output. There are at the station daily possibly 10 hours of full labour and 14 hours of one-half or one-third labour, and if this is charged against the three-hour output, it makes the cost of operating the station, per horse-power-hour, enormous. Whether or not electric power may be economical in various cases is, as Mr. Prout has said, a matter of the distribution of traffic. These remarks apply equally to electric power plants where the prime power is derived from steam engines or water wheels. The larger cost of development of a water-power plant will often cause an excess interest charge which is equal to the cost of fuel in a steam plant designed to do the same work, and the average small water-power plant does not embrace such economical advantages as are generally ascribed to it. The case of a main line feeder, as put by Mr. Haines, is a special case under the general proposition, and under some circumstances it is possible that electric power can handle the traffic most economically. These conditions would assume a number of main line feeders, located reasonably near a given point, so that the entire load of all these branches may be carried by a central station, using a fairly high transmitting pressure. The traffic should be broken into units somewhat smaller than would be operated ordinarily by steam power direct, and schedules of train movements should be so arranged that the station may be fairly well loaded during at least 12 hours. If the schedules are so arranged that once or twice during the day a single mixed train will be running simultaneously over each of these branches, he doubted if electric power, from the point of view of dollars and cents, can ever compete with the steam locomotive.

Mr. Gustav Lindenthal said a railroad train, in descending a grade, wastes power in grinding up brake-shoes, and heretofore this power has not been stored in any form. It is possible to generate and store that power in the form of electricity, which can be used again in hauling trains or cars up an ascending grade, or for lighting or heating purposes. He believed that the feature of storing electric power should have an important bearing in any comparison of the economies of locomotive and electric traction, particularly in mountainous countries, where coal may be dear and water-power cheap.

Mr. Edward Wegmann said he objected to the statement that steeper grades can be used on electric tramways than on ordinary steam railroads. While it is undoubtedly true that steeper grades are used on trolley lines than on ordinary railroads, this difference should not be credited to electricity as against steam, but to the placing of a motor under each car. If a steam engine were applied to a car in this manner, the car could be driven up any of the grades to be found on trolley lines. Before any trolley lines had been constructed he had spent two or three years in assisting an inventor in developing and introducing a steam street car, which was run successfully in Brooklyn. This car, which was propelled by a small three-cylinder steam engine, placed between the axles and suspended from the car frame, was able to run up 10 per cent. grades. While such a car might be used to advantage, where only a few trips had to be made each day, it had several disadvantages compared with trolley cars: 1. The weight of the boiler was objectionable. 2. A licensed engineer was required for each car. One of the great advantages of the trolley system is that men of ordinary intelligence can soon be taught to run the cars. In the case of pulling a train by a special motor, the grade that could be overcome depended, as was well known, on the weight on the driving wheels, the rolling friction of the wheels, and the weight of the train. It made, therefore, no difference as regards the grades, whether steam, electricity, compressed air, or any other motive power were used to propel the motor.

Mr. Robert Moore said each particular case of this kind must be considered by itself. In the case indicated by Mr. Haines, in which the power is to be rented and paid for, presumably, by a meter, the conditions of economy would be very different from those in which the railroad company would be required to instal the plant, and bear the cost of the current whether it were being used or not. Therefore a proposition which would cover all cases might be very delusive. So far as a general proposition can now me made, it must be substantially as indicated by Mr. Prout. When the conditions are those of an urban traffic—a very large number of small trains—electricity has abundantly demonstrated its superiority over every other form of motive power; but when the conditions are very different from those of urban traffic—when the trains are infrequent or heavy—he doubted its economy, and saw no indications that it is

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likely to be economical in the near future. Regarding the superior economy claimed for the electric motor on heavy grades, the point cited by Mr. Wegmann is a sufficient answer. The power is developed only by the traction of the driver on the rail, and that is a function of its weight; thus, there can be no saving in that respect. But there is another point which should not be lightly regarded, the great danger, in operating on very steep grades, of the failure of brake power. Any such failure means disaster, as many who have had occasion to operate heavy grades well know.

Mr. C. W. Buchholz said the facts are against the assertion that the grades on an electric road can be steeper than on a steam road. The power of a locomotive depends upon its adhesion to the rail, and it makes no difference whether the power is steam or electricity.

Mr. Haines, in reply, said: This question was suggested because he considered it to be of practical moment, and because he desired to obtain from members of the Society an authentic expression of opinion as to how far, in the present state of the art, it was advisable to substitute electricity for steam as a motive power on branch lines of steam railroads. If electricity is used on branch lines it must be used in connection with the vehicles in which passengers and freight are transported on the main lines. It is not only desirable to ascertain what can be done with electricity under this aspect of the case, but also what cannot be done. There is one general proposition that all will accept, viz, that in the present state of the art there is no doubt that electricity can be economically substituted for steam on a branch of a steam railroad where there are single units of transportation moving at frequent intervals, because the power can be used uniformly and continuously, and because a large plant is not lying idle for the greater part of the time. To state the cases in which electric transmission cannot be applied, a process of exclusion must be used; therefore, let it be said that it can be applied economically on branch lines for suburban purposes. If that is the case, it strengthens the steam railroads which have suburban branches competing with trolley lines. He recently had occasion to talk this matter over with some of the principal officials of the New York, New Haven, and Hartford Railroad, who have probably had more experience in this matter than anyone else; and the impression received was that they are quite well satisfied with what they have done thus far in an experimental way, and they are extending the system. There is one point, however, that they have not yet determined, and that is, the conditions under which the third rail should take the place of the trolley wire. Admitting that electricity can be used economically on suburban lines, the next question is: Can it be used on branch lines under other conditions? Judging from the discussion, Mr. Haines believed that electric motors might be used to great advantage on branch lines in a manufacturing district, even for handling freight, if power can be obtained along those lines from manufacturers who have it to spare. On a line running into a rural district it would seem hardly practicable to use electricity, unless water-power could be obtained. He need not discuss the question of heavy grades, as that has been covered so well by Mr. Buchholz. Unless by the use of electricity the traction can be made stronger than the mere adhesion due to the weight of the locomotive, that question need not be considered. To sum up, it may be said that in the present state of the art it is only admissible to apply electricity on what may be called suburban passenger lines, except that it may be applied where power, for certain local reasons, may be obtained more cheaply than by means of the steam locomotive.

AMERICAN LOCOMOTIVES IN GREAT BRITAIN.

A very curious article appears in *Cassier's Magazine* on the above question, from the pen of Mr. C. H. Jones, of the Midland Railway. Mr. Jones as a railway man, belongs to that body of men whose efforts in the way of bringing about the building of engines by the railway companies themselves, are the cause of the fact that the locomotive shops of the country are so small. Mr. Jones's article is very curious reading, and is an example of special pleading of an apologetic order, as though he felt somewhat afraid of the whole business, and had to justify it somehow. He begins by blaming the English makers who, too small to furnish the engines wanted by Mr. Jones's friends, could not promise prompt delivery, and could hardly enlarge their shops quickly enough to do so. Moreover, the Midland, or any other company, would not have gone outside their own railway works had they not been very hard pressed, so it is hardly fair to put a slur on the English builders. Mr. Jones is full of the virtues of Americans. They are satisfied with less showy engines than we in England, he calmly states. Why, in the world, if this be a virtue, have the Midland Railway only just found it out? Any locomotive builder in England would be glad to furnish the same rough and unfinished stuff. As an example of American finish, we might cite the coupling rods of American engines and other similar parts, which are bright only on the face side and left as forged on the other side.

This, we admit, is perfectly good practice, but why have Midland directors and their men in the locomotive department only just found it out? The Midland Company's own shops would appear to be very badly carried on, for Mr. Jones is struck with wonder that American engines are made to template and are accurate. He actually puts down this as an argument in favour of American engines. Is it because Mr. Jones has influence, that the same system is not carried out on the Midland, for evidently by Mr. Jones's surprised statement, it has come to him as a novelty? He ought to get some experience at Crewe or Horwich. And so Mr. Jones jogs along stating what ought to be mere platitudes if the Midland Company has been properly served by its locomotive staff. He tells us how many packing cases were needed to pack each Baldwin engine, and is good enough to startle us by a statement that they are not all of the same size or even of the same weight. Very foolishly, too, the engines came by the Manchester Ship Canal, a work that, we believe, railway men were loud in declaring would never be built, and when built would never be used. From Mr. Jones's description of some of the details, it appears that the makers have been allowed to put in the cheapest kind of material, and have narrowed the fire boxes by the bar framing just as is usual in American practice. It is very evident that had English builders been allowed the same latitude in departure from the Midland style of engine and the same cheap construction and finish, they could have promised much quicker delivery. Mr. Jones's article, coming as it does from a Midland official, only shows how ridiculous have been the officials of our railways when they accept as good enough a class of work so far inferior to what they have demanded from home makers. We do not necessarily condemn the style of finish they have agreed to accept, but we cannot praise their consistency in purchasing engines practically without inspection or specification after their past demands. They have accepted locomotives with three supporting points to the boiler, with valve boxes out in the cold, single wheel bogies, outside cylinders and no foot plates —merely running boards. It is all cheap work and design, and if it is going to pay the Midland Company, is it not a pity they did not find it all out years ago and reduce some of their heavy charges that have driven manufacturing out of their district to the seaside?

TRAIN LIGHTING.

A writer on the staff of the *Railway Engineer* is much exercised over two of his contemporaries.

Recently, says our iron road exchange,

> The *Engineer* stated that it was informed that the total weight of the electric plant (Gill system) was less than that of a gas lighting system giving an equal amount of light. Pintsch's Lighting Company replied that the fittings necessary for a better light by their system weigh rather less than half the weight of the fittings necessary for the electric system. The *Engineer* suggests that the correct weights of both systems should be published, and the Electrical Review thinks that, "this information, if forthcoming, should be interesting."
>
> It is surprising that the *Engineer* should have allowed such a vapid, misleading, unfair, but technically accurate statement to have appeared in its columns.
>
> In the electric system all (except spare accumulators) the plant is carried on the coach, and therefore no doubt its *total* weight is less than that of the plant necessary to produce an equal amount of light by the Pintsch system would be; but in the Pintsch system none of the generating plant is carried about on the coach, and the gas holders and fittings which are carried only weigh, as stated by the Pintsch Company, about half as much as the total electric plant. This extra weight is a very important factor for locomotive superintendents to consider, and they are not likely to attend to stupid remarks about "the *total* weight of the plant" when they know perfectly well that with the electric system the locomotive has got to do the work of lighting the train, and with the Pintsch or Pope gas systems it has not. The weight of the plant carried cannot be usefully, or (with due deference to our electrical contemporary) interestingly *considered apart* from *the much more important question of the* extra work *thrown upon the locomotive in order to generate the necessary electric currents.*

Without discussing the shocking impropriety of taxing the *Engineer* with stupid remarks as to the respective weights of the gas or electric equipments, we will consider how far the railway organ is justified in gravely trying to make its readers believe that the extra work of the locomotive in driving a small dynamo is of such vast importance that the officials, whose duty it is to superintend the locomotive departments of our great English lines, are to have their unhappy lives burdened by another heavy responsibility, heavier by far than the weights of gas cylinders, or dynamos and batteries.

We may remark that what our contemporary calls the Gill system is better known as Stone's electric light system, Mr. Gill being the manager of Messrs. J. Stone & Co.'s electrical department.

The relative weights of gas and electric light apparatus must depend not only on a variety of circumstances such as the size of coach, amount of storage capacity required, &c., but any correct comparison is rendered quite impossible by

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the fact that whereas gas-lighted coaches require to be recharged at more or less frequent intervals (either from the gas works or from travelling gas holders), coaches fitted with Stone's patent system are not dependent on any storage, but can run, so far as the lighting is concerned, at any time, for any distance, and over any railway, the lighting being perfectly automatic and independent of charging facilities, &c.

We are informed that largely from this cause electrically lighted coaches run a very much greater mileage than coaches requiring to have their reservoirs periodically charged with gas.

Altogether apart, however, from these considerations, the question of any difference which may exist in the relative weights can be of no practical importance, as it cannot amount to more than an insignificant fraction of the total weight of the train.

This remark applies equally to the question of extra power required for haulage. Some time ago a test was made by Prof. Capper, of King's College, with a view to ascertaining what was the actual power required for driving these dynamos, and the result shows that this could not amount to more than 0·6 H.P. per coach, being equal to an extra consumption of fuel of $\frac{1}{20}$th lb. per coach per mile at both high and low speeds.

It is interesting, however, to note that the actual practical experience of the locomotive superintendents of the various railways where Stone's system has been fitted to large numbers of coaches for upwards of 12 months, demonstrates that there is no appreciable increase in the consumption of fuel. Considering what a very small fraction of the total power of the locomotive is required, no different conclusion could have been expected.

Even the systems which may now be termed more or less obsolete could scarcely have exercised the minds of locomotive superintendents to the extent that our contemporary would have us believe Stone's method will involve. We have in our mind's eye a typical example of a London, Brighton and South Coast train which is made up of Pullman cars, bogies, and ordinary carriages. It is composite in its illumination, being lighted partly by gas, partly by electricity in the proportion of five coaches with the former to 21 with the latter. The total number of electric 8-C.P. lamps is 140, the weight of the train complete is 360 tons, the average speed 46 miles per hour, and the average horse-power developed by the locomotive is 550. The calculated horse-power we find agrees very closely with the observed horse-power. Yet the weight of two dynamos and the secondary battery is less than 2 per cent. of the whole train, and the "extra work thrown upon the locomotive in order to generate the necessary electric currents" is less than 3 per cent.! And these, forsooth, are the very important factors for locomotive superintendents to consider!

The London, Brighton and South Coast Railway Company was one of the pioneers of train lighting by electricity, under the able supervision of Mr. E. Houghton; and it may interest, even if it grieves, the *Railway Engineer* to learn that the company is about to discontinue its own system of lighting and adopt that of Messrs. Stone, the very system which has aroused our contemporary's ire. The reason assigned for this change is the inability of the company's method to light independent coaches, the plant being concentrated in the guard's van, which is inconvenient.

The coaches of this company are light compared with the 20-ton carriages, say, of the Great Western, and with the adoption of Stone's system, we shall certainly be surprised if, generally speaking, the weight of the electric lighting plant is much more than 1 per cent. of that of any train, or if the power required for driving the dynamos ever goes beyond 2 per cent. of the horse-power developed by the locomotive. In any case, as Mr. Houghton tersely puts it, "So far as I can learn, the weight of the electrical apparatus and the power required for working it are of little importance in such a train." The following tables of the approximate annual cost of Messrs. J. Stone & Co.'s electric light system, as compared with gas and oil lighting, should appeal to those railway companies who still pin their faith to dangerous gas lighting or miserable oil illumination! If the directors are blind to the advantages of electric lighting, the shareholders should combine to remove the scales from their eyes, for to them economy effected in expenses of working means increased dividends.

GAS.

Table A.—Average cost of production of oil gas, exclusive of maintenance, &c. (See Table B.):—

One-tenth of a penny per hour for 8 C.P. One-fifth of a penny per hour for 16 C.P.

					Per coach per annum.
If lights burning	4 hours per day,	8 C.P.	per compartment		£3 13 0
"	4 "	16	"	"	7 6 0
"	7* "	8	"	"	6 7 9
"	7* "	16	"	"	12 15 6

Table B.—The experience of some of the largest users of oil gas among the English railways, shows the cost of gas, including maintenance of gas producing plant, filling gas cylinders and holders, repairs to gas fittings in carriages, &c., to average about 13s. per 1,000 cubic feet. The consumption of gas for 8 C.P. light is 1 foot per hour, and for a 16 C.P. light, 2 feet per hour.

					Per coach per annum.
If lights burning	4 hours per day,	8 C.P.	per compartment		£5 14 0
"	4 "	16	"	"	11 8 0
"	7* "	8	"	"	9 19 6
"	7* "	16	"	"	19 19 0

OIL LIGHTING.

Table C.—Average cost of oil lighting, including expenses incidental thereto, is between ⅝d. and ½d. per lamp per hour. Taking the lower of these figures, ⅝d. per lamp per hour, this would give the following:—

					Per coach per annum.
If lights burning	4 hours per day,	5 C.P.	per compartment		£13 14 0
"	7* "	5	"	"	24 0 0

* In case of tunnels.

Table D.—The cost of producing the electric light by Stone's system is simply that of the fuel consumed by locomotive for extra haulage, which, according to calculation, should be as follows, though, as a matter of fact, the experience of the locomotive superintendents of railways who have used Stone's system for upwards of 12 months is that the extra consumption of fuel is imperceptible:—

Lights burning.	Extra fuel burned per coach per annum.	Price of fuel per ton.	Per coach per annum.
4 hours per day, 16 C.P. per compartment.	20 cwts.	15s.*	15s.
7 hours per day, 16 C.P. per compartment.	35 "	15s.*	26s. 3d.

* On many railways the price of fuel would, of course, be much less than this

Table E.—The cost of maintenance of Stone's electric light system, including renewal of lamps, plates of accumulators, belts, bearings, and other wearing parts (spread over, say, 300 coaches), is estimated to be as follows:—

					Per coach per annum.
If lights burning	4 hours per day,	16 C.P.	per compartment		£2 0 0
"	7 "	"	"	"	3 10 0

SUMMARY.

As compared with oil gas the annual cost of Stone's electric light system is less than half, while giving double the light, or less than one-fourth for the same amount of light, whilst at the same time saving all the trouble and derangement of traffic necessitated by having to charge the reservoirs in carriages with gas.

As compared with oil, the cost of Stone's electric light system is about ⅓th, whilst giving more than three times the light.

Messrs. Stone & Co. set themselves to fulfil the three following conditions, which were essential to train lighting, and their perseverance seems to have met with a most gratifying reward. The conditions laid down were as follows:—

1. Each coach must carry its own generating plant, and the installation must be complete in itself, so that every coach should be independent of every other coach.
2. The amount of electric current produced must be practically the same whatever the speed of the train might be.
3. That each coach must be fitted with an accumulator, which should automatically come into action whenever the train was brought to a standstill without interfering with the steadiness of the light, and have sufficient storage for all stoppages at stations or elsewhere.

The system, details of which are well known to readers of the ELECTRICAL REVIEW, has already been fitted, or is in course of being fitted, on upwards of 100 different lines of railways, and, as frequent travellers on the Great Western, we should be glad to announce in the near future that the directors of this very conservative company had availed themselves of Messrs. Stone's system, and so given the travelling public another concession which is the one thing required to make that almost perfect line approach still more nearly to absolute perfection.

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POLYPHASE DISTRIBUTION FOR TRAMWAY WORK.

THE *Street Railway Review* devoted a recent editorial to this important subject, which is of special interest on this side at the present moment. Its comments are as follows:—

"Until quite recently continuous currents have held practically exclusive sway in street railway work, and as far as can be clearly seen at present, they will contrive to hold their advantage over the alternating and polyphase distribution in the tramway service of cities and thickly populated sections, where short hauls and heavy travel are the rule. Polyphase current distribution, however, is a comparatively new factor in certain classes of railway work, which has undoubtedly come to stay, and it possesses some notable advantages in the case of suburban and interurban railways, and where cheap water-powers are available at some distance from the line of the road. A few cases are to be found abroad where polyphase currents are used direct by means of induction motors on the cars, but this method cannot yet be said to have assumed much prominence, although it is one which gives promise of important developments in the future. The general practice at present where polyphase currents are used is to generate them at one central station, the location of which is not important, as far as the cost of conductors is concerned, and at this station, if distant from the line, the current is raised to 5,000 or 6,000 volts by means of stationary step-up transformers. From the central station these high potential currents are led to transformer stations located at convenient distributing points along the railway, where the current is first reduced in voltage by means of step-down transformers, and then changed from alternating to direct in character by means of rotary transformers, giving a continuous current of 550 volts, which feeds into the trolley line.

"At first sight the losses incident to the three transformations of the current lead to the impression that such a system cannot be economical, and such would have been the case of a few years ago. In the modern types of stationary transformers, however, and especially in those of considerable size, the loss of energy is very slight, amounting to less than 2 per cent. at full load, and perhaps 4 per cent. under average conditions. The loss in the rotary converter is somewhat greater, amounting to, say, 6 or 8 per cent., which is required to overcome friction and core losses. The total efficiency of the transformations, therefore, need not fall below 80 per cent. in a properly designed plant; but even if a considerably lower efficiency is realised, the loss will be less than the drop usually allowed on long direct current lines, while the whole saving in copper, due to the use of the high potential circuit, remains to be credited to the polyphase system.

"Some examples of this method of distribution are now in evidence upon a number of roads in this country, with results which have proved highly satisfactory for the time this system has been under observation. One of the earliest examples of this system was in Lowell, Mass., where the cost of polyphase transmission was shown to be 70 per cent. of the cost of a separate direct current power station. An 18-day test of this system showed an average efficiency of 70 per cent. measured from the alternators to the direct current output of the rotary transformers, the losses including those of two sets of static transformers, the line and the rotaries. The best day's efficiency during this test was 73 per cent. The Chicago and Milwaukee Electric Railway's equipment is on this same general plan of distribution, and, although only opened for traffic over its full length for a comparatively short time, is pronounced by its engineer to have shown remarkably good results. This plant will undoubtedly show a higher efficiency than the preceding one, as the generators deliver three-phase currents directly to the converter station without the intervention of step-up transformers. The frequency of these generators is considerably lower than the general practice for combined lighting and power plants, being 25 cycles per second, while from 40 to 60 is more common, the higher number being essential where lighting is involved.

"A similar system has been introduced in Washington, D.C., where all the city and suburban lines have been consolidated under one operating company. All the lines extending beyond a certain distance from the power house are supplied with three-phase currents, and considerable economy over the former separate stations has been realised even with the temporary plant now in use. The Citizens' Traction Company, of Oshkosh, has just completed a plant of this description, and two others in course of construction for the Toledo, Fremont and Norwalk, and the Dayton and Northern roads in Ohio. Other examples of this distribution could also be mentioned, showing the growing use of this system in railway work, and it may be said that when we come to distances beyond, possibly, 15 miles, the polyphase system must be used for economical transmission.

"A farther development of this system promises to be introduced at no distant date which will add still more to the efficiency of such transmissions. This lies in the use of induction motors on the cars, which, as suggested above, has already met with some success in Europe. In this case rotary transformers are entirely dispensed with, and only static transformers are used, which not only increases the efficiency of the transformation, but dispenses with the labour of personal attendance at the converting stations. The troubles incident to commutators are also avoided, although the necessity of a double trolley system is introduced. This system was installed in Lugano, Switzerland, in 1896, at Evian-les-Bain, France, and other places, where it is working successfully.

"There are some advantages in the induction type of car motor over direct current types, one of which is the retarding action of the motors when driven beyond a certain speed by the car on down grades. They may be designed to develop a retarding force much greater than their working torque when their speed increases above the normal, and this effect takes place automatically, being inherent in the machine. The working torque may also be increased by connecting the motors in series, the torque being proportional to the number of motors so connected."

CORRESPONDENCE.

Transformer Sub-station Regulations.

A correspondent has written to us as follows:—

"Will you kindly inform me where I can find, published, the rules to be observed in construction of high tension alternating transformer sub-stations to Board of Trade requirements, and applicable to the provinces?

"The ordinary rules, so far as I can find out, barely mention the matter and give nothing definite or in detail. Surely Board of Trade inspectors must have some definite rules to adhere to.

"T. B."

[For the benefit of our correspondent and of other readers to whom the subject may be of interest, we have compiled the following notes thereon:—

The Board of Trade are given power to control the technical details of generation and distribution of electrical energy, by a clause in Provisional Orders (now embodied in the "Electric Lighting Clauses Act," just approved by Her Majesty) under title "Nature and Mode of Supply," which is of the form:—

"Energy shall be supplied only by means of some system which shall be approved in writing by the Board of Trade, and,

Subject to such regulations and conditions for securing the safety of the public and for insuring a proper and sufficient supply of energy as the Board of Trade may impose."

Taking the latter clause first, our correspondent can obtain a copy of the Board of Trade Regulations from the Corporation of his town as undertakers under their order, as it is also provided in Provisional Orders that—

"All regulations and conditions made by the Board of Trade . . . . shall, within one month after the same as made or last altered have come into force, be printed at the expense of the undertakers and . . . . copies shall also be kept by them," *i.e.*, the undertakers, "at their principal office within the area of supply and supplied to any person demanding the same at a price not exceeding sixpence for each copy."

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The undertakers are liable to a daily penalty not exceeding £5 if they fail so to do.

The only other rules in force are specific or local and are embodied in the description of the "approved system of supply," as settled between the undertakers and the Board of Trade. As a general rule there is little of a technically valuable character embodied in this authorisation. As a guide to the general form which the approval takes, the following relating to the transforming plant of a London supply may be cited:—

"A high pressure alternating current supply at constant pressure to transformers, placed as a rule in converting stations, but in some instances where this is impracticable, on consumers' premises.

"It is intended to utilise cast-iron street boxes as converting stations. Each such station will contain one transformer only of a power not exceeding 30,000 watts, which, with suitable high pressure fuses, will be enclosed in a second cast-iron case standing on the base of a street box and in metallic connection with the armouring of the high pressure mains.

"The inner cast-iron case will be gas-tight and water-tight, the vacant spaces round the case being filled up with suitable material to such an extent as to prevent any danger of explosion should gas by accident obtain access.

"The converting stations will be examined at least twice in each week. Each transformer will be protected by a suitable automatic quick-acting cut-off. From the converting stations a low pressure supply at constant pressure will be given for the use of consumers."

No general rules are issued by the Board of Trade as to sub-stations. Each undertaker submits his proposals, and officers of the Board draw up a description of the system as it will be "approved," and embody in this document such special conditions as they think necessary to ensure a proper supply and secure safety. The "definite" requirements of the Board's inspectors can only be ascertained by perusing copies of the "approvals" to high pressure alternating systems at work all over the country, and as these are not made public the only course to pursue would be to request the engineers of such systems to cause copies to be made and forwarded.

Some useful information would be obtained from "The Second Interim Report of the Departmental Committee appointed by the Home Office to inquire into Dangerous Trades," "Electrical Generating Works," 1897; published by Messrs. Eyre & Spottiswoode, as a Governmental departmental paper at the cost of a few pence. A summary of the committee's "recommendations" is as follows:—

The frames of metal transformer boxes shall be efficiently earthed, and all permanent metallic parts in transformer chambers shall be connected together and to earth.

High pressure connections in transformer chambers shall be so protected that it is impossible to touch them.

Holes through which high pressure conductors pass shall be bushed with insulating material.

Switches, which can be operated from the outside for cutting off both the high pressure and low pressure connections, shall be fitted in all transformer chambers.

The designers of sub-stations would also find it advantageous to peruse the various reports of the Board of Trade inspectors upon accidents which have happened from time to time. Most of these have been given in our columns as they were issued.—EDS. ELEC. REV.]

American Engines for Electric Traction.

My attention has just been called to your issue of the ELECTRICAL REVIEW of the 1st ult.; on page 343 the following note appears:—

"At Dudley, some engines by another maker, the Ball and Wood Company, have a distinctly light appearance, and like other American engines, lack the finish and neatness of English work."

I think that these comments on the engine, for which I am agent for Great Britain, are decidedly uncalled for, seeing that the point under discussion was purely on the "Allis" engine, and seeing that the statement is misleading, I take this opportunity of correcting you.

If you will compare weight for weight of the Ball and Wood engine with those manufactured in Great Britain, you will find that the Ball & Wood engine is far heavier; the difference I have found out in actual practice to vary from 10 up to as much as 30 per cent. in excess of English practice; under these circumstances it speaks very highly for the ingenuity of design, which supplies an engine heavier in weight with larger diameter shafts and larger wearing surfaces than is the practice on this side, and at the same time to give the engine the appearance of being flimsy.

One of the points of the Ball & Wood engine which is not found in English practice is, that the engines are capable of taking 50 per cent. momentary overloads. These engines have been running for some 10 or 12 years in the States, and in no instance has there been a single case of a broken crank-shaft, or any trouble outside ordinary wear and tear. With regard to the finish and appearance, the engine has been very highly complimented by practical experts on this side for its neatness in design, and for its massive proportions.

As regards the finish, the engines at Dudley run with an entire absence from vibration, which is shown by the fact that a penny can be placed on end on the cylinders and will remain there, and a visit to the station will prove that the Ball & Wood engines run noiselessly, and the purchasers have expressed themselves satisfied with the economy. There is no advantage in putting on finish, such as is the practice in this country in some instances, if there is to be no corresponding benefit in the working economy of the engine.

F. Nell.

[We had no intention of speaking disparagingly of these engines. We cited them merely as an instance of satisfactory engines that were not enormously heavy, as we are of opinion that the demand for excessive weight is uncalled for. We are fully aware that the Ball & Wood engine runs practically free of vibration. We fail entirely to see any cause for grievance.—EDS. ELEC. REV.]

Stresses in Engine Shafts.

Anent your recent articles and correspondence regarding the stresses in the shafts of electric generators, the following particulars which relate to the 7,500-KW. alternator, which was designed in 1888 by Mr. Ferranti for the Deptford station, may be of some interest:—This machine was designed to run at 60 revolutions per minute. The approximate weight of the revolving armature complete is 200 tons. The diameter of the shaft in the hub at centre of armature is 36 inches, and in the bearings 28 inches, with a 12-inch hole running right through. The span from centre to centre of bearings is some 14 feet 8 inches. The diameter of the crankpins is 24 inches, with a 6-inch hole running through them.

The above figures are representative of what may be taken as the best English rolling mill practice, and a comparison between these and the Glasgow dimensions is somewhat interesting.

E. J. S.

THE ELECTRICAL ENGINEERS' SWISS TOUR.

(*Continued from page* 523.)

THE evening of Tuesday, September 5th, was signalised by a banquet given by the Swiss Electrotechnical Association and some Swiss firms to the visitors at the Tonhalle. The entertainment was most enjoyable, but the most interesting feature of the occasion was the speeches which were delivered during the evening.

Prof. Wyssling, the President of the Swiss Association, opened the proceedings with an apology for the absence of Colonel Huber, whose severe illness prevented his attendance, to his very great regret.* In the absence of the colonel, Prof. Wyssling greeted the visitors in the names of the Swiss Association, of the British Consul and Vice-Consul, of the Swiss scientific societies, and of his fatherland. Pointing to the great importance of the engineering industry to his country, he acknowledged the obligation under which it lay to English theory, on which he laid stress.

* We are glad to say that, according to latest advice, Colonel Huber is convalescent, and making good progress towards recovery.

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Colonel Huber's speech was then read, in which he welcomed the Institution, and expressed his thanks to the British Minister, the president of the Town Council of Zurich, the representatives of the Polytechnic, and the directors of power stations, who had joined in welcoming the visitors. Col. Huber proceeded to explain how Prof. Thompson approached him unofficially early in the year with a view to arranging a visit, and how he at once consulted Mr. C. E. L. Brown and Prof. Wyssling, and informed Prof. Thompson that the visit would be heartily welcomed. The programme was drawn up so as to enable the visitors to obtain a general idea of Swiss activity in electrical science; while the latter is the most modern branch of industry, its development has led to great advances in the construction of prime motors, and in Switzerland this applies especially to hydraulic machinery. But even in Switzerland steam and gas motors are of great importance, for the supply of water-power, although very great, is not so abundant or so cheap as to balance the advantages possessed by other countries, especially by England. Switzerland has no coal or metal mines, and no seaports, while she is encircled by a girdle of customs duties. He welcomed in the visitors the representatives of Free Trade principles, which were carried out in Switzerland so far as conditions allowed.

Referring to the cosmopolitanism of science, which knows no fatherland, Colonel Huber hoped that the members of the party would profit by the tour, but they must allow for the difference in conditions from English circumstances. In conclusion, he hoped for closer intimacy between the Swiss and the English engineers, and proposed the toast of "The Queen," which was heartily received.

Dr. Thompson replied in a glowing speech, eulogising the prosperity of Switzerland, especially seeing that it has been attained in spite of the lack of mineral wealth, and in the face of keen competition on the part of the neighbouring States. He ascribed her success in overcoming obstacles to the fact that Switzerland "has the men"! The splendidly equipped Federal Polytechnikum had contributed largely to the success of the country; he strongly recommended all present to join in the visit of inspection on the following day. The health of the President of the Swiss Federation was then honoured.

Other toasts followed, and great efforts were made to induce Mr. Brown to speak, but he was obdurate. Mr. Crompton declared that he made a practice of picking other men's brains when he visited their works, and was heartily applauded! The majority of the English retired soon after midnight, but it was rumoured next day that our Swiss friends kept up the celebration well into the small hours, and thought us early birds!

(To be continued.)

BUSINESS NOTICES, &c.

Aluminium.—In India much is being done in the manufacture of aluminium domestic utensils, &c. According to a letter from an engineering professor at Madras, to a Madras paper, the work was originally started at the School of Arts, but there are now several other centres of manufacture, and the more general adoption of the metal is being hastened by the prevailing high prices of copper and tin. A large order for cooking vessels for the 28th Madras Infantry has recently been filled at the school. Aluminium has also recently been used as a bearing metal for shafting in the Madras College of Engineering and has proved satisfactory.

Air Brakes for Electric Cars.—The French Thomson-Houston Company has within the past week placed an order for 150 air brake equipments, and 90 air brake trailer equipments for electric motor cars. These will be of the Standard Air Brake Company's improved axle-driven compressor type as used in England on the Liverpool Corporation Tramways, the North Staffordshire Tramways, the Potteries Electric Tramways, the Bolton Corporation Tramways, the Dublin United Tramways, &c, The French Thomson-Houston Company has been a leading exponent of the principle exemplified in the magnetic disc form of electric brake, and their placing of this large order for Standard air brakes is considered to mark a significant step in the decison of the mooted question as to the relative merits of air or electric brakes for electric traction work.

Bandon (Ireland).—The *Skibbereen Eagle* says that the old project for converting the long-idle mill into "an electric works" is now being revived. The mill has abundant water-power.

Electrical Wares Exported.

Week ending Oct. 4th, 1898.		Week ending Oct. 3rd, 1899.	
Adelaide	Value £20	Adelaide. Teleg. mat.	Value £658
„ Teleg. mat.	820	Brisbane. Teleg. mat.	3,446
Aden	29	Buenos Ayres. Teleg. mat.	663
Amsterdam	102	Calcutta	694
Boca. Teleg. mat.	566	Cape Town	114
Bombay	10	Chinde. Teleg. mat.	988
Boston	40	Colombo	114
Boulogne	87	Copenhagen. Teleg. wire	26
Buenos Ayres	28	Durban	108
Calcutta	289	„ Teleg. mat.	63
Cape Town	1,718	East London	160
Cologne	357	Hamburg. Teleg. mat.	100
Demerara	51	Helsingfors	36
Durban	297	Hobart	24
„ Teleg. mat.	248	Lorenco Marques. Teleg. mat.	349
East London	207	Malta	63
Fremantle	375	Melbourne. Teleg. wire	2,033
Gothenburg	37	Montreal	70
Halifax. Teleg. cable	26,000	Oporto	45
Hong Kong	185	Perth	70
Monte Video. Teleg. wire	407	Port Amelia. Teleg. mat.	1,415
Ostend	20	„ Elizabeth	370
Para. Teleg. cable	9,000	„ Said	336
Perth	125	Rio Janeiro. Teleg. mat.	3,312
Port Elizabeth	128	Rockhampton	42
St. Petersburg. Teleg. wire	173	Rotterdam	20
Stockholm. Teleg. wire	24	St. Petersburg. Teleg. cable	99
Sydney	2,653	Shanghai	75
Yokohama	281	Sydney	817
		„ Teleg. mat.	721
		Trinidad	45
		Wellington	901
		„ Teleph. mat.	567
		Yokohama	78
Total	£44,174	Total	£17,997

Foreign Goods Transhipped.

Durban. Telephone	£30	Antwerp. Elec. machinery	Value £50
		Port Amelia. Teleg. wire	920
Total	£30	Total	£970

The Art of Illustrating.—The process block is among the modern improvements in the production of high class magazines and trade journals, but modernity notwithstanding, the up-to-date editor knows that few things are more essential. Interest in processed illustrations is not however confined to the editorial sanctum, for the business man who is ever striving to outrival his competitors in the production of catalogues and price lists and by the extent and frequency of his advertisments, must keep in mind the necessity for good pictures wherewith to embellish his productions. There was a time when we used to turn to the pages of American journals for interestingly arranged advertisments, but during the past few years we have witnessed an improvement in those appearing in English periodicals, and the process block has performed its part in bringing about the change. For the benefit of those who are anxious to see some good specimens of such work, we may mention that Messrs. Penrose & Co., of Upper Baker Street, W.C., have issued their pictorial annual for 1899, with the title the *Process Year Book* (a review of the graphic arts). Mr. Wm. Gamble is the editor of the publication, which like previous issues is well worth a study. We can hardly afford space to mention the many excellent works of art from which reproductions have been made by half-tone copper and zinc etchings, three colour printing, photo-chromotype, collotype, and other processes, but a perusal of them shows what excellent effects may be obtained. In addition to the pictorial part of the book there are a number of useful articles on the technics of process work and printing by various writers.

Bankruptcy Proceedings.—The first meeting of creditors was held on Tuesday at the London Bankruptcy Court under the failure of Frederick G. W. J. Adams, electrical engineer, lately trading in partnership with C. M. Downie, at 24, Newman Street, Oxford Street, as Downie & Adams. The debtor ascribes his position to his liability for the partnership debts, which he estimates at £1,700 and states that the business was carried on for 2½ years up to last June. There was considerable discussion as to the best way to administer the estate, and eventually the case was left in the hands of the Official Receiver to be wound up in bankruptcy. It was intimated by a creditor that in order to facilitate the proceedings he would apply for a receiving order to be made against Mr. Downie.

Books Received.—"Fire Tests with Glass."—(1) The casements glazed by the British Prism Syndicate, Limited; (2) two skylights glazed with wired glass by Messrs. Pilkington Bros., Limited. London, 1899: The British Fire Prevention Committee. 2s. 6d. each.

"Quarterly Journal of the Royal Meteorological Society." London Edward Stanford. 5s.

"Practical Magnetism and Electricity," by J. R. Ashworth. London: Whittaker & Co. Second Edition. 2s. 6d.

"Electric Wiring, Fitting, Switches, and Lamps," by W. P. Maycock. London: Whittaker & Co. 6s.

"Arc Lamps," by H. Smithson and E. R. Sharpe. London: Whittaker & Co. 1s.

"Engineering Magazine." London: 225, Strand. 1s.

Catalogues.—Messrs. Alldays & Onions Pneumatic Engineering Co., Limited, of Birmingham and London, have issued two excellently prepared sections of their catalogue. Section (X) is an illustrated list of turbines of improved types, in which the construction of the machines is explained by the aid of some very neat diagrammatic and other sketches. In tabulated form we find dimensions, &c., of horizontal shaft Girard turbines of various sizes from 11 to 31 inches, there are also notes of low and medium fall

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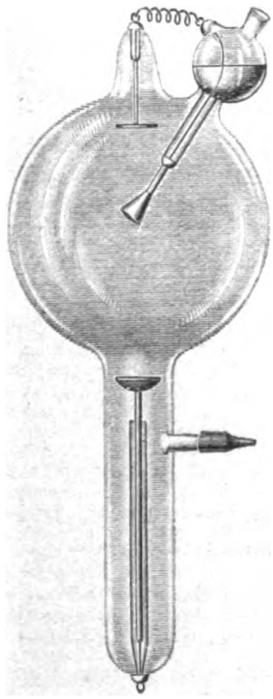
Girard types, Pelton wheels for 100 to 260 feet falls, horizontal shaft Jonval turbines, accompanied by first class explanatory drawings. The remainder of the list is taken up largely with general information regarding water-power. Section (Y) list, which is also arranged and illustrated in a very creditable manner, deals with improved blowing, exhaust, ventilating and pressure fans, together with a large amount of general information, valuable to fan users. The direct electric motor driven fan finds a place in the catalogue.

From Mr. G. Braulik, of Upper Thames Street, we have received a priced catalogue of his latest electrical fittings. The list is in fact an electrical supplies catalogue covering almost all the likely requirements of the trade. The aid of the illustrator has been called in somewhat extensively, for the book abounds in cuts showing the various switchboards, switches, lamp fittings, measuring instruments, linemen's tools, electric heating apparatus, telephone equipments, &c.

Deed of Assignment.—A deed of assignment has been executed by W. P. Mendham (trading as Mendham & Co., at Bristol), with various creditors. Mr. E. T. Collins is the trustee. It is stated that the accounts show that the deficiency is largely due to a heavy loss made under his dissolution arrangements with his late partner, Mr. King, and to losses on subsequent trading. The summary of affairs shows a deficiency of £3,228 13s. 7d.

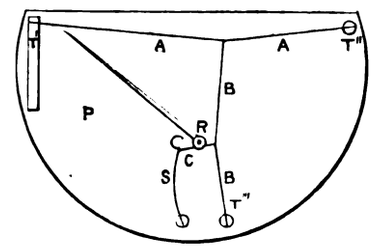
For Quick Delivery.—We believe that it is not very usual in these times of full order books and congested works for large electrical contracts to be completed under the time stipulated when the orders are placed. But a case which has just been brought to our notice shows what English firms can do when they are given the opportunity. The Atbara Bridge and other recent contracts placed with American firms, seemed to indicate that quick delivery of new work must not be expected at present; but it is pleasing to be able to record an instance of quick delivery of electrical equipment of the Burma Ruby Mines. About the middle of July Messrs. Johnson & Phillips, who received the contract, thought that delivery might be given within five months, but as Sir Lepel H. Griffin, the chairman of the mines, brought pressure to bear upon the firm and quoted "Atbara!" Messrs. Johnson and Phillips buckled-to with a will to show what they could do, with the result that the whole of the material was despatched within six weeks. This is undoubtedly a very creditable performance, but it occurs to us that when contractors quote they ought to be able to state pretty accurately when the machinery can be ready, for in nine cases out of ten if the time promised for delivery were a month or so longer than another house offered, "Atbara!" would not be uttered as a warning note, but the contract be straightway given over to the foreign rival. On the other hand, we think that making quick delivery promises which one has no prospect of fulfilling is to be more strongly condemned. The evils resulting from such a course have been clearly shown of recent years both in the electrical trade and out of it.

New Vacuum Tube.—Since the discovery of the electrolytic interrupter for use with X ray work, one of the difficulties has been to find tubes suitable to stand the current. Messrs. Harry W. Cox, Limited, of Cursitor Street, Chancery Lane, the well-known manufacturers of X ray apparatus, are now making tubes which have been specially designed and patented to work with the electrolytic break. The tube, as shown in sketch, has a cone-shaped anode



which is hollow. Into the small glass bulb at the top of the anode is poured a little cold water which fills the hollow anode so that when working the water prevents the anode from melting, with the result that a much stronger current may be used. The results on the screen are stated to be excellent, and the time to take a radiograph is greatly reduced.

Hot-Wire Ammeters and Voltmeters.—Messrs. Johnson & Phillips inform us that they have acquired the sole rights of manufacture and sale in the United Kingdom of the Hartmann and Braun patent hot-wire instruments, which are widely used on the Continent and in this country by those who are "in the know." The instruments are being manufactured in their entirety by Messrs. Johnson & Phillips, under the superintendence of an experienced assistant. They are equal in every respect to the original pattern, the only alteration being in their external appearance, which is modified to conform with English usage. In these instruments the heating effect of the electric current in a wire of suitable resistance is by special mechanism made to serve the purpose of indicating current or pressure in the measuring apparatus. The quantity of heat developed by unit current in unit time is the same for every kind of current, continuous or alternating (of any frequency), and is quite independent of the phase or method of generation. The instruments are absolutely unaffected by magnetic fields, and not having a solenoid, are, of course, entirely free from self-induction. The measuring or hot wire, A A, is of platinum silver, 160 millimetres long, which is stretched between two terminals, T′, T″. In the centre of this wire another wire of phosphor bronze, B B, is attached at right angles, and held taut by a third terminal, T‴. Near



the centre of this phosphor bronze wire a cocoon fibre, C, is fixed by one end at right angles, the other end passing round a specially grooved metal roller, R, fixed on a pivoted steel spindle mounted in jewels, and finally terminating in a small eyelet attachment to a flat steel spring, S. The whole arrangement of the fibre and wires is thus subjected to tension, and any slackening or "sag" of the measuring wire is immediately taken up by the steel spring, and is transmitted by the phosphor bronze wire and fibre to the grooved roller which carries the pointer. By this method the smallest extension of the wire is very greatly magnified and conveyed to the pointer, thus rendering the deflections easily perceptible. Another advantage of this construction is, that the scale has larger divisions in the part most frequently needed. That the instruments may be used for accurate laboratory work is affirmed by the Imperial Physical Laboratory, Berlin, where a large number are in use; they are also employed at the Central Technical College, London. The whole of the hot wire movement is mounted on a metal compensation plate, P, made from a carefully tested alloy, whose temperature coefficient is the same as that of the measuring wire. To deflect the pointer of the voltmeter over the full scale, a current of 0·2 ampere is required. For ranges up to 400 volts, a series resistance of constantin is placed in the backs of the instruments, where special means are provided for efficient ventilation. For higher ranges than 400 volts the resistance is placed in a separate case. In the ammeters the hot wire is divided into equal parallel parts of two or four, by thin silver foil strips; by this means 4 or 5 amperes may be sent through the wire with a drop of potential not exceeding ·25 volt. All the ammeters are provided with a constantin shunt, which, when the range does not exceed 100 amperes, is placed in the back of the instrument. For higher ranges the shunts are separate, and may be had to carry several thousand amperes. The instruments are exactly similar, except that a thicker hot wire is used in the ammeter than in the voltmeter, and a shunt substituted in the former for the resistance in the latter. They, moreover, absorb comparatively little energy; a thin metal plate situated near the hot wire protects the latter from air disturbances and insures a uniform heating of the wire. This is a distinct advantage over other instruments of the same type. A magnetic damping arrangement is provided, thus rendering the instrument dead-beat and without the unpleasant oscillations so common to most instruments due to a sudden rise or fall in the current, and the pointer is in perfect equilibrium in every part of the scale. For high pressure the whole internal mechanism is mounted on ebonite, the cover being also made from the same material. The instruments may be had with either front or back connections, and for central station work the usual large type can be supplied with illuminated dial. The portable instruments are mounted in strong oak cases and fitted with plug fuses to prevent damage by any accidental excess of current. Means are provided to reset the pointer to the zero position should it at any time show a zero error. Having had considerable practical experience with these instruments, we have formed a high opinion of them, especially as ammeters for alternating currents; in this capacity we believe them to be unexcelled.

The Jerry Wirer at Buenos Ayres.—The jerry wirer is to be found wherever electric lighting makes its way. We have already referred to his predations at Buenos Ayres, and we now read that his doings are by no means at an end there, any more than they are here at home. The *Review of the River Plate*, which has concerned

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itself with the evil, returns to the subject in a recent issue in the following terms:—

"A case came to our notice the other day which shows how strict inspectors have to be in overhauling electric light installations, both parts exposed to view as well as those hidden away in casing. It appears that several of the numerous tinkers who call themselves electricians are accustomed to put in good wire at all points within reach of the inspector, all that out of reach being merely cotton-covered wire. This accounts for how some men are able to put in installations as low as two dollars gold. The average shopman will take the cheapest he can get, and knows nothing about the quality until the trick is discovered, and he has to have the whole installation done over again. We think that the electric light companies would do well to make a note of those installers whose work is refused by the inspectors, and if it is found that they are continuing with their bad work, they should be warned off. This can be done by combination on the part of the companies, as the entire question of good or bad wiring lies with them, and the sooner that the bad wirer is scotched the better for all; but we are much afraid that we shall have him with us for some considerable time, if not for ever.

"A party of members of the Institution of Engineers at Buenos Ayres has had a debate on the house wiring question. It was generally acknowledged that there was plenty of room for improvement in the average work of the present day. It was further pointed out that the majority of bad work was to be found concealed in wood casing, and also in piping in the walls, when the installation had not been carried out by firms of any standing."

Liquidations, Dissolutions, &c.—The Tramways Union Company, Limited, is winding up voluntarily. Messrs. E. M. Underdown, J. B. Concanon, G. Richardson, and W. G. Woolston (directors), have been appointed liquidators.

Creditors of the Dargue Acetylene Gas and Electrical Company, Limited, are required to send their names and the usual information to the liquidator, Mr. W. H. Dargue, 57, Grey Street, Newcastle-upon-Tyne, the liquidator, by November 15th. The company is winding-up voluntarily for the purpose of its transference to a new company now registering (the Dargue Acetylene Gas Company).

Creditors of the Electric Lighting Extension Syndicate must send particulars of debts, &c., to Mr. C. O. Bastian (Bartholomew Works, Lawford Road, Kentish Town, N.W.), the liquidator, by November 12th.

A meeting of the Niagara Battery Company will be held on Monday, November 6th, to receive an account of the winding-up from the liquidator (Mr. F. Offor).

Messrs. C. T. Briscoe and E. Jones (Briscoe & Jones, electrical engineers and contractors, Richmond Terrace, Blackburn), have dissolved partnership as from July 31st.

Messrs. C. Allen and H. E. Fiford (Fiford & Co, electrical engineers, 94, New Road, Southampton) have dissolved partnership. Mr. Allen will attend to debts, &c.

Notice is given in the *London Gazette* of release of trustee (Mr. E. L. Hough, official receiver), in the case of E. S. D'Odiardi, medical electrician, of Silver Street, Notting Hill, &c.

McNeill's Code.—The publishers (Whitehead, Morris & Co.) inform us that Mr. Bedford McNeill's Mining and General Telegraphic Code has been extensively adopted in all the more important mining centres throughout the world. The book is now rendered still more serviceable by the publication of an extra part consisting of a "terminal index." This index permits of quickly determining the possible alternatives to any mutilated cipher word. So long as the termination only of a cipher word is mutilated, no great loss of time occurs owing to the alphabetical arrangement of the code itself, but when the beginning of a cipher word is wrongly transmitted much valuable time may be lost. The "terminal index" will prove invaluable in preventing this loss of time.

Motor Controllers.—The Ward-Leonard Electric Co., of Bronxville, N.Y., U.S.A., have just produced several new types of instruments. Principal among these are the HR and HV types. In this type of instrument the lever-bearing magnet keeper is released at failure of current, delivering a hammer blow to the main controlling switch lever, and driving the same to the position of open circuit. The HR type is for reducing to half the speed a motor whose torque is constant at all speeds; for example, a motor driving shafting. The HV type has a two to one gradation in ampere capacity and is intended for reducing to half the speed of a motor driving a ventilating fan.

A New York View of the Copper Situation.—From some notes in the last issue of the *Electrical World* to hand, it seems that the outlook for cheaper prices of copper is promising. Promises are received from many quarters, as the inevitable result of the development of production in various mines. Among the most formidable of these are the great copper mines of Rowan and Cabarrus Counties, North Carolina, which furnished all of the copper used by the Confederacy, and which are rich enough in ores, it is said, to supply the world's demand for years. These mines were originally worked for gold exclusively, and were abandoned entirely not long after the close of the war. Boston and New York capitalists, supposed to be backed by great electrical interests, bought them for a song, and have organized the Union Copper Mining Company, under the laws of New Jersey, for the purpose of operating them. The capital of the company is only $3,000,000, but it has already begun the erection of an extensive plant, and by January 1st next will be producing 1,000 tons of ore a day, which will yield 200,000 lbs. of pure copper a day. The company purposes to market the copper in New York at 10 cents a pound, which will give it a profit of 4 cents a pound. "There is no question that the claims of the copper pool that it can regulate the copper production of the United States and hold the price of copper at present rates are utterly absurd," said Walter G. Newman, president of the Union Copper Company. "We can market copper profitably at 10 cents a pound in New York, and there are new mines being constantly opened."

Partnership.—Prof. A. B. W. Kennedy intimates that he has taken into partnership, as from October 1st, Mr. Bernard Maxwell Jenkin, who has for some years past been his principal assistant at 17, Victoria Street, S.W.

Raw Hide Gear Wheels.—We have received from Mr. W. F. Dixon, 63, Percival Street, Manchester, particulars of his improved metal bushed buffalo raw hide gear wheels for noiseless driving. By an improved process he obtains a wheel which is practically a solid block of raw hide of any desired thickness. Pinions are built up in layers on a metal bush with lugs finished externally with a plain ring. A special medium is used to attain adherence and the teeth are then machine cut. Samples seen by our representative showed in the finished wheel a remarkably homogeneous texture more resembling hardened horn than built-up hide. In the same material and by the same process he is also producing insulators, clips, &c., for electrical work. Mr. Dixon claims to produce his hide gears as quickly as metal wheels.

Reduction of Capital.—A petition has been presented to the Chancery Division for confirming a resolution reducing the capital of Messrs. Hick, Hargreaves & Co., by returning to the shareholders £2 per share on the understanding that the amount may be again called up.

Soldering Tools.—Mr. J. W. Manley has designed (and Messrs. W. Tasker & Sons, of 39, Victoria Street, S.W., are selling) the "Moto" soldering tools for use in the construction of trolley, telegraph and telephone lines. These tools have been designed to meet a need which has existed among electricians. For use in electric tramway work, we understand that the "Moto" tools have been adopted by the British Electric Traction Company, also for use in connection with the West Hartlepool, Bristol, and London United Tramways Company, and their employment has given satisfaction. The tools are also made with straight copper bits for soldering armature connections and for general purposes. The bits are made in three sizes weighing 3 ozs., 11 ozs., and 1¾ lbs. Special sizes and shapes are made to meet requirements.

The South Western Polytechnic, Chelsea.—The Day College for Men, the Day College for Women, and the evening classes commenced on September 25th. Full particulars of all these classes may be obtained from the Secretary, Manresa Road, Chelsea.

Trade Announcements.—Messrs. J. E. Spagnoletti and Crookes inform us that the Alliance Fire Apparatus Company, Limited, which was noticed in our last issue, has been formed to take over the fire apparatus business which has been a small branch with them for the last 18 months. As the Articles of Association of Companies at the present time have such a wide range, they have included electrical and mechanical engineering, but we are asked to state that the Alliance Fire Apparatus Company is in no way connected with Messrs. Spagnoletti's ordinary business of electrical and mechanical engineers.

Messrs. Speedy, Congdon & Co., of 14, Victoria Street, S.W., announce that Mr. G. H. Congdon retired from the firm in August, and all debts, &c., will be attended to by the remaining partners, who will continue the business under the style of Speedy, Eynon and Co.

Mr. R. C. Sharp and A. O'Brien have dissolved partnership by mutual consent, and Mr. O'Brien announces that he will continue the business of English and American gas, steam, and water tubes merchant on his own account as O'Brien & Co., at 62 and 63, Minories, E.C. Debts of the old firm will be paid by him.

Messrs. H. Pickford & Co., have taken over the business of electrical and general engineers carried on for nearly 20 years by Mr. F. Ingram at 21 and 25, Leader Street, Chelsea. Mr. H. H. Pickford, A.I.E.E., will have charge of the electrical department at 21, Leader Street.

Messrs. A. Gray & Co., wood turners, have removed from Ladywood Road, Sparkbrook, to Breedon Cross Saw Mills, Stirchley, near Birmingham, where they will continue the manufacture of switch-blocks, boards and boxes, &c.

Turbine Works at Leeds.—The winter session of the Leeds Association of Engineers was opened on Thursday last week, when the president (Mr. Joe A. Tempest) delivered an address. Alluding to the prosperous state of the engineering trade, he referred to the enormous increase in the cost of raw materials, and trusted the demand for the finished product would justify them in asking such advanced prices as would cover the extra cost of production. He alluded to the latest engineering industry introduced into the city by Messrs. Greenwood & Batley Limited—namely, the manufacture of the De Laval steam turbines, turbine dynamos, turbine pumps, turbine fans, &c., and said that special works were being erected, having an area of nearly an acre, entirely under cover. The motive power was obtained from a 100 H.P. steam turbine dynamo (to be afterwards supplemented by two more), steam being supplied by a 10 ft. 6 in. × 10 ft. 6 in. marine type boiler with induced draught, (Ellis and Eave's patent). A surface condenser of very large capacity is provided, so that all the steam turbine motors may be submitted to an exhaustive test under working conditions before being sent out of the works. The shops will be equipped with machine tools specially designed for the economic machining of the various parts, and the larger tools will have separate electric motors to each machine; the lighter tools will be driven in groups from an electrically driven countershaft. The larger overhead cranes will also be electrically driven, and a light railway will run throughout the works to facilitate transmission of material and finished machines.

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ELECTRIC LIGHTING NOTES.

Austria.—The Austrian Union Electrical Company, of Vienna, is about to establish a large central station at Schatzlor for the supply of electrical energy for lighting and power purposes within a radius of 35 kilometres.

Berwick.—Mr. Campbell Swinton met two Committees of the Town Council on Tuesday afternoon and conferred as to the electric lighting of the town.

Birkenhead.—The Watch Committee approves of the Lighting Sub-Committee's report that the use of incandescent gas for street lighting be extended to 13 of the principal streets.

Bombay.—In a letter to the Corporation, according to the *Times of India*, the Municipal Commissioner, Mr. W. L. Harvey, states that three electrical firms are applying for leave to undertake electricity supply in the city; there is at present no public supply, nor has there been any attempt to introduce electricity into the city since the collapse of the Eastern Electric Light and Power Company. The applicants referred to are Messrs. Killich, Nixon and Co. (representing Callender's Cable and Construction Company), Turner, Hoar & Co. (agents for Siemens Bros. & Co.), and Mr. J. B. Foster. The first-named firm has priority in order of application, but the Commissioner understood that Messrs. Turner, Hoar & Co.'s scheme was in the more advanced condition.

Bridlington.—The District Council has resolved to apply to the Board of Trade for a provisional order under the Electric Lighting Act, 1892, to enable the Council to supply electricity for public or private purposes within the area of the district.

Brierley Hill.—The District Council on Monday last decided to make application to the Board of Trade for a provisional order under the Electric Lighting Acts to authorise them to supply electricity for public or private purposes.

Brighton.—The Town Council has adopted the recommendations of Mr. Wright, advising the erection of a new 25,000-H.P. station on a site at Aldrington Basin.

Chelmsford.—The Town Council having given the electric lighting company notice that the supply of water to the works would have to be discontinued after one month, the company has, very naturally, complained of the short notice, and suggested that the Council had been remiss in not providing properly for the requirements of the town. The company, however, has decided to lease a well in the meantime, and has asked for an extension of the notice, which expired on September 29th.

The Council has expressed dissatisfaction on account of recent alleged failures of the electricity supply, and is considering whether or not to apply for powers on its own behalf.

Cleethorpes.—The Electric Lighting Committee of the District Council have decided to recommend the lighting of the whole of the town by electricity with arc lamps.

Crewe.—The Town Council a short time ago obtained sanction from the Local Government Board to borrow £26,000 for the borough. As the Co-operative Stores are setting up an independent installation for their own premises, Messrs. Hopkinson and Talbot, engineers for the Corporation scheme, advise the Council to enlarge their radius, and borrow an additional £8,000.

Dartmouth.—The Town Council, acting on the suggestion of Oldham Corporation, has passed a resolution in favour of reducing the cost of obtaining provisional orders. The Edmundson Electricity Supply Company having objected to the Council's proposal to have the option of purchasing the undertaking at cost after 14 years, the Council agreed to purchase at a valuation.

Eastbourne.—The Electric Lighting Committee recommends the Council to appoint Mr. John Kempe Brydges (Wakefield) as resident electrical engineer for the borough.

Gloucester.—The City Council has found it necessary to consider the question of extensions of the electric lighting plant already, although the supply has not yet commenced. Mr. Hammond, the consulting engineer, is to report on the matter. The Council has entered into an agreement with the National Electric Wiring Company, Limited, for the wiring of private houses.

Grantham.—On Wednesday the Town Council decided to obtain professional advice before taking active steps with reference to adopting the electric light for the borough.

Grimsby.—The foundation stone of the electricity works was laid yesterday, with much ceremony and the usual luncheon.

Hythe.—The Folkestone Electrical Supply Company, having declined to alter their terms for supplying the town with electric light, the Town Council have decided to consider the question of applying for powers.

Ilford.—The District Council has applied to the Local Government Board for powers to borrow £68,000 for the purpose of lighting the area under its control by electricity.

Italy.—The prefectural authorities of Verona have received an application for a concession to utilise the water-power of the Adige in the generation of electrical energy and for the distribution of the same. It is said that 5,000 H.P. is available.

Inverness.—The Town Council last week resolved that the plans and specifications submitted by Mr. Craven, electrical engineer, for the electric lighting of the town be remitted to Messrs. Kincaid, Waller & Manville to examine and report. The plant to be laid down, which was to cost the town from £20,000 to £25,000, would be sufficient to light the whole of the town.

Lancaster.—The Local Government Board is prepared to grant a provisional order including only those parts of Scotforth, Skerton, and Bulk as were applied for in 1888, instead of the whole as applied for, on the ground that the incorporation of such large areas was unusual. But is it therefore wrong?

London, E.C.—At the Farringdon Ward Club on Wednesday last week Mr. A. C. Morton delivered an address on the electric lighting in the City. After saying that the matter was still *sub judice*, preventing his dealing freely with it in an outspoken manner, he proceeded to deliver a rigmarole covering as many points as possible in this now wearisome controversy. The views of the Board of Trade and Sir Courtenay Boyle favouring a competitive supply as a means of improving the City supply were supported by Mr. Morton, the advantages of a cheap supply of electricity dwelt upon, also the injustice of the gas authorities in charging so high a price for their commodity on the North side of London. He referred to the enormous depreciation in the market value of the shares of the City of London Electric Lighting Company, and while he regretted this he maintained that it was the duty of the Corporation to study the public interests of the entire City before those of a body of private shareholders. Mr. Morton, in referring to the great advantages of a plentiful and cheap supply of electricity, said that the City ought "to join itself to some other public lighting district where there was a resident population, which, requiring light through the night as well as through the day, would make the supply doubly remunerative to the company, and, therefore, available to the public at reduced rates." It would be interesting to know what, if any, district Mr. Morton had in mind in making these mysterious remarks at the conclusion of his speech. We have quoted them from the *City Press* report, and we are tempted to suppose that somewhere near London there is an underground residential district whose inhabitants require "light through the night as well as through the day." Truly, an ideal supply system this would be, 24 hours continuous lighting at full load, more or less! We imagine the City of London Company would be very happy if it had a steady supply for a few hours each evening instead of its sudden rise and its sudden drop. It is somewhat amusing to read Mr. Morton's comment that the matter was *sub judice*. Evidently he imagined that such being the case it was an opportune moment to deliver himself of an oration upon many of the difficult points which have arisen in connection with the City supply. He promised to abstain from outspokenness, therefore, presumably to his own mind, in keeping that promise he contended that if members of the Corporation, when acting as trustees for the public, did wrong, they should be punished, and he held also that the Court should do its best to controvert the action of the wrong-doing member. Personally, therefore, he regretted that the Court of Aldermen had not taken action against the prime mover in the transactions he had referred to. We tremble to think what language is used by Mr. Morton when he allows himself to be outspoken! Many of Mr. Morton's remarks are criticised in the *City Press*, of Wednesday, by Mr. J. W. Martin. Mr. Martin advocates the termination of the controversy by the Corporation purchasing the City Company's undertaking.

The *City Press* says that the Streets Committee will bring up a report on an offer by the City of London Electric Lighting Company to reduce the price of the current. The consumer is to be given the right to choose which of two methods of charging he prefers. The same committee will recommend that the alteration of the standard pressure from 100 volts to 200 volts should be complied with, subject to the City of London Electric Lighting Company agreeing:—

(1) To make, at their own expense, the necessary alterations to consumers' lamps, wires or fittings, directly or indirectly incidental to such change; and (2) that the prices of supply shall at no time be raised above those contained in the notice issued by the company and dated July 26th last; and (3) to establish, concurrently with the alteration of the pressure, proper means of testing the public and private supply.

Macclesfield.—The Gas Committee will not, in the meantime, consent to the application of the Electric Power Distribution Company, *re* electric lighting, but will consult an electrical expert.

Manchester.—At Wednesday's City Council meeting, Alderman Higginbottom, in reply to inquiries as to the recent frequent failures of the electric light and the disturbance of foot paths for the renewal of cable, said that originally the Corporation adopted rubber-covered cables. Time had shown that the cables had depreciated seriously throughout the city. They began to give way about 12 months' ago, and after a careful examination it was found that they were incapable of bearing the pressure. A new system was adopted, and many new cables had been laid, none of which had caused accidents at present. There were still about 12 miles of cable to be renewed. A discussion ensued on the tramway question. After a long discussion, it was decided, with two dissentients, that the Committee should apply to the Board of Trade for sanction to borrow the sum of £860,000 for the purposes indicated in our "Traction Notes" to-day.

Norton.—Messrs. O'Gorman & Cozens-Hardy have reported to the District Council that an electric lighting scheme could be carried out at a cost of about £10,000, and recommended that a provisional order be applied for.

Paisley.—The electric lighting authority has decided to purchase an Adamson engine, with Ferranti alternator, for the electric light works. The reason for purchasing an additional engine

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is that the electric light department is already overloaded with orders for supply, and it is absolutely necessary that the machinery should be extended.

Newcastle.—The City Lighting Committee of the Corporation have received an offer from the Electric Supply Company to supply public lighting at the annual cost of £15 10s. per arc lamp, as against the offer of the Tramways Committee, viz, £16 3s. 4d. A sub-committee was appointed to deal with the matter.

Poplar.—The District Board has resolved to provide accommodation for a house-wiring department at the electricity works, at a cost of £1,200. The space is required for stores and showrooms. The principle involved in this step appears to us to be highly objectionable on various grounds. There is a limit beyond which municipal trading should not be carried, and this is overstepped as soon as the local authority enters into competition with its own ratepayers, with the intention of carrying out work at little above cost price. There is no question of preventing a monopoly here; on the contrary, competition is crushed. The adoption of this principle at once throws open the door for municipal groceries, tailoring, &c.—if one, why not the others?

The Board has come to terms with the dock companies for wayleaves for electric cables.

Redditch.—The Urban Council on Tuesday decided to apply to the Local Government Board for permission to borrow £7,000 for necessary works in connection with the public electric lighting and contemplated extensions.

Redruth.—Mr. Trentham has been instructed by the Urban District Council to report on electric lighting for the town.

Rhyl.—Messrs. Trentham & Preece have submitted a scheme for the lighting of the Promenade with 19 arc lamps, at a cost of £3,800, as well as a more comprehensive scheme, costing £14,000.

Saltburn.—Last year a scheme was considered by the District Council for the electric lighting of the district, at an estimated cost of £9,000, but it was shelved. According to the *Saltburn Times*, the Cleveland and South Durham Assets Company, Limited, has now taken up the matter, and has erected a supply station on its own account. The motive power is obtained from a gas-producing plant capable of supplying 5,000 lamps, but engines and dynamos are at present installed for 2,000 only. The price of supply is 6d. per unit., and it is singular to note that the maximum load will occur in August and September! Supply will be commenced in a few days.

Shoreditch.—It had been expected at Tuesday's meeting of the Vestry that a discussion would have taken place on the accounts of the electricity and refuse destructor undertaking for the past year. This anticipation was, however, not fulfilled, in consequence of the slight indisposition of Mr. N. Moss, chairman of the Lighting Committee, whose hoarseness prevented his introducing the subject on that occasion. The Vestry clerk read a letter from Mr. H. E. Kershaw, resigning his position on the Lighting Committee, partly on the ground of a statement said to have been made that he was "actuated by personal motives in advocating one make of cable over another." It was moved by Mr. Wells and seconded that the resignation should be accepted, and to this an amendment was proposed by Mr. Johnson that Mr. Kershaw should be asked to reconsider his decision. A somewhat personal discussion ensued, but in the end the amendment was adopted by a large majority. A letter from the clerk to the Shoreditch Guardians was read, expressing regret at the refusal to allow the Vestry's electrical engineer to prepare a specification for the electric lighting of the Hornchurch Cottage Homes, and intimating the intention of the board to obtain the services of other advisers. On the recommendation of the Lighting Committee the Vestry resolved to insure the six new boilers, steam pipes and economisers with the National Boiler Insurance Company, and to approve new wiring rules, prepared by Mr. Newton Russell, the chief electrical engineer.

Sittingbourne.—The District Council last week decided to apply to the Board of Trade for a provisional order to enable the Council to introduce electricity into the town and district.

Stockton.—At Tuesday's Council meeting it was stated that progress had been made with the electric lighting works, and applications are to be invited for a resident engineer at about £250 a year.

Stoke-on-Trent.—The Town Council has decided to adopt a low pressure direct current supply, and has chosen a site for the works where coal and water are easily available. Mr. J. N. Shoolbred has been asked to report on the matter.

Sunderland.—The tenders for the erection of boiler house, &c., for the electricity works extensions are considerably in excess of the borough engineer's estimates. The contract is to be given to Mr. Elrick for completion by November 7th, but if he cannot complete by then, the work will have to be done by Corporation employés under the engineer's supervision.

Torquay.—An inquiry was held last week by Major-General H. D. Crozier, R.E., on behalf of the Local Government Board, relative to the Town Council's application for leave to borrow £10,000 for electric lighting purposes. The original loan was £22,300, which was exceeded by £2,659, on account of a change in the position of the boilers at the generating station. The inspector made searching inquiries into the cause and exact amount of the loss, and expressed much dissatisfaction at the vague and indefinite testimony of the officials.

Todmorden.—At a recent meeting of the Town Council, according to the local paper, the chairman read 12 applications from electrical engineers offering their services to report on electricity for lighting and motive power within the borough, and it was resolved that a tabulated list of all the applications be prepared, printed, and sent to each member of the Committee, giving particulars of experience, &c. Comment is hardly necessary.

Ventnor.—The offer of the Electric Light and Power Company to light the streets of Ventnor by electricity was accepted by the District Council, provided the company would reduce the price quoted for the 24 arc lamps from £16 10s, to £15 each per annum. The company has consented to the reduction, so that the matter is finally settled, and the town in the near future will be lighted entirely by electricity.

West Bromwich.—The General Purposes Committee of the Town Council have considered the report of the engineer with regard to the laying down of plant for supplying the borough with electricity, and have decided to recommend the Town Council to make application to the Local Government Board for permission to borrow £30,000 to be expended in plant and mains for lighting and motive power purposes.

West Ham.—The Town Council has agreed to a report of the Public Health Committee recommending that the Dagenham Hospital be electrically lighted.

Withnell.—The Urban District Council having received a scheme for a gas supply for the district, have requested Mr. G. R. Peers, of Manchester, to prepare a scheme of electric lighting to be worked in conjunction with the sewerage scheme.

Woodford.—The District Council last week received a letter from Messrs. Taylor & Field, who stated that they had been in communication with the Buckhurst Hill Urban Council with reference to an electricity supply scheme, and that Council had viewed the proposal favourably. They now wanted to know whether the Woodford Council were favourable to a scheme for the Woodford district. The letter was referred to the General Purposes Committee.

York.—The Electric Lighting Committee of the City Council expects to commence supply in two months' time. The charges will be 7d. per unit for the first hour, and 3d. afterwards; for power, 3d. per unit will be charged.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aston.—The General Purposes Committee recommends the District Council to take over the Aston sections of the tramways of the Birmingham and Aston Tramways Company, and the City of Birmingham Tramways Company, at the times allowed for purchase in the Tramways Act. A change in the mode of traction will then be made.

Belfast.—The deputation appointed to visit other large towns regarding the laying of the proposed tramway extensions, intimated that last week they were now in a position to hand in their report, and it was arranged that a special meeting of the Improvement and Electric Committee should be held to consider the report.

Blackpool.—A man, with a child in his arms, alighted from an electric car while it was in motion; in fact, when it was negotiating a curve. He was caught by the wheels and killed, nearly every limb being broken.

Blackpool-Morecambe.—The Mayor of Lancaster, at the last meeting of the Lancaster Town Council, expressed the hope that the proposed electric railway from Knot End, to complete the Coast electric line from Blackpool to Morecambe, would not be altogether dropped. The Corporation hoped the scheme would go on, but could not consent to interference with the navigation of the river. If a detour were made through Lancaster to Morecambe, it is believed the Corporation would enthusiastically support the scheme.

Brighton.—The tramways question came up at the last Council meeting. Mr. Kincaid, the engineer engaged by the Council to advise them on the question, had prepared a detailed report on a system of tramways for Brighton. Having considered this report, the Tramways Committee recommended that the northern termination of the line of tramway in Ditchling Road be at the Drove Road, and that of the tramway in the Lewes Road be at the Ship Inn, and that, subject to these arrangements, the suggestions contained in the report of Mr. Kincaid be approved of and acted upon. Application should be made, they advised, for powers to purchase compulsorily, if necessary, for the purposes of the scheme, the premises at the junction of Viaduct Road and Beaconsfield Road, formerly Longhurst's brewery and malthouse. Application should be made for authority to appropriate a strip of the Level, and a request made to the Waterworks Committee to permit the piece of land belonging to the Corporation on the north side of the Lewes Road pumping station to be appropriated for the purposes of a tramcar station. The report was adopted.

(*Continued on page 563.*)

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CARLISLE CORPORATION ELECTRICITY WORKS.

That the ancient cathedral town of Carlisle is possessed of youthful vigour and prosperity is well shown by the fact that the Corporation has adopted electricity supply and electric traction (the latter through a company) with businesslike thoroughness, while the inhabitants have done their share by promptly connecting over 7,000 lamps (equivalent 8 c.p.), the number which it was estimated would *ultimately* be required, within six months of the commencement of supply, and applying for 1,300 more!

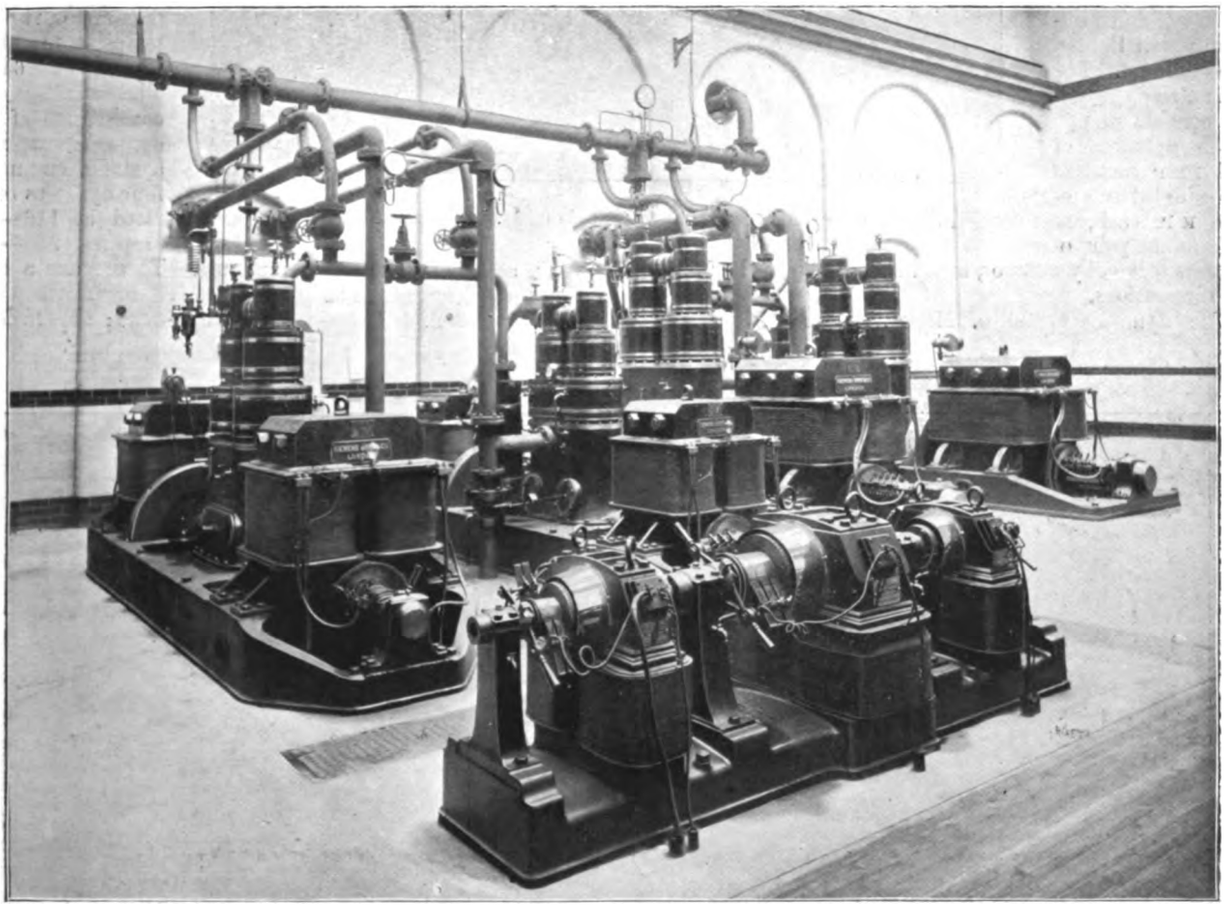
The scheme originally drawn up by Prof. Kennedy involved an expenditure of £30,000; the Local Government Board inquiry was held in December, 1897, by Col. Durnford, and the loan was sanctioned in due course. The scheme was put in hand without delay, and Mr. C. D. Burnet was appointed resident engineer.

In addition to the boiler and engine rooms, the buildings consist of general offices and waiting room, private offices for the engineer and his assistant, meter room, and drawing office, which may also be used as a test room.

The works have been erected close to the Citadel railway station, on a site where water for condensing can be obtained from the river, while coal is brought direct to the boiler house by means of a siding from the adjoining railway.

The floor of the boiler house is about 4 feet below the outside level, so that the coal is easily delivered from the trucks. At present there are three Lancashire boilers in position, made by the Oldham Boiler Works Company, Limited. These are 28 feet × 8 feet, working at a pressure of 160 lbs. per square inch, and are fitted with four cross tubes in each of the flues. The latter are 3 feet 3 inches in diameter at the furnaces, and the grates are 5 feet 6 inches long.

The boilers are fitted with the Union Iron Works Company's "Autostoker," with shifting firebars, which slowly convey the fuel from the firedoor to the back of the furnace, and drop the clinker through a space left for that purpose in the grate. Firing is, however, at present done by hand. A Green economiser of 192 tubes is provided; a clear space is left between this and the wall of the engine room, in which the condenser pipes from the latter are accommodated.



Generating Plant; Booster in Foreground.

The feed pumps are of the Worthington compound duplex type, and are rated at 1,400 gallons per hour each; but with the assistance of a head of water from the feed-water tank, they are capable of actually delivering 3,000 gallons per hour each. Feed water is obtained from the town mains, the river water being too muddy; the whole system is in duplicate, and the copper "bus" pipes, after passing the economiser, are separately connected with each boiler. The whole of the water is passed through a Kennedy water meter under pressure before entering the economiser.

Space is provided for two additional boilers, which will soon be installed.

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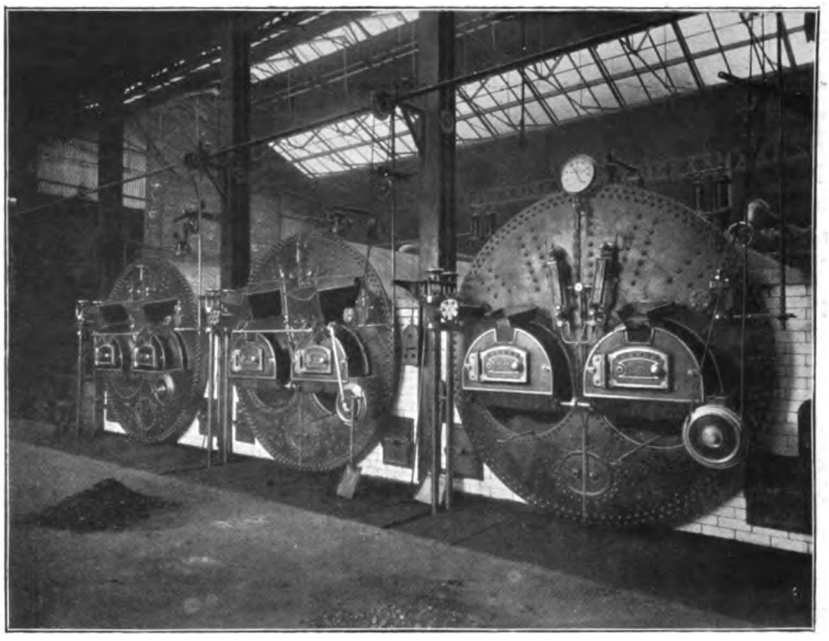
The steam pipes are of steel, with cast-iron tees and copper bends; there is a complete ring main, and two separators are placed in the course of the steam, close to the boilers. The pipes, 8 inches diameter, are made with screwed and brazed flanges, and the joints are packed with Taylor's corrugated rings. These are to be covered with "Washington" lagging, while "Leroy" lagging has been used for the boilers.

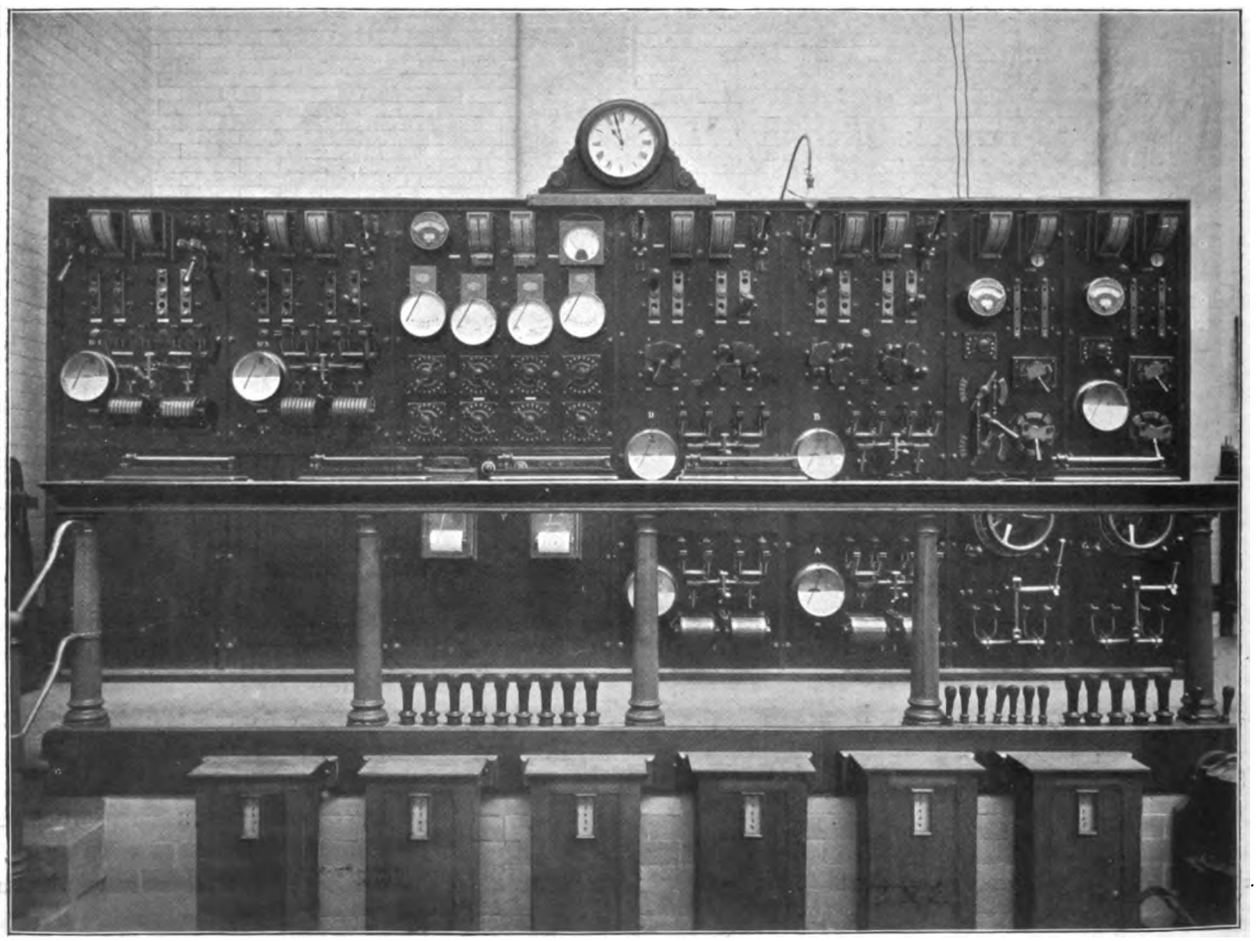
The chimney stack is 160 feet high, and about 7 feet diameter inside.

The engine room is lofty, and unusually well lighted from the roof. The plant already installed consists of two steam dynamos of 200 I.H.P. each and two coupled sets of 100 H.P. each, as well as a pair of boosters driven by a motor, seen in the foreground of one of our illustrations.



Lancashire Boilers.

The dynamos are all of Messrs. Siemens Bros.' manufacture coupled to Willans engines; the larger machines are provided with series over-compounding coils for tramway working, as the Corporation will supply power to the tramway company. These machines are rated at 255 amperes, 490 volts, at 330 revolutions per minute when running shunt, and 550 volts, 227 amperes, at 350 revolutions per minute, when compound; the increased pressure in the latter case being obtained partly by increased armature flux and partly by increased speed. The combined efficiency of one of these sets was 78·35 per cent. at ¾ load, with a consumption of 22·27 lbs. water per E.H.P.-hour at that output. The maximum rise of temperature above the air was 65° F. The smaller sets consist each of two dynamos coupled to a single engine, all four dynamos being rated at 116—131 amperes, 230—260 volts, at 460 revolutions per minute. These gave a combined efficiency of 78·35 per cent. at full load, with a consumption of 22·5 lbs. water per E.H.P.-hour; the efficiency at ¾ load was 73 per cent.; at ½ load 66·3 per cent., and at ¼ load 51·73 per cent., with a maximum temperature rise



Main Switchboard.

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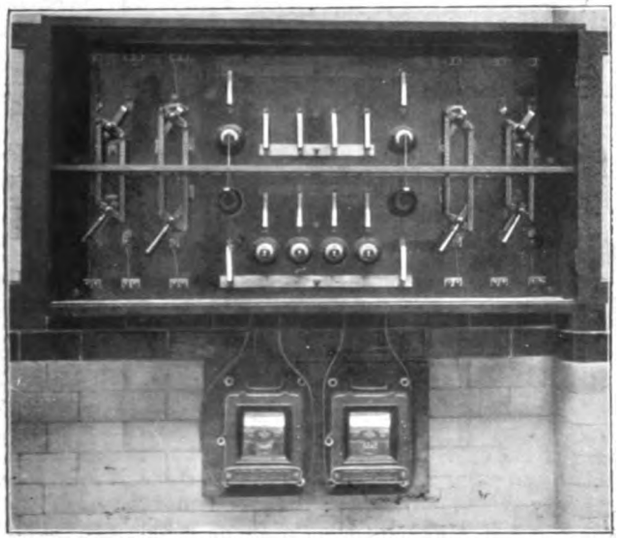
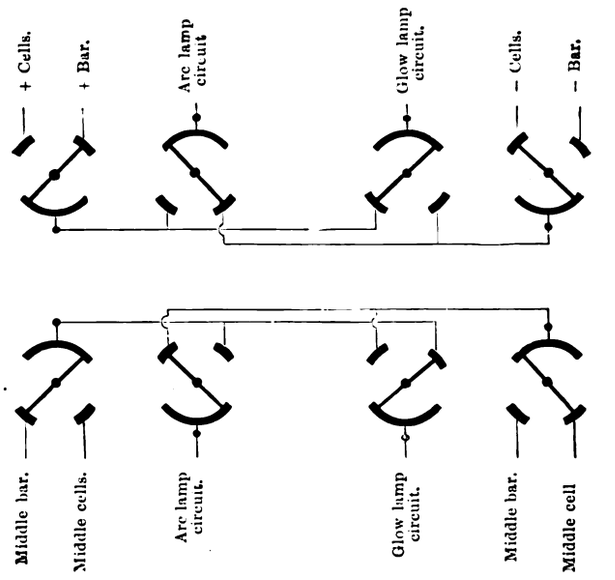
of about 63° F. Two 400 I.H P. Willans engines, coupled to dynamos by Messrs. Bruce Peebles & Co., are on order; when these are erected, the whole of the space at present available will have been taken up. The booster set consists of a motor with speed variable from 500 to 1,050 revolutions per minute, coupled to two boosters taking 60 amperes each, with a maximum boost of 80 volts. This set was manufactured by the Electric Construction Company, Limited.

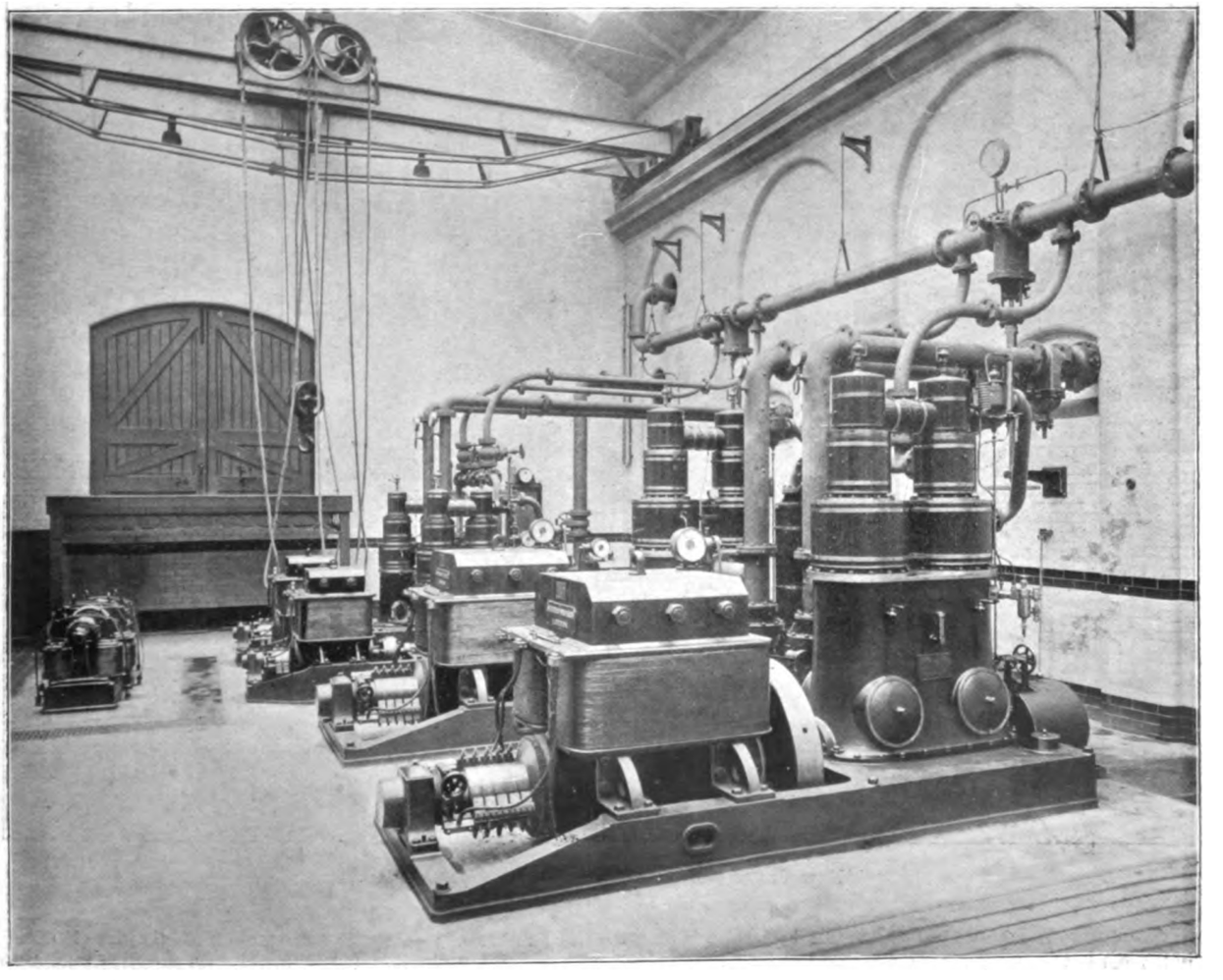


Works Lighting Switchboard, showing coupled two-way switches.

The steam pipes to the engines are so arranged that each is provided with a duplicate supply; the exhaust pipes are teed to a vertical pipe, which leads upwards to the condenser and downwards to the main exhaust pipe to the atmosphere. The latter path lies through a balanced automatic relief valve, which may be opened by hand, but is intended to provide an alternative outlet for the exhaust steam in the event of an accident to the condenser. The main exhaust pipe is 12 inches in diameter, and is led up to a height of 44 feet.



Station Lighting Switchboard.
Diagram of connections of coupled two-way switches.



Generating Plant.

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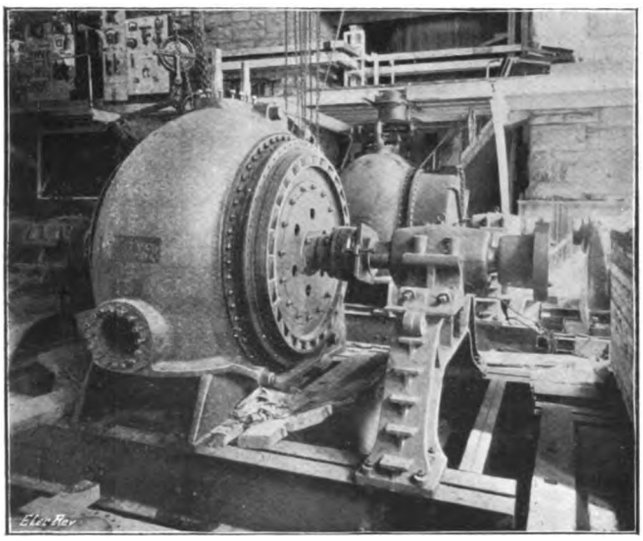
The condenser pipe passes through the wall of the engine room and downwards to a Ledward ejector condenser, which is fed from a water tank 36 feet × 14 feet



New Plant for Niagara.—Fig. 2. (See page 563.)

× 8 feet deep on the roof of the boiler house. In addition to a sluice valve, an automatic non-return valve is fixed between the engine and condenser, to keep the water out of the engine in case of a mishap. Each of the larger condensers is capable of condensing 4,000 lbs. of steam per hour, while the smaller ones are rated at half that value. Condensing water is derived from a tank built in the river bed, whence the water is drawn by a centrifugal pump made by Messrs. Drysdale & Co., Glasgow. The pump is driven by a 25 H P. Siemens motor, and is able to deliver 45,000 gallons per hour to the tank, with a total lift of about 46 feet. Some difficulty is experienced in dealing with the water, which is very muddy. It is no uncommon thing for fair-sized eels to be found in the water tank!

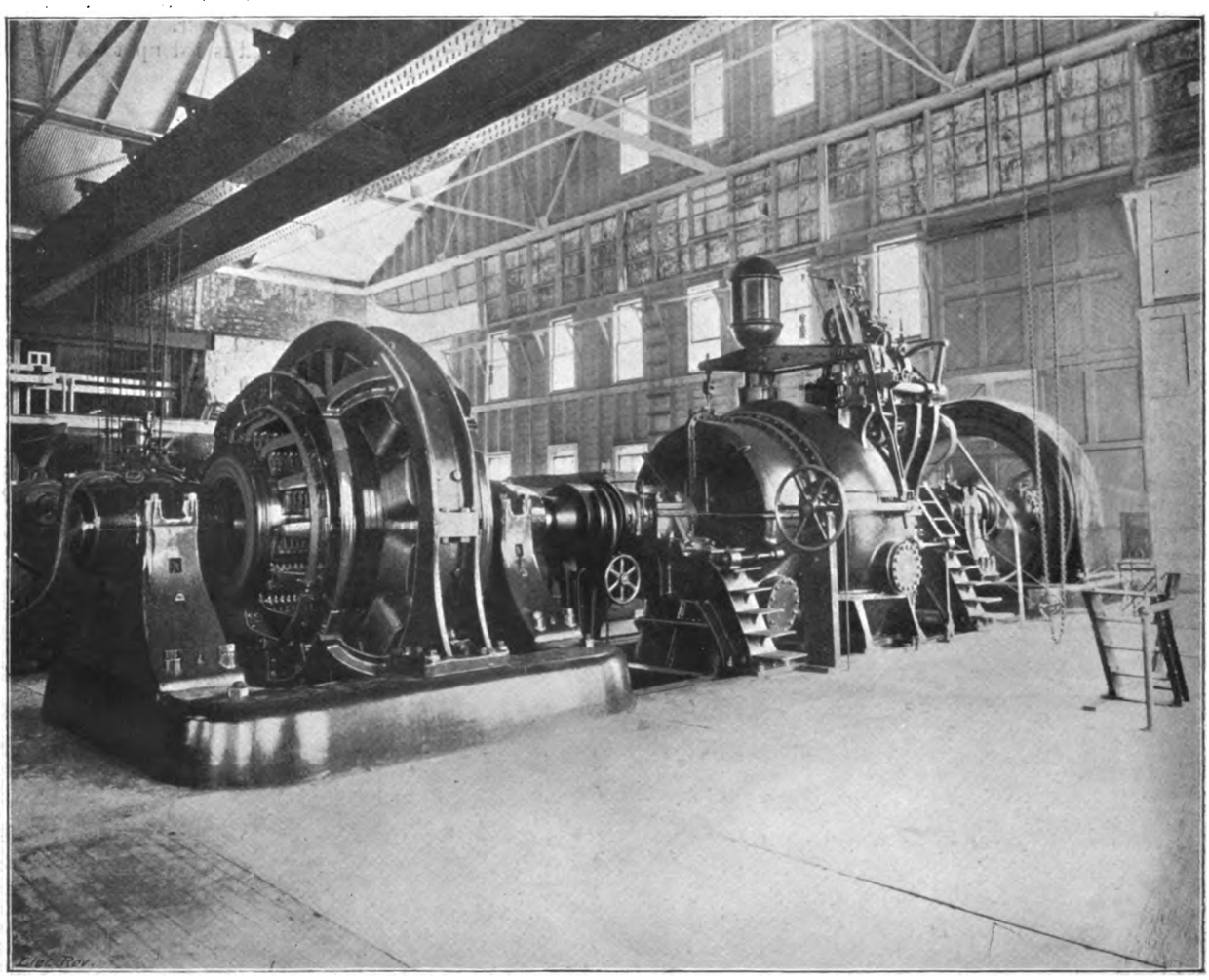
An overhead crane of light construction spans the engine room. This was made by Messrs. Carrick & Ritchie, and is capable of lifting a load of 10 tons.

The foundation of the works is borne on a gravel sub-soil. To minimise vibration a layer of concrete 18 inches thick was first put down all over, and the engine block, of concrete 26½ feet × 60 feet × 6 feet thick, was constructed upon this with sand centres at intervals. Passages are provided beneath the floor, in which the exhaust and other pipes are laid.

A battery of 250 Chloride cells is housed in a room adjoining the engine room. The normal capacity is 300 ampere-hours, with a maximum discharge rate of 120 amperes for half an hour. The plates are contained in glass boxes, which are arranged in two tiers.

The main switchboard, of which we give a photograph, is arranged for a three-wire distribution system, and was built and equipped by the Electric Construction Company, Limited. It is mounted on a platform commanding a clear view of the engine room, with ample space both behind and below. Most of the instruments are of the Kelvin type, made by White, of Glasgow; the exceptions are four Weston voltmeters and two Holden recording voltmeters. There are seven slate panels, arranged as follows:—

Panels 1 and 2—double-pole feeder switches, two 240-ampere gauges of the edgewise type, double-pole automatic cut-out, bus bars, and dynamo ampere gauge to 320 amperes.



New Plant for Niagara.—Fig. 1. (See page 563.)

Panel No. 3—edgewise ammeters on middle wire (150 amperes) and earth connection (10 amperes) with direction indicators, two 450—570 voltmeters, and two 200—300 voltmeters, eight voltmeter

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switches with eight points each, and two Weston voltmeters for pilot wires from feeding points (190—270 volts).

Panels 4 and 5—d.p. feeder switch, two edgewise ampere gauges (240 volts), two ampere gauges (200 amperes), two d.p. automatic switches, bus bars, and middle-wire bus bars with safety shutters.

Panels 6 and 7—two edgewise 120 ampere gauges (one with direction indicator for battery), one Weston voltmeter (0—90 volts), shunt switch and reversing switch for booster, battery regulating switch (12 cells) and emergency switch, while one panel bears the booster motor starter, the other the motor ampere gauge (50 amperes).

The booster starting resistance is placed half on each pole, with the contacts slightly "out of phase;" as the positive and negative are coupled together, the effect is, of course, the same as if twice as many contacts were placed on one pole, but the arrangement is neater, and the travel far less than would then be the case.

The booster reversing switch is interlocked with the battery regulating switch in a singular manner; it is impossible to move the former except when the latter is in one of two equivalent positions, in which the whole of the cells are in circuit. The booster can then be switched on, and can be used either to charge the battery or to assist in the discharge; but as the battery is never disconnected from the mains, the voltage of the booster has to be varied according to the position of the regulating switch, and this is a source of great inconvenience, apart from the excessive pressure which may be applied to the mains when introducing the booster into or removing it from the circuit.

The automatic cut-outs are provided with a differential arrangement, by means of which a wide range of adjustment is obtained, with the important advantage that the circuit is broken if the current falls to zero, or if the current reverses in direction, but not if a short occurs on the mains. This is accomplished by the addition of a shunt coil to the usual series winding.

The battery is at present able to cope with the whole of the ordinary night load, which includes public lighting. A Miller reversible meter is to be used for checking the performance of the battery. Each machine also is in circuit with an Aron meter, including the motor which drives the boosters.

The public lighting is carried out by means of 25 10-ampere Crompton arc lamps, run 10 in series across the 460-volt mains, from dusk to daybreak. The lamp-posts are of a neat design, made by Messrs. McKenzie, Edinburgh.

Private supply is provided for with concentric mains, armoured and laid direct in the ground. The whole of this work was done by the Callender Company on their usual system.

The distributors are triple concentric, ·12, ·06, ·12 square inch; the feeders, of which there are three, are two-wire, ·25 square inch, the middle wire being connected with the works by two single cables of the same section.

The arc lamps are wired with 7/16 S.W.G. armoured cable. There are also a number of three-core pilot cables. All the feeder and pilot cables end in an underground chamber in the roadway near the works, whence they are carried as separate conductors through a subway to a chamber beneath the switchboard, and distributed to the back of the board. In this chamber are also the Siemens resistances for the generators and the E.C.C. resistances for the boosters and motor. The main fuses are mounted on the back of the switchboard, where there is ample space.

The supply to consumers is charged for on a sliding scale, as follows:—

For lighting, up to 1,000 units per annum	...	5d. per unit.	
" 1,000 up 3,000	"	...	4⅝d. "
" over 3,000	"	...	4¼d. "
For power, up to 50,000	"	...	2d. "
" over 50,000	"	...	by agreement.

A number of Ferranti meters are in use, but the greater part are Chamberlain & Hookham's.

The supply to the tramway company was originally estimated at 400 H.P., but this will probably be exceeded. Energy supplied will be charged for at the rate of 2d. per unit for a minimum of 200,000 units per annum, with a sliding scale for higher consumptions. As these terms are no better than those offered to ordinary consumers of one-fourth the amount specified, we imagine that the price will be subject to modification.

The station was wired for electric lighting by the British Illuminating Company, Edinburgh. Mr. Burnet's experience of breakdowns at other works, and of repairs effected by the light of vestas and dips, has led him to devise a special switchboard, which we illustrate on page 561. The connections are made clear by the diagram, which shows that there are no less than *four* alternative ways of obtaining connection, either with the battery or the bus bars on either side of the system.

We have to express our thanks to Mr. Burnet, the city electrical engineer, and his assistant, Mr. G. G. Scurfield, for their kind assistance in the preparation of this description.

NEW PLANT AT NIAGARA.

We reproduce on the opposite page two photographs recently taken in the station of the Niagara Falls Hydraulic Power and Manufacturing Company at Niagara Falls. In fig. 1 is to be seen a new set of machines lately connected up. The generator in the foreground supplies the National Electrolytic Company with current of 5,000 amperes at 175 volts. Its capacity is about 875 KW. The turbine was made by Messrs. R. D. Wood & Co, Philadelphia, and is of about 2,500 H.P. This is the first turbine installed in the station by the company. The machine connected to the far side of the turbine is the dynamo recently portrayed in these columns while being lowered over the cliff. It is a dynamo which supplies current to the incandescent system of the Buffalo and Niagara Falls Electric Light and Power Company.

Fig. 2 shows two new turbines of Messrs. Wood's make in course of installation. The turbine in the foreground gives an excellent idea of the construction of these power producers; others of the same class and type will be installed in the immediate future. Each of the turbines is of 2,500 H.P. capacity, and will be operated under a head of 210 feet. Their location will be over valves on the same penstock as shown in fig. 1, but they stand to the rear of this turbine. Each turbine is fed through a 60-inch valve.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page 558.*)

Chester.—A special meeting of the General Purposes Committee was held last week to consider whether it would be advisable for the Council to take over the present tramway system at the expiration of the present term, which terminates shortly; 13 members were in favour, and 13 against the proposition. Further consideration was adjourned until next Council meeting.

Derby.—The Electric Light Committee has decided to fix the charge for power as follows:—3d. per unit for the first 12 hours per week, 2d. per unit for the next 18 hours per week, and 1d. per unit for all quantities after.

Dublin.—On 28th ult. Mr. A. P. Trotter, Board of Trade inspector, opened an inquiry at the Four Courts into four accidents that occurred to the electric trams recently. The following report is from the *Irish Daily Independent*:—Messrs. J. Gordon, Q.C., and J. Fitzgerald Murphy (instructed by Messrs. Casey & Clay), represented the Tramway Company. Mr. Bonass, law agent to the Corporation, Mr. H. Campbell, town clerk, and Mr. S. Harty, borough surveyor, attended on behalf of the Corporation.

The accident of June 20th, when a standard was broken in Grafton Street, was first investigated.

Mr. J. W. Towle, electrical engineer to the Tramway Company, explained that the accident was caused by the trolley head catching in the wire and breaking the cast-iron base of the standard. The trolley head then in use was one of the oldest style they had. The company were replacing these trolley heads by others of a new design, that were so constructed that they would, as far as it was possible to do it, get rid of the projections that seemed to cause the accidents. A chain was used to prevent the trolley head from falling.

The Inspector considered the accident was a very obvious one.

Mr. Trotter next dealt with the accident that occurred at Talbot Street on July 30th, and which was caused by a passenger pulling the trolley rope in mistake for the bell rope. He (Mr. Trotter) had the evidence given at the police court before him, and he considered the matter was very clear.

Mr. Gordon pointed out that the bridge was very low at the point where the accident occurred, and at first the Corporation and the tramway company were not quite at one as to the best method of putting up the wires there. A change had now been made that would practically prevent the occurrence of accidents at the place in future—the span wires had now been done away with. The accident

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was really one of those which the company could hardly avoid. It was almost impossible to prevent a passenger from doing occasionally something that was wrong, not thinking, of course, that it was wrong. What actually caused the alarm and electrical flashes was that after the trolley head had come off, and one of the span wires had been broken, a second car coming from the opposite direction, tried to go through. The result was to intensify the accident which had already occurred. When the servants of the company became better acquainted with the working of the system these dangers would be eliminated. Some of the passengers were injured and taken to hospital, but had long ago been discharged. The injuries were not serious, and any claims made had been settled by the company. Counsel pointed out that the company were obliged to put up guard wires to prevent any injury being caused by telephone wires dropping on the electric wires. He was instructed that within a very short period a very large proportion of the telephone wires would be put underground, and to that extent the guard wires could be abolished. Mr. Parshall, who was an expert, considered it would be better to have the guard wires, where they existed, insulated, and then if they came in contact with the current, there would be no explosions. That would prevent the destruction of the wires, and also prevent people from being alarmed.

The Inspector: That is a very technical matter. I should like to discuss it with Mr. Parshall, and convince him of another view. I have the police reports and the newspaper cuttings here, and I see nothing there about the second car.

Mr. Gordon: It was the second car that really caused the flashes. The company are most anxious that everybody should know what exactly occurred. The company are now in a position to get rid of all the causes, as far as it is possible to get rid of them.

Dr. Chance, in reply to the Inspector, stated that about September 1st he examined the persons who were injured. They suffered mostly from mental shock. He believed there were some slight burns, but they were healed when he made the examination.

To Mr. Gordon: One of the men was a car driver, who was not in the tram at all. He drove the injured persons to the hospital, and went back and picked up another fare.

And afterwards got an electric shock?—Yes.

Mr. H. F. Parshall, electrical engineer, stated it was the first time in his experience that a passenger had mistaken the trolley rope for a bell rope. He believed the trolley could be so constructed as to prevent accidents in such a case. At present the trolleys were liable to jump the wire on various occasions. There should be stops on these trolleys, and already they were proceeding to put up these stops. Dealing with the slackness of the ropes, he thought it might be remedied by running them through a ring at the head of the standard, and then bringing them down by the side of the car. He should prefer that the conductors did not keep the trolley rope in hand coming round corners.

The Inspector said he was in favour of the abolition of guard wires altogether.

Mr. Bonass said Mr. Harty was anxious on behalf of the Corporation to give any information required, and also to make some observations about speed.

Mr. Gordon: I think the question of speed does not arise.

Mr. Harty: I think the question of speed does arise. I have returns here from the police, and the number of accidents really is astonishing—collisions with both cabs, cars, and people.

Mr. Gordon submitted that the matter of speed did not come within the inquiry. The company were carrying out the conditions laid down at the last inquiry with regard to speed.

The Inspector ruled that the question of speed was outside the scope of the inquiry.

Mr. Harty: We think the speed limits are vastly exceeded, and that there should be speed indicators on the cars.

Mr. Gordon: We don't admit that. We think we are keeping within the limits of the order.

Accidents of July 31st and August 6th were then dealt with. Mr. Towle stated that the former one, which occurred at the junction of Gardiner Street and Talbot Street, was caused by the trolley coming off the diagonal crossing wire, coming in contact with the guard wire, and pulling it against the trolley wire. The other accident occurred in College Green. The new trolley had got caught in the frog, and was pulled off. The trolley wheel was very deeply worn. It was after that accident the chain was introduced, and he believed that would prevent such accidents in future.

To Mr. Gordon: Stops are being put on now to prevent the trolley wire getting too high. I have endeavoured to arrange the stops so that the trolley would not reach the guard wire, but that would be a very difficult adjustment.

This concluded the inquiry.

At Dublin last week the case of the Pembroke Urban District Council *v.* the Dublin Southern District Tramway Company was listed on an application by the plaintiffs for an injunction to restrain the defendants from breaking up certain of the roadways in the Pembroke township for the purposes of their electric tramway contrary to the wishes of the road authority and to an agreement of May 20th, 1896, entered into between the parties. It was alleged that the defendant company had, for the purpose of laying down new conduit pipes for electric cables, improperly broken up the macadamised portion of the road between Merrion and Ballsbridge, instead of laying them down underneath the paved tram tracks. The tramway company contended that they were entitled to lay the new cables outside the tram tracks. Mr. Justice Kenny granted an adjournment for a week on the undertaking that the work complained of would not be proceeded with.

After the inquiry was closed, Mr. A. P. Trotter, inspector to the Board of Trade, inspected the most recently equipped lines of the Dublin United Tramways Company. Mr. Trotter, who was accompanied by the engineers and other principal officials of the company, expressed his complete satisfaction with the manner in which all the works connected with the establishment of the electrical service in the districts included in the latest development of the company's system have been carried out. Mr. Trotter also visited the new power station at Ringsend.

Holywell.—At a meeting held to consider the need for improved railway facilities, Mr. L. Barnes (of Sloan & Barnes, electrical engineers, Liverpool) attended to explain a proposed scheme for an electric railway from Holywell through Bagillt and Flint to Shotton, in order to get into communication with the Great Central Railway. Nothing was decided *re* same.

Huddersfield.—A section of the extension to the tramways was completed last week. The track (Crossland Moor Bottom to Pinfold Well) has been prepared for electric traction, although in the meantime steam cars are running over it.

Keighley.—The Town Council last week accepted the following recommendations submitted by the Gas Committee:—That the electricity works be built on the Low Bridge site; that an interview be arranged between the Electricity Committee and the Tramway Company's directors; and that the object of such interview be the purchase of the Tramway Company's undertaking.

Kingston.—The Town Council has resolved to apply to the Board of Trade for a provisional order for the construction and working of tramways in the borough.

Light Railways.—The Duke of Devonshire, on Tuesday, cut the first sod of a light railway which is to be constructed, under the provisions of the Light Railways Act, in North Staffordshire, by the North Staffordshire Railway Company. The line is not an electrical one, but the statements made by the Duke in proposing the toast of "The Leek, Caldon, Low, and Hartington Light Railways," are of interest to all who are in any way identified with the light railway development, for which there is such great scope in this country. He said that, compared with other railway undertakings, this was not a very big one, but nevertheless it was of very considerable interest to that district, and he hoped it would prove of very substantial advantage to it. There was every prospect of the work being shortly put in hand and brought to a speedy and successful completion. If they compared the conditions under which the small sum yet to be raised was asked for, with those under which appeals to the speculative public were generally made for railway enterprise, he could only express his astonishment that all the capitalists of London, Birmingham, and other large towns were not tumbling over each other to obtain this investment. He could only suppose that it was because it was so very small that they did not think it worth their attention. He had been looking at some railway statistics the other day, and as far as he could make out, railways in the United Kingdom had cost about £50,000 per mile to construct, and notwithstanding this enormous expenditure, they were, he was happy to say, earning a return of over 3½ per cent. on that expenditure. In this case they would have nearly 10 miles of railway for £35,000, or between £3,500 and £4,000 a mile. Nearly 30 per cent. of the capital had been presented to them by the Government. According to the statistics to which he had already referred, the railways in the United Kingdom were now earning £4,000 a mile, but in this modest undertaking they would be quite satisfied if they could earn £5 a week, or £260 a mile per annum, for a return to that extent would give the shareholders 5 per cent. for their money. He knew it was very idle to compare such vast things as the great railway system of the United Kingdom with their little undertaking; but, without going into comparisons such as those he had entered into, he believed the estimates of expenditure and traffic receipts would show the desired return. They were only founded upon the resources of the district as they at present existed, but he need hardly say that, in this case, and in a great many others, it was quite possible that the construction of a light railway would develop in the district resources at present dormant and unknown. They knew that in former times very valuable mines had been worked in close proximity to this line of railway, and he believed that it was not at all impossible that, with improved access to them, mining enterprise might again be opened in the district. At all events, it was quite certain that this line would give access to a most beautiful and picturesque district, and they all knew how great a source of profit to railways in recent years had been the tourist traffic which had been developed. He could not help thinking, therefore, that this line had a very good prospect before it.

Leeds.—A resolution was submitted to the City Council on Wednesday, authorising the Tramways Committee to take steps to equip on the overhead electric system the following tramways:—Vicar Lane, Beeston Hill, Elland Road, Whitehall Road, Wortley, Armley and Stanningley, Woodhouse Street and Victoria Road, Meanwood, Park Lane, Burley Street, and Cardigan Road, and Hunslet Carr.

A deputation from the Leeds Tramways Committee inspected the Springburn electric tram system, Glasgow, last week.

Lincoln.—The City Council, meeting in committee, has resolved to apply to Parliament for power to carry out one of the three schemes before it for providing electric tramways. The adopted scheme will give a line from the Burton Road to St. Mary's Square. A second line will begin near the race-course, and run eastward to the Arboretum.

Liverpool.—At Wednesday's Council meeting the Tramways Committee advised that application be made for a provisional order giving them the power to affix to any house or building brackets, electric conductors, wires, and apparatus, provided com-

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pensation is paid for any injury sustained. The Committee was also to ask for a supplementary grant of £65,000, and the approval of the tender of Messrs. Dick, Kerr & Co., of London, for the supply of 200 cars at £525 per car.

Last week an electric tramcar collided with a trap and threw out the occupant; another car collided with a lorry laden with flour, with serious results to both the car and the driver. Another day a car collided with a bus and threw the horses down. There must be something wrong somewhere, if the facts are as recorded.

A would-be suicide threw himself in front of an electric car in Park Road last week. The lifeguard was promptly brought into play, and the man was lifted out of harm's way practically uninjured. The brake was also promptly applied, and the man was taken from the guard three yards from the spot where he fell.

Llanelly.—It was reported at the meeting of the borough Council on Monday that the estate committee had two excellent schemes before them for lighting the town by electricity and laying down a system of electric cars, to take in the surrounding villages of Llwynhendy, Pwll and Felinfoel. The committee were expecting a third scheme in a few days, and they proposed to call in an expert to advise them as to the best of these.

London.—The Wandsworth Board of Works, which is, as a rule, not at all favourably disposed towards the London County Council in regard to tramway matters, has decided not to raise any objection to an application by the Council to the Board of Trade for a license permitting the experimental use of mechanical traction on the line between Westminster Bridge and Tooting.

Manchester.—The Tramway Committee recommends the Council to obtain borrowing powers for the electric tramway scheme as follows:—

£250,000 for the reconstruction of the permanent way,
£150,000 for the overhead equipment,
£360,000 for the purchase of 600 cars,
£90,000 for certain lands and the erection of a car shed in Queen's Road, and
£10,000 for other preliminary expenses.

The total amount required to date is £860,000, and this is but an instalment of the committee's ultimate requirements. At the next meeting of the City Council an important report will be presented by the Tramways Committee in the name of the Routes and Permanent Way Sub-committee. The report says that the advice of Mr. J. Kincaid confirmed the opinion of their own engineer that the whole of the permanent way required reconstructing. It recommends *inter alia* the borrowing of a quarter of a million sterling for that purpose, and advises that work be immediately commenced by the Corporation's own workmen reconstructing the Cheetham Hill lines, the Rochdale Road lines, and the Bury New Road lines, and constructing new lines in Queen's Road, giving access to the car shed. In regard to overhead equipment, the committee advised the use of poles on each side of the road with short arms (having bowstring suspension for the trolley wires), necessitating the adoption of the side-running trolley, as seen by them at Liverpool; in the streets which are too wide for this form of construction centre poles with bowstring suspension are advised, and Mr. Wordingham, the city electrical engineer, concurs. The committee is preparing plans and sections of a large number of proposed extension lines, with a view to Parliamentary powers being obtained during the next session. The new lines aggregate about 22 miles.

The Mersey Railway and Electricity.—The chairman (Mr. J. Falconer) of the Mersey Railway Company addressed his shareholders as follows last week *re* electric traction:—

"At the last half-yearly meeting it was explained that the board proposed to take the best advice they could obtain with reference to the traction which should be employed on the railway. The subject had been repeatedly under the consideration of the directors and of the receivers and managers; and they had had the assistance of electrical engineers. The board had hoped that they might have been enabled to present at that meeting an authoritative report on this question; but the working of such an undertaking as theirs by electricity was novel, and the step would be attended with such important consequences to them that he was sure the shareholders would recognise the necessity of the fullest consideration being given to the matter before any scheme was adopted. The directors had been impatiently pressing for progress on the part of their electrical engineers, but he could not say that those gentlemen had shown any undue delay, looking at the importance of the subject. The electrical engineers whose advice the directors proposed to take finally were Sir William Preece and Major Cardew, who had promised to submit their report soon As soon as possible after receiving it the directors would present to the shareholders their recommendations on the whole matter.

Oldham.—Last Thursday week the Surveyors and Tramways Committee had an important question before it in regard to the tram rail contract. It seems that an agreement had been entered into with a Barrow firm whereby the latter undertook to supply the Corporation with 25 miles of steel rails. The Corporation wanted rails for 25 miles of track, and understood the contract in that way. The company now contend that they only undertook to supply 25 miles of rail, or 12½ miles of track, at the price named. The price of steel, it seems, has gone up considerably since the contract was made, which means that the Corporation would have to pay considerably more if the contract, as they understood it, was not carried out. Some discussion followed but no decision was come to.

Paisley.—The proposals of Glasgow for taking over the working of the Paisley tramways not having come to fruition, the whole question, so far as Paisley is concerned, is still in solution, and the Council now have three alternative schemes for the improvement of their system. A Glasgow paper says that Glasgow's offer still holds, the course for municipalisation is open, and overtures of a practical nature have again been put forward on behalf of the British Electric Traction Company, Limited, whose previous offer was finally rejected at an inquiry by the Light Railways Commission a year ago. At the last monthly meeting of Paisley Town Council it was agreed that they were not in a position to reply definitely to the offer of Glasgow Corporation to hold to the agreement entered into between them last year, and a proposal to municipalise was rejected as being premature. It is anticipated that the whole question will be submitted to the ratepayers at the November elections.

Nottingham.—At Monday's meeting of the City Council the report recommending the overhead trolley for the tramway system was adopted. The course which matters have taken was explained by Alderman Brownsword, who proposed the adoption of the report in the following terms:—

Now he came to the joint report of the Committee, recommending the Council to authorise the starting of the laying down of the system of electric traction. The Council had already come to the conclusion that electric traction should be used, but there was some little doubt as to whether it should be the overhead or the conduit system. The Committee had two or three very pleasant little jaunts to several places to look at the kind of traction used there, and Mr. Brown and Mr. Talbot, the electrical engineers, had paid a visit to the United States of America to inspect the systems used there. Their report was presented to the Council at the last meeting, but he did not think the report received the amount of attention it should have done. Those two gentlemen and the Committee had come to the conclusion that overhead electric traction was the most suitable for the city of Nottingham. The underground system would do harm to the sewer pipes; and it was also not thought advisable to lay it down because of the bridges. There were other difficulties in the way of the underground system which it was felt did not apply to the overhead system, and, taking all the circumstances into consideration, the Committee unanimously agreed to recommend the Council to commence the overhead system of traction. The difference between the cost of electric traction and horse traction would at least double the net receipts from the undertaking—that was to say, where it cost 10d. per mile now to run the horse cars, the probability was that 6d. per mile would be the outside cost of the overhead electric traction system. If the present system, therefore, produced a profit of £12,350, the electric would produce £24,000. All the money would be wanted, however, to pay the sinking fund and relievable profit, but when the electric scheme was instituted they would carry a greatly increased number of passengers.

St. Helens.—The Electric Supply and Tramways Committee has decided to include in the proposed application for a provisional order the following additional tramways: Along Eccleston Street and Knowsley Road, from Lawrenson Street to Dunriding Lane; and from Westfield across Ormskirk Street to Cotham Street.

Seville.—The *Financial Times* says that the first main section of the electric tramways at Seville, which are the property of the Seville Tramways Company, Limited, has now been opened to traffic. The conversion of the tramways to the electric system, and the extension of the lines, have been carried out by the General Electricity Company, of Berlin, which constructed the electric lighting station at Seville, from which the current for the working of the tramways is supplied. It is stated that although owned by the Seville Tramways Company, the undertaking has been financed by the General Electricity Company and the Zurich Bank for Electrical Enterprises.

Sheffield.—An electric car on the Walkley section collided with a two-horse carriage on 28th ult. Both were slightly damaged. The Pittsmoor section of the municipal electric tram system was opened last week. The first car ran for public service on 27th ult. The Board of Trade inspector, Mr. Trotter, went over the line the previous day and passed it.

South Shields.—A public meeting has been held in support of a movement for the Corporation taking over the working of the tramway system.

Southampton.—The Tramways Committee will not include any of the extension works outside the borough in its application for a provisional order, but will defer these matters for the present. The town clerk is to confer with the electrical engineer for arranging the necessary plans, &c., for deposit with the Board of Trade in connection with the order.

Spen Valley.—On Monday the Liversedge District Council considered the correspondence which had passed between the clerk and the solicitor to the British Electric Traction Company with reference to a suggestion that the company were not bound to construct the local branch lines promised to the Council during the negotiations preceding the inquiry at Dewsbury, and referred to in an agreement between the Council and the company. The company's solicitor said that the necessary steps were being taken for the promotion of the lines mentioned. His clients were not promoters in the ordinary sense, but investors seeking suitable outlets for their capital, and, therefore, they only promoted lines with the intention of constructing and working them at the earliest possible opportunity. The probability was, moreover, that the company would carry out a much larger scheme than that passed by the Commissioners and referred to in the agreement.

Staffordshire.—A Wolverhampton paper says that under an arrangement arrived at between the South Staffordshire and British Electric Traction Companies, Tipton, Wednesbury, and West Bromwich will soon be linked to Dudley in the system of electric tramways that are so revolutionising the Dudley district.

Tipton.—The Urban District Council Tramway Committee last week reported that representatives of the South Staffordshire Tramway Company and of the British Electric Traction Company had waited upon the committee in reference to the tramways question. It was then stated that an arrangement had been come to for the formation of a new company, three of the directors of which would be from the South Staffordshire Company and three from the British Electric Traction Company. If the Council did not avail themselves of this opportunity of purchasing the lines three years hence, the company proposed to enter upon a

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lease of 21 years' duration from 1902. Electric traction on the overhead system would be adopted. The proposals should be considered by a committee of the whole Council.

Traffic Regulations.—The bye-laws and regulations made by the Oldham, Ashton and Hyde Electric Tramways, Limited, are printed in the *London Gazette* for September 29th.

Warrington.—The Warrington Corporation has received an application from the Ormskirk and Southport Electric Light Railway Company, asking for the support of the Corporation in their application to the Light Railway Commissioners to construct light railways outside the borough and tramways inside the borough. The General Purposes Committee report that while the Committee are willing to give support to the construction of a light railway from the borough to Lymm and Knutsford, they cannot recommend the Council to entertain the proposal of the company to construct tramways within the borough.

Wigan.—The Tramway Committee will not entertain the purchase of the Wigan tramways at the price named by the tramway company. They recommend that application be made for a provisional order authorising the Corporation to construct certain additional tramways. The engineer was instructed to prepare plans for the proposed tramways to Maitland Mill Bridge. The electrical engineer was also instructed to prepare estimates for the electrical equipment of the line.

TELEGRAPH AND TELEPHONE NOTES.

The Amazon Cable.—The *Electrical World* says that the Amazon Telegraph Company, Limited, is stated to have decided to abandon the cable in the Amazon River from Para to Manaos. They are, however, building a landline with some links of cable, and have issued bonds for $600,000 at 5 per cent. A subsidy of $85,625 a year for 12 years was granted to the company by the Brazilian Government.

The American Cableship "Hooker."—The New York *Electrical Review* says that the United States War Department has learned that the United States cableship *Hooker* (described in this journal on May 12th, 1899), which recently ran aground on Corregidor Island, in Manila Bay, and was considered a total loss, may be saved. She had material for a submarine cable on board, and it was intended to use her in connecting all the important islands of the Philippine group by telegraph. General Otis reports that arrangements have been made for getting the *Hooker* off the rocks and taking her to Cavité arsenal, where she will receive repairs sufficient to permit her to go to Hong Kong to be thoroughly overhauled and put in first-class condition.

The Pacific Cable.—The *Times* correspondent at Ottawa says that the Earl of Aberdeen and Lord Strathcona have been invited to act as representatives of Canada on the Board of Control of the Pacific Cable. Sir S. Fleming in a letter to the Press on cable matters, advocates the acceptance by Australia of the offer of the Eastern Extension Company to lay a cable from Cape Colony to Australia, but with the condition that the Australasian Colonies may purchase the line at a fair valuation when they so desire.

Railway Telegraph Clerks.—A meeting of the Railway Telegraph Clerks' Association was held at Chester on Saturday, to protest against the action of the London and North-Western Railway directorate in declining to entertain the memorial presented last June, asking for an increase of salary and a few minor concessions, all of which had been refused. It is stated that in the service of the London and North-Western Railway there are 104 telegraphists with over 15 years' service, 52 with over 20 years, and 21 with over 25 years respectively, and the maximum salary (£80) is identical in each case.

Telegraph Congress.—The first annual congress of postal and telegraph officials opened at Derby last week. There were present 134 delegates from all parts of the United Kingdom, representing the various sectional associations connected with the service.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa...	April 4th, 1898 ...	...
Latakia-Cyprus	June 20th, 1899 ...	...
Corea-Japan	August 7th, 1899 ...	...
Jamaica-Colon	June 30th, 1899 ...	...
Landlines.		
Lines from Haiti to Gonaives, Gros Morne, Port de Paix Plaisance, Cape Haitien, Port au Prince to Miribalais and Jacmel	August 18th, 1899 ...	...

Telephone Conduits in Bermondsey.—The General Purposes Committee informed the Vestry at the meeting on Monday that the Postmaster-General desired to take up certain carriageways and footpaths in the parish for the purpose of laying conduits with multiple ducts or cast-iron pipes, and to construct manholes at intervals of about 150 yards. It was unanimously decided to give permission for the work to be carried out.

The Telephone Service.—We are authorised to announce that the board of the National Telephone Company has come to a decision respecting rates for telephone exchange service, elsewhere than in London, which will be received with widespread interest. It has been charged against the company that its present rates are prohibitive to people in a small way of business, who need to be on the system for the purpose of being accessible to their customers and others, but who do not otherwise require to make a large use of the service. The system which the company has hitherto adopted of charging all alike, whether they make great or small use of the service, does undoubtedly place the small user at a disadvantage. The Select Committee of the House of Commons which sat on the telephone question in the session of 1898, reported that whilst the company's present charges are reasonable in amount for those who make a large use of the service, they are unduly high for small users, and have, as a consequence, operated to retard the development of the telephone in this country. The Committee also expressed the view that the rates ought to be based upon the amount of use which each subscriber makes of the service. The directors of the National Telephone Company now propose that any subscriber shall have the option of taking at the existing rates an unlimited service—that is to say, a service without limitation as to the number of calls which he may make—or of paying an annual sum of £3 10s. (that is, £3 3s., the company's installation charge, and 7s. Government duty), which will confer the right of being called up, and the sum of 1d. each time he initiates a conversation. This fee of 1d. per call, which also includes the Government duty of 10 per cent., will give the subscriber the right to converse with all other subscribers on the same exchange as himself, or on such number of exchanges as may be grouped together to meet the requirements of local circumstances. It is also proposed to issue call office signs freely to shopkeepers and others who may join the system on the new terms, and it is anticipated that many will take advantage of the arrangement, as it will tend to attract customers. The opening of a large number of call offices from which messages can be sent for a small fee, should prove of material benefit to the general public. We understand that the proposed rates will be brought into operation on and from January 1st next, and that in the meantime full particulars will be advertised in the local press throughout the country. In view of the fact that the Government has decided to set up, by the Post Office, a telephone system in London, in competition with that of the company, the directors of the company are unable at present to deal with the question of the London rates.

The St. Luke's Vestry on Tuesday, on a second application from the Postmaster-General, decided to grant permission for the laying of telephone mains in certain roads in the parish.

Wireless Telegraphy.—The *Scientific American* says that "the *New York Herald* has made arrangements for the exclusive use of the Marconi system of wireless telegraphy for reporting America's cup races off Sandy Hook. Signor Marconi and four assistants have sailed from Liverpool with all the necessary instruments for use in reporting the races, and the work will be done under the personal supervision of Marconi and his assistants. The instruments will be placed on the *Grande Duchesse*, of the Plant line, upon the upper deck of which a tall pole, extending 60 feet in the air above the water line, will be placed, and a running account of the races will be telegraphed by Marconi and his assistants. On board the cable ship anchored near Scotland light a similar pole will be erected, and here two expert operators will be stationed to receive the message after it has been transmitted from the *Grande Duchesse*. From the cable ship the message will be transmitted by means of submarine and land wires. The steamer *Ponce* will also be equipped with wireless telegraphy apparatus, the system of Mr. W. J. Clarke being used. Rear-Admiral Bradford, chief of the Bureau of Equipment of the Navy Department, has been informed that Signor Marconi will go to Washington to discuss with him the proposed experiments with wireless telegraphy. Admiral Bradford will recommend that one of the vessels of the navy be set aside for experimental work. It is proposed to place the receiver on shore, and the warship will communicate with it from varying distances. By this means it is believed the system will be developed and the value of it will be definitely determined. It is stated that Signor Marconi has been approached with a view to experiments being made in wireless telegraphy between Canada and Newfoundland, and also between Nova Scotia and Cable Island."

CONTRACTS OPEN AND CLOSED.

OPEN.

Barking Town.—October 24th. The District Council wants tenders for boilers, pipe work, two 100-kw. steam dynamos, switchboard, motor and trailer cars, trucks and electrical equipment, overhead equipment, underground feeders, conduits, road work, &c., for the Barking and Beckton light railways. See "Official Notices" September 1st.

Darwen.—October 25th. The Corporation wants tenders for poles and overhead electrical equipment, also main feeder cables, for electric traction. See "Official Notices" this week.

France.—October 10th.—Tenders are being invited by the French Post and Telegraph Authorities, in Paris, for a quantity of telephone cable, and also of telephone insulated wire. Tenders to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, 103, Rue de Grenelle, Paris, whence particulars may be obtained.

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France.—October 19th. The French Post and Telegraph Authorities in Paris are inviting tenders until the 19th inst. for the supply of 600 tons of copper wire in 12 lots. Particulars may be obtained from, and tenders are to be sent to, Le Sous Secretariat d'Etat des Postes et Telegraphes, 103, Rue de Grenelle, Paris.

Germany.—October 16th. Tenders are being invited by the municipal lighting and tramway authorities of Königsberg, Prussia, until October 16th, for the supply of six boilers required in connection with the extension of the electric power station, to supply steam to new engines aggregating 1,800 E.H.P. Tenders to be sent to Die Direction der Städt, Beleuchtungswerke und der Electr. Strassenbahnen Kaiserstrasse 41, Königsberg, Prussia, whence particulars may be obtained for 1s.

Germany.—October 21st. Tenders are being invited until the 21st inst. by the municipal authorities for the supply of a 1,000-H.P. steam engine and multiphase dynamo at the local central station. Tenders are to be sent to Die Städtisches Electricitäts-Werke, 29, Silberstrasse, Dortmund, whence particulars may be obtained for 2s.

Glasgow.—October 10th. In connection with the tramway scheme the Corporation wants tenders for switchboards, fuel economisers, two 50 and one 30-ton electric travellers, power station steel work, and cables. See "Official Notices" September 8th.

Glasgow.—October 10th. The Corporation wants tenders for the reconstruction of tramways according to specification. See "Official Notices" September 23rd.

Great Western Railway.—October 23rd. The Great Western Railway directors want tenders for the supply of 12 months' stores including electric light and telegraph sundries. See our "Official Notices" this week.

Huddersfield.—October 13th. The Corporation is now advertising for tenders for the erection of tramway generating station, car shed, &c., at Longroyd Bridge.

Islington.—October 25th. The Vestry wants tenders for a secondary battery of 60 cells (1,000 ampere-hours capacity). See "Official Notices" this week.

Leeds.—October 11th. Tenders are required for the installation of electric light and electric bells, at the Cookridge Street Baths. Particulars may be obtained at the office of Messrs Walter Hanstock & Son, Britannia Buildings, Oxford Place, Leeds. Tenders to be delivered at the office of Mr. W. J. Jeeves. Town Clerk.

Leeds.—October 11th. The Board of Guardians is inviting tenders for the supplying and fixing of a system of telephones and alarm bells at the workhouse, Beckett Street, Leeds. Specifications and plans have been prepared by Messrs. Shepherd & Watney, consulting engineers, Greek Street Chambers, Greek Street, Leeds, (copies may be had on payment of £1 1s., returnable on the usual conditions). Tenders to be delivered to Mr. James H. Ford, Clerk, Poor Law Offices, East Parade, Leeds.

Leeds.—October 18th. The Council wants tenders for 50 electric tramcars. See "Official Notices" September 23rd.

Leeds.—The Council requires tenders for 50 electric tramcars. Particulars, &c., may be had on application to Thomas Newson Esq, M.I.C.E., city engineer, Municipal Buildings, Leeds. Tenders must be to hand not later than noon, October 18th.

London.—October 23rd. The Post Office is inviting tenders for Swedish, Norwegian, or Finland red fir telegraph poles, and for creosoting them with 10 or 12 lbs. of creosote to the cubic foot. Particulars, &c., from Mr. C. E. Stuart, controller of stores, G.P.O., London.

Peterborough.—October 19th. Tenders for the erection of electric generating station for the Corporation are now being invited.

Poplar.—The Guardians want tenders for Lancashire boilers, water-pressure drums and tanks, steam jet plant (ejector condensers, injectors, and jet pumps), also auxiliary pumping plant. The work is divided into several sections and copies of the conditions, &c., for each may be obtained from the consulting engineer to the Guardians, Mr. F. J. Warden-Stevens.

Rotherham.—October 9th. The Corporation is wanting tenders for Lancashire boilers, engines, dynamos, pumps, condensing plant, crane, economiser, battery, switchboard, boosters, feeders, mains, roadwork, &c., for electric lighting. Specifications from the Town Clerk on payment of £1 1s. for each of five specifications. The consulting engineer is Prof. A. B. W. Kennedy, at whose offices specifications may be seen. See "Official Notices" September 8th.

Salford.—October 17th. The Corporation is inviting tenders for about 500 central and 100 side-arm or span-wire steel tramway poles. Tenders, with drawings, to the town clerk (*pro. tem.*) Mr. L. O. Evans, Town Hall.

Spain.—November 7th. The Spanish Ministry of Public Works in Madrid is inviting tenders, until November 7th, for the concession for the construction and operation of an electric tramway in the town of Cadiz. Particulars may be obtained from, and tenders are to be sent to, La Direccion General des Obras Ribleas, Madrid.

Swansea.—October 9th. The Corporation wants tenders for medium speed vertical engines, continuous current generators, booster and balancer. See "Official Notices" September 23rd.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

Warsaw.—The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul-General at Warsaw, stating that tenders are invited by the municipality of that city for the construction of freezing chambers and electric lighting in the covered market halls. The latest date by which the tenders have to be sent in has not yet been fixed. Such particulars as have been received may be examined at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

Wigan.—October 25th. The Corporation wants tenders for feeders, mains, water-tube boilers, superheaters, stoneware conduits, steam dynamos, boosters, motor balancers, battery, inspection boxes, &c. See "Official Notices" September 29th.

CLOSED.

Enfield.—The tender of Messrs. Stanley, Davis & Pollard for electric lighting work at the Alma Road waterworks has been accepted by the Urban Council at £159.

Hull.—The Electric Light Committee has accepted the tender of Messrs. Bannister & Co. for Hickleton Main coal for the Sculcoates Lane station at 15s. 2d. per ton. The tender of Messrs. Ream, Wokes & Co. for the wiring of the Sculcoates Lane lighting station was also accepted at £83.

Lancaster.—The Council has accepted the tender of Messrs. Mather & Platt, Limited, for a balancer at £350 and a switchboard at £65 for the electricity works.

Llandilo.—The *Contract Journal* says that the following tenders were submitted for lighting the town by electricity for the Urban District Council:—

Kite & Co., London	£8,935
A. Bayley, London	8,820
Crompton & Co., London	8,007
Fletcher, Cardiff	2,440
B. Thomas, Manchester	2,201
D. Isaac, Maindingham	2,200

London.—The Shoreditch Vestry on Tuesday considered the following tenders for the supply of 1 mile of ·25 low tension lead-covered cable:—

The British Insulated Wire Company (accepted)	£968
W. T. Glover & Co.	870
Henley's Telegraph Works Company	876

The Vestry also considered tenders from the undernoted firms for the supply of a 2-H.P. electric motor:—

	£	s.	d.
Brush Electrical Engineering Company (accepted)	47	10	0
General Electric Company	55	0	0
Electric Construction Company	59	0	0

Salford.—The Electric Light Committee of the Town Council on Wednesday recommended the acceptance of the tender of Messrs. Mather & Platt, Limited, for steam dynamos, with Browett Lindley engines, required for the Strawberry Road station, for the sum of £72,000, subject to certain conditions, and that application be made to the Local Government Board for sanction to borrow the requisite amount of money for the buildings and plant for the new low pressure generating station in Strawberry Road.

Southampton.—The Council has adopted the recommendation to accept the tender of Mr. F. Osman for the reconstruction of tramways between the Southampton Docks Station and Portswood. The following is a list of the tenders sent in:—Mr. F. Osman, £16,883; Mr. William Griffiths (London), £18,213 18s. 9d.; Messrs. A. Krauss & Son (Bristol), £20,200; Mr. Peter Smith (Manchester), £21,562 12s.

NOTES.

Opaline Lamps.—We are sorry that through a misunderstanding wrong prices have been given in the advertisement on page xxx. for the new "Opaline" lamp, manufactured by the Improved Glow Lamp Company, Limited. The prices should be 1s. 9d. for the 50 to 120 volts, and 2s. 3d. for the 200—250 volts, less usual discount.

Marriage.—Mr. J. C. Wigham, the well-known engineer to Edmundson's Electricity Corporation, Limited, was married on 27th ult. to Miss Lucy Kathleen Brown, of Saintsbridge, at the Friends' Meeting House at Gloucester.

Appointment Vacant.—The Poplar District Board of Works want a chief distributing assistant for the electricity department, at £156 per annum. See "Official Notices" this week.

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Junior Electrical Engineers.—A new society, known as the Junior Electrical Engineers' Society, held its first annual general meeting at Manchester on Tuesday last week, when the following gentlemen were elected as officers for the session 1899-1900:—President, W. W. Haldane Gee; secretary, H. Rust; treasurer, A. Joannidi; librarian, J. G. Bagot; committee, Messrs. S. Payne, A. Blackburn, D. G. Nye, H. T. Wilkinson, A. Rothwell, and S. Utting. A set of rules were drawn up, and will shortly be printed for distribution amongst the members. The next meeting of the Society will be held on Tuesday, October 31st, when a paper will be read by Mr. S. Payne on "Steam Condensers as Applied to Electrical Engineering." Candidates for admission to the Society should make application to the honorary secretary, 13, Harcourt Street, Gorse Hill, Stretford.

The Sunderland Tenders.—The following reaches us from a correspondent:—"Last month the Sunderland Electric Lighting Committee asked for tenders for three 250-KW. steam dynamos complete with surface condensers, cooling tower, &c. The work has been given to the Sunderland Forge and Engineering Company, but the list of tenders has not been published, as is usual in these public contracts; in fact, we understand that the Council have made a special order that they shall not be published. Surely those firms who have gone to very considerable expense in quoting should be furnished with a list of the tenders, even if the information is not published in the technical press. We think, however, that in order to prevent any suspicion of jobbery, it is essential that the results of tenders should have publicity. Only by this means can the methods of our municipalities remain clean and above-board. Of course, it is natural that preference should be given to a local firm, but if a Corporation put outside firms to the trouble of tendering, then it is only fair that in adjudicating, local influence should be kept in the background—at any rate, let us have the results of the tenders published."

The Electric Lighting of Churches.—Chancellor Espin, at the Liverpool Consistory Court, ruled last week that the incumbent, churchwardens, &c., of a church have not legal power to substitute one method of illumination for another without having obtained a faculty for the alteration. The Chancellor proceeded to show that the hardship was not so great as some might imagine, because many matters might be covered in one faculty. The matter arose at the Liverpool Court on the statement of Archdeacon Madden, that in recent years about half-a-dozen churches in the diocese had substituted electricity for gas lighting, without thinking of the faculty question.

Pneumatic Despatch Tubes.—At a meeting of the Langbourn Ward Club on Wednesday evening, October 4th, at the London Tavern, Fenchurch Street, E.C., papers were read by Mr. Geo. Threlfall, M.I.Mar.Eng., M.I.M.Eng., and Prof. Carus-Wilson, M.I.E.E., &c., "On the Resuscitation, after Thirty Years' Disuse, and the Electrical Equipment of the old underground Pneumatic Despatch Tube between Euston Station and the General Post Office—a distance of 2¼ miles." Mr. Threlfall dealt with the commercial aspect and importance of the re-equipment and extensions of the tube, and Prof. Wilson with the electrical view of the matter, with other details of interest.

The City Company's Continuous Current Service.—We hear that at the present time the City of London Electric Lighting Company is supplying continuous current within the central streets of the City for motors equivalent to 200 H.P., and by the end of the year the company will have three 1,000-KW. continuous current sets running.

Lectures.—At 8.30 p.m. on Monday, October 9th, Prof. C. A. Carus-Wilson, B.A., will commence a course of 10 weekly lectures on "The Direct Current Motor," at the South-Western Polytechnic, Chelsea. The fee for the course is 5s. See our "Educational Notices" this week.

On Tuesday evening, October 3rd, a lecture on "Electricity as a Motive Power for Printing Machinery," was delivered by Mr. H. Scholey before the Printers' Managers and Overseers Association, at the Albion Hotel, Ludgate Circus, E.C. The lecture was illustrated by limelight views.

Personal.—We understand that Messrs. T. O. Mullings and F. H. Wilson, of Messrs. Crompton, have been appointed electrical engineers to the Mansourah Electric Lighting Company, Egypt. They sail to-day (Friday) by P. & O. *India*.

Class Experiment Showing How the Resistance of Carbon Falls with Rise of Temperature.—Mr. J. J. Kavanagh, S.J., of St. Mary's College, Montreal, writes to the *Scientific American* as follows:—"I am in the habit of giving an illustration of the decrease of resistance in carbon with increase of temperature, which commends itself by reason of its effectiveness and simplicity. In a 110-volt circuit, I introduce a piece of charcoal some 4 or 5 inches long. The spark produced upon short circuiting this stick at one of the contacts ignites the charcoal there. Then I slowly draw the short-circuiting wire from the ignited point zigzag along the surface to the end. The glow follows the wire and is maintained. Thus the current keeps to the path it has 'blazed' for itself throughout all the 15 or 16 inches of meandering, preferring the road that is hot, though long, to the short but uninviting chilliness of the straight line."

Therapeutic Properties of Alternating Currents.—At the recent Congress of the French Association for the Advancement of Science at Boulogne, a paper on "The Undulatory Alternating Current: Its Therapeutic Properties," was contributed by Drs. G. Gautier and J. Larat. The authors said that the alternating current may be represented as a function of time by a sinusoidal curve characterised by its effective intensity and its frequency. What specially characterised this current is really the progressive manner in which it increases and decreases. This is its characteristic quality, and the one to which must be attributed the special physiological and therapeutic effects observed in connection with it. In 1895, taking as their basis the experiments of Prof. d'Arsonval, the authors conceived the idea of applying this current to the entire service of the body by means of the hydro-electric bath. Their results, subsequently published, have met with no contradiction. They now draw attention to the comparison which they have been making for five years between the therapeutic action of these currents and that of alternating currents of high frequency. It is true that in certain local affections the current of high frequency obtained by means of the Oudin resonator is an excellent therapeutic instrument, but as far as general effects are concerned, they think that the opinions expressed affirming the superiority of high frequencies, especially in diseases of an arthritic nature, have been somewhat premature. A long experience leads them to believe, at any rate at present, that the superiority of high frequencies over the ordinary alternating current does not exist.

Indian Electric Power Scheme.—Reuter's agent at Bombay telegraphs that, in connection with the scheme for utilising the power of the Kaveri Falls, the Mysore Government has offered to supply mining companies on the Kolar goldfields with electric power free of charge for one year. This means a saving of £360,000. The cost of the scheme is roughly estimated at 24 lakhs of rupees.

Electric Power of the Rhone.—We read in a New York exchange that, though but partly completed, the plant of the Société Lyonaise de Force Motrice du Rhone has now 504 contracts for power, amounting to 2,465 H.P., and 834 contracts for current for lighting, equivalent to 36,266 10-C.P. lamps. Of the above 1,303 H.P. and 21,810 lamps are now being supplied.

Tests of a Three-Phase Railway.—We understand that Prof. Carus-Wilson has been making a series of tests of the three-phase equipment on the Burgdorf-Thun Railway, assisted by engineers representing the railway company and Messrs. Brown, Boveri & Co., who installed the electrical apparatus. The special object of the tests was to determine the behaviour of the three-phase motors during the process of acceleration.

Will.—The will of Sir Edward Frankland, K.C.B., F.R.S., &c., who died on August 9th, has been proved, and the estate is sworn at £138,627 3s. 11d., of which £126,471 10s. 6d. is net personalty.

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Aluminium for Electric Railway Work.—"R. A.," of Cleveland, Ohio, writes to our New York namesake regarding the employment of aluminium for electrical conductors. He says that on the inter-urban road, which is being built between Kansas City and Leavenworth they are using 76 miles of 350,000 circular mils. aluminium cable, purchased from the general manager of the Pittsburg Reduction Company. The field for aluminium has appealed to "R. A." so strongly that he is now devoting himself to the sale of aluminium wire for electrical conductors.

Electrical Treatment for Lead-Poisoning Cases.—The *Daily Chronicle* in a brief article says that the electrical bath treatment to which a number of lead-poisoned patients have been subjected at Wolverhampton is showing exceedingly satisfactory results. In several cases the improvement in the condition of the patients has been very marked.

J. Bowman Lindsay.—The *Pall Mall Gazette* says that a bust of James Bowman Lindsay, whose work in wireless telegraphy is now pretty well known, is to be placed in the Victoria Art Galleries, Dundee. The cost is to be borne by Lord Provost M'Grady. It is also proposed to erect a monument in Dundee by public subscription.

CITY NOTES.

Tunbridge Wells Corporation Electricity Accounts.

Public lighting and private supply.

Tunbridge Wells Corporation has, in its electricity supply business, a progressive undertaking, and the engineer, Mr. Boot, deserves to be well treated at its hands. From the borough accountant's report we extract the following figures, showing the percentage increase for last year over the previous year:—

Increase. Consumers.	Increase. Revenue.	Increase. Expenditure.	Increase. Gross profit.	Increase. Net profit.
25 per cent.	27 per cent.	23 per cent.	30 per cent.	34 per cent.

These figures show that the reductions in price of electrical energy so strongly urged by Mr. Boot, are appreciated, and it is rather a matter of regret that the Council are so strongly in favour to handing over nearly a thousand pounds to the rates, despite the arguments against treating the department as a profit-yielding business. One penny on the rateable value of the borough may sound very pleasant to the ears of the ratepayers, but, with the engineer of the Corporation, many would regard it as better finance to create a reserve fund and materially reduce the price charged. Another feature of the report that strikes the outsider is the meagre street lighting. Some 60 arcs is a small advertisement for a resort of the standing of Tunbridge Wells. There seems to be some inexplicable dislike to arc lighting on the part of some members of the Council, who would probably change their opinions were they to take a trip and see how arc lighting is going ahead, while, near at hand, Brighton is an example which ought to carry conviction.

The small total capital expenditure is one of the features of the accounts, the general particulars of which may be summarised thus:—

General Statement.

	1897.	1898.	Increase.
Total capital expenditure ...	£31,275	£37,818	£6,543
Number of units sold	258,641	334,709	76,068
Number of lamps connected ...	18,044	24,000	5,956
Gross revenue	£5,822	£7,381	£1,559
Gross profit	£3,049	£3,895	£846
Average price per unit sold ...	5·21d.	5·12d.	—·09d.

The sale of current for public lighting (after deducting from the gross amount received, the expenditure for attendance, carbons, and repairs) is not by any means charged at an exorbitant rate, the amount received per unit being 2·33d. in 1897, and slightly over 2¼d. in 1898, while the average price for private lighting only was little more than 5½d.

Revenue Statement.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current	£5,620	5·21d.	£7,138	5·12d.	—·09d.
Meter rents	170	·16d.	209	·15d.	—·01d.
Supply of ashes, &c. ..	20	·02d.	8	...	—·02d.
Sundry	12	·01d.	26	·02d.	+·01d.
Gross revenue ...	£5,822	5·40d.	£7,381	5·29d.	— 11d.

The net profit in 1897 was £1,635, and in 1698 £2,172, after paying interest at 3 per cent. and redemption at about the same rate. These figures seem to have attracted the attention of the Finance Committee, as the proposal was actually made to make a charge of £250 for rent of offices and services rendered by the town clerk's and borough accountant's departments. The price in 1898 was 6d. per unit for the first two hours daily and 3d. per unit after. This has been modified by dropping the second hour to 3d.

Costs of Production.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal and other fuel	£1,386	1·29d.	£1,351	·97d.	—·32d.
Oil, waste, water and engine room stores.	141	·13d.	146	·11d.	— 02d.
Salaries and wages incurred in generation and distribution.	525	·49d.	632	·45d.	— 04d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	100	·09d.	155	·11d.	+ 02d.
Works' cost ...	£2,152	2·00d.	£2,284	1·64d.	—·36d.
Rent, rates, and taxes ..	127	·12d.	213	·15d.	+ 03d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	351	·32d.	814	·58d.	+·26d.
General establishment charges, stationery and printing, law charges and insurance.	121	·11d.	175	·18d.	+·02d.
Other expenses	22	02d.	...	...	— 02d.
Total costs ...	£2,773	2·57d.	£3,486	2·50d.	— 07d.

We are glad to see the item for coal so largely reduced on a comparatively small output, and also to note that salaries shows a tendency to increase. If we mistake not, Tunbridge Wells once expected to get assistant engineers at the rate of £50 per annum. As Mr. Boot stated in his 1897 report, "it is only just to our men that they should share in our good fortune." In dealing with the accounts, it may be noticed, however, that only a portion of the chief engineer's salary is shown under "Management expenses" in 1897, whereas it is all charged under this heading in 1898.

Profit Statement.

	1897.	1898.
Interest on loans	£742	£890
Sinking fund for repayments	672	833
Net profit, carried to credit of rates	900	900
„ being surplus	735	130
„ expended in increasing pressure, demand indicators, &c.	...	1,142
Gross profit	£3,049	£3,895

Halifax and Bermudas Cable Company, Limited.

The following report was unanimously passed by the shareholders at the meeting held on September 28th, at 33, Old Broad Street, E.C.:—"The directors beg to submit to the shareholders duly audited statements of account for the year ending June 30th, 1899. In the earlier part of the year the receipts were greatly augmented by the Spanish-American war, and subsequently the company's revenue was favourably affected by the interruption of other routes. On the other hand, some loss has resulted from the reduction in August, 1898, of the charge for messages between Halifax and Bermuda from 3s. per word to 1s. 6d. The net result of the year's working is a profit of £10,141 19s. 10d., as compared with £6,655 0s. 8d. for the previous year. An interim dividend of 2½ per cent. has already been paid, and it is now proposed to make a further equal payment, which will together absorb £2,500, and leave £7,641 19s. 10d. to be carried forward. This will increase the amount to the credit of revenue account to £11,797 0s. 6d. The directors regret to have to report that, so far as the new year has gone, there is shown a serious falling off in the receipts, chiefly as the result of the discontinuance of the special aids to revenue described above, and partly to interruption of connecting lines beyond Jamaica. In the nine weeks from July 1st to September 2nd, the reduction in traffic receipts is as much as £4,510. The company's own cable has worked with complete efficiency. Offers for the sale of debentures to the trustees were invited in December and June last, and £4,988 15s. 2d. was paid for £5,000 of debentures, which amount has been written off capital expenditure. Mr. T. G. H. Glynn and Mr. Thomas Skinner retire on this occasion, and, being eligible, offer themselves for re-election. The auditors, Messrs. Gribbon, Holroyd and West, retire, and offer themselves for re-election.

Direct West India Cable Company, Limited.

The following report was unanimously passed by the shareholders at the meeting held on September 28th, at 33, Old Broad Street, E.C.:—"The directors beg to submit to the shareholders duly audited statements of account to June 30th, 1899. The receipts of the company were abnormally increased in the early part of the year by the Spanish-American war, and subsequently by interruptions to other routes. The net result is a profit of £19,186 1s. 1d. An interim

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dividend of 2½ per cent. has already been paid, absorbing £750, and it is now proposed to make a further equal distribution, which will leave £17,686 1s. 1d. to be carried forward, thereby increasing the amount to the credit of revenue account to £21,490 16s. 10d. Since the close of the company's financial year, a most important falling off in the traffic receipts has taken place. Not only have the exceptional sources of traffic referred to above been discontinued, but interruptions to connecting lines beyond Jamaica deprived the company of through traffic for the time being. In the nine weeks from July 1st to September 2nd, there is a falling off, as compared with last year, of as much as £14,156. The company's own cables have worked with complete efficiency. Mr. C. R. Hosmer and Mr. Thomas Skinner retire on this occasion, and, being eligible, offer themselves for re-election. Messrs. Gribbon, Holroyd and West, the auditors, retire, and offer themselves for re-election.

Stock Exchange Notices.—Applications have been made to the Stock Exchange Committee to appoint a special settling day in and to grant a quotation to:—Electric Lighting and Traction Company of Australia, Limited, 20,000 6 per cent. cumulative preference shares of £5 each; Thames Ironworks Shipbuilding and Engineering Company, Limited, 300,000 5 per cent. cumulative preference shares of £1 each, and £200,000 4 per cent. irredeemable first mortgage debentures; and to allow the following securities to be quoted in the Official List:—Aluminium Company, Limited, 5,000 shares of £1 each, fully paid, Nos. 60,001 to 65,000; Edmundson's Electricity Corporation, Limited, 8,700 vendors' ordinary shares of £5 each, fully paid, Nos. 17,408 to 26,107. The Committee have appointed special settling days as under:—Thursday, October 12 h.—Giffre Electro-Chemical and Power Company, Limited—110,000 £1 shares, fully paid, Nos. 20,001 to 130,000. Nernst Electric Light, Limited—115,000 7 per cent. cumulative preference shares of £1 each, fully paid, Nos. 1 to 115,000. The Giffre Company's securities are also to be quoted in the Official List.

Anglo-American Telegraph Company, Limited.—The directors have resolved, after placing £6,000 to the credit of the renewal fund, to declare an interim dividend for the quarter ending September 30th, 1899, of 15s. per cent. on the ordinary stock, and £1 10s. per cent. on the preferred stock, less income-tax, payable on November 1st, to the stockholders registered on the books of the company on September 30th, 1899.

The Eastern Telegraph Company, Limited.—The directors have announced the payment on 13th inst. of a dividend at the rate of 3½ per cent. per annum, less income-tax, on the preference stock for the quarter ending 30th inst., and the usual interim dividend of 1½ per cent. on the ordinary stock, free of income-tax, in respect of profits for the quarter ended June 30th last.

Barcelona Tramways Company.—The directors have been offering to their shareholders 7,000 5 per cent. cumulative preference shares of £10 each, the balance of a total of £100,000 authorised in 1896, for subscription at par.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending September 30th, 1899, were £768 2s. 4d.; receipts for week ending September 30th, 1898, £683 18s. 4d.; aggregate for half-year to date, £17,586 0s. 8d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending September 29th, 1899, were £3,059 17s. 3d.; corresponding period, 1898, £2,958 7s. 3d.; increase, £101 10s. 0d.

The City and South London Railway Company.—The receipts for the week ending October 1st, 1899, were £968; week ending October 2nd, 1898, £955; increase, £8. Total receipts for half-year, 1899, £13,164; total receipts corresponding period, 1898, £13,267, decrease, £103. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending September 30th, 1899, were £210 13s. 0d.; week ending October 1st, 1898, £209 5s. 8d.; increase, £1 7s. 4d. Total receipts to date, 1899, £7,872 14s. 0d.; corresponding period, 1898, £6,416 15s. 4d.; increase, £1,455 18s. 8d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,864; 1898, 4,085. Number of cars, 1899, 11; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, September 29th, 1899, were as follows:—D. U. T. Co., horse cars, £1,061 18s. 3d.; ditto, electric cars, £1,933 19s. 10d.; D. S. D. Co., electric cars, £785 4s. 1d.; total, £3,782 2s. 2d.; corresponding week last year—D. U. T. Co., horse cars, £2 379 17s. 1d.; ditto, electric cars, £424 15s. 10d.; D. S. D. Co., electric cars, £573 15s. 10d.; total, £3,678 8s. 9d.; increase, £108 13s. 5d. Aggregate to date, £59,131 8s. 9d.; aggregate to date last year, £57,430 14s. 2d.; increase to date, £1,700 9s. 7d. Worked:—The mileage open is 25 miles electrically, 19 miles by horses, as against 12 miles electrically, and 80 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending October 1st, 1899, were £570. Miles of track open, 10. Car miles run, 11,493. Number of cars, 21. The receipts for the week ending October 5th, 1898, were £261. Increase, £309. Miles of track open, 3½. Car miles run, 3,565. Number of cars, 10. Total receipts to date, 1899, from April 1st, 1899, £15,750; total receipts to date, 1898, from June 29th, 1898, £3,964.

The Liverpool Overhead Railway Company.—The receipts for the week ending October 1st, 1899, amounted to £1,481: corresponding week last year £1,597 (visit of Channel fleet); decrease, £116.

The South Staffordshire Tramways Company.—The receipts for week ending September 29th, 1899, were £709 9s. 11d.; aggregate receipts for 39 weeks, £25,962 4s. 5d.; week ending September 30th, 1898, £666 5s. 10d.; aggregate receipts for 39 weeks, £24,612 14s. 4d.

STOCKS AND SHARES.

Wednesday Evening.

These are days of war markets. Consequent upon the fear of hostilities in the Transvaal there has arisen a sudden scare of dearer money, the action of New York further assisting this cause of anxiety. The two combined have been altogether too much for what verve the Stock Exchange had left to it after the past few months of unrest and trouble. For Consols to fall two points in the same number of days was sufficient to rock all markets in the House, particularly those whose strength lies to a great extent in the fact that their shares are sound enough to warrant the price returning only a small rate of interest to an investor. To this class, of course, belong most of the Electrical Supply shares, and immediately the raising of the Bank Rate was announced in the Stock Exchange, a thorough weakening set in even amongst the best of them. With the official minimum standing at 4½ per cent., it is scarcely likely that investors will keep securities that yield less than this rate, unless by selling they incur a heavy loss, and some are not unwilling to do this, believing that the "war-panic day" has not yet come. Whether it has or not no one can tell, but there is a fortune ready made for the investor who strikes the psychological moment for buying when things are at their very worst.

Weakness has been most pronounced in Chelseas, House-to-House and Westminster, which are all 10s. lower. Other shares in this department maintain their nominal quotations, but sellers are constantly disappointed at finding their orders executed below the price officially named. The market must not be blamed for this. Rather it is the result of weak holders rushing in to realise at a time when there is naturally no public buying. It is difficult not to sell when falls are recorded day after day, but the reaction is inevitable, and a little patience in seeing the fall through is the best antidote against this eagerness to sacrifice shares at any price. Charing Cross new Ordinary settle on Thursday, October 12th, and are to be quoted in the List, but no change is marked in the price of the old shares. We attempted to extract some definite information the other day from a member of the Marylebone Vestry, with regard to the negotiations now on foot between that body and the Metropolitan Electric Supply Company, but he said that the scheme was too intricate for the Vestry to pronounce judgment upon at present. The Lighting Committee is now hard at work on the task of marshalling all the pros and cons of the case.

In the electric railway market Central London shares have fallen, and the quotation for City and South is warily widened, but Waterloo and City remains unchanged, its recent falls having brought it to a level, below which it is unlikely to sink further. Home rails, on the whole, have exhibited such unmistakable flatness at the dear money scare, that it is surprising that so slight a fall should have overtaken the electrical section. There is after all some advantage for a stock to possess a narrow market.

Telegraph issues are giving way in nearly every direction, but an improvement has to be noted in the senior securities of those companies whose ordinary stocks are flat. For example, Eastern 4 per cent. Mortgage Debenture is up 1, as is also Eastern Extension 4 per cent. Debenture. Heavy declines occurred in the Anglo-American Telegraph Stocks, despite interim dividend and the business which the company is doing in connection with the famous yacht races. Commercial Cable has moved up a point, on what is believed to be a buying order from "across the herring pond." The depression in telegraph stocks has affected Globe Telegraph and Trust shares. Both Ordinary and Preference have shed ¼, but there is no change in Submarine Cables and Trust. Reuters are also unmoved, but the shares remain steady at 7½, and the international events now passing should be a good wind to the company. National Telephones have been easier, but firmed up again. It is not thought that the concessions to be granted to provincial subscribers next year will materially affect the company's business.

Traction and Tramway shares participate in the prevailing dullness. British Electrics are now quoted, *ex* the dividend of 9s., and the price has not recovered the deduction, as it most likely would have done in healthy times. We hear that a market will shortly be made in the shares of the Seville Tramways, a Spanish company which has just opened the first section of electric tramways to general traffic. It seems a pity that one of the British companies could not have secured the contract for the line's construction instead of a German concern. But that the home undertakings are not behindhand in enterprise is apparent from the fact of Callender's Cable Construction negotiating for the purchase, with the Westinghouse Electric Company, of an Adelaide tramway system. Brush Second Debenture has advanced two points. Henleys are no weaker at 14, and 10s. is the nominal price of Nernst Electric.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Sept. 27th.	Closing Quotation, Oct. 4th.	Business done during week ended Oct. 4th, 1899. Highest.	Lowest
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	62 — 65	61 — 64	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	113½—114½	111½—112½	114	111½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	14½— 14⅝	13½— 14	18⅞	13⅝
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	14⅝— 15½	14⅝— 15½	15	14⅝
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	188 —193	185 —190 xd	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	104 —106	102 —104 xd	...	...
234,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9⅜	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5 xd	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9½— 10½	9 — 10 xd	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107½	103 —107½	...	...
60,710£	Direct United States Cable	20	3 %	3¼ %	3¼ %	11¾— 12¼	11½— 12 xd	12	11⅝
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6¼ %	7 %	7 %	142 —147	140 —145	144½	140⅜
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	99 —102	99 —102	99¾	99
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	117 —122	118 —123	121½	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14 — 14½	13⅞— 14¼	14	13¾
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,040, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	116 —121	117 —122	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
800,000£	Do. 4 % Mort. Debs., Nos. 1 to 8,000, red. 1909	100	4 %	...	...	101 —104	101 —104	101	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —105%	...	...
180,297	Globe Telegraph and Trust	10	4½ %	4½ %	5⅛ %	10⅜— 11¼	10½— 11	10 1/16	10⅝
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	14½— 15½	14⅜— 15¼	15¼	15
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	...	...
89,500	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5⅛ %	6 %	6 %	5⅛— 5⅝	5⅛— 5⅝	5 1/16	5⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13¾	13½
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅝	...	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	99 —102	100	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	¾— 1	¾— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5⅛	4⅜— 5⅛	...	...
151,738£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	102 —105	102 —105	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
93,321	West India and Panama Telegraph	10	1 %	2%	...	1½— 1⅝	1½— 1⅝	...	...
34,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10⅝	10½— 10⅝	10⅝	10½
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9⅛	8½— 9⅛	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	5 %	5 %	...	104 —107	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	10 — 11	10¾	10½
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
84,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7⅛— 8⅛	7 — 8	7 1/16	7½
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	110 —112	110 —112	111	110¾
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11 — 12	11 — 12	11¾	11⅝
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13½	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	11 — 11½	10⅜— 11¼	11 1/16	10⅜
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	13¼	...
220,000	Do. 4½ % Deb. Stock, Prov. Certs (£30 % to be paid) Rd.	...	...	...	...	82 — 85	81 — 84	81¾	...
17,400	Edmundsons Elec. Corp., Ord. Shares 1—17,400	5	...	5 %	7 %	5 — 5½	5 — 5½	...	...
19,661	House-to-House Electric Light Supply, Ord., 101 to 19,661	5	...	4 %	6 %	8 — 9	7½— 8½	8	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	9⅜	9⅛
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 6⅝	6½— 6⅝	6 7/16	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	105 —107	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	14½— 15½	14½— 15½	15¼	15
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14 — 15	14⅛	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	16 — 17	16 — 17	16½	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3⅞— 4½	3⅞— 4½	4	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	15 —16	14½— 15½	15⅝	15¼

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being vred as capital
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Sept. 27th.	Closing Quotation Oct. 4th.	Business done during week ended Oct. 4th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2⅜— 3½	2⅜— 3½	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	97 —102	95 —100 xd	...	...
80,000	British Electric Traction	10	...	...	6 %	17½— 18½	17 — 18 xd	17	...
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13½— 14	13½— 14	14	13⅞
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	127 —130	125 —128 xd	127¼	126½
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6⅝	6½— 6⅝	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅝— 2	1⅝— 2	1⅝	1½
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	3	4 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2⅛	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —114	109 —113	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	102 —104	104 —106	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13½— 14½	13½— 14½	14⅛	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10⅜	10 — 10½	10⅜	10⅛
178,308	Do. do. do. £8 paid	10	...	...	...	..	...	...	...
61,083	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5½	4½— 5	...	..
71,447	Do. do. Def. do.	5	...	...	...	5½— 5⅝	5 — 5½	...	...
630,000£	City and South London Railway	Stock	1⅝ %	1⅞ %	2½ %	64 — 66	63 — 66	64	63⅛
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6½— 6⅝	6½— 6⅝	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	3½	3½
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½ %	6 %	6 %	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5½ %	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2½— 2⅝	2½— 2⅝	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,800	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	105½	105
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅝— ¾	⅝— ¾	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
8,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	110 —113	110 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21 7/16	21
800,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104 xd	100 —104 xd	102	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞ %	3½ %	3½ %	8⅜— 8⅝	8½— 8⅝	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½— 13⅝	13½— 13⅝	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	...	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9⅜	9¼— 9⅜	9 1/16	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5⅝— 6¼	5⅝— 6 xd	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	100 —103	100 —103	102	101

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10
British Aluminium, Ordinary, 9½—10; 7 % Pref., 9—11.
House-to-House, 4½% Debentures of £100, 104—107.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 1—3.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7½—7⅝. Debentures, 10¼—107. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 18⅜.

* From Birmingham Share List.

Bank rate of discount 3½ per cent. (July 13th, 1899).

MARKET QUOTATIONS, Wednesday, October 4th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
„ Nitric .. .. .. per cwt.	22/-	22/-	..
„ Oxalic .. .. .. per cwt.	32/-	32/-	..
„ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. per cwt.	35/-	35/-	..
a Ammonia, Muriate (crystal) .. per ton	£25	£25	..
a „ „ .. .. per ton	£23	£23	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. per ton	£27	£24	£3 inc.
a Lead, Nitrate .. .. per ton	£23 10	£23 10	..
a „ White Sugar .. .. per ton	£31	£31	..
a „ Peroxide .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks .. per lb.	3¾d.	3¾d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£294	£294	..
b „ Sheet, in ton lots .. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8¼d.	8¼d.	..
c „ Tube (brazed) .. .. per lb.	10¼d.	10¼d.	..
c „ Wire, basis .. .. per lb.	8¼d.	8¼d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g „ Wire (basis price) .. per lb.	10¾d.	10¾d.	..
g „ Sheet .. .. .. per ton	£88	£88	..
g „ Rod .. .. .. per ton	£88	£88	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/2½ to 4/4½	4/2½ to 4/5	½d. dec.
t Iron, Charcoal Sheets .. .. per ton	£18	£18	..
t „ Pig (Cleveland warrants) per ton	66/7	67/10½	1/3½ dec.
t „ Forgings, according to size per ton	From £11	From £11	..
t „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
t „ Wire galvanised No. 8 .. per ton	£14 5	£14 5	..
g Lead, English Ingot .. .. per ton	£15 15	£15 5	10s. inc.
g „ „ Sheet .. .. per ton	£16 10	£15 7½6	2s/6 inc.
m Manganin Wire No. 28 .. .. per lb.	8/-	8/-	..
g Mercury .. .. per bott'e	£8 12	£8 12	..
d Mica (in original cases), small per lb.	2d. to 6d.	2d. to 6d.	..
d „ „ „ medium per lb.	1/9 to 2/6	1/9 to 2/6	..
d „ „ „ large per lb.	8/6 to 7/-	8/6 to 7/-	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd str'p & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£140	£149 10	10s. inc.
g „ foil .. .. per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/10	1/10	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb	7¾d.	7¾d.	¼d. inc.
j „ Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j „ Hemp, 8 ply 10 lbs. .. per lb.	8½d.	8½d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£18	£18	..
j „ Manila, 24 thread .. per ton	£39 10	£39 10	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£27	£27	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakespeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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THE BRITISH ASSOCIATION.

SIGNALLING WITHOUT CONTACT.

A System of Railway Signalling specially suitable for Fog Signalling.

Paper read before Section G on Monday, September 18th, by Mr. W. S. Boult, Assoc.M.Inst.C.E.

(*Concluded from page 537.*)

Road Circuits.

Referring now to fig. 20 (in which permanent magnets are shown by single and electro-magnets by double circles) it will be seen that at each signalling position the engine first gets the danger signal—distant or home as the case may be, according to the polarity of the permanent magnets—immediately followed by "Line Clear" and a road number if current is on the electro-magnets. If current is not on, the danger signal only is taken.

The diagram shows the arrangements at a junction, each branch from which leads to another junction. Equivalent roadside semaphores are also shown.

To economise current it may be switched on and off in the signal boxes A and B by means of the apparatus indicated, so that it is used in a section only whilst the train is there. In each signal box is a key, or plunger, for throwing magnetic switches (constructed like the indicator movement above described, but not permanently polarised, and therefore workable by current in either direction) to close their respective circuits through contacts on pendent tongues and the cores of the lowest coils—taking the view as a front elevation. In each switch the tongue working between the two upper coils acts simply as a tumbler to move the pendent contact-making tongue through a small angle. On plunging, the tumblers will all be thrown into the position shown, and the respective circuits be all earthed. This will be done at each signal box on the approach of a train.

Suppose now that a line has to be cleared for an approaching train. The magnetic switches will be in the opposite position to that shown, with road circuits open.

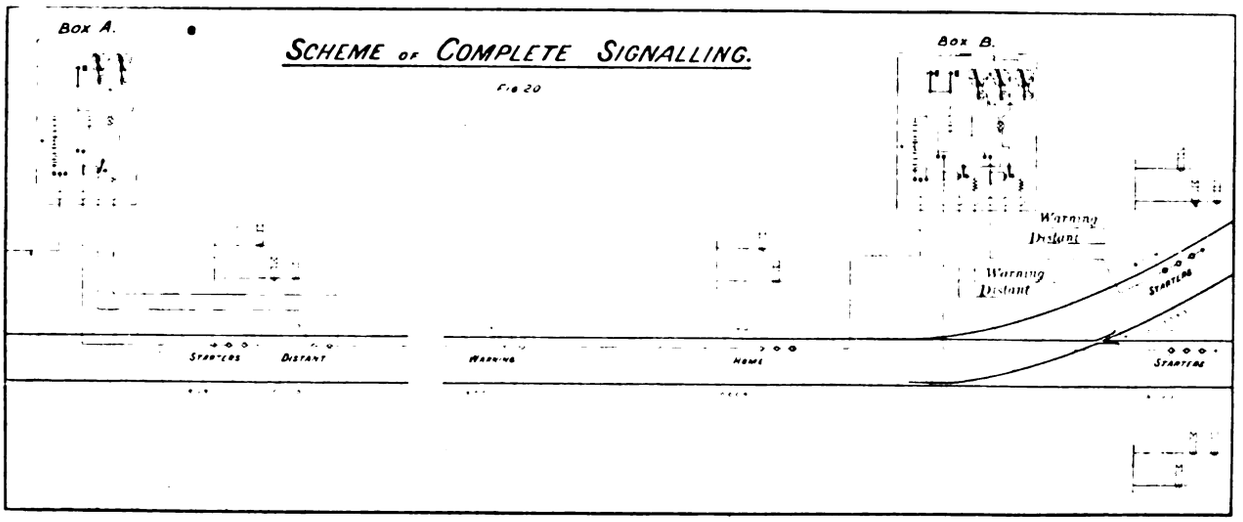
Signalman A switches in the battery for his starter magnets and B the battery to give the required polarity to the distant, warning, and home magnets. As the train comes near, A plunges (just before giving B the train-on-line signal), and thus completes the circuits through the magnetic switches, and current flows, the starter current immediately cutting in the distant magnets by the intermediate switch, as will be readily understood from the diagram. Current now flows through the two right-hand coils of each magnetic switch, whereby the pendent contact tongue is held hard up, and the tumbler is thrown over to the right, till held by its knuckle joint. As soon as the train has passed A, he breaks the starter circuit, so as to put this signal on. By means of the intermediate switch the distant signal is also immediately put on. Current ceasing in the right-hand coils of the left-hand magnetic switch, the pendent contact tongue is released, and pulled back by the weight of its tumbler. A similar action takes place in the other switch when B puts on the warning and home signals. In order that the right-hand magnetic switch may not be opened too soon, the intermediate switch may be constructed so as never to break one circuit till it has closed the other.

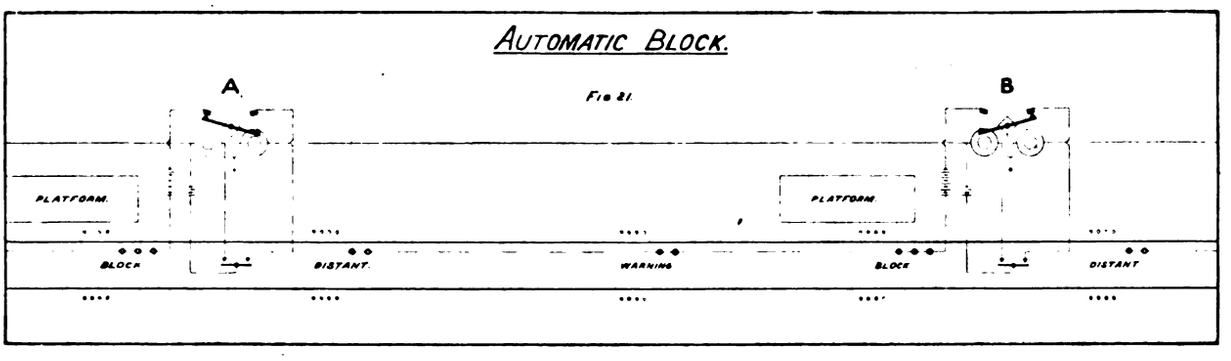
In the diagram small circles in the signal boxes represent galvanometers for showing when, which, and how much current is flowing in each circuit; that is in effect for "repeating." Crossed circles stand for "veto" switches, whereby a signalman, if he sees anything wrong with a train as it passes, can instantly veto line-clear signals given by the man in advance, without wasting time in communicating with him.

For the number of branch lines shown, electro-magnets for one armature only are required. Where more than two diverging roads have to be signalled at the same spot, the other inside armature also must be utilised by another set of electro-magnets. It is then possible to select from eight different roads as follows:—

Let the four numbers of the indicator controlled by the two armatures be respectively M2 and 1 on one armature and 2 and 5 on the other, then:—

Branch No. 1 = 1.
" " 2 = 2.
" " 3 = 1 + 2.
" " 4 = M2 + 2.
" " 5 = 5.
" " 6 = 1 + 5.
" " 7 = M2 + 5.
Main Line = M2.





In any exceptional case requiring more than eight road indications, if such can be found, a second set of magnets to one of the armatures can be provided giving two more, thus:—

Branch No. 8 = 1 + 2 + 5.
" " 9 = M2 + 2 + 5.

By doubling the magnets of the other armature as well, one more is obtainable, thus:—

Branch No. 10 = 1 + M2 + 2 + 5.

A total of 11 roads can thus be differentiated if necessary—probably more than will ever be wanted under any circumstances.

With the indicator above described (see fig. 7), the home semaphore on is an invariable order to stop; when off it signifies "Go," the distant arm pointing to "slow" or "fast," according as it is on or off. It is only when moving out of a block section up to a starter that this interpretation of the distant arm does not strictly hold, as the starting signal will be off or "fast;" but as in this case the train *cannot* be going fast, the giving of permission to do so does no harm.

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With the arrangement of road magnets shown in the diagram, the working of traffic is as follows:—

Suppose a train travelling from A to B and finding the signals on. On receipt of the distant signal, speed will be slowed down in the usual way. The "warning" magnets (which might be, perhaps, 200 yards in rear of the home magnets) will throw on the home semaphore, and the train will be brought to a stand. After stopping, it will crawl up the home magnets or block station, and stand over the electro-magnets of this group, which, as shown by the third magnet, may have an extra long pole-plate. The bells may now be stopped by the "relay-push." As soon as current is switched on to the road-magnets, the starting signal will be given by the throwing off of both semaphores and the appearance of a road number; the "relay-push" being at the same time again closed ready for the next danger signal.

A simple scheme of automatic block signalling is shown in fig. 21. At or near each block station is a two-point magnetic switch, conveniently formed with the polarised movement above described, controlled by road armatures operated by magnets on the train.

As the train comes up to each switch, it finds it in the position shown at station A, and by means of its front magnet, throws it into the position shown at station B, thus breaking the circuit of the magnets behind it and earthing both the rear end of the magnet wire in front and the other contact of the armature being passed. The tail magnet of the train on coming up closes the needle on this contact, thereby completing a circuit through the right hand coil of the switch in rear. The diagram shows the position of the switches when a train has completely passed station B. A following train coming up to A, will earth the rear of the magnet wire A—B, but the forward end will not be earthed until the leading train has reached station C; the following train being meanwhile blocked at the platform in rear of B.

This scheme thus ensures that the whole of one train must have passed out of a block section before another is allowed to enter it, and uses current in each section only whilst a train is in it.

Such a system as that outlined in figs. 19 and 20, compared with the usual methods of semaphores, coloured lights, and detonators, possesses most substantial advantages as the regular every-day method of working.

In the first place, it is *one* system for *day, night, and fog*, instead of *three systems as now used.*

Obviously, such a simplification is most desirable. Not only are the first cost and working expenses thereby reduced, but there is distinctly less chance of mistakes being made, and there is *no* chance of the system required in any particular moment not being got ready in time, there being no lamps to light, and no foggers to call out.

Then, the signal is always given in the same spot, and only the signal for the one train, so that the driver's attention is not distracted from his engine, and a general look-out ahead to peer out anxiously and constantly, often through fog, snow, hail, rain, and wind, trying to see in what direction a continual succession of arms on top of posts are pointing, or what coloured lights are visible at frequent intervals, and decide which arms or which lights (often out of a large number in view at the same time, when not all obscured by fog or snow) refer to his train.

Again, if the present distant and home signals are on separate posts, there is nothing at night to indicate to a driver which it is he is approaching, so that there is always the chance of his mistaking a home "danger" light for a distant "caution," and so running past when he should stop. With the author's apparatus this is impossible.

There can be no two opinions as to which system, with equal reliability of action, is the safer; and railway engineers and managers should gladly welcome a system giving signals on the trains where they are wanted, instead of on the roadside where they are not wanted, if they only can have confidence in the certainty of its action under all circumstances.

This raises the question of relative simplicity of construction, in which it will be noticed the advantage is all on the side of the author's system. The parts on the road are simply the boxed-in magnets and connecting wires, with no moving parts, as against a combination of signal wire and pulleys, post, ladder, lever, rod, semaphore, spectacles, lamp, "fogger," and detonator, an accident to almost any part of which will throw the apparatus out of order. Further, the magnets are completely encased, and so protected from accident, while the whole of the semaphore apparatus is thoroughly exposed to wind and weather and mechanical injury; indeed, the same may be said of the unfortunate foggers. The receiving apparatus carried by the train consists of parts, the management and keeping in order of which are well understood, and which are all carefully boxed in, so as to be protected from damage; besides being of so small and simple a nature as to admit of duplication.

The author's apparatus thus consists of the simplest and best protected parts possible, producing an absolutely unfailing field, acting on *at least two* independent contact makers, the proper working of *one* of which ensures safety. Beyond doubt this is immeasurably safer than a signal which cannot be seen at all in thick fog or snow, is liable to fail any night by the accidental extinction of a lamp remaining unnoticed by the signalman for a little while, and at the best of times has to be carefully discriminated from other signals, in many cases distributed round it in profusion.

It is needless to detail to those in any way connected with railways the numerous accidents that have occurred, and *nearly occurred*, through drivers mistaking their signals or being unable to see them.

A further most important point in favour of such a system as the author's is the great reduction thereby to be effected in "fogging" expenses as incurred under the present method, to say nothing of oil, gas, and attendance for the present signal lamps, and cleaning, oiling, and adjusting for the wires.

Finally, the cost of this system for new lines would be very small compared with the expense hitherto necessary.

It is, however, a good fog signal that is the pressing want, and the author trusts he may be forgiven for adding to this already very lengthy paper a few words as to the relative costs of the present and proposed systems.

As mentioned above, Sir George Findlay states that on the London and North-Western Railway in the great fog of 1888 (which lasted five days) 2,462 posts were dealt with. This gives an average of about 1⅛ post per mile of road. Mr. Acworth gives the cost of the same fog to the Manchester, Sheffield and Lincolnshire Company as £1,250. Assuming the same ratio of posts to mileage, this sum would be divided among 470 posts at the rate of £2 13s. 2d. per post for the five days' fog. The author is not in a position to quote definite figures for his system, but he feels little doubt that for this sum of £2 13s. 2d. per *annum* (not per fog) it could be permanently maintained, giving twice the number of signals (both danger and line clear) at twice the number of posts (distant and home). The "complete" system, giving routes and repeating, would no doubt exceed this figure.

In order to test the working of the armature-relay and indicator movements, four groups of electro and permanent magnets were put down on the up fast road of the Great Northern Railway at New Southgate, and an express engine (No. 1,008) was fitted with two armatures, indicator and bell. Although the apparatus was in many respects inferior to the designs now put forward, signals were taken perfectly at speeds of over 70 miles an hour, with a clearance of over 3 inches between armatures and road magnets.

List of Drawings.

Fig. 1 is a plan showing groups of permanent and electro-magnets on the road.

Fig. 2 shows electro-magnets in side elevation.

Fig. 3 shows permanent magnets in side elevations.

Fig. 4 is a cross section of the same, showing also four armatures carried by iron straps attached to the ash-pan and frame of the engine.

Figs. 5 to 10 show the construction of the indicator on the engine.

Figs. 11 to 15 show the construction of the armature relay.

Figs. 16 to 18 show the "relay-push."

Fig. 19 is a diagram of engine circuits for complete signalling.

Fig. 20 is a diagram of road circuits for complete signalling with "economy switching."

Fig. 21 is a diagram of road circuits for automatic block working.

Discussion.

Sir W. H. White, in presenting the thanks of the section to Mr. Boult, said he had seen the apparatus before, and he thought that no one who had seen the demonstration that day could feel otherwise than that it was a thoroughly workable thing if it was wanted, and the test to which Mr. Boult referred in the paper, of service on the Great Northern Railway, was a very severe one certainly.

Mr. Boult said that in those trials every likely severe condition had been undergone—fog, frost, snow, &c.

Mr. W. A. Price said he had been intimate with the mechanical construction ever since the beginning. At first he thought it too intricate to be of practical effect, looked at as a piece of electrical instrument making. All the experience he had had of it made it appear to him that it *was* of practical value. The parts had to move with very little force, but they were extremely simple; they were those commonly accepted in the best telegraph practice, which was a conspicuous success. The trying conditions on the Great Northern Railway seemed to exhaust all the obviously weak points of the system. The difficulties of the thing certainly were rather obvious at first sight, and the extent to which they were got over was not so clear, but anyone who knew as much about the inside of it as he had the pleasure of knowing, saw a better future in it than one could see from some promises of the kind. It was a very delicate thing, but he had every hope that Mr. Boult would make a success of it.

ELECTRICAL CHANGES ACCOMPANYING THE DISCHARGE OF THE RESPIRATORY CENTRE.

Report of the Committee, consisting of Dr. A. Waller (*Chairman*), Prof. E. Waymouth Reid (*Secretary*), Prof. F. Gotch, and Mr. J. S. Macdonald. (Drawn up by Mr. J. S. Macdonald.)

Further Examination of Changes in Phrenic Nerve and their comparison with Simultaneous State of Blood Pressure.

Section A.—September 14th.

The further prosecution of research has taken the form of an inquiry *into the nature of part (if any) played by alterations of blood pressure in the causation of electrical phenomena observed in the phrenic nerve.*

In a nerve well supplied with blood-vessels, and with a circulation preserved in such good condition as that noted in experiments, errors might be introduced by such alteration in several ways.

(*a*) By alteration of volume of blood and lymph in nerve, and so of conducting media external to electrically disturbed tissue.*

By such means a change, produced in the relative proportion of current derived through galvanometer circuit, might in records give rise to an apparent change of total current.

(*b*) By action of changes of blood pressure upon the walls of vessels or upon the flow of blood through them, setting up electromotive changes of entirely different origin from intrinsic changes in nervous tissue.

* Source of current of injury.

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(*c*) By direct effect of alterations of circulation upon the nervous tissue itself, especially in nerve partially dried and cooled from exposure, giving rise to intrinsic alterations in current of injury by altering conditions of moisture, temperature, presence of waste products, &c., affecting its development.

There were considerations which made it improbable that such causes were at work in the production of current changes observed in phrenic nerves. Amongst these may be mentioned:—

1. The constancy of base line in tracings.

2. The character of the rhythmical oscillations, the first part of each of which bore evidence of being a true and negative variation; the second part, as observed both in galvanometer and electrometer, being due to return of instrument to rest at a rate determined by instrumental elasticity.

3. The observation that phenomena in phrenic ceased when blood pressure was still considerable, and the heart continued its beat.

It was indeed anticipated that the relation between circumstances was really in a reverse order. That the phenomena, being genuine indications of large discharges from respiratory centre, would probably, in their most extreme form, be accompanied by discharges of vasomotor centres leading to alterations of blood pressure; and not that such indirectly caused changes of blood pressure would declare themselves so obviously by indirect effects upon injury current of phrenic nerves.

It was, however, deemed advisable to satisfy any criticism upon presence of errors of this nature by as careful as possible an estimation of their value. To do this it did not seem necessary, or even advisable, to confine the research to direct experiments upon the phrenic nerve, as it was presumed that errors (such as were sought for) would affect the apparent changes in any nerve under similar conditions of experiment to a degree dependent upon the vascularity of the nerve and the maintenance of its blood supply.

Experimental means were obtained for the simultaneous record upon same travelling surface of the movements both of a galvanometer and of a blood-pressure manometer. In this way two curves were obtained, one of electrical changes in tissue experimented upon and one of blood pressure in general circulation, admitting of immediate contrast.

The nerves chosen for experiment were:—

(*a*) The central end of divided vagus.

(*b*) The peripheral end of divided vagus.

(*c*) The recurrent laryngeal.

In all these cases phenomena were found characteristic of each individual nerve and irrespective of state of blood pressure, which will be elsewhere described.

But in addition indications were obtained and records taken of a relation sometimes existing between change of blood pressure and change of demarcation current in nerve, a fall of pressure being accompanied by a fall of current, and a succeeding rise of pressure by an increase in current.

In such cases the parallelism of curves, when obtained, is of a crude description, the galvanometer record following the main trend of the blood-pressure record, but not responding to the finer variations. It is also thought that such parallel curves are best obtained at the end of an experiment, when the nerve has presumably suffered from exposure.

A somewhat similar comparison* has been made previously by other observers in the case of spinal nerves, in which the demarcation current was noticed as dependent upon the condition of animal.

A very remarkable variation from such observations was, however, several times obtained from the peripheral end of divided vagus, in which the relation between the curves was inverted; a rise of blood pressure being accompanied by a negative variation in demarcation current, a fall with an increase. There is also a marked difference in the nature of correspondence between the two curves from that previously related, in this case much more exact, finer changes being responded to and with a constant latency.

The possible presence of a double relation of demarcation current in the peripheral end of vagus to changes of blood pressure, one in the opposite direction to the other, was naturally the cause of a multiplicity of experiments made upon this stretch of nerve. It might be remarked that whilst the first type of change is analogous to that so far found in other nerves, this second is peculiar to the nerve in question; and although admitting of a simple explanation by the behaviour of the electromotive changes in the walls of blood-vessels contained in it, is not (for reasons to be elsewhere advanced) thought to be so caused.

In continuation of general research an attempt was made to differentiate between the secondary results of an altered circulation in nerve and the direct effects produced by changes in the blood-vessels contained in it.

For this purpose direct experiments of a similar kind were carried out upon large blood-vessels. An artery was ligatured and divided, the central end (towards the heart) dissected from its surroundings, raised in air, and connected with galvanometer in same manner as nerves had been connected. The stretching was found of importance, and the femoral artery first chosen was abandoned for the carotid, as free from branches and, therefore, from local injuries during dissection.

In such a preparation current changes are found proportional to changes of blood pressure of a gross kind and with a marked latency. The relation between two is of same kind as that found in the peripheral end of vagus nerve, a rise of pressure causing a fall of current. Such current changes are not due to alterations in resistance of tissue to any current found there, as their nature remains unaffected by the compensation or over-balancing of the demarcation current, retaining always the same direction whatever the direction of current traversing tissue may be.

As to the real source of such changes no positive statement can be made. The most probable cause would seem to be an alteration in tonus of muscular coat secondary to the change of pressure within vessel. This is supported by the result of one experiment, in which an otherwise uninjured carotid artery was separated from surrounding tissues by a thin sheet of india-rubber and a portion of its length connected with the galvanometer. The galvanometric curve bore at first no relation to the blood-pressure curve, but a relation was imperfectly introduced by injury to artery at electrode distal from heart. In other experiments attempts were also made to introduce electrodes into blood stream, but experiments were lost owing to coagulation of blood and the effects of pressure upon electrodes themselves. It is, however, felt that without further evidence an attempt to fix source of origin is futile.

It was thought that the general research might be assisted by a study of such changes as might be obtained under similar conditions from largest combination of nerve and artery to be obtained in body. Experiments were performed, in which the vagus and carotid, having been divided and ligatured at same place, were lifted up without being separated from one another. The piece of tissue so formed was stretched to its normal length, and its distal end connected to galvanometer in usual way.

From this preparation it was found possible to obtain, with unfailing regularity, a galvanometer curve having the most marked correspondence to simultaneous blood-pressure curve, a rise of pressure being accompanied by a negative variation of current.

It is to be noticed that the demarcation current obtained from this tissue was exceedingly small, and that the variations in it were of a magnitude bearing an extremely large ratio to it; in fact, the most successful comparisons were made in preparations in which the original current was practically nil. It is also of note that the quantity of change obtained from this preparation in response to a change of blood pressure is greater than that obtainable from carotid artery alone, and much greater than that obtainable from vagus nerve alone.

In the total result it seems possible that a contribution is due to artery, a portion to nerve, and that in this case the components have same direction; for ligature of nerve near to trunk and as far as possible from electrodes produced a diminution in the steepness of curve, and it is believed an alteration of its character.

The value of this latter observation is enhanced by the manner in which other changes unrelated to changes of blood pressure, but known from further research to occur in nerve during conditions of experiment, are swamped by the superposition of artery, it being presumed that value of derived circuit through galvanometer is rendered comparatively negligible by its relatively large resistance.

In cases of all previous part of research it may be said that the physiological continuity of tissue examined is essential.

Summing up, it may be said that all the experiments upon which statements have been based were carried out under the conditions of original experiments upon phrenic nerves; that is, that the experimental method used for obtaining the alterations of blood pressure* consisted of curarisation, artificial respiration, and intervals of its suspension.

This, though not a good method for the unravelling of secondary problems which have presented themselves, allows one to translate all the occurrences which have been found in other nerves and tissues to a probable occurrence during any one of phrenic experiments. The main results may be tabulated as follows:—

1. Current changes have been found in divided nerves directly proportional to changes of pressure, the relation between the two being, however, as to time and quantity of a gross kind.

2. Current changes have been found in peripheral end of divided vagus nerve *inversely* proportional to changes of blood pressure, in which relation is much more exact.

3. The latter class of changes has not been obtained from any other nerve examined;

4. but is constantly to be obtained from the divided carotid artery, though here less exact;

5. and with great exactness and magnitude from vagus carotid preparation.

6. That this latter result is diminished by ligature of vagus below point examined.

Having thus obtained information of events met with in other tissues, nerves, and blood-vessels, situated in near neighbourhood and obtaining their blood supply from very similar sources, experiments were resumed upon phrenic itself.

Simultaneous curves of electrical changes in phrenic and of general blood pressure show no correspondence of a kind to explain the characteristic phenomena obtained in phrenic nerve alone of all the nerves examined, and the large alterations of blood pressure which occur in every experiment cannot be even definitely said to constantly affect the base line of phrenic tracing.

To make the result more conclusive, simultaneous records were taken both of current changes in phrenic and in vague carotid preparation, which latter is known to repeat all the incidents of a blood-pressure curve.

The tracings obtained show the typical appearances of either curve, of quite diverse types, showing no relation of the kind sought for. Oscillations in one curve are unaccompanied by oscillations in the other, with an exception of no moment from point of view of question at issue.

It is worth stating that, as two galvanometers of same pattern but of different internal resistance were used in the latter class of experiment, care was taken to change the instrument connected to either tissue during the course of experiment. This, however, may be looked at as of considerable advantage, and serves to make result obtained more conclusive.

* Gotch and Horsley, Croonian Lectures, 1891.

* Chloroform anæsthesia was used.

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The final statement may be therefore made with positive conviction:—"That the phenomena obtained in phrenic nerves are independent of, in the sense of being in no way due to, local changes of blood pressure or of circulation; neither in so far as such conditions affect the nerve nor the blood vessels contained in it."

This does not affirm the absence of circumstances analogous to those obtained elsewhere, but places them, when present, in a position of very minor importance.

ELECTRIC WIRING SYSTEMS.

By J. D. F. ANDREWS.

The appurtenances involved in electric light wiring installations have since the commencement of the industry been subject to such a diversity of treatment and conception, that even at the present advanced stage of the industry we have to look upon wiring as still in a state of development.

The aim of the writer during the past few years has been as far as possible to reduce the innumerable variety of devices into one systematic series of appliances, applicable to any of the chief methods of protecting the insulated conductors.

For this purpose it has been assumed that the most effective methods of protecting the insulated conductors are armouring with lead or with iron wires and conduits or tubes. There are several modifications of these main methods of protection, but in order to effect the objects that the writer has in view, he has only chosen those which it is most widely admitted possess the properties required in the respective methods to the greatest degree, namely, lead or iron wire for sheathing for twin or concentric wiring, and galvanised steel or brass tubing for twin wire and also concentric conduits.

In the concentric system of wiring are to be found features of such conspicuous superiority in all respects to those obtained in any modification of twin wiring that it would doubtless be in common use if it were not for the established regulations being specially drawn to suit twin wiring. In most cases no modification in the conditions of supply are necessary, and it is gratifying to note that several engineers have agreed to permit the introduction of concentric wiring in connection with their supply mains.

The concentric system of wiring possesses features so different from all others that it is not possible to retain all the advantages it possesses when confining it to a series of appliances designed for twin wiring; additional appliances have, therefore, been introduced into the series expresaly for the concentric system.

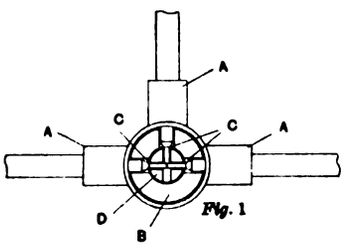

Fig. 1

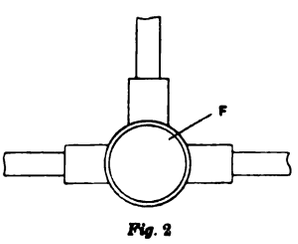

Fig. 2

The design of the accessories for electric light wiring is regulated by a few points of detail, which give a character to the construction of the series. Thus a system in which the joints are made by twisting and soldering, and insulating with rubber lapping, necessitates the construction of the appliances to suit this feature, including the cables which would require to have stranded conductors to comply with the amount of bending involved in this mode of jointing. Owing to the fact that this form of joint has hitherto been the most common, the construction of even the smallest cables or wires with strands has become general. A joint insulated with pure rubber lapping, which is a perishable article, requires to be done by specially reliable men, for, when once the joint has been made, it is not easy to ascertain the quality of its construction. This class of joint is also costly in point of labour. Soldering in connection with joints is considered an inconvenience, and devices have consequently been introduced with screw terminals as a substitution. The liability of screws to loosen is, however, too serious a danger to permit of such joints being hidden away in all parts of a building. In cases, however, where it is possible to dispose of these joints in groups in the form of terminal distribution centres, the method has advantages. With this exception, soldering has become recognised as the only effectual means of uniting metals for electrical purposes, and it must be regarded as an essential part of a reliable joint. The use of pure rubber for the insulation of joints in wires has always been acknowledged to be defective and providing a serious weakness in the system The vulcanisation of the innumerable joints in an installation, which would be a cure for the evil, has been found impracticable.

The aim, therefore, of the writer in devising his series of appliances has been to adapt porcelain in the joints to replace the insulation round the soldered junction. The conductors are not twisted together, and in none of the appurtenances are they subject to sharp bends. There is, therefore, no objection to using solid conductors for the smaller sizes, of which Nos. 18, 15, and 12 have been adopted by the writer for many years past, and no other sizes are arranged for beyond the distribution board, off which to take branches. Having decided upon the materials and principle of jointing, the next points for consideration in the construction are compactness and accessibility for

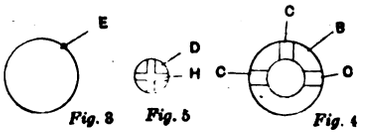

Fig. 3 Fig. 5 Fig. 4

inspection. In the concentric system the joints are more compact than for twin wiring, and the two necessarily differ slightly in construction, but the principle in both is the same.

The concentric joint is illustrated open in fig. 1, and closed in fig. 2, and figs. 3, 4, 5 illustrate those insulators and connector respectively.

The sheathing of lead or iron wires or the conduit tube is soldered into the trunnions, A, A, A. B is the porcelain insulator provided with recesses, C, C, C, in which the vulcanised insulation of the conductors rest; D is a brass conducting piece provided with recesses, or grooves, H, for the conductors, which are soldered in position; E is a porcelain disc placed over the joint, and upon this is a disc of metal a little smaller than a penny, which is soldered into the outer box of the joint. The time occupied to make this joint is about 12 minutes when there are several to make. It is applicable to both conduits and cables.

For twin wiring the joint is necessarily somewhat different in form but the same in principle. It consists of a metal box, figs. 6

Fig. 6.

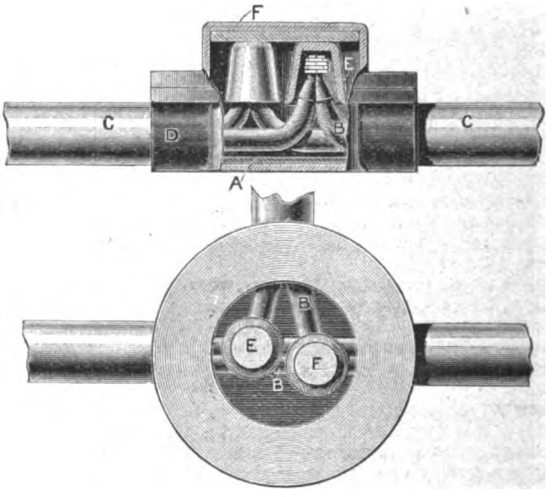

Fig. 7.

and 7, with a disc of porcelain, A, placed on the bottom. The armouring of the cables or tubes, C, is soldered into trunnions, and the inner conductors, B, extend inside and are bent towards the open side. The insulation is then removed from the ends sufficiently to be able to unite the respective ones together. This is done by binding them together with copper wire and soldering. A porcelain thimble, E, is then put over the united ends, and a metal cover, F, fixed on by screws over the whole, which may be made water-tight

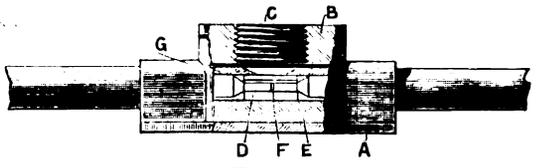

Fig. 8.

by either soldering or red lead between the flanges. This joint is equally well suited to conduit wiring. It has been used for concentric wiring with advantages, but it does not fulfil the functions for this purpose so well as the one specially designed. Nor is it so cheap.

In the case of conduits it is often necessary to provide openings in the length of tube to assist in drawing in, these would consist of boxes the same as the joint boxes but with a flat plate cover fixed on with screws instead of the recessed one. The conduits for use in connection with these boxes are of galvanised steel, usually $\frac{3}{8}$-inch outside diameter for concentric conductor 3/22 = No. 18, or 7/19 = No. 15, and $\frac{1}{2}$-inch outside tube for 7/19 = No. 12 or 7/17. Stranded conductors are preferable for conduits on account of their pliability for drawing in.

The larger sizes of tube are used to distribution boxes for feeders only, and no joints are required in them. Draw-in boxes are, how-

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ever, sometimes required, for which galvanised cast-iron boxes are devised.

In this system it is important to note there is only one size of joint box or draw-in box in the network, beyond the distribution boards, the openings only are modified to suit the tubes or cables they are to take.

The outlets in the concentric system are necessarily somewhat different from those for the twin wiring, in order to preserve all the advantages the system offers. The principle of their construction is similar to the concentric joints, the same insulator being used, and the same junction for soldering in the central conductor. The outer case is provided with a flange, A (fig. 8), through which are holes by which to fix the outlet. The cover, B, is screwed into the box, and it may be soldered to finally fix it. It is provided with a ⅜ inch gas internal screw, C, in the centre, into which the nipple of the fitting to be carried is screwed. The junction, D, recessed in the china insulator, E, is provided with a thin brass disc, F, of the same diameter, which is soldered in position, and forms a fixed contact to connect with the spring contact in the fitting. A porcelain ring, G, is provided over the porcelain base insulator, and the hole in it is somewhat smaller than the contact.

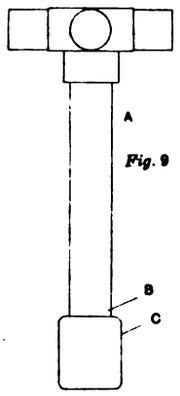

Fig. 9.

These outlets are made two, three and four-way, and also backway. When the wiring is run under the flooring for lights in the rooms below, outlets are provided, consisting of a backway joint with an iron tube screwed into the backway. An insulator, with a fixed contact in it, is provided in the end of the tube, on to which is screwed a ⅜-inch gas thread coupling to carry the fitting. The contact in the tube is connected to the connector in the joint.

This form of extended outlet is used in cases where the cable is

Fig. 10.

required to pass on to another joint, or in cases where branches are to be taken off. When the extended outlet is to form a terminal to the wire, the joint at the top of it is dispensed with, and instead of it a nipple is provided into which the outer conductor is soldered, the central conductor being taken down to the contact in the end of the tube (fig. 10).

(To be continued.)

ELECTRIC WELDING.*

By R. F. DANFORTH, Superintendent International Traction Company, Buffalo.

Since the first carriage started on its trip on an ironclad roadway, the problem of maintaining joints has been an unsettled one. Within a decade we have made steady progress in the improvement of our roadway construction, having gone from a strap to a Richards rail, from the Richards to a 4-inch girder, then to 6-inch, and now to a 9-inch girder with its concrete base. Devices innumerable have been exploited to preserve the continuity of the roadway. Wedged joints and bolted joints have been found to be uncertain, and miles and miles of rail have been "scrapped" because the ends have become badly battered and the rail surface bent from lack of proper support at the joints.

The question has resolved itself into one of obtaining a practical method of securing a continuous rail by welding the lengths of rail together. Two well known methods have been followed, and it is the writer's desire to present one of these to you.

The Thomson Welding Company has for years successfully welded together pieces of iron and steel by use of electricity. The Johnson Company has taken up this process with a view of welding its girder rail into continuous lengths, in the street. Its first method of welding the abutting ends of rail by bringing the joint to a welding heat by the flow of an enormous current has been found to be a failure, because the homogeneity of the metal was destroyed. In the process of welding now being used in Buffalo, it has been the endeavour to follow as closely as possible the method employed in ordinary welding. After the metal is brought to a welding heat it is worked by being put under a pressure of about 35 tons, which has the same effect upon the material as the repeated blows of the blacksmith's hammer.

Under the former process of electric welding track joints the ends of the rails being together, the entire cross-section of the rail has to be brought to a welding heat. In the process now in use the ball of the rail seldom reaches more than a dull red. It is believed that the quality of the steel in the rail head is not injured by this low temperature.

In the true sense of the word, the abutting rails are not welded together, but the splice bars are welded to the web of the rail. These bars are of steel of the same quality as the rail, and measure 1 × 3 × 17 inches.

The weld is made at three points, the centre and ends of the bars. After the centre weld is made, the ends of the bars are welded. Each bar has in the centre a strip of steel pressed over the face, 1½ inches wide and ¼-inch thick. The ends of the bar are drop forged, making a pear-shaped projection on the side, having an area of about 3½ square inches, and projecting ¼-inch above the surface of the bar.

In order to obtain contact for the welder at the point opposite these end projections, a sheet of iron of the same shape as the projection is pressed into the depression on the back, which was made by forging the lug on the opposite side.

The process of making a weld on old rails is in general as follows: The pavement is removed for a space of 20 inches on either side of the rail and about 40 inches along the rail, and the material removed to the ties. The splice bars are taken off, and, if the bolt holes in the rail were punched, the holes are reamed out about 1½ inches or more to remove any check which may have resulted from punching the metal. The joint is then slightly crowned by driving a wedge between the rail and the tie. The three points to be welded are then cleaned by a sand blast. The bars are placed in position, resting on small wood blocks, and the contact points of the welder placed at the centre of the bars. By means of a hydraulic device, the jaws are brought together with about 14 tons pressure, and the current turned on and kept up one minute until the points of contact are brought nearly to a white heat; the pressure is then reduced to about 3½ tons, and at the end of another minute or less, the metal comes to a welding heat. The current is then shut off and the pressure increased to about 15 tons and kept on for one minute, or until the metal "sets." The end contacts are then welded in a manner similar to the method followed in the centre contacts, with the exception that the pressure, when the current is shut off, is raised to 35 tons and is kept on for two minutes. Under this pressure the bar is brought in its entire length in close contact with the web of the rail and the upset metal in the boss or projection disappears. After the weld is made the head of the rail is ground to a true surface by an emery grinder and is then complete.

The machines used in this process may be described as follows: The current from the line is passed through a railway booster, which raises the pressure to 500 volts. (This booster is not used where the initial voltage can be maintained at 500 or over.) This direct current at 500 volts is then used to drive a rotary transformer generating alternating current at 300 volts. This in turn is reduced to five volts in a static transformer; the secondary circuit consists of a single loop of copper and its ends form the contact points which are brought to bear against the bars.

It is found that at 500 volts the current required is about 250 amperes. The current flowing through the weld at five volts is about 30,000 amperes alternating. With this current flowing through the low pressure secondary circuit, it is found necessary to cool the contacts by circulating water around them.

An ingenious cooling device is used to reduce the temperature of the water so used. A tank is provided upon the top of the welding car, containing coils of pipe through which the water flows. These coils lie close together and the tank is filled with water. Air is forced through the water from a coil lying in the bottom of the tank through perforations in the coil. The evaporation from this cooling tank is found to be 47 gallons in 12 hours.

The welder proper is in the form of a rectangle, the lower portion of which is hinged so that the parts may be moved back and forth in the plane of the rectangle. On the upper portion there is a transformer coil, the primary of which consists of many turns of wire, the secondary being the rectangle above mentioned. This is a solid bar of copper, 4½ × 7½ inches in cross-section. The hinges in the two sides are spherical contacts. Around the outside of this rectangle is a steel frame of horse-shoe form, having at the upper end a modified hydraulic jack. The movement of the piston in the cylinder back and forth moves the lower jaws of the contact points. A varying pressure can be placed on the material grasped between the jaws. The pressure is measured by a pressure gauge, placed in a convenient position. The joints in the secondary circuit, the contact points and the transformer itself, are cooled by a flow of water.

The sand blast is obtained by blowing sand, by means of compressed air, through a flexible hose. The air is compressed by a motor-driven compressor.

The emery grinder previously referred to consists of an ingeniously designed carriage, supporting in its centre the emery wheel, and running on two rollers, which are moved back and forth on the surface of the rail to be ground. Its action is similar to a carpenter's

* Paper read before the New York Street Railway Association.

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jack plane. The depth of cut made by the emery wheel is governed by means of a regulating screw, which raises and lowers the emery wheel. The wheel is driven by a belt from a collar motor mounted on the car.

Welds can be made as described at the rate of a joint every 13 minutes. It is found that the machine will average four joints an hour without any difficulty. In Buffalo the line voltage has averaged 410 and the current required about 375 amperes.

You probably ask why we decided to use the welded joint? The reply is that we find that the welded joint not only solves the problem of maintaining a continuous rail, but also of the best return circuit. The carrying capacity of the bars as welded is greater than that of the rail itself; there is no opportunity for electrolytic action between two dissimilar metals; there are no expanded contacts to work loose and no added investment for copper.

Another question frequently asked is, "What do you do about expansion and contraction of your rail?" This is solved in two ways. First, by placing an expansion joint every 2,000 feet; second, by leaving the bolted joints at the special work.

The reason for doing the latter is found in the method of construction used in Buffalo. When the rail is laid in concrete it is firmly gripped its entire length by this mass of material. The weak points in the rail or in its concrete base are bound to be developed. If there is any tendency for the rail to contract, the movement will be greatest where the pressure upon the rail is least. The rail is liable to break under the great tension at this point. The chances are very small for this movement being near enough an expansion joint to have that joint save the rail. If the rail breaks, a regular expansion joint can be easily placed at the break. In following years the expansion and contraction of the rail will be taken up at that point. In order to thoroughly test this question, track has been laid in Buffalo, both with and without expansion joints. The coming winter will solve the problem.

The effect upon a piece of old track, of welding the joints, is most satisfactory. In one instance we welded 6,000 feet of 6-inch girder rail, which had been in use since 1891, and whose surface was so badly bent and battered that it was thought to be well-nigh useless. The rail had been originally laid on chairs with special two-tie joints. We removed the chairs and relaid the track in its proper position, but with low joints. After the pavement was in place (except at the joints) we brought the rail ends up by shims. After the welds were made and the shims removed, the track was found to be in fine condition. After this experience, we welded our track first and resurfaced and relined it afterwards.

The cooling of the weld depresses the joints about $\frac{1}{8}$th inch. We therefore raise the joints to allow for this depression. The old rail in question is considerably worn under the head as well as upon the ball of the rail, and it would therefore be difficult to fit loose splice bars or other mechanical joints so as to obtain a tight fit. The welded bars maintain the joint in its position and make that portion of the rail stronger than any other part.

The cost of welded joints is not materially more than that of the bolted joint with ample bonding. The same result may be obtained with cast-welded joint mechanically, but it is doubtful whether the cast-welded joint gives as good electric contact as the method described.

At the end of another year the Buffalo Railway Company will be able to present interesting data upon the saving in coal resulting from a perfect return circuit. The work of this year has been largely done with the intent to furnish an ample return circuit to the power stations. As the work progresses, a marked saving is shown in the economy of the station.

The *Street Railway Review* in publishing the above paper gives the following brief notes of the discussion:—

Mr. M. G. Starrett, of New York City, asked the author what experience he had had in Buffalo with effect of change in temperature on the electric welds, also did the raising of the temperature of the steel in the ends of the rails in the welding process have any effect on the structure of the steel. Mr. Danforth replied that as far as his experience went, out of 3,100 welds, 17 had broken, and these failures were due to defects in manufacture. In the work they are now doing in Buffalo they do not expect 1 per cent. of the joints to break during the coming winter, and they have the maker's guarantee to that effect. So far two joints have broken in Buffalo. The heating of the rail in welding has no noticeable effect on the steel. Mr. W. B. Reed, of New York City, asked if the joint is found to be as rigid as the rail itself. Mr. Danforth answered that after repeated testing with falling weights at various heights they had been unable to break a single joint at the joint.

The president called on Mr. Nicholl for his experience with electric welding. He replied that his company had done no work of this kind, but was considering the advisability of electrically welding its joints.

WATER-TUBE BOILERS IN THE MERCANTILE MARINE.

An anonymous correspondent of the *Times* seeks to justify the water-tube boiler policy of the Admiralty by a piece of special pleading on behalf of Messrs. Wilson, of Hull, who have fitted eight ships with the Babcock and Wilcox boilers. The author is not very happy in his facts. Water-tube boilers are claimed as essential for the Navy, because they can be safely forced. Yet when Messrs. Wilson have attempted to get additional power by forced draught, they have in each case damaged the water-tube boilers. Further, the Belleville boilers so rashly introduced in the Navy, and so extravagant in fuel, are an entirely different boiler from the type used by Messrs. Wilson, so that even had this firm's experience been quite satisfactory, nothing would have been settled thereby of any comparative value for the Navy. One of Messrs. Wilson's ships, the *Tasso*, is cited as illustrating the advantages of the water-tube type. On six voyages made, first with ordinary boilers, and next with water-tube boilers, the vessel performed as follows:—

	Ordinary.	Water-tube.
Total distance	9,472 knots.	9,200 knots.
Total coal	1,072 tons.	981 tons.
Average speed... ...	11·45 knots.	12·05 knots.
Coal per voyage ...	178½ tons.	163½ tons.

Now, what do these figures show? The writer says that, figuring out the speeds, it means a total coal saved of 130 tons. But this is misleading. The old boilers ran 9,472 knots, with a ratio of knots to coal per voyage of 5·3; the new boilers with a ratio of 5·63. This is in favour of the new boilers. But the old boilers had been at work since 1890, and the boilers had become defective and troublesome, and the new boilers carried 210 lbs. pressure against 160 lbs. of the old boilers. Quite apart from the question of boilers, the figures produced may be taken as a good basis on which to found an argument for higher pressure steam. But the facts advanced say nothing favourable to putting Belleville boilers in war vessels, boilers which have proved wasteful in the Navy, on the Newhaven and Dieppe service, and on the ss. *Kherson*. The old style of boiler is girded at because, if it lasts 20 years, it has little of its original matter but the shell left in its composition. But does not M. Bertin, of the French Navy, say the same as this of water-tube boilers with, however, a much shorter period of years? Six years seems an outside life for water-tube naval boilers. We are told a good deal about the comparative smokelessness of the *Tasso* when using Yorkshire coal, but we are not told that the boilers have, or have not, a special form of furnace. Either they have this special form of furnace, or the boilers did smoke with Yorkshire coal. Generally, this *Times* correspondent has omitted essential technicalities, and does not appear qualified to speak technically. To praise Mr. Wilson for supporting the rash procedure of the Admiralty seems a little out of place. Why, if Mr. Wilson wished to be so very consistent, did he not himself employ the Belleville boiler, so well tested for us all by the Admiralty, in place of employing an entirely different and non-comparable form of water-tube boiler?

Something much more definite is required to satisfy engineers that the policy of the Admiralty is sound. The issue is quite confused by this letter in the *Times*. There is no comparison between torpedo boat practice and line of battle ship practice, yet this writer speaks as though the *Powerful's* boilers were replicas in type of the boilers of torpedo vessels, whereas there is nothing common between them except the unfortunate name water-tube.

TRAIN LIGHTING IN TUNNELS.

On the occasion of a recent visit to Glasgow, the writer came across two very excellent examples of how *not* to do it, in the direction of lighting trains and carriages when running in or through tunnels.

The first of these was the Glasgow and District Subway, which, as most of our readers will remember, is an underground circular line, double track, with two tunnels side by side, about 6 miles long, running at various depths below the surface, but averaging perhaps about 30 or 40 feet, and therefore for the most part keeping under the streets. It is worked by cable, and has a dozen or more stations, with platforms reached by means of staircases from the streets. There is a fine big power house on the south side of the circle, containing two massive horizontal engines, each of about 1,500 H.P., and either of which is capable of driving the whole system through the regular kind of cable driving gear.

No serious trouble can be said to have arisen from the cable working; every now and then, however, an automatic grip release fails to act, or some other such incident occurs, and one, or both, lines may be stopped for a few minutes or for a few hours; but the same kind of breakdown might readily occur in an electric line, and on that score, therefore, one need not just now find fault with cable working *per se*.

When, however, the traveller buys his ticket, and goes downstairs to take a subway train, which usually consists of a motor or grip car for ordinary passengers, and a smaller trail car behind for those who want to smoke and spit (and they all do that), he is tempted to wonder whether the management of the line is in league with all the opticians of the country to create serious eye trouble.

As a rule, the trains each carry and burn half-a-dozen ordinary oil lamps, which give a dim, religious, but fairly regular light. Each car, however, is also fitted with half-a-dozen or so electric lights, which vary in candle-

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power perhaps from that of the proverbial red-hot hairpin to just short of bursting point, and all within the merest fraction of a second. As for the voltage, the lamps appear to be intended for a pressure of 110 volts, but if so, it must range from nearly zero to 120 or 130.

On inquiry as to the probable cause, the explanation given by one local man was that the company had had a lot of trouble with its electric mains, owing to dampness in the tunnels, which, it may be explained, are of brick, and not of cast-iron, like the London electric undergrounds. The current for lighting stations and rolling stock, it should have been stated, comes from the cable power house, and is, for the latter purpose, led into a couple of iron T-shaped conductors carried on insulators and pins fastened into the tunnel walls at, or near, the level of the eaves of the cars. Contact with the cars is made by means of a sort of double trolley or sliding contact at the front end of the car, which gives a fine pyrotechnic display as the car moves along.

Dampness in the tunnels might account, by leakage, for the car-lamp pressure dropping below normal, but not for the intensely rapid variations in the voltage and candle-power which make it almost impossible to read, or even to use the eyes at all, when in the cars. Of course, the method of collecting current is to blame, and no other result need have been expected from attaching the trolley contact to the car just at a point where its side motion, or oscillations, would be greatest.

This criticism was met by the statement that the tunnels are so small, and the rolling stock so close fitting (though only on a 4-foot gauge), that it is quite impossible to have the contact on top of the car, and the use of a cable for driving—with its attendant pulleys, &c.—prevents a third rail being employed for the electric contact.

Of course, it might be replied that electric traction had better be substituted for the noisy and ever-dangerous cable; the mere thought of seeing a reckless, drunken man, on one of the station platforms a yard or two away from the exposed running cable, is enough to give one a nightmare; but since it is claimed that the working expenses of cable driving are much less than those of electric traction could possibly be, then the next obvious thing to do is to put in a small regulating battery on each train. Or if that is considered too costly, why not use a system of train electric lighting like that adopted on the Brighton and so many other lines, or else dispense with electricity altogether in favour of compressed gas?

Nothing could appear worse than the oil lamps and absurd attempts at electric lighting now in vogue, and no electrical engineer could see the latter without a blush of shame to think that such things can be done in the name of electricity.

It may, by the way, be noted that at the recent annual general meeting of this Subway Company, the question of electric working was again raised by shareholders, and it is probably raised still oftener by the general public. Granted that cable driving may give a lower percentage of expenses to receipts, the greater popularity of electric working, due to its quietness and flexibility, might yet so increase the total receipts by inducing more passengers to travel, that the net results would be no worse, but perhaps even better, than at present.

It is, however, rather a timorous shirking of the problem for the chairman to say—as he is reported to have done—that "one of their greatest misfortunes had been in connection with their electricity, but they would again go into the matter." The directors should do it at once, with a bold front, and not fear that because they may have had a defective electrical arrangement in one direction, therefore they had better keep clear of electricity altogether.

The second instance of ingenuity misapplied may be found on the local line of the North British Railway, which runs east and west through Glasgow, and for three or four miles under cover. Of course, for such a comparatively short run, even though comprising as many stations as miles, and one very important station—Queen Street—it could hardly be expected that the rolling stock should be provided with gas, or other such lamps, kept lighted all day long, just for the 10 or 15 minutes occupied in traversing the city each time the train passes.

An attempt, therefore, has been made to use electricity as a suitable means of providing light, and here one sees the same sort of infantile effort to give light as on the subway. A couple of small candle-powered lamps are put into each compartment, and at times, when the train is stationary, the light is not much below half the normal. When running, however, one sees the same painful flickering from "nothing" up to "not much;" and the reading of a paper, or practical use of the eyes at all, is quite impossible. Yet here the absence of a cable has given opportunity for a third rail, from which the current is taken; but a broad disc or wheel is employed at the rear of each train to pick up the current, and the fitness of such an arrangement, considering the rust and dirt which must inevitably gather on the third rail, would be questioned (one might suppose) by the veriest tyro.

What is wanted is either a brush contact, which would, of course, spark and soon wear out, or else a sliding contact like that used on the Liverpool Overhead Railway; but better still, to employ the Stone system, or a similar method of using the train's energy to generate and store up electric energy to be switched on when required by the guard or other responsible person on the train; or it might even be done automatically.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

18,759. "Improvements in disconnecting boxes for electric and other cables." C. C. Fowler and The Reason Manufacturing Company, Limited. Dated September 18th.

18,768. "Improvements in the means of enclosing wires for use in connection with electrical installations." A. Normanton and R. O'Brien. Dated September 18th.

18,769. "A new or improved arrangement in conjunction with telephoning." H. Salmon. Dated September 18th.

18,744. "An automatic gravity electric fuse replacer." J. R. Craig, Jun., and A. M. Owler. Dated September 18th.

18,776. "A new or improved arrangement of driving mechanism for connecting electro-motors to machinery." G. J. Gibbs. Dated September 18th.

18,797. "Improvements in method and means for simultaneous electric telegraphy and telephony." C. A. Randall. Dated September 18th.

18,811. "Improvements in conduits for electric conductors." J. J. Bate Dated September 18th.

18,868. "An improved dynamo." M. H. Hurrell. Dated September 19th.

18,870. "Improved manufacture of insulating material." A. J. Boult. (J. Jungbluth, Germany.) Dated September 19th. (Complete.)

18,891. "Improvements in instruments for use in measuring electrical resistances and currents." F. H. Elkington. Dated September 19th.

18,892. "Improvements in electrical 'damping' apparatus." G. W. Johnson. (Hartmann & Braun, Germany.) Dated September 19th.

18,904. "Improvements in the method of and means for preventing electric sparking at contacts in circuits, including electro-magnet coils or other coils or conductors in which a self-inductive or sparking capacity exists." W. L. Wise. (C. L. Buckingham, United States.) Dated September 19th.

18,910. "Improvements in electricity meters." H. L. P. Boot. Dated September 20th.

18,953 "Improvements in electric motor vehicles." H. Leitner. Dated September 20th.

18,962. "Improvements in telephone registering apparatus." O. Linke-Graf and J. Geiger-Benz. Dated September 20th. (Complete.)

18,968. "Improvements in or relating to electric incandescent lamps." W. P. Thompson. (A. Sinding-Larsen, Norway.) Dated September 20th. (Complete.)

18,972. "Improvements in switches for electric lamps." J. Hunter. Dated September 20th.

18,980. "Improvements in telegraphic apparatus." A. C. Crehore and G. O. Squier. Dated September 20th.

18,989. "Improvements in automatic devices for use in connection with motor starting and regulating switches." W. J. Spikins and A. H. Mayes. Dated September 21st.

18,996. "Improvement in apparatus for telegraphing." H. W. C. Cox. Dated September 21st.

19,020. "Improvement in electric arc lamps." T. Wilby. Dated September 21st.

19,026. "A new or improved electro-magnetic brake for cycles, motor cars, and other wheeled vehicles." A. E. Patrick. Dated September 21st.

19,031. "Improvements in driving and steering gear for electrically-propelled motor vehicles." E. Kuhlstein and J. Vollmer. Dated September 21st. (Complete.)

19,035. "An electro-chemical method of disintegrating rocks carrying minerals." C. H. Logan. Dated September 21st.

19,065. "Improvements in and in the manufacture of the balance weight fittings of electric lamps." R. F. Hall. Dated September 22nd.

19,103. "Improvements in telephone conductors or cables." The Joint Stock Company (styled Kabelwerk Rheydt, and J. Zappe, and A. Hohnholz). Dated September 22nd.

19,105. "Improvements in secondary batteries." P. A. Chalas. Dated September 22nd.

19,124. "Improvements in electric thermostat." J. E. Spagnoletti. Dated September 22nd.

19,148. "An electric pull switch." C. I. Cummins. Dated September 23rd.

19,189. "Means and apparatus for electrically working vacuum and air pressure railway brakes." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated September 23rd.

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ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

143. "Improvements in electric arc lamps." W. J. Davy and G. Thomas-Davies. Dated January 3rd, 1898. Relates to clutch arc lamps with enclosed arcs in section. The frame of a lamp consists of an externally ribbed dome, an insulator, a central tube, a chamber made in two parts and screwed together, and two rods depending from this chamber to support an open yoke, not shown. An insulator supports an outer casing. An outer globe is supported by a nut and screw on a cross-bar, which rests in notches in the yoke. The inner globe and lower carbon are carried by a holder on a spring in the cross-bar. The upper carbon is inserted in a guide which slides in an inner tube, movable vertically in the tube; the guide has a conical top carrying balls to maintain electrical connection with the inner tube. The upper carbon passes between two jaws carried by pairs of links, which are pivoted together and hung by other links from a collar and disc on the end of the inner tube, so that when they are lifted from the bottom of the chamber they grip and lift the carbon. The inner tube is linked to a dash-pot which is hung by cords from pulleys carried by the tube, the outer ends of the cords being attached to a sliding ring; this supports a U-shaped core above two series coils, and a similar core below two shunt coils, carried by the tube. The piston of the dash-pot is supported by this tube. Series resistance or impedance coil is held between the dome and a lining. A cut-out is provided consisting of a horse-shoe electro-magnet situated above an armature, which is pivoted upon the top of the chamber and is thus in electrical connection with one terminal of the lamp. The magnet core is connected electrically through the coil on it with the other terminal of the lamp. The action of the shunt regulating coils may cause their core to lift the cut-out armature into contact with its electro-magnet, which then maintains this contact, short-circuiting the lamp. 4 claims.

166. "Improvements in the method of fixing and suspending bare electric conductors." A. S. Blackburn and N. H. White. Dated January 3rd, 1898. Bare conductors such as those employed in electric railways and tramways are supported by clips attached to pivoted insulators. An insulated conductor in the form of horns is mounted over the insulator and is connected to the earth return circuit. Snugs are formed on the ends of the clip, and on the breakage of the wire make contact with one or other of the horns so as to short-circuit the generator and fuse which is at once broken. Guy wires may take the place of the snugs, the horns being suitably modified, or a loop of wire may pass over a metal plate, as a substitute for the horns, and be drawn into contact therewith on breakage of the wire. 2 claims.

462. "Improvements in or connected with electric mains." G. H. Nisbett. Dated January 7th, 1898. Relates to conduits or mains for electric conductors are formed of glazed earthenware, &c., made in sections, and are arranged to contain either bare or lightly insulated or armoured conductors of any pattern. The troughing is of rectangular or circular outer section, and is closed by a lid. The troughing is preferably rounded on its lower inner surface, and is provided with either fixed or movable bridge pieces on which the conductor rests. The remaining space is preferably, but not necessarily, filled with bituminous material. The troughs may fit together by various patterns of jointing, and the lids are cemented into position. One or more cables are placed in each trough. The ends of the sections may be chamfered for ease in making branches. 8 claims.

1899.

1,024. "Improvements in dynamometrical apparatus." H. Bouron. Dated January 16th, 1899. Relates to calculators of the work absorbed by a transmitting shaft in motion and consists in replacing the usual balance springs by hydraulic balances. One modification consists of a reservoir filled with water communicating with a manometer and closed by an elastic and impermeable membrane attached to the reservoir by means of a bridle in which a block can slide. This block bears evenly on the whole surface of the membrane left free in the interior of the bridle. 1 claim.

2,726. "Improvements in electrical measuring instruments." J. W. Flower and T. E. Gambrell. Dated February 7th, 1899. Relates to measuring instruments of the d'Arsonval type. Consists in the use of a coil very thin in proportion to its other dimensions, enabling the poles of the magnets to be brought very close together thus producing an intense magnetic field. 2 claims.

3,233. "Improvements in conduits for cables for carrying electric currents." L. Bolknap and A. Sundh. Dated February 14th, 1899. Relates to the protective case employed for protecting the cable from fire, water, and wear. Consists of a flexible rubber tube and flexible metallic armour in the case. 8 claims.

3,717. "Improvements in 'switch throwers' for steering electric tramcars and the like." O. Ward, jun. Dated February 20th, 1899. Consists of a shaft located below the platform of the car and journalled thereto. A foot lever in movable connection with said shaft, and located slightly above the floor of the platform a spring for holding the foot lever in an elevated position, a thrower which co-operates with the ordinary switch forming a part of the track, and hinged to one end of the shaft a hand lever pivoted to the dashboard of the platform and projecting through the platform, and suitable connection between said thrower and lever. 1 claim.

4,276. "Improvements in automatic potential regulators for dynamos." N. Browne. (The Thrrill Automatic Potential Regulator Company, United States.) Dated February 27th, 1899. Refers to 1,535 of 1889. Consists in a combination with the solenoid coils, their core and the lever having specially constructed contact points of a subjacent spring bearing a contact point and a clamping support made adjustable to grasp the spring at different points, so as to vary its range of vibrations. 7 claims.

4,774. "An improved electrical cut-out or fuse." F. W. Heaton and H. Smith. Dated March 4th, 1899. Relates to an improved method of insulating the terminals of cut-outs. The cut-out is made entirely of porcelain, and the fuse is bent round in the form of an M, and a V-shaped cavity is made to receive the V portion of the M. 4 claims.

5,111. "A new or improved electrically operated gas tap and apparatus for lighting at a distance." G. Schuneemann and O. Rieder. Dated March 8th, 1899. Consists of a gas tap in connection with an apparatus which lights the escaping gas, both operated by electricity. The tap is worked through the medium of an electro-magnet, lever and pawl, and ratchet wheel, and an electric spark causes the gas to light. 4 claims.

5,190. "Improvements in telephone switchboards." J. M. Overshiner. Dated March 9th, 1899. Relates to the construction of the switch and drop device. Consists mainly in the combination of a jack, a drop, a latch for the drop, and an electro-magnet for controlling the latch, of contact arms secured to the respective sides of the jacks, one of which is included in circuit with the coils of the electro-magnet a spring arm placed near each side of the jack, and having buttons on their free ends whereby to permit them to be forced against the contact arms, one of the spring arms being included in a listening circuit and the other spring arm being included in a signal circuit, the latter spring arm being adapted to move the operating contact arm so as to open circuit the magnet coil when the signal circuit is closed. 22 claims.

5,217. "Improved construction of commutators for dynamos and electromotors." J. Burke. Dated March 10th, 1899. Consists in giving the commutator bars an angular or curved cross-section, so that each single bar is held in position by the adjacent bars on each side of it. 1 claim.

5,572. "Improvements in insulators for carrying electric line wires." G. Neitstrang. Dated March 14th, 1899. The insulator consists of two sections, one of which is more or less hollow and adapted to be connected to the screw of the spike or bolt by which the same may be attached to a wall or other surface, the upper portion of which is provided with a neck which has a male thread formed thereon, and in the neck is formed transversally a straight irregular zig-zag or otherwise undulatory passage through which the line wire is passed. The latter being gripped by means of an internally threaded cap forming the second section. 4 claims.

5,941. "Improvements in incandescent electric lamps." The British Thomson-Houston Company, Limited. (E. W. Rice, jun., United States.) Dated March 18th, 1899. Relates to electric lights. The filament is made of an incandescing body composed of a material which is a non-conductor at ordinary temperatures, but becomes conducting only at high temperatures. A heating device is therefor provided which, when it has heated the filament sufficiently, stops heating. 8 claims.

6,024. "Improvements in and relating to electrical incandescence lamps." V. J. Feeny. (Allgemeine Elektricitats Gesellschaft, Germany.) Dated March 20th, 1899. Consists of a lamp with an illuminating body composed of electrolytes for non-automatic excitation, a box inserted in the usual holders in combination with a globe fixed directly to the holding ring. 3 claims.

6,025. "Improvements in and relating to electrical incandescence lamps." V. J. Feeny. (Allgemeine Elektricitats Gesellschaft, Germany.) Dated March 29th, 1899. Relates to improvements in electric lamps with second class conductors. Consists of a base which carries the illuminating body and of a lampholder for receiving the base and in the form of a switch lampholder. 1 claim.

6,026. "Improvements in and relating to electrical incandescence lamps." V. J. Feeny. (Allgemeine Electricitats Gesellschaft, Germany.) Dated March 20th 1899. Consists of a lamp with illuminating bodies made of second class conductors, the distinguishing feature of which is that of the three pairs of contacts between the base and the lamp-holder, two are formed as sliding or sliding spring contacts, spring piston contacts, or bayonet catches, for the purpose of securing a simple and cheap connection. 1 claim.

6,026. "Process for the production of electrical resistances with small heating capacity." V. J. Feeny. (Allgemeine Elektricitats-Gesellschaft, Germany.) Dated March 20th, 1899. Relates to the heating of resistances. Consists in reducing to a minimum the insulating bearer or core for the conducting material by winding the wire on rods having thin sides made of insulating material. 2 claims.

6,167. "Improvements in electric arc lamps." W. C. Johnson and A. Wunderlich. Dated March 21st, 1899. Relates to Specification 4,231, 1899. A choking coil is substituted for the resistance coil. Two lateral solenoids are substituted for one in the above specification. 2 claims.

6,213. "Improvements in insulating lining for electrical apparatus and process of making same." The British Thomson-Houston Co., Ltd. (G. B. Painter, United States.) Dated March 22nd, 1899. Relates to that class of electrical apparatus in which a metallic shell surrounds other metallic parts serving to carry an electric current. Consists in forming a single lining made of one piece and of a means of working insulating material. 6 claims.

6,270. "Improvements in combined electrical switches and lampholders." R. F. Hall. Dated March 23rd, 1899. Relates to electric lampholders. Consists in the employment of a movable or rotating block of non-conducting material having directed through it a pair of separated metallic conductors which are adapted to be brought in line with upper and lower sets of plungers or contact pieces to make the circuit and out of line with such contacts to break the circuit. 2 claims.

6,300. "Improvements in apparatus for electro-plating." H. Beckmann. Dated March 23rd, 1899. Relates to an improved apparatus for electro-plating small articles in large quantities. Consists of a rotary shaft within a tank, and in electrical contact with the negative pole of a battery, and carrying two or more adjustable discs or wheels. 8 claims.

6,347. "Improvements in electric brakes for railway and tramway vehicles." W. L. Wise. (The Action Gesellschaft Elektricitats-werke, vorm V. L. Kummer and Co., Germany.) Dated March 23rd, 1899. Relates to an electric brake for electric railway and tramway vehicles. The brake bands or blocks are applied by means of one or more electro-magnets energised by the short circuit current of the motor, whilst for emergency the same brake bands or blocks are applied by spring or weight force which is operated when the trailer is separated from the motor vehicle. 4 claims.

6,420. "Improvements relating to electrical resistance boxes and like apparatus, and to switches therefor." C. T. Gambrell and T. E. Gambrell. Dated March 24th, 1899. Relates to electrical resistance boxes and like apparatus. Chiefly consists in the use of a conducting bar arranged in proximity to each series of fixed contact pieces and provided with a sliding contact block which can be brought into engagement with either of the fixed contact pieces. 8 claims.

6,443. "An improved pocket galvanometer." C. Beez. Dated March 25th, 1899. Relates to pocket galvanometers. Consists in an improved contact carrier, one of which is secured to the galvanometer by a conducting cord while the other is detachable. 2 claims.

6,479. "Improvements in electric arc lamps." R. F. Hall. Dated March 25th, 1899. Relates to the feed mechanism of arc lamps and is worked on the principle of an Archemedian screw. 3 claims.

6,510. "Differential hot wire voltmeter." A. M. Clark. (Hartmann & Braun, Germany.) Dated March 25th, 1899. Consists in measuring by means of the compensation of different tensions of elastic wires as produced by an electric current or currents. 1 claim.

6,582. "Improvements in or relating to current regulators for electric batteries." M. E. Field. Dated March 27th, 1899. Relates to current regulators for electro-medical batteries. Consists of a regulator capable of gradually varying the current from a very small to as large a one as the patient can endure. 2 claims.

6,582. "Electrical furnace with peripheral heating by means of electrical resistances." D. Lance, R. L. E. de Bourgade, and L. Schmitz. Dated March 27th, 1899. (Date applied for under Sec. 103, Act 1883, August 29th, 1898, being date of application in France.) Consists of a chamber of annular form containing two compartments, (1) a supply chamber enclosing fragments of porcelain capable of dividing the current of gas; (2) a reaction chamber heated over its entire periphery by means of conducting wires. 1 claim.

6,647. "Improvements in wall plugs for electric lighting and heating." A. P. Lundberg and G. C. Lundberg. Dated March 28th, 1899. Relates to wall plugs and connections of the two-pin type. Consists in split contact pins which fit on wedges enclosed in tubes thus making a tight connection. 1 claim.

6,664. "Improvements in carbons for electric arc lamps." D. Bacon. Dated March 28th, 1899. Consists in an electric arc lamp carbon having a longitudinal groove extending inwardly as far as the circumferential line of the crater or arc, but not to the axis or centre of the carbon. 1 claim.

6,883. "Improvements in apparatus for the production of silent electric discharges." M. Otto. Dated March 30th, 1899. Relates to 11,010, 18,7. Consists of movable separating discs having alternately conducting and insulating sectors for the purpose of giving successive startings and interruptions. 1 claim.

7,883. "Improvements in means for supplying current to electrically propelled vehicles." W. H. Wheatley. (D. G. Stoughton, United States.) Dated April 14th, 1899. Relates especially to trams and railway vehicles with a line conductor midway between the rails. Consists of an enclosed electric line conductor, automatically operating covering leaves, a wheel electrode, a leaf opener adapted to precede the wheel electrode and leaf opener. 9 claims.

7,886. "Improvements in apparatus for producing electric sparks." H. H. Lake. (A. R. Shattuck, United States.) Dated April 14th, 1899. Relates to the ignition of gas by electric sparks. The spark is produced by means of an induction coil having in the circuit a simple commutator. 1 claim.

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THE

ELECTRICAL REVIEW.

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THE

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1899

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TRANSMISSION OF POWER IN FACTORIES.

QUIETLY, but surely, electrical transmission of power in factories is superseding the methods of the old millwright with his shafting, pulleys, belting, bevel wheels, spur wheels and ropes, with all their attendant friction, oil, dirt, noise and danger.

The cost of up-keep in factories, due to renewal of transmission gear, is considerable if the gear is kept in first-class order; but, as a rule, it is not kept so, and there is, consequently, a considerable waste of power, and, therefore, of money.

In many places belts are supposed to be almost everlasting. They are renewed bit by bit, a foot or two at a time, till at last nothing remains of the original belt; yet it is considered to be the same old belt.

Similarly with shafting, it gets out of line due to unequal wear and changes in buildings. It is exceedingly difficult to locate all the sources of losses in mechanical distribution of power; we can only find approximately by careful indications of the engine, what amount of power is delivered in driving machines. What is lost over all the system in most cases amounts to 50 per cent., and sometimes more. The greatest loss is being incurred not when everything is working to make profits, but when many of the tools and machines are idle.

There are two distinct cases for consideration in electrical power transmission — first, when it is desired to drive machinery at a distance by some available surplus power. In this case only one generator and one motor might be used, distributing the power by shafting and belting, wheels, &c. This plan should be adopted only in a case where the mechanical distribution system already exists and objections are raised to its removal. In any case, however, there would be a gain in using the surplus power, but the gain would be greater if the power were not only transmitted from the generator to the works, but also distributed among the various machines by electricity, for not only is there the advantage of utilising cheap power, but also of saving the losses which occur in mechanical distribution.

The second case is more commonly met with, viz., where the generator is on the premises, and the power is to be distributed only among machines situated within a few hundred yards radius.

In some places the attempt has been made to drive groups of machines from line shafts driven by fairly large motors; this system is a mixed one, and is only successful where the machines to be driven are very small, such as sewing machines, 20 or 25 to the horse-power; even in this case it is not advisable to run larger units than 4 H.P. each.

Where a few large motors are put down to run lines of shafting from a generator on the spot, there is no gain as regards economy, although in some cases it may have certain conveniences.

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Except in the case of sewing machines and such like, one motor to each machine is the better system; in such a system the whole of the advantages of electrical distribution of power are secured, and nearly the whole of the mechanical losses abolished. The losses are nearly the same in percentage at all loads, not greatest at least load and least with greatest load, as in mechanical distribution.

In many cases the reduced speed can be obtained by a belt drive from motor to machine. A good deal has been said about gearing for motors, and whether it should be belt or spur wheel gearing, but no hard and fast rule can be made in this matter.

Belt driving is a necessity in some cases, as it forms the necessary flexible link protecting the motor from jarring shocks, and many machines run smoother with belt driving from the motors, such as paper cutting guillotines, litho. presses, stamping machines, and so on. Then, again, many machines are built for belt driving, and it will be found in most of them that the driving shaft, not being designed for wheel gearing, is not fitted to carry gear wheels stiffly and truly enough for satisfactory working, and no allowance is made for taking up wear and tear on the bearings. In all these cases belt driving from the motor must be adopted, whether we like it or not, unless we go to considerable expense in altering the driven machines.

Spur wheel gearing, using a raw hide pinion, is no doubt the most elegant gearing, and where it can be properly fitted with wheels truly in gear, and so fitted that under all loads they remain so, it should be adopted in ordinary practice; this adaptability is not often to be found. Only in cases where the driven machines are built with electrical driving in view, does wheel gearing prove entirely successful. If a machine is built for belt driving, as a rule it should be geared by belts.

As to efficiency, if a belt is properly proportioned to its work, speed, and size of pulleys, its efficiency is as high as wheel gearing of the best, but it generally takes up more room.

The gearing of motors is always an important question. In connection with this, the speed of the motors must be considered. Motors can be built for such a slow speed as to require no gearing for speed purposes, but their first cost is prohibitive. A 4-H.P. motor to run at 300 revolutions per minute costs, from a well-known maker's quotation, £112; a 4-H.P. motor at 1,200 revolutions per minute costs £43; so that in a factory using motors, the first cost will be about three times more for slow speed than for high speed motors, and so high that only millionaires could afford them. And after all they do not last longer, nor are they cheaper in repairs; all they save is simply the gearing. The slow-speed motor for direct driving is a luxury for the wealthy manufacturer.

Now as to motors themselves. About the only good that has come out of fire insurance companies dabbling in rules for safety in motors, is the adoption of enclosed motors. This has been a real blessing in disguise; it has done more to bring British makers into uniformity of designs than anything else. The enclosed motor is the only one for factory work. Of course fire risk with motors is small, but short circuits occur sometimes, and with 200, 250 and 500 volts coming into use the risks are greater. A short circuit often results in burning insulation, and sometimes in globules of molten copper. These are much better confined to the inside of an enclosed motor.

Of late fancy wire winding has become common on armatures made by some firms. It is cheap to put on, the coils being made in a former; it looks pretty, but it is weak in insulation and easily damaged. Nothing can equal plain Gramme ring winding between teeth on an armature; it is easily replaced and as easily perfectly insulated.

The ring armature, as made by some American firms, large in diameter and narrow, working in four and six-pole fields, has much to recommend it, having plenty of ventilation and considerable fly-wheel effect.

Speaking from actual experience, a well-known engineer informs us that he has, in less than 12 months, come across no less than 17 failures in insulation in motors with so-called symmetrical windings, while in the same time, out of some scores of plain toothed Gramme ring armatures, insulation has held without a failure.

The enclosed motor need not be gas and water-tight, but should be tight enough to effectually prevent any melted flying metal or burning insulation from escaping.

In most cases where the power is considerable, it is cheaper to generate the electricity on the spot. For over 100 H.P., probably a steam plant is the cheapest, but gas engines of large power are now so perfect that a dynamo and gas engine generator is sometimes preferable.

A gas engine requires large fly-wheel power, and for power distribution purposes there is no reason why fly-wheel dynamos with the armature on the gas engine shaft, should not be used.

In towns where a continuous current supply at 1d. per unit can be got, this generator question may be ignored, for taking everything into account, it would be better to take the supply from the street mains. Even at 2d. per unit, there are very many cases where factories would be better supplied than by their own steam or gas plant.

The introduction of high pressure into public supplies is in some respects a drawback to direct supply for motors; 220 volts is high enough for any motor in factories, this can be handled with liberty and safety, and has not a single drawback. The extraordinary precautions insisted upon by supply companies, &c., in using motors on their mains at 500 volts, supports the view that such pressures are too high for every day motor work. On these grounds, the isolated plant still holds the field for power work, inasmuch as the pressure can be chosen freely.

The question of private lighting and power plants combined, is one of some interest. In most factories the lighting season is very short, so that it does not pay to keep a plant large enough to do all the lighting and power; in some cases 1,000 lights may be found in a factory in which the machinery is run by 50 H.P.; the 1,000 lights are wanted only for a few hours a day in winter time, while the power is needed eight or 10 hours a day all the year round. In these cases, while it pays to use electric power, it does not pay to keep the 100-H.P. lighting plant idle two-thirds of the time.

Finally, the motor business in factories could be much extended by greater facilities in getting delivery of motors; the scarcity of motors in stock keeps up a fictitious price and greatly hampers those who are promoting the adoption of power distribution by electric motors.

Something might be said about motor starting switches, but that detail, perhaps, deserves an article to itself.

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SIEMENS & HALSKE'S WEHNELT BREAK.

What appears to be a very efficient and well designed form of the Wehnelt break has lately been brought out by the firm of Siemens & Halske. The platinum wire anode is not introduced laterally into the acid vessel, as has hitherto been the common arrangement, but from above through the lid of the vessel, as shown in fig. 1. This gets over the difficulty of making a fluid-tight joint. The platinum wire passes down through a vulcanite tube with a porcelain nozzle, and the length of the electrode may be varied from 0 to 20 mm. by means of a screw at the top. The frequency of the breaks can thus be varied from a few to 1,700 per second. The apparatus is fitted with a cooling arrangement, which, by means of a slow circulation of water, prevents the temperature of the electrolyte rising above 35° C., even with long continued use and heavy currents.

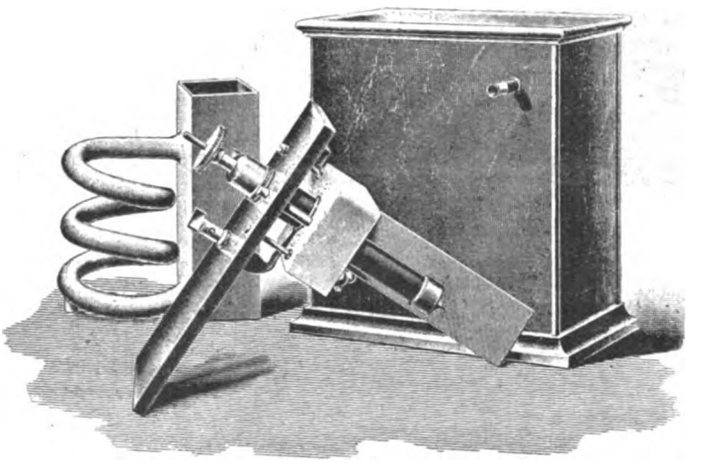

Fig. 1.

The primary coils of the Siemens & Halske inductors are specially designed to work with pressures of supply mains from 220 to 110 volts, no controlling resistance being necessary to obtain the maximum spark length. The break works satisfactorily from alternating current mains.

Fig. 2 shows the discharge obtained from a 30 cm. inductor, copied from a photograph taken with an exposure of two seconds.

The firm supplies a Röntgen ray outfit

Fig. 4.

specially adapted for use with this break This is illustrated in fig. 3. With this apparatus ordinary Röntgen photographs can be taken with an exposure of two seconds, and photographs of the human trunk in 10 seconds, without the aid of a fluorescent screen. Fig. 4 shows the instantaneous character of the break, the ordinates representing current and the abscissæ time.

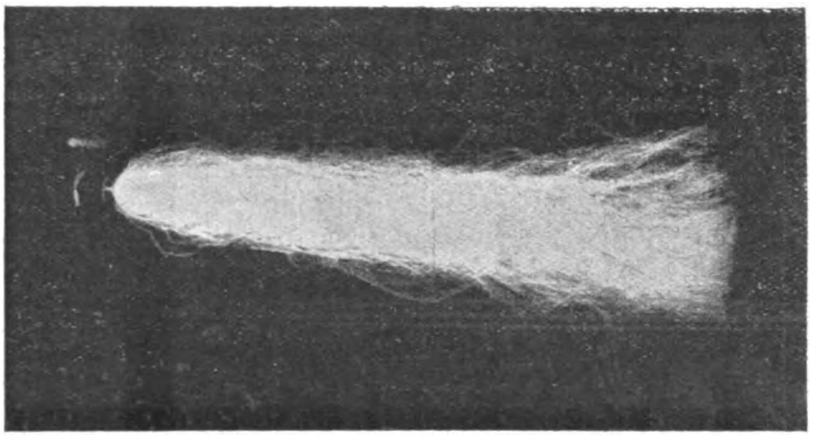

Fig. 2.

THE STRESSES IN CRANK-SHAFTS.

Apropos of this question, the indicator diagrams shown on the next page have been sent to us, and may prove both interesting and instructive, having been taken under peculiar circumstances. The diagrams are from an engine direct coupled to a traction generator. The engines are of compound tandem type, and the diagrams were taken simultaneously from each cylinder, by a couple of indicators with springs $\frac{1}{80}$th and $\frac{1}{20}$th scale.

The right-hand, or front end cards, had already been taken, and show a fairly steady load, the maximum and minimum diagram having been since inked in before photographing; the space between these appears dark, being filled with a large number of intermediate lines made by keeping the pencil pressed to the paper for a considerable time, but these have not been inked over. The two-way cocks were then turned to take the diagrams from the back ends of the cylinders, and dark shaded areas were traced out during numerous revolutions of the indicator cylinder with the pencil applied. While the pencil was still in contact, the circuit breaker went out, on account of a sudden demand for current on the line, or from some short circuit; and when the cards were removed from the instrument the high pressure card was found to have had two very full lines traced on it, as shown. As the engines revolved about four times per second, these two full

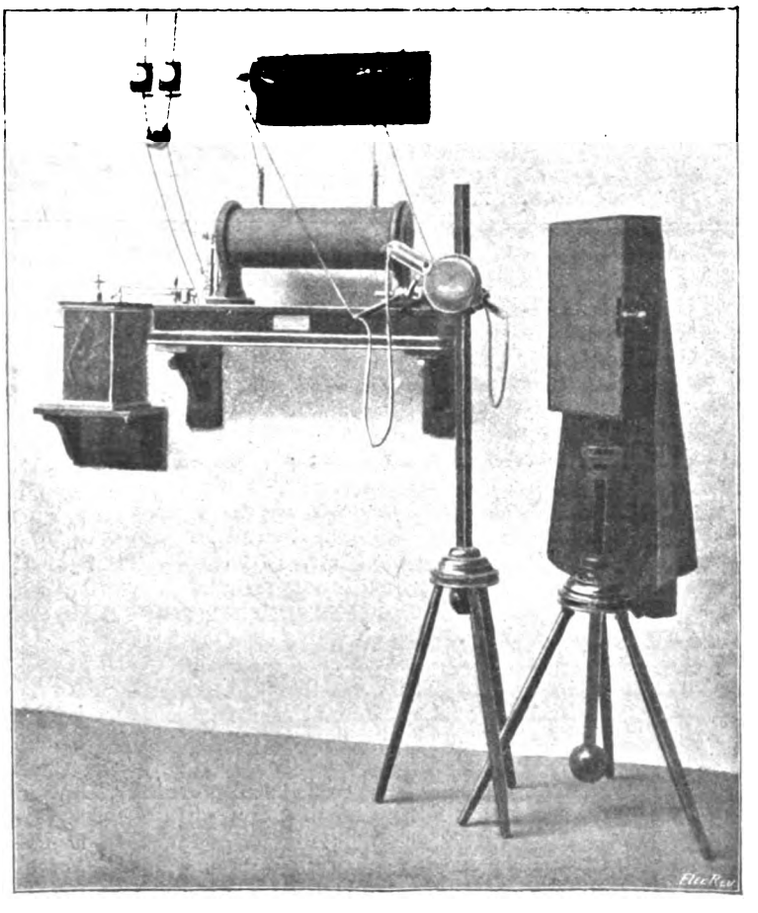

Fig. 3.

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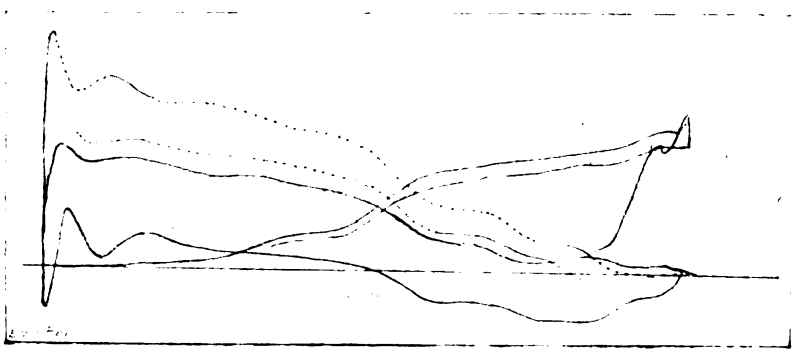
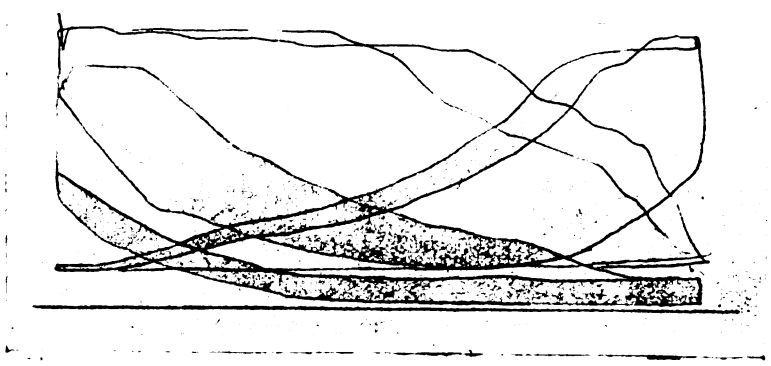
diagrams represent a time duration of nearly half a second (·375), during which the engine was responding to a large demand for current before the circuit breaker went out.

It is possible, of course, that simultaneous indications from the other end of the cylinder might show a full diagram, both preceding and following the strokes



Scale $\frac{1}{20}$.



Scale $\frac{1}{10}$.

shown in the figures obtained, which would imply a duration a little more extended, or ·625 of a second. Possibly the mean of half a second is fairly correct. Turning to the low pressure cylinder, the same effect is seen in two very full inked-in diagrams, followed by a line of very low pressure indeed, the lowest line of the low pressure diagram being evidently drawn after the circuit breaker had gone out. Negative work is shown by this lower line, the area below the atmosphere being greater than the area above it. A good deal is to be learned from these figures. They tell us that the energy called for by the line was such as to swallow up so much fly-wheel energy as to slow down the engines in a couple of revolutions, until steam was admitted by the governor to the fullest extent. At this moment the breaker went out from excess current, but not before the crankshaft had been made to transmit the stresses indicated. The probability is, therefore, that the rapidity of action of a circuit breaker is fairly good; that the stress caused by a sudden flush of current is dealt with at once by the fly-wheel, and that the maximum engine stress is that due to full pressure on the piston, acting at the full leverage of the crank-arm. Our correspondent, Mr. Taylor, as well as our previous contributor, appear both to have arrived at the same conclusion. A little confusion seems to have arisen merely on questions of detail. The designing of a shaft for a stress approximated at 50 per cent. in excess of the maximum steady power of an engine, was intended to represent the excess of the maximum torsion on the shaft, due to crank-phase, above the mean torsion. This is usually considered a good allowance. Then for stresses beyond the fly-wheel, double the stress suddenly applied should be provided for. But it is clear that the best circuit breakers will not confine such sudden stresses within absolute limits, and such being the case, it is the duty of designers so to design, that the stresses set up shall not require to be transmitted through the crankshaft, but shall be provided against by proper design of the generator and fly-wheel in the way of their direct connection. The diagrams herewith show, however, that the amount of current going out thus suddenly did not at once attain a maximum. The first large figure shows a cut-off at about half the stroke, followed next revolution by a cut-off at about two-thirds.

The speed variation of the engine is very small for the full action of the governor, so that it is clear there was no very serious diminution of speed during the first revolution, when the current was running up. A second revolution was required before the current attained such a flow as to throw out the circuit breaker. These particular diagrams were caused, in all probability, by the nearly simultaneous starting of a number of cars uphill, and it is extremely improbable that a number of cars would ever start absolutely together. There would always be so much time interval as to give a definite time duration to the growth of current volume. Enormous stresses are not likely to be caused by the cars in ordinary action. The point of limit of the circuit breaker will be reached only after a definite interval, and the breaker will open and prevent further stress. It is doubtful if the suddenness of addition of load can ever approximate to the point at which it causes a double stress.

What, however, are the conditions for a sudden short circuit, such as might be caused by a broken guard wire? We think, again, there would be such a fall in voltage, and so much lag in the machine, as to represent a distinct time interval in the growth of current, and that the protection of the current breaker is something real. We are unaware of any indicator diagrams having been secured under such conditions. The probability of a dead short circuit occurring just when diagrams are being taken is very slight indeed, and such diagrams could only be secured by actual experiment, by an intentionally produced short circuit, which no station engineer would be justified in doing without special leave. To render the diagrams clearer, it may be added, for those who care to measure their relative areas, that, as regards the high pressure diagrams, the ordinary load, as shown by the left-hand figure, is represented by the area between the lowest but one and the fourth curves, the large power figures having the third curve for their lower boundary. The lowest curve is the lower boundary of the smallest of the many diagrams which are included below the fourth curve. This fourth curve is the top or steam line of the largest diagram developed in the course of numerous revolutions at ordinary load. The maximum power shown by the diagrams from the H.P. cylinder is thus about double the maximum ordinary load, and the same is shown by the low pressure diagram. The maximum ordinary diagram, however, represents a power much less than the rated power of the engines. The maximum reading, therefore, is by no means indicative of any seriously faulty action on the part of the circuit breaker.

The subject is one on which it is desirable that more light should be thrown, and we should be pleased to receive any diagrams, with particulars, that would further elucidate matters.

THE PRACTICAL LIMITATIONS OF DRY BATTERIES.

During the last 10 years a large number of so-called dry batteries have been placed on the market, and as the facilities of transport and storage are recognised, additional cells are being rapidly introduced.

These new cells are in many cases only new in name, the composition of the great majority being similar, if we except one case where it is directed that about a pint of water should be poured into the "dry" cell to bring it into action.

The stimulus given to the production of "dry cells" has

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caused manufacturers to recommend them as being of so many amperes capacity, 6-ampere and 12-ampere cells, for example, which is a very misleading description, as these cells are simply a form of agglomerate Leclanché in which the depolarising amorphous manganese and carbon powder takes the place of the agglomerate blocks, while the exciting solution of ammonium chloride is replaced by a paste, which is supposed to remain in a moist condition.

The 6 or 12 amperes referred to could only be ensured *for a few seconds* by short-circuiting the cell, and could not be obtained as a working current unless a large number of such cells were connected in parallel.

As the effective force of all Leclanché elements is lowered principally by polarisation, it may be admitted that, if an ordinary Leclanché element were made of sufficient size, heavy currents could be obtained from it, but experience has proved that the volume of depolarising material being the same in each case, a Leclanché cell having a liquid excitant is much more effective than any dry cell.

Indeed, if the volume in cubic inches of any dry cell be ascertained, it will be found that a continuous current of more than 1 milliampere per cubic inch (approximately) cannot be obtained without a rapid fall in E.M.F., but at this rate an average total amount of energy in watt-hours equal to about 1·1 times the total volume in cubic inches may be got from each cell before the force falls to 1 volt.

The measurements, taken in order to find the total volume, will in most cases be sufficiently accurate if it be taken over the zinc cylinder, but as some cells contain a layer of cork, or even a series of springs, to admit of expansion due to the production of water and ammonia, the effective volume can only be ascertained by opening the cell.

Currents much in excess of this value of 1 milliampere per cubic inch require very long intervals of rest, and as the energy produced costs about a halfpenny per watt-hour, it will be seen that small sized dry cells, although recommended for use with small voltage lamps, can only be used efficiently for this purpose for very short periods, with long intervals of rest between each period of work.

If the cost were calculated on the actual commercial value of the materials consumed, and if the cells were worked to exhaustion, the figure named might be considerably reduced, but as it would not be convenient in practice to employ an initial voltage largely in excess of the requirements, the minimum voltage would suffice. The effective life of the cells are supposed to lie between 1·5 and 1·0 volts, and the original average cost of the various cells is taken as the value of the material; for many purposes, however, a considerable amount of useful work could be got from dry cells which had fallen below the 1-volt level.

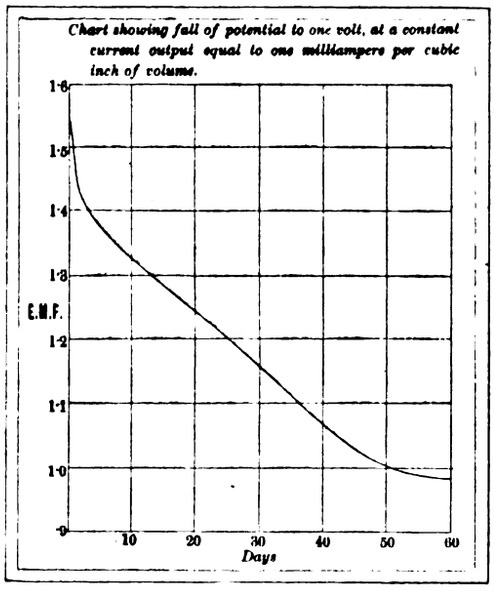

Fig. 1.

It will be seen that dry cells are limited in their application if efficiency is to be considered, and where manufacturers advocate their use for small incandescent lamps, some disappointment would be prevented if it were clearly understood that the lighting could only be depended on for brief periods, and that the titles "6" or "12"-ampere cells were only trade terms, having no electrical meaning.

As substitutes for ordinary Leclanché or other primary cells, there are many isolated situations where dry cells can be used effectively, as if they are not worked above their limit of efficiency, a saving is effected in the cost of the labour and

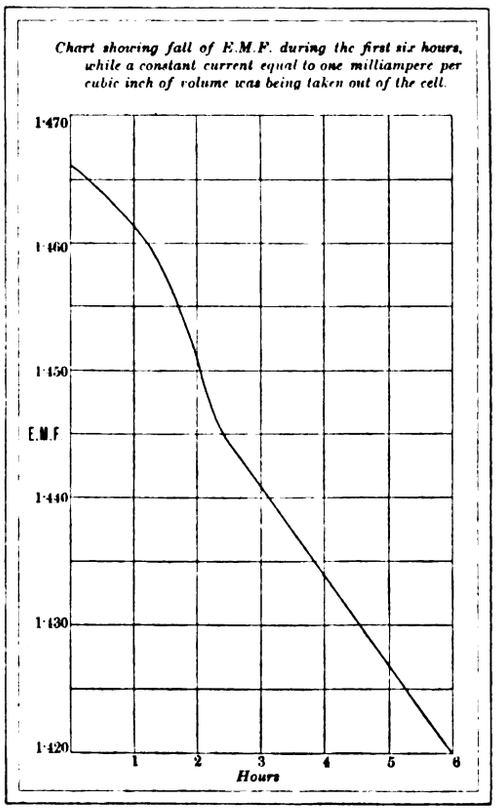

Fig. 2.

material involved in cleaning and replacing solutions which have become exhausted by evaporation or other causes.

For electric bells, dry cells are very useful, as even when the voltage of the cell has fallen from the usual initial voltage of 1·50 to 1·1, the rate of additional voltage fall is often extremely slow if more than 1 milliampere per cubic inch is not demanded.

Two curve diagrams are furnished, showing the fall in force where a constant current of 1 milliampere per cubic inch has been taken from dry cells. No. 1 diagram shows the gradual fall during the whole period covered by the observations down to a force of 1 volt, while No. 2 diagram furnishes the fall during the first six hours, and proves that for this particular current value, the force is fairly constant.

The question of the internal resistance of these cells has not been mentioned, but for a cell of, say, 30 cubic inches, the resistance will rise from ·5 to 3 ohms during use, while if stored without being used for 12 months or more the resistance is usually found to rise to 1 ohm.

If used to furnish current for small incandescent lamps from ordinary sized dry cells, the periods of lighting should be short, and very much less than the periods of rest, or the cells should be of large size and proportionate cost, which in the case of the ordinary consumer would be a sufficient reason for the adoption of some other source of power.

Dry cells have been tried for the purpose of producing the ignition spark for Petrol motors, but have not given satisfactory results for any length of time, unless of a cumbersome size, and it may be said that while a wide field is available for dry cells, electric lighting or the supply of current to motors cannot be said to be included in their sphere of efficiency.

The Economy of Electrical Working.—Sir Lepel H. Griffin, the chairman of the Burma Ruby Mines, told his shareholders the other day that the future industrial development of the world belonged to electricity. In consequence of the introduction of electricity for working the mines, the company is saving in the cost of wood alone £500 per month. The electrical installation is worked by water-power.

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ALUMINIUM CONDUCTORS.

Transmission Lines.*

The important transmission line, which carries the power of Snoqualmie Falls to the cities of Seattle and Tacoma, Washington, is unique in several particulars, among them that it is constructed of aluminium wire.

At the plant at the Falls there is a cavity 250 feet below the surface of the water, where the water wheels and electric generators are located. A steel pipe, 10 feet in diameter, leads the water there through a shaft, and thence it passes into and through the wheels, going finally into a tunnel, entering the river again several hundred feet below the Falls. There are four water wheels, each of 3,000 H.P. capacity, each of which drives an electric generator of corresponding capacity.

The current is led up through the shaft, down which the water goes, on aluminium wires into the transforming house, where the pressure is raised to the enormous figure of 30,000 volts. It passes from the power house over 12 aluminium wires, equally divided between two lines of poles. These two lines run 20 miles to Renton, and are there received at a station erected for the purpose, where there is a plug board. From Renton six wires go to Seattle, while the others go to Tacoma.

Aluminium tie wires are also used, and soft No. 8 B. & S. gauge wire was found best suited to the work. No electrolysis at the tie joints can take place with aluminium ties, which might be troublesome with iron or copper.

Line conductors are spliced with the McIntire joint, which consists of a flattened aluminium tube 9 inches long, and with walls $\frac{1}{16}$th of an inch thick, large enough to snugly enclose two wires. The whole is given three complete twists by special clamping tools, and the joint is complete.

The Seattle lines contain about 67,000 lbs. of wire, and the Tacoma lines 72,000. The line is approximately ·26 inch in diameter for the Seattle circuits, and ·23 inch in diameter for the Tacoma circuits.

It is carried on porcelain insulators, which are 4½ inches high and 6½ inches in diameter, weighing 4 lbs. each. Paraffined locust pins are used, supporting the lowest part of the insulator 4 inches above the cross-arm. Two circuits are run on each pole line, one on each side, with a triangular spacing of 30 inches between wires. Four wires on the lower cross-arm are spaced on either side, 25 inches and 75 inches from the centre of the pole; 25½ inches above on another cross-arm are two wires 40 inches on either side of the pole.

The cross-arms are 4½ × 6 inches; the poles are mostly 36 or 40 feet long, with 8-inch or 9-inch tops. In order to carry the wires at a uniform grade over the broken ground, longer and shorter poles were often necessary. In some places they were 70 feet long. The whole line is built in the most substantial manner. Poles are braced whenever necessary, and on all curves, turns, and crossings double cross-arms are used.

Methods of Joining Aluminium Wire.*

The interest in aluminium wire, which is becoming widespread on account of the continued high price of copper and the possible substitution of the newer metal, extends also to the details of the use of such wire in practice. There are presented herewith five illustrations of methods recently patented in Germany for making joints in aluminium wire, and described in one of our German contemporaries.

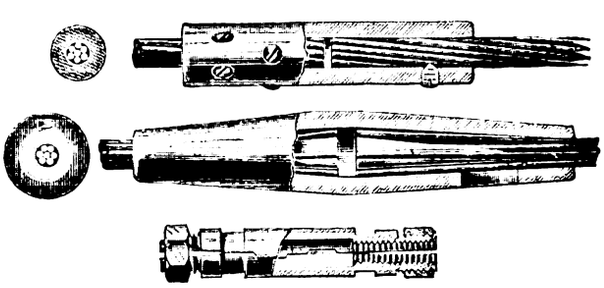
It is well known that it is an exceedingly difficult matter to solder aluminium. At the same time when a mechanical joint is made it is necessary that all the parts of it should be of aluminium, otherwise an electrolytic action will take place which will be very detrimental.

In fig. 1 is shown a simple connector, consisting of a slotted tube of aluminium with the end holes slightly coned. The wire ends are thrust through from the outside, bent around through the slotted hole, their ends upset by means of a hammer and hand vice, and then drawn back to the position shown. Fig. 2 is too simple to need description. After the halves of this clamp have been screwed together it is made fast by a pin driven through the threaded part. Fig. 3 shows an arrangement for clamping cables. This, it will be seen, is simply a short tube with numerous set-screws in it, so arranged that they will bind tightly the end of the

Fig. 1.

Fig. 2.

cable into the tube. In fig. 4 a simple and ingenious arrangement is displayed. It consists of a double-coned aluminium tube. A round conical wedge, having an axial hole through it, is started on the middle wire of each cable end. When the two are thrust into the opposite ends of the coupling, the butts of the wedges meet, driving the wedges home, as shown in the illustration, and expanding the cable so it cannot pull out through the ends. Fig. 5 is a simple screw coupling, with expanded ends, the whole being made in two longitudinal halves. This is intended for large wires and cables, and is said to be satisfactory in operation. None



Figs. 3, 4, and 5.

of these methods seems to be any more satisfactory than some of the tube unions used in this country. A good, simple, and satisfactory joint may be made as follows: Take a sheet of aluminium, of a thickness of about one-quarter the diameter of the wire, and cut strips of it so that each edge may be rolled around a mandrel toward the middle, to form, when this is done, a sort of twin tube. One wire end inserted in each of these tubular channels, and the whole then vigorously twisted with two pairs of pliers or monkey-wrenchers, makes a good, solid, and substantial, if unsightly, joint.

According to the German paper *Elek. Auz.*, the Allgemeine Electricitäts Gesellschaft, of Berlin, recently issued a note discussing briefly the advantages of aluminium for conductors. Bare aluminium wire is furnished down to a diameter of 0·05 inch at 30 cents per lb., so that the price is 35 to 45 per cent. lower than that of bare copper wire of equal resistance. Aluminium is especially recommended for trolley wire. The company claim, says the *Electrical World* digest, to have found a perfect method of joining at the factory, which enables them to supply continuous wire in any length up to a weight of 660 lbs. For other splices they supply aluminium connecting sleeves and a liquid solder with which to fill them.

* New York *Electrical Review*.

ELECTRICITY ON CANALS.

Since the introduction of railways, canals have been very much neglected. While railways have had the advantage of every advance in engineering, canals, up to the beginning of the last decade, have remained in much the same state as they were at the beginning of the century.

Germany has taken a leading part in the modern development of canal traffic. This began with the deepening of the Plau Canal, to adapt it to carry ships of 450 tons burden, and the construction of the Oder-Spree canal to take ships of similar size. It had become evident that the canals for ships of 100 to 150 tons burden could not compete with

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modern railways (the old English canals carried vessels of 30 to 80 tons only), and a 450-ton ship was fixed upon as the type for a single canal. To still further reduce freights by increasing the tonnage, the Prussian Government decided on a canal profile, for future undertakings, adapted to take ships of 600 to 750 tons burden.

The first of these modern waterways was the now completed canal from Dortmund to Emshäfen. The latest advances in engineering were utilised in the mechanical arrangements throughout the length of this canal, since these are known to have an important influence on the cost of transmission of goods. Naturally, electricity plays an important part in the service of the canal. The import of Swedish iron ores, and the export of Westphalian coal, furnish the principal cargoes for the new waterway.

At the terminal harbour of the canal at Emden, Siemens and Halske have erected a central station, which supplies continuous current at 500 volts for power, and at 2 × 220 volts for lighting. An accumulator battery serves at the same time for sub-dividing the voltage for lighting, and as a buffer battery. The central station, when completed, will contain three sets of machines, each of 100 H.P., two sets having been already erected. Provisionally, three electrically-driven travelling cranes have been erected in the harbour

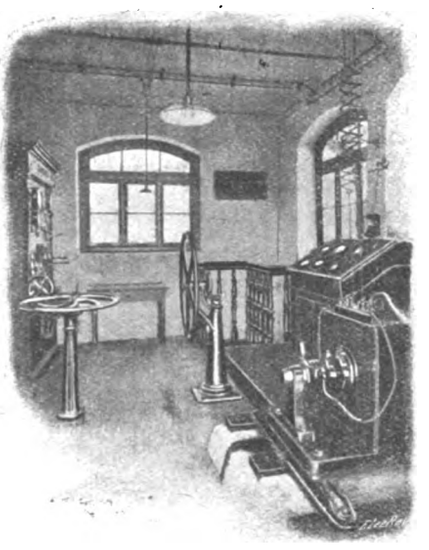
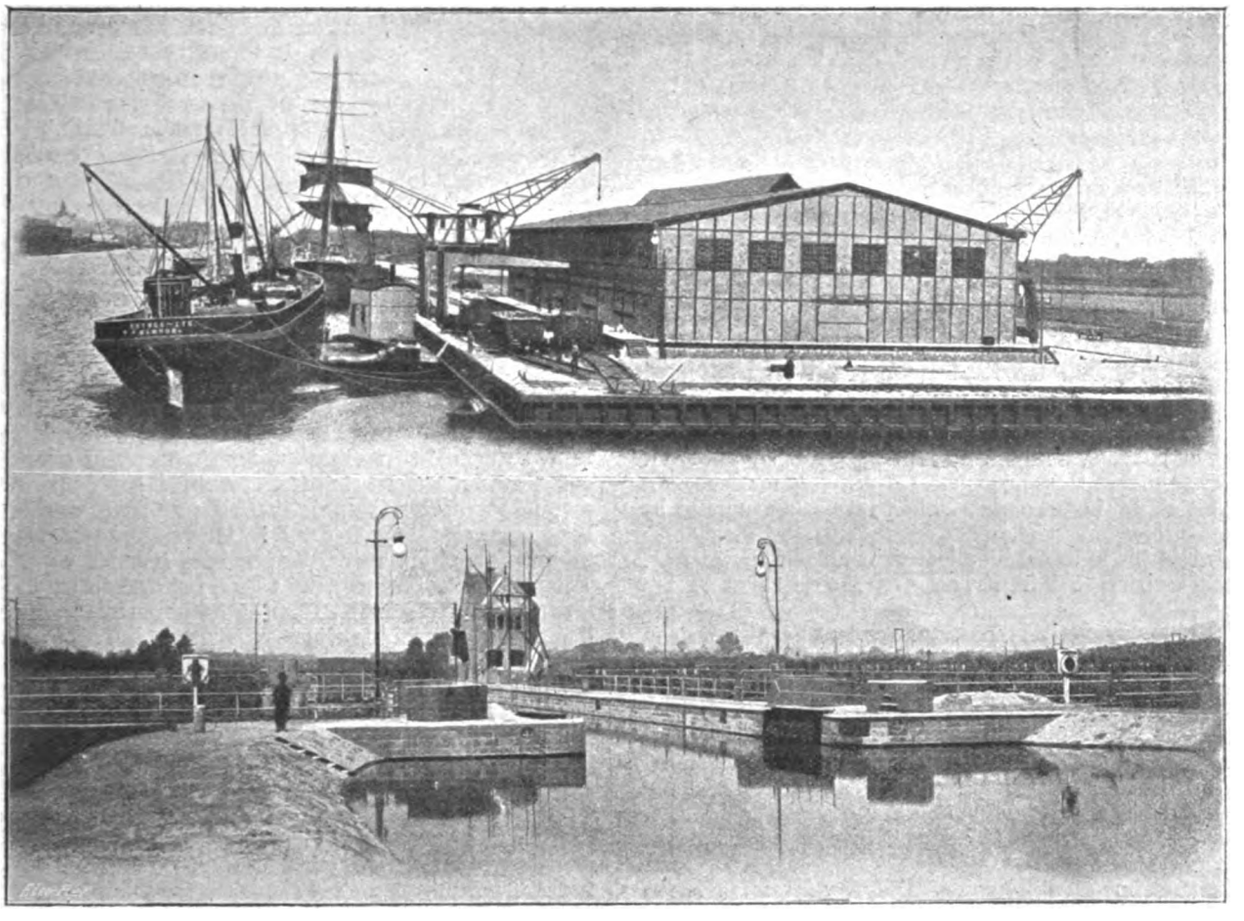


Fig. 3.



Figs. 1 and 2.

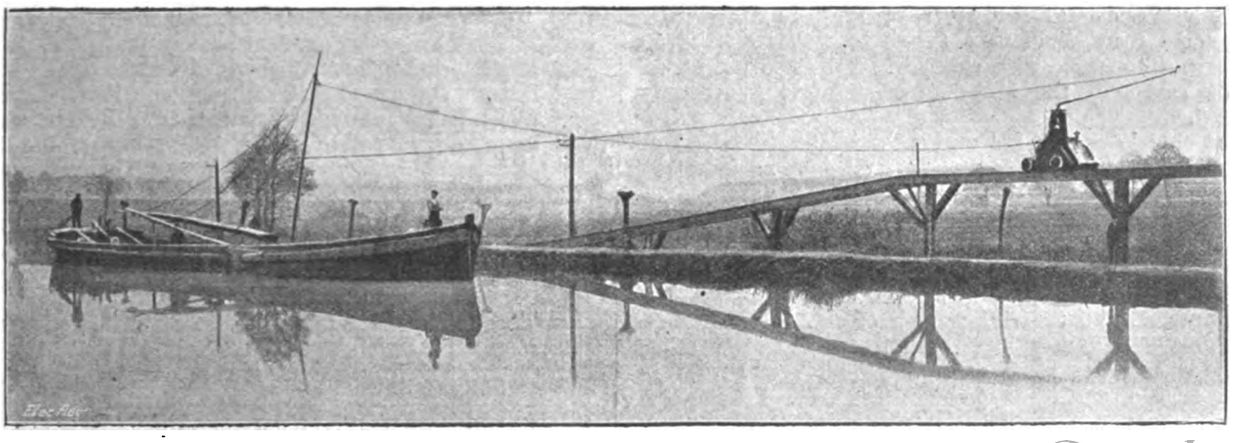


Fig. 4.

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(fig. 1). Each of these cranes is capable of lifting 2,500 kg., the mechanical parts having been made by a Hamburg firm. More cranes are projected, and also a floating dock, with pumping machinery, worked by electricity.

All the work at the locks is done by electricity. In iron

Fig. 5.

casings at each side of the gates, motors with switch apparatus are placed (fig. 2). They open and close the sluices for connecting the lock with the upper or lower canal, work the lock gates, and pull the ships into and out of the lock by means of two capstans. The motors may be driven by means of a key on the spot, or from the steering house (fig. 3). Here, to the right of the window, is a desk with switches, from which the whole lock can be overlooked, and all the movements of gates, &c., effected by a simple lever. It is evident that these arrangements will very much shorten the time of waiting at docks. The power being supplied by a small turbine is very cheap.

At night the locks are illuminated by arc and glow lamps. In the harbour, at Münster, an electric grain elevator has been erected.

A towing locomotive, recently introduced by Siemens and Halske, is likely to contribute much to the economical working of canal traffic. This locomotive has been thoroughly tested on the Finoro Canal, near Eberswalde. Difficult parts of the bank near factories, &c., are traversed by means of light bridges (fig. 4). For medium sized and small canals, one rail is sufficient, stability being attained by weakly loaded lateral wheels running on the ground. Fig. 5 shows the locomotive running on a normal section of the track.

The most important aspect of this new invention is the extraordinary economy which is claimed for it. On canals with sufficient traffic (from 500,000 tons per annum and upwards), neither steamer nor horses can compete with it. It has been calculated that for a traffic of 10 million tons per annum there would be a saving of 40 per cent. to 50 per cent. as compared with steamers. The great destruction of the canals by the backwash of steamers is evidently avoided.

The electric energy for working this electric system of traction for canals will best be drawn from industrial centres arising along the side of the canal, and locks, cranes, &c., can be supplied with electricity from the traction main.

The only element of the prime cost of manufactured articles which is now likely to be much reduced, is the cost of transport, and the introduction of electric traction on canals may have a very important influence in this direction, if the calculations of Siemens & Halske are verified in applications of this invention on a large scale. Possibly this invention may effect the financial salvation of the Manchester Ship Canal.

THE ELECTRICAL ENGINEERS' SWISS TOUR.

(*Continued from page* 554.)

On Wednesday, September 6th, the first item on the programme was a meeting of the members of the Institution at the Polytechnikum, at 10 o'clock. In spite of the countervailing attractions, including a visit to the Landes Museum —which contains a most interesting collection of antiquities and other curios —there was a good attendance. The President opened the proceedings, thanking the directors of the Polytechnikum for kindly placing the meeting room at the disposal of the Institution, and expressing regret at the absence of Mr. E. Huber, who was unable to read his promised paper on account of Colonel Huber's illness. Professor Gnehm having delivered a short address of welcome to the meeting, the President next explained the arrangements for the visit to the Polytechnikum, to take place in the afternoon, stating that several of the professors had broken their holidays and returned to Zürich in order to conduct the visitors through the laboratories.

The secretary then read a paper, written by Dr. Amsler, on "The Construction of Hydraulic Works." This paper will appear in the *Proceedings of the Institution* in the ordinary course. A short discussion ensued; Mr. Kapp said that he used to be at Schaffhausen, and narrated an experience which he met with there; certain consumers having complained that they could not get sufficient power from their motors, after two days' investigation it was found that the oil in the bearings got thick during the Sunday rest, and when thin oil was used the trouble disappeared. A speaker pointed out that Swiss municipalities, in taking over an undertaking, did not confiscate the property as in England, but bought up the shares at their market value. Prof. Perry said that engineers never set eyes on a waterfall but they immediately wanted to use it; Niagara would soon be bare, except on Sundays, when no doubt there would be an extra charge for seeing it! He was glad to receive the information in the paper, having been a pupil of Prof. J. Thomson, who formulated the theory of the turbine. The lowness of the falls used—10 or 15 feet—was noticeable. He believed that a higher turbine speed would be advantageous; for a given fall the speed could be predetermined according to theory, but an *unessential* rule was that requiring a rectangular section for the path of the water, and if this were abandoned, it would be possible to work at three times the usual speed without great loss. Prof. Prásil made a lengthy communication in German, outlining a method of "transforming" the water pressure, which promised good results; on the President's invitation the speaker promised to prepare an account of the system for inclusion in the *Proceedings*. Mr. Addenbrooke regretted the backward state of England as regards power transmission, especially referring to the excessive cost of underground lines. At starting, when the demand is indefinite, it is essential to pioneer with overhead lines, to find out where and in what magnitude the demand exists. The discussion was ultimately postponed to the next meeting in London, and a vote of thanks to the writer of the paper was passed with acclamation. Profs. Threlfall and Carus-Wilson, as representing Greater Britain, moved and seconded a vote of thanks to the directors of the Polytechnikum, which was heartily accorded. The meeting was then adjourned.

At midday the party assembled in force at the Tonhalle, where our Swiss hosts were to be entertained to lunch. As usual, the courses were beguiled with speeches and music. Prof. Thompson toasted "The President of the Swiss Federation," Prof. Perry "The Queen." Mr. Raworth, in proposing prosperity to the Swiss electrical industry, said that one's first impression of Switzerland was that the land wanted rolling before anything could be done with it. The copy-book maxims which we traced in our youth and disbelieved, we here saw realised. The Swiss had made heroic efforts in the

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cause of freedom, and Mr. Raworth deduced that the reason why one never saw a "drunk and incapable" in Zürich was because there were so few police!

Prof. Wyssling having toasted "Electrical Industry in all Countries," the principal ceremony of the day took place—the presentation, by Mrs. Thompson, of three illuminated albums, containing the signatures of the visitors, to Mr. Max Huber on behalf of Colonel Huber, Mr. C. E. L. Brown, and Prof. Wyssling, as tokens of gratitude for their kindness, and souvenirs of the occasion. The presentation aroused great enthusiasm, and the acknowledgments of the recipients were heartily cheered. Mr. Brown's speech we give in full, both on account of his extraordinary popularity, and of the fact that on no other occasion was he prevailed upon to speak:—

Ladies and Gentlemen: I am sorry that my English is not good enough to convey to you the pleasure I felt at the kind manner in which you have addressed me both yesterday and to-day. I make use of this occasion to propose the continued success of the Society of Electrical Engineers of London, of which I am so proud to be a member.

Mr. Mordey, and a Swiss gentleman, also addressed the meeting. The proceedings soon afterwards closed, and the visitors dispersed for the time.

Many went on at once to Lucerne, to seize the opportunity of arriving there by daylight; a considerable number, however, gathered at the Polytechnikum at 3 p.m. to inspect the laboratories. Prof. Perry once more proceeded to differentiate the party into four groups, the operator being his umbrella, which he wielded with as much dexterity as if it had been an equation!

The department of most interest to our party was, of course, that of Physics, over which we were conducted by Prof. Weber himself and Prof. Pernet. The laboratories are situated in a handsome building, large enough to take in the whole of one of our technical colleges, and fitted up in a manner showing that ample funds are at the command of the directors, in this respect presenting a lamentable contrast with our own. Be it remembered, however, that this University—for it is no less—is maintained and equipped by the Federal Government, and that it is the *only* one of the kind in the Federation.

We do not propose to describe the laboratories in detail; the apparatus, for the most part, resembles that in use in our own colleges, and we did not observe any marked advances on our own practice or methods of teaching, so far as could be seen in a somewhat hurried inspection. The laboratories were divided up into many small rooms, containing apparatus for different subjects of experiment. We were struck by the number of tangent galvanometers scattered about. These are certainly simple and useful instruments, but we are glad to think that we, in this country, have practically emerged from the state when the tangent galvanometer pervaded our laboratories! We understood that the usual ratio of students to demonstrators was 10 to 1, not including honorary demonstrators; this compares favourably with the conditions at home, where often twice as many students are dependent on one long-suffering demonstrator—here, again, the lack of funds is felt.

There were several dynamos, alternators, motors, and transformers, but most of them were of small size; secondary cells on trucks, resistance frames (manganin strip in zig-zags chiefly), banks of lamps, artificial cable of glow lamps and condensers, and numberless glazed cases packed with apparatus. We only saw one d'Arsonval, and none of the modern narrow moving-coil galvanometers, though these may have been somewhere in the department. We came away feeling reassured as to the pre-supposed backward state of our electro-technical laboratories.

The Mechanical Engineering department is at present in course of construction; we were informed that up to now the department has been practically non-existent. A very complete installation is, however, being put down, including a Niclausse and a Sulzer multitubular boiler, and two vertical boilers, a 150-H.P. triple expansion engine driving a three-phase fly-wheel alternator and a dynamo, arranged thus:—

L.P. cylinder — Three-phase alternator — I.P. cylinder — Dynamo — H.P. cylinder

—with couplings, and a vertical engine coupled to a rotary converter, which can, of course, be used as an alternator or dynamo. De Laval steam turbines and gas engines are also to be installed, as well as motor-driven pumps, raising water to an elevated reservoir, whence it may be drawn for driving hydraulic turbines of various types. Steam pressures up to 300 lbs. per square inch will be employed. A travelling crane driven by three-phase motors spans the engine room. Altogether it will be a most excellent training school, based, we learnt, upon English and American examples.

Testing of materials is carried on in a separate building, which is well equipped for the purpose; we were told that manufacturers and others send their products thither to be tested. The Chemistry department was, of course, beyond praise; however, we need not go into particulars in this case.

After the inspection of the Polytechnikum the visitors proceeded to Lucerne, arriving there in darkness, much to their sorrow.

(*To be continued.*)

REVIEW.

Compulsory Licenses under the Patents Act. Crown 8vo. By J. W. Gordon, Esq., of the Middle Temple, Barrister-at-Law. Stevens and Haynes, 1899.

The casual reader will almost be tempted to ask, "What are they?" An answer to this question, couched in the most graceful language, will be found in Mr. Gordon's latest work. Well qualified for the task in hand, he has produced a book upon an obscure, yet important branch of law, which will form a welcome addition to the library of the lawyer and to the office of the patent agent.

Before attempting to criticise the result of the author's labours, it may, perhaps, be of interest to take this opportunity of giving a short explanation of the compulsory license. If any precedent for such conduct on the part of a reviewer is asked for, it is sufficient to mention Lord Macaulay's essay on Warren Hastings!

The compulsory license has its origin in the 22nd Section of the Patents, Designs and Trademarks Act of 1883. The effect of that section—which, in point of fact, forms the theme of Mr. Gordon's study—is, that if an invention in respect of which a patent has been duly granted is (*a*) not being worked at all, or (*b*) not being worked on a sufficiently large scale, having regard to the public demand for it, or (*c*) if the patent right controls the use by another person of another invention; in any of these cases the Board of Trade may, upon proof of default by the patentee to grant licenses upon reasonable terms, order the grant of such licenses upon such terms as the Board may consider just.

A little reflection will show that this enactment is founded upon the first principles of justice. A patentee who obtains the sole right "to make, use, exercise, and vend" a certain commodity, is the proprietor of a monopoly, and he must not be allowed to exercise that monopoly unfairly. It being to the interest of the public to encourage invention, so also is it in the common interest to bring the results of the inventive faculty within reach of all. Therefore, if, for some reason of his own, the patentee refrains from manufacturing or licensing the manufacture of his goods in this country, he may be compelled to do so by the Board of Trade. To show the evil which may result from "dog in the manger" policy on the part of a patentee, Mr. Gordon quotes the following passage from a speech made by Mr. Chamberlain in 1883 when the Bill was before Parliament:—"In consequence of the patentee refusing to grant licenses in this country, the manufacture of artificial colours derived from coal tar has almost entirely gone to Germany."

The few cases which have arisen have been referred by the Board to a legal arbitrator, who, after hearing the evidence and counsel for the parties, makes a report, upon which the Board bases its decision.

The jurisdiction which is thus conferred upon the Board of Trade, which is really nothing more than a committee of the Privy Council, has only been exercised within the last two years. This delay was mainly caused by the fact that it could not have been brought into play in connection with any patent granted prior to 1883. Unwillingness to tread upon virgin soil may also have been a deterrent. In the few cases

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which have already been heard the expense has been very large. This is partly due to the fact that both petitioner and patentee have, in a sense, being taking a leap in the dark. Unable to foretell the points in the evidence which would have any effect upon the mind of the arbitrator, they have found it necessary to fortify themselves against every contingency, by calling numerous witnesses, and employing the most eminent counsel.

We need hardly remark that the above is a very bare outline, indeed, of the history and origin of this important section. Our author has dealt with the whole question in the first chapter of his work, through which there runs a note of favour towards the public, as against the patentee who takes an unwarrantable advantage of the privileges conferred upon him.

Bearing in mind the paucity of cases, and the chaos which exists with regard to rules of procedure, &c., in this extraordinary tribunal, it will at once be seen that Mr. Gordon's task has been by no means a light one. In an ordinary legal text-book, dealing with some topic of frequent discussion in courts of law, abstract propositions, unsupported by references to decided cases, are not of much use to the practising lawyer. But we must not judge this work side by side with the tomes which fill the lawyer's book-shelf. The author has worked, as it is stated in the preface, "in an uncultivated field." That field must from time to time be traversed by the patent agent or the legal practitioner, who, in the absence of assistance from the law reports, will have to base his opinion upon first principles. In such a predicament the carefully reasoned arguments and valuable suggestions of Mr. Gordon, illustrated and perfected by reference to the few cases which have already been heard by the referees, will be of considerable value.

We may regard this work as a guide to those who find themselves compelled to seek the assistance of the Board of Trade in order to obtain leave to work or vend any patented invention. No step which must be taken for this purpose has been neglected by Mr. Gordon, though, of course, it should be remembered that the procedure which he recommends is for the most part based upon his own wide experience in all matters connected with the law of patents.

The first chapter deals with the history of the 22nd Section of the Patents, &c., Act of 1883. It is pointed out that in addition to the relief which is thereby granted, the Courts have always had power to deal with a defaulting patentee. Thus, in the very patent itself, there is a proviso to the effect that if the grant is at any time found to be contrary to law, "or prejudicial to our subjects in general, it may be revoked." The exercise of this power has been neglected for some reason by the Courts.

In the third chapter the nature and jurisdiction of the tribunal is fully discussed. Two of its more prominent defects are more particularly emphasised; (*a*) it is in no way bound by, or subject to, the High Court; (*b*) the referee is merely present to make a report to the Board of Trade, which decides whether the petition shall be dismissed or not.

In Chapters IV. and V. the author points out who may be parties to the proceeding, and what relief may be claimed.

Perhaps the most important part of the work is contained in Chapter VI. Reading this chapter together with the skeleton of a deed of license which is printed in Appendix IV., the legal practitioner will find an explanation of every clause in that lengthy and difficult document.

In the chapter on Procedure, a summary is given of the relief which should be asked for in the petition. This must contain a statement of the petitioner's interest, showing plainly (*a*) the facts which give the petitioner the right of applying to the Board of Trade; (*b*) the facts from which it can be inferred that the order, if made, will actually enure for the petitioner's benefit. The enforcement of the order of the Board of Trade is left in the hands of the Court, to which an application for a mandamus must be made.

In the ninth chapter the author makes a few valuable suggestions as to procedure which should be adopted in cases before the Board of Trade.

While the text of the book, as we have already observed, unavoidably consists, to a large extent, of speculation on the part of the author, its practical value is very greatly enhanced by the Appendices. Of these, the first comprises a complete report of all the cases which has hitherto been heard by the Board of Trade. The text of certain statutes dealing with patent rights is also to be found at the end of the work. These, in addition to the selected Rules of the Supreme Court, the Crown Office, and the Patent Office, render the book very handy as a work of reference. Amongst the forms occurs the skeleton of a deed of license annotated and carefully explained by foot notes, references to rules, cases, and to other forms.

An index, which might, perhaps, be improved in a later edition by an alphabetical arrangement of the sub-headings, completes a work which we can confidently recommend to the lawyer and the patent agent as a handy legal guide—to the layman as an interesting dissertation upon an important branch of the patent law.

CORRESPONDENCE.

Single-Phase Motors.

My attention has been drawn to Mr. Eborall's article on single-phase motors, which was published in your issue for the week ending September 29th, and in which the following passage occurs:—"To sum up, the design of the Heyland motors, with regard to the starting device, is along lines directly opposed to generally accepted practice, insomuch as the starting coils, causing the flux of great phase difference, have a much smaller self-induction than that of the running coils."

I should like the author of the above article to look up my patent specification, No. 24,098, accepted on August 26th, 1893, in which I describe a method of, and apparatus for, starting non-synchronous single-phase alternate current motors. Among the methods claimed therein is one which does not involve the use of any auxiliary apparatus, and consists of the use of a second or additional winding of *greater or less self-induction* than the running winding. I further illustrate my meaning by a sketch (fig. 1) in which one of the windings is represented as being a drum winding, and the other as a ring winding, and I distinctly state that *either* may be used as the starting winding.

Mr. Eborall will see from this that the device which he claims to be a new departure, due to Mr. Heyland, was patented by me nearly seven years ago.

C. E. L. Brown.

Baden.

The Sunderland Tenders.

I have noticed your paragraph on page 568 in your current issue, which sets forth a complaint from a firm which recently tendered to this Corporation for four steam dynamos, and which firm takes objection to the non-publication of the figures of the several tenders. It has been the rule of this Council for several years past not to divulge the prices of any tender received, and as a responsible official, I have no option, of course, but to conform with this resolution.

I do object, however, to the suggestion that local influence is brought to bear upon whomsoever may be responsible for adjudicating upon tenders. I am the official who is solely responsible in this matter, and from three tenders selected by me, my committee made a final selection. I will hardly deign to repudiate any asseveration that local influence has biassed my selection. Your correspondent may say that it is not intended to affirm such a disgraceful suggestion, but in my opinion, if the influence be made to bear on the committee, and by them on their engineer, the latter would be as criminally responsible as if he permitted any direct pressure to influence him. As a matter of fact, in this case, though the local firm was not absolutely the lowest, there was so little difference between them and the lowest, that the contract was naturally given to the local firm. As a matter of fact, in the last extension the contract was given to the Silvertown Company, so that it is not always the local firm which gets the contract. I may add, further, that every tender on this occasion, as on other occasions, received every consideration, both from me and from my committee.

John F. C. Snell,
Borough Electrical Engineer.

Sunderland, *October 7th*, 1899.

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Singular Occurrence at Hastings Electricity Works.

On Friday last, for some reason which I am at present unable to explain, the whole of our alternators running at the time suddenly ceased to generate, apparently through the failure of the exciting circuit. I am sending you a full report of what happened before and after the event, hoping that some of your readers may be able to suggest some cause for the apparently *sudden* demagnetisation of the alternators.

L. Andrews.
Borough Electrical Engineer.

Hastings, *October 10th*, 1899.

On Thursday last, at 5.50 p.m., when the front line lamps were switched on, our No. 2 alternator flashed to poles, at the same time a short circuit occurred on the even number lamps on the front line circuit, and another short on a 7/20 concentric high tension service feeding a house transformer. The following day the faults were repaired, circuits tested, and found satisfactory. As, upon examining the coil that sparked to pole-pieces in No. 2 alternator, we found it was a coil that had been slightly damaged about 12 months previously, we concluded the sparking of this coil was the primary cause of the other two breakdowns, and did not anticipate further trouble; but on Friday night, when again switching on the front line circuits, No. 3 alternator flashed to pole-pieces; this was almost immediately followed by an inner connection on No. 2 alternator flashing to a flexible lamp wire on the works' lighting transformer, and by another short circuit on the lamps on front line. Simultaneously with the flashing to the works' lighting circuit, all lights in the town went out suddenly, leaving the works in darkness. The alternators running at the time were switched out of parallel, and an attempt was made to run them up on separate circuits, but finding they would not excite, it was concluded that the exciter had broken down. The field bus bars were then switched on to the spare exciter, with the desired effect. All lights were on again within three minutes of the first breakdown. The exciter which would not excite was then overhauled, and as no fault could be found upon it, it was entirely disconnected from the switchboard, and connected up with temporary wires and switching arrangements to the field of the spare alternator. These arrangements had barely been completed before they were called into use by the failure of a coil on No. 3 alternator apparently damaged by the flashing to poles earlier in the evening. For the rest of the evening all went well. The fault on the front was located and found to be in the temporary joint that had been made upon the repaired section the previous day. This was again repaired on Saturday, and when tested proved satisfactory; but on Saturday night the same section of main again broke down, though this time 100 yards away from the first fault. As, however, we had this night isolated the public lighting from the private lighting, the trouble was this time confined to the even number public lamps west of Warrior Square.

I have endeavoured to ascertain the real order in which the above mishaps occurred, to enable the root of the troubles to be got at, and up to a certain point have been, I think, fairly successful.

It is necessary to explain that it has been customary during the past few months to run the public lamps up on a separate machine, and then, when they were burning satisfactorily, to switch this machine in parallel with the alternators doing the private lighting. The object of this arrangement has been to prevent the fluctuation in the private lamps that was at one time caused by switching the public lamps directly on to the bus bars. The high tension switching arrangements are single pole and the outer conductor was at one time earthed, but owing to there being so many small high tension services feeding house transformers connected to the mains, it was found impossible to keep the system entirely free from small leakages, and these leakages effected the local telephone service to such an extent that it became necessary to disconnect the earth connections. The capacity of the cables was, however, sufficient to keep the outer conductors at earth potential without their being actually earthed.

My opinion now is that at some point on the public lighting circuits there occurred intermittently a leakage to earth from the inner conductor. The exact point I have not yet been able to ascertain, though I expect to find it in a transformer. When the arc circuits were being run on a separate machine they were connected to the private lighting bus bars by their outer conductors only prior to connecting them in parallel by the switches on the inners. When in this intermediate position I think the intermittent fault must have occurred putting the inner to earth. As the potential between the inner and outer was 2,000 volts, the outer being insulated would now take a potential 2,000 volts above earth; but the inner potential of the private lighting circuits was already 2,000 volts above the outers, therefore the potential of the private lighting inners would now rise to 4,000 volts above earth. This being greater than they were designed to stand caused them to break down at the weakest points; this proved to be in one case to the works lighting circuit. Beyond this point I have at present been unable to trace it.

From the results obtained it appears that by some means the high tension alternating current got into the exciting circuit and so demagnetised the whole of the fields, but I am unable to trace any signs of leakage either between the field circuits and the main circuits or between the field and the works lighting circuits. The insulation resistance in both of the above cases is practically infinity. I am now convinced that the failure was not caused by the opening of the shunt circuit of the exciter, as I at first thought it might be, as everyone agrees that the interruption of the lights was sharp and instantaneous, as if they had been switched off, whereas I have since ascertained by experiment that when the shunt circuit is broken the lights do not entirely die out for about 10 seconds; on the other hand, I have as yet been unable to prove that even if the alternating current could be traced to have got into the field current, it would have completely and instantaneously demagnetised the fields. I have endeavoured to clear up this point by short circuiting an alternator running considerably below normal speed across the exciter, but the demagnetising effect was practically *nil*.

[We shall be pleased to receive any observations which our readers may be able to make with a view to solving Mr. Andrews's problem.—Eds. Elec. Rev.].

LONDON COUNTY COUNCIL.

The Council, on reassembling on Tuesday, again adjourned the consideration of a proposal to establish a municipal telephone system in the metropolis.

Electric Traction.

In a report by the Highways Committee, the Council were reminded of the expenditure of £10,000 recently sanctioned for the preparation of plans and estimates in connection with the proposed introduction of underground systems of electric traction on the Westminster Bridge-Tooting section of the tramways, and of the intention to engage Prof. A. B. W. Kennedy to advise the Council in regard to that line and other lines where electric traction might be employed. The Committee now stated that they had arranged with the consulting engineer the heads of an agreement under which he would undertake the work. These heads, which it may be well to place on record, are as follows:—

1. Prof. Kennedy to be employed as the engineer in charge of the work of applying mechanical traction to an experimental line of tramway from Westminster Bridge to Lower Tooting and to certain new tramways and light railways which the Council is, by means of applications for orders under the Tramways Act, 1870, and the Light Railways Act, 1896, about to seek power to construct.

2. The duties of the said engineer shall include all the necessary and usual duties of an engineer in charge of such work, and shall in particular include the following duties—To devise and work out in detail the scheme or schemes for systems of electrical traction. To prepare all the necessary drawings in connection with such scheme or schemes, and submit estimates to the Highways Committee. To prepare the necessary plans and estimates for deposit with the Board of Trade and the Light Railway Commissioners, and to give evidence in support of the schemes. To prepare complete specifications for the whole of the work to place before the Highways Committee. All designs, plans, specifications, estimates, and other documents connected with the schemes shall be the property of the Council. All plans, specifications, estimates, and other documents shall at all times during the preparation and carrying out of the schemes, be open for inspection by any official of the Council duly authorised by the Highways Committee. To advise as to tenders when these have been sent in. The whole of the work will be done to tenders from outside if thought best, but, if preferred, no doubt a considerable portion of the work in the streets as well as the actual work of building the generating stations, might be done by the Council itself. During construction the principal duties of the engineer will be as follows—To supervise the whole of the work, providing at his own cost a drawing office with drawing office staff, as well as the engineers in charge of the construction of the line and of the erection of the machinery at the generating station or stations. To inspect and test all the material, apparatus, or machinery at the manufacturers' works either at home or abroad. To pay at his own cost all salaries, travelling and office expenses of all engineers, inspectors, and draughtsmen whether at home or abroad, and all outgoings of every kind. The engineer's duties in reference to buildings to be confined to the preparing and supplying of general-arrangement drawings only, showing all the engine and boiler foundations, boiler setting, openings in walls, &c., and in general any other matters specially pertaining to the machinery; beyond this the engineer to have nothing to do with the buildings, nor with the appointment of the clerk of the works to the buildings.

3. The remuneration to be paid to the said engineer shall be as follows:—(*a*) He shall be paid a commission of 4 per cent. on the cost of the experimental line, exclusive of buildings, and also on the cost of such of the proposed electrical tramways and light railways, exclusive of buildings, as the Council may obtain powers next year to construct on the applications now about to be made, and a commission of 1 per cent. on the cost of the buildings. (*b*) In no case, other than the experimental line, shall the commission be paid upon more than £15,000 a mile, including equipment. (*c*) In calculating the amount upon which commission is to be paid, the cost to be included in respect of cars shall be the cost of the number mentioned in Mr. Kennedy's printed report, namely, 2¼ cars per mile. (*d*) If the Council should fail to obtain power to construct, or should determine not to construct, or not to continue the construction of, any of the said tramways or light railways, Prof. Kennedy shall be paid in respect of the services rendered by him in connection with the applications with regard to tramways or light railways which the Council shall fail to obtain power to construct, or shall decide not to construct, such sum as the Council's chief engineer shall fix. (*e*) If the Council shall fail to obtain power, or shall decide not, to construct any of the tramways or light railways except the experimental line, Prof. Kennedy's commission on the cost of the experimental line shall be at the rate of 5 per cent. (*f*) Prof. Kennedy shall receive no commission on the amount paid for property acquired for street widenings, or on the cost of the removal of gas and water pipes or other pipes or wires, or of the re-paving or alteration of any portion of the roads other than that occupied by the tramways or light railways, and 18 inches beyond the outer rail on each side thereof.

The Overhead Trolley System.

Next week the Council will consider a long report by the Highways Committee in reference to the proposed applications to the Light Railway Commissioners for the construction of light railways in London. In the course of this report the Committee state that Mr. Kennedy is actively engaged in the preparation of plans and estimates for submission to the Light Railway Commissioners. He has expressed the opinion that the cost of light railways for underground or conduit electrical traction will amount to about £15,000 per mile of single line, while the cost of construction for overhead electrical traction would be about £12,000 per mile; the estimate including in each case the cost of mains, rolling stock, plant and power houses, but not of car sheds.

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The Committee further state:—

We have given careful consideration to the question whether or not it is desirable that the Council should adopt, for some of the more suburban light railways, an overhead system of electrical traction. We have consulted the tramways manager and Mr. Kennedy upon this matter, and they have expressed the opinion that two of the light railways, namely, that in the Archway Road, Islington, and that from West Hill, Wandsworth, *viâ* Kingston Lane, to the county boundary, might advantageously be constructed for overhead traction, as the roads through which they would pass are suburban in character, and the usual objections to overhead traction do not apply to them. We have, therefore, based our estimate on the assumption that overhead traction is to be adopted for these light railways. The roads along which the light railways from Deptford to the Herbert Hospital, and thence to Beresford Square, Woolwich, are also suburban in character, and we should have preferred to suggest that overhead traction should be used for the light railways there, and the same remark applies also to that portion of the proposed light railway between Lee Green and Eltham. Mr. Kennedy and the manager are, however, of opinion that the Government might raise considerable objection and difficulty if the Council were to propose to adopt that system, as it is considered probable that it might cause electrical disturbances at the Greenwich Observatory, against which possibility the Government is anxious to guard on account of the delicate instruments in use there; and we have, therefore, come to the conclusion that, in the circumstances, it would be expedient that these lines should be constructed for an underground system of traction. As regards the other light railways which would be on roads where there is already considerable traffic, and which are in urban districts, we think that underground electric traction should be adopted.

[This matter is also referred to in our "Traction Notes" this week.]

LIGHTING AMENITIES IN THE EAST END.

In a batch of reports of work carried out by the Highways Committee acting for the Council during the recess, the Committee refer to a notice received from the County of London and Brush Provincial Electric Lighting Company of intention to lay high and low pressure mains in various thoroughfares in the East End. It appeared that two of the local authorities, namely, the Vestry of Mile End and the Limehouse District Board, whose districts would be affected by the proposed works, had called attention to the fact that the order was granted in 1897, but that the company had not hitherto taken any steps towards the carrying out of works under the order, although under Section 21 (1) thereof the company was required to lay mains in Mile End Road and Commercial Road within two years of the date of the granting of the order, viz, August 6th, 1897. The action of the company in now taking steps to exercise its powers under the order appears to have been caused by the Poplar and Whitechapel District Boards having begun to exercise the powers conferred by their respective orders. The Vestry of Mile End Old Town stated that it had decided to ask the Board of Trade to revoke the company's order, in consequence of the failure of the company to comply with the requirements of Section 21 (1) above referred to.

Commenting upon the position the Highways Committee said:—

We are advised that, apart from the fact that the company has not exercised its powers within the time prescribed by the order, there appears to be no objection to the works referred to in the notice; but, in the circumstances, we think that the sanction of the Council to the works referred to in the notice should be withheld, as otherwise the local authorities might be hampered in their action with regard to the matter. As it was necessary that the Council's approval or disapproval of the works referred to in the notice under consideration should be signified within one month from the receipt thereof, we have, acting on behalf of the Council, formally disapproved the works. We have also given instructions for assistance to be rendered to the local authorities by the Council's officials should the Board of Trade decide, as is probable, to hold an inquiry in consequence of the application of the Vestry of Mile End Old Town for the revocation of the company's order.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

WEEK ENDING OCT. 11TH, 1898.

	Value £
Amsterdam	53
Antwerp	809
Auckland	85
Bangkok	9
Batavia	6
Boulogne	129
Brisbane	159
Buenos Ayres. Teleg. mat.	16
Calcutta	616
Cape Town	526
Christiania	244
Colombo	271
Copenhagen	867
Durban	644
East London	41
Gibraltar	11
Launceston	30
Lyttleton	49
Madeira	83
Melbourne	45
Montreal. Teleg. cable	264
Ostend	33
Port Elizabeth	164
St. Petersburg	850
Shanghai	54
„ Teleg. mat.	367
„ Teleph. mat.	44
Stockholm. Teleg. mat.	867
Sydney	178
Trinidad	366
Wellington	167
„ Teleg. mat.	157
Total	£7,294

WEEK ENDING OCT. 10TH, 1899.

	Value £
Amsterdam	26
Antwerp	63
Auckland	220
Beira	118
Bombay	54
Buenos Ayres	124
„ Teleg. mat.	332
Canterbury	50
Cape Town	269
Calcutta	260
„ Teleg. wire	50
Chinde. Teleg. mat.	1,576
Christiania. Teleg. wire	162
East London	899
Gibraltar	18
„ Teleg. apparatus	135
Gothenburg	53
Grenada	12
Halifax	160
Hong Kong	672
Madras	101
Melbourne	442
Montreal. Teleg. mat.	60
Ostend	241
Penang	39
Port Elizabeth	91
St. Petersburg	206
Singapore. Elec. plant	1,104
Stockholm. Teleg. wire	194
Sydney	428
Tientsin	17
Vancouver. Teleg. wire	72
Wellington	347
Total	£8,110

Bankruptcy Proceedings.—On Tuesday last week at the Cardiff Bankruptcy Court, Sydney Ferris Walker, electrical engineer (S. F. Walker & Co, Cardiff), was up for public examination. Debtor said he had no "Co." in the business. He had previously been in partnership at Nottingham with a Mr. Oliver, upon terms which left him to pay off the liabilities. He continued paying off those liabilities till two years ago. He had for some time past been pressed by his creditors. His business was so exacting that he was not able to devote the time that he desired to an examination of his books. At the time of his petition he had a number of apprentices in his shops. Asked who taught the apprentices he replied that they were taught in various ways. They went through a course. The place was very much like an academy. He had a great demand for the apprentices after they had been trained by him, and that was one reason why he kept such a large number of them. He was the professor. They were his demonstrators, and the apprentices did the jobbing work. There was not a lad left his place who had not learnt his work thoroughly, and is not now earning a good wage. He had two classes of apprentices. In some cases he trained their heads, and in other cases he trained their hands. He did not always get 50 guineas for training the hands. Questioned with reference to his miners' safety lamp patent, which he valued at a quarter of a million, debtor said he had issued shares to shareholders in respect thereof, and had received under this head a large sum during a period of five years. The Official Receiver: Then, had it not been for money received from these shares, and money received for premiums from apprentices, would you be able to have carried on your business? —I cannot say that without an exhaustive investigation. He estimated having received several hundreds of pounds in premiums from apprentices. The money went into the business, but he could not say whether the item appeared in the books. Mr. Belcher, for the trustees, asked that debtor be ordered to supply (1) an amended deficiency account, and (2) an account showing the premiums received from pupils and apprentices during the last five years. The debtor made a strong protest against such an order being made. He had, he said, to go out to the world to earn his living, and he had already given the trustees and Official Receiver all the assistance in his power. It was absolutely impossible for him to give those figures. The Registrar: I am afraid the Bankruptcy Court compels you to do so. The order was made accordingly, and the examination was adjourned until next court.

A receiving order has been made at Banbury against Wm. Upton, electrician, Bridge Street, Banbury, Oxon., on debtor's own petition.

A similar order has been made against C. F. S. Pilling, electrician Halliwell Road, Bolton, Lancs.

The adjourned first meeting of creditors was held last Tuesday at the London Bankruptcy Court under the failure of J. Stewart Edwards, electrical engineer, Moorgate Court, E.C. The debtor was brought to the Court at the instance of the Syndicate of Electrical Engineers, Limited, and he attributes his failure to expenses incurred in connection with ventures which proved unsuccessful. The liabilities are estimated at £13,000. Mr. Bowyer, assistant receiver, reported that the meeting was adjourned on the former occasion to enable the debtor to file a statement of affairs and lodge a proposal, but up to the present he had done neither. The debtor explained that the recent trouble with the Transvaal had entirely upset his arrangements, and he asked for a further adjournment of one week. Mr. Bowyer observed that he was very much afraid there was no chance of the Transvaal difficulty being settled in one week. After some discussion the creditors decided to leave the case in the hands of the Official Receiver to be wound up in bankruptcy. The chairman added that the assets included a half share in an electrical patent and an option over a copper mine in Wales, but he did not regard either interest as having much realisable value.

Liquidations, Dissolutions, &c.—The Cottonwood Water-Power and Electric Company holds a meeting on November 11th, at Winchester House, to receive an account of the winding up proceedings from the liquidator (Mr. E. A. King).

The Prism Globe Syndicate, Limited, of 57 and 58, Chancery Lane, W.C., is winding up voluntarily for purposes of reconstruction. Mr. J. H. Bardsley, 60, King Street, Manchester, has been appointed liquidator.

The Superheated Steam Power Company is winding up voluntarily, Mr. T. L. Hurry, of 2, Queen Anne's Gate, S.W., being liquidator.

We learn that Messrs. Laing, Wharton & Down, Limited, have gone into voluntary liquidation, Mr. L. Warmington, 80A, Coleman Street, E.C., being appointed liquidator. Mr. E. Kennedy (of Howard Bros. & Howes, 27, Clements Lane, E.C.) has been appointed receiver and manager for the debenture holders, and he is carrying on the business. The above step is understood to have been taken through inability to meet creditors' demands—a state of affairs produced by inability to collect certain large debts.

Books Received.—"History of Wireless Telegraphy," by J. J. Fahie. Edinburgh: William Blackwood & Sons. 6s.

"Handbuch des Telegraphendienstes der Eisenbahnen," by Ingenieur A. Prasch. Wien, Pest, Leipzig: A. Hartleben's Verlag. 3 marks.

"London University Guide and University Correspondence College Calendar." London: University Correspondence College Press. Gratis.

"Fire Tests with Doors, Nos. 24 and 26." London: 1899, British Fire Prevention Committee. 2s. 6d. each.

"Le Magnétisme du Fer," by Ch. Maurain. Paris: Georges Carré et C. Naud.

Catalogues.—We have received from the Electrical Company, Limited, a list of electrically-driven portable drilling machines and electric motors. The list has only about 13 pages, but these are exceedingly attractive in their arrangement and in the delicacy of the illustrations. The opening page has a few prefatory remarks about the enormous progress being made by electric driving, and records the fact that the company is developing the motor branch of its business so as to keep pace with the increasing demand. At the works there are 11,000 men employed, turning out 10,000 dynamos and motors per annum with an aggregate of over 200,000

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H P. The portable drilling machine with detached portable motor is recommended for working upon non-portable parts of large machines, and for erecting and repairing jobs, but for the work-bench and in factories where articles are turned out in great quantities the combined drilling machine and motor form a complete and convenient apparatus. The motors which come in for general description and illustration are of both direct current and three-phase portable types. Prices of certain sizes are given, also of portable drilling apparatus, drill stands, and speed drilling machines with three-phase motors.

Messrs. Cuttriss, Wallis & Co., Limited, of Leeds, have issued a 20-page pamphlet describing and illustrating small dynamos for various purposes, including laboratory and class work. Small motors for dental, fan, and other similar purposes, starting and regulating resistances, reducing gear, also the "Elmwood" air propellers, and "window" propellers for alternating and continuous current, are detailed.

The British Thomson-Houston Company is sending out a circular of its double reflector arc lamps as a supplement to the pamphlet recently mentioned. These lamps are claimed to give the maximum amount of distribution with the least shadow. The direct rays of light, impinging upon the lower porcelain reflector, are reflected upon the upper metal reflector and then down upon the work. The light is soft, white, and evenly distributed and is suited to the needs of specially fine work, and enables a high grade of material to be produced with the same ease and rapidity as when the illumination is furnished by daylight.

Messrs. Dobson & Curtis Bros, of Dublin, send us a copy of their list of small electric motors for various purposes with illustrations and prices.

The Trusty Engine Works, Limited, has brought out a new illustrated catalogue giving a general description of the Trusty gas and oil engines, with list of sizes and particulars.

A pocket catalogue and price list of dynamos, motors, and electrical appliances has been issued by Messrs. Webster, Michelson and Co., of Dudley, in which the Dudley C and U and M type dynamos, motors, the Rational gas engine, &c., are described. Sir Wm. Ingram has, we understand, given the firm the order to light his bungalow at Westgate-on-Sea with electricity. A "U" type (200 16-C P) dynamo and gas engine, also a storage battery, form part of the installation which is not only for lighting, but for heating and cooking as well.

The Tudor Accumulator Company is sending out a new edition of its catalogue of stationary cells. Since the last issue no alterations have been made in the cells, but certain intermediate sizes omitted from the 1896 list have now been added. The continued rise in the cost of all raw materials has slightly advanced the prices. The demand for Tudor cells has been steadily growing in this country during the past four years, and to-day there are about 50 central station batteries in use or on order. The continued demand for this and other classes of contracts has necessitated frequent extensions of the Dukinfield works. The company is supplying several large batteries in connection with traction and power stations for steadying the load on the generating plant, and in some cases for keeping up the voltage at distant points of the line. "H" type cells shown in the catalogue are considered specially suitable for this purpose. In tabulated form the list gives capacity, working rates, approximate weights, prices, &c, of various types of Tudor accumulators.

The Copper Market in September.—Messrs. H. R. Merton & Co.'s statistical circular, for the month ending September 30th, shows that the deliveries have been 4,061 tons in excess of the supplies during the month, the totals being 22,634 tons and 18,573 tons respectively. The former total includes 950 tons shipped to New York. The stocks on September 30th held at European ports, or afloat thereto, were 28,328 tons as against 32,389 tons on August 31st. In spite of this decline in stocks, the price of G.M.B's. has given way during the last 15 days of the month, and it is 20s. per ton lower than on August 31st. The unsettled state of the market still continues, and there would appear to be some signs of the long expected break in prices. A fall of 20s. per ton in G.M.B's. when stocks exhibit a decline of over 4,000 tons is certainly significant; and consumers of the metal can only hope that such signs of weakness may continue to be exhibited. The shortness in supplies during September is due to the shipments from North America and from Spain and Portugal being below the average. The shipments from Australia and outside countries maintain their increase and are promising for the future, especially the shipments from the latter, which total 5,456 tons as compared with a monthly average of 3,500 tons for the preceding 12 months. There have been no new copper mining company flotations in London during September, but in our last issue we gave some details of an American company which has been formed to reopen and work most extensive copper ore mines in North Carolina, and from America also comes the news that valuable belts of copper ore have been discovered in the Yukon district of British Columbia. Since the former mines are expected to yield 1,000 tons ore per day, on and after January 1st, 1899, and the Yukon ore belts are also to be rapidly developed, the Amalgamated Copper Company of New Jersey will have increasing difficulty in maintaining its control of the American supplies. The Yukon ore is said to carry 38 to 53 per cent. copper, while that of North Carolina apparently averages over 10 per cent. copper; as an output of 1,000 tons per day is calculated to yield 100 short tons copper.

Educational Notices.—We have before us a copy of the calendar of the Royal Technical Institute, Salford, for the 1899-1900 session. In about 250 pages there are given very complete particulars regarding the various day and night classes and courses of instruction, accompanied by some capital photographic reproductions of the engineering and electrical workshops, laboratories, &c.

Colliery Plant.—The Plaspower Colliery Company, near Wrexham, are putting down an electric haulage plant in their mines.

Electrical Enterprise in Greece.—The National Bank for Greece is stated by the financial press to be largely interested in the formation which has just taken place in Athens of the Greek Electrical Company, with a provisional capital of 5,000,000 drachmas. The leading spirit in the new undertaking is, however, the well-known American Thomson-Houston Company, which already has a branch establishment in Athens, and the other founders include the Athens Bank and the Société Générale d'Enterprises. The object of the Greek Electrical Company is not only to undertake electric lighting in Athens, the Piræus, Syra, Patras and Kalama, but also to construct a street electric railway in Patras. The most important proposal is, however, a scheme for working the Athens-Piræus Railway by means of electric traction, which, if brought to maturity, will naturally necessitate a large increase in the provisional capital, which has already been fixed by the promoters of the company on the above basis.

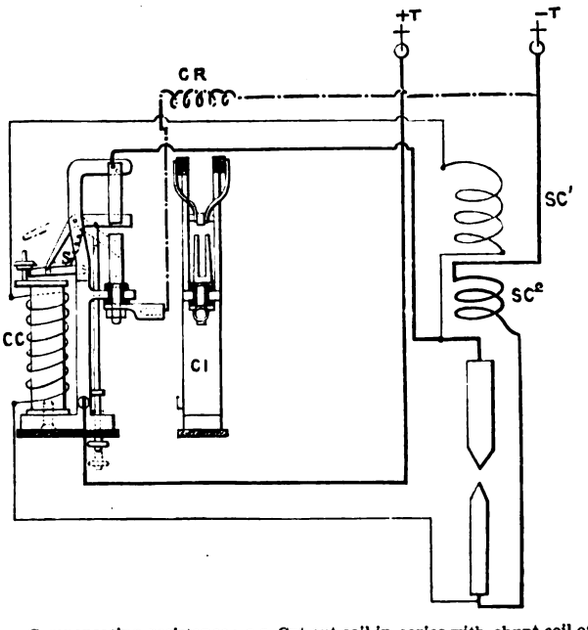
For Sale.—In our "Official Notices" are given details of an engine and Mordey-Victoria alternator (with exciter) offered for sale by the Huddersfield Corporation.

The Glasgow 1901 Exhibition.—A Glasgow paper says that a deputation has been in London on behalf of the Glasgow Exhibition, and has had interviews with a number of electrical plant manufacturers. They made some satisfactory arrangements for having that particular section of the Exhibition as complete as possible, showing the various kinds of lighting and motive power. A special feature of the section will be the direct application of small motors and the comparative absence of the usual mass of pulleys, belting, &c.

The Institution of Junior Engineers.—On Friday, October 20th, the annual general meeting is to be held, at 8 p.m, at the Westminster Palace Hotel, for the election of officers, to receive Council's report, &c.

A Large Boiler Contract.—Our New York exchanges state that the New York Gas and Electric Light, Heat and Power Company has just awarded to Thayer & Co, of that city, the biggest single contract for boilers ever placed. These are for the company's station in First Avenue, and the capacity of the plant, which is to cost fully $500,000, will be no less than 35,560 H.P. Fifty-six Cahall boilers of 635 H.P. each have been ordered, and will be manufactured by the Aultman-Taylor Company, of Mansfield, O. The contract calls for completion of delivery inside of two years.

New Cut-out and Compensating Resistance.—The cut-out and compensating resistance which we show in the drawing is placed on the lamp, so saving cable, but may be placed elsewhere, made up on a slate base, if required. When on the lamp, the cut-out is placed on the base of the lamp and the resistance is wound on porcelain pillars inside the lamp cover. The cut-out is insulated from the base of the lamp. The current passes straight from the terminal of the lamp to the casting, C I, of the cut-out, and thence to the carbons, by passing from one contact strip to the other at the top of cut-out



C R, Compensating resistance; C C, Cut-out coil in series with shunt coil of lamp; S, Tension spring; C I, T T, Terminals; S C¹, Shunt coil; S C², Series coil.

by means of a trigger. When the lamp sticks or anything goes wrong, so that the voltage on the lamp becomes too high, the shunt current which passes through the cut-out coil, C C, (which is in series with the shunt coil, S C¹, of the lamp) magnetises the cut-out core sufficiently to attract the armature which releases the trigger. The latter then

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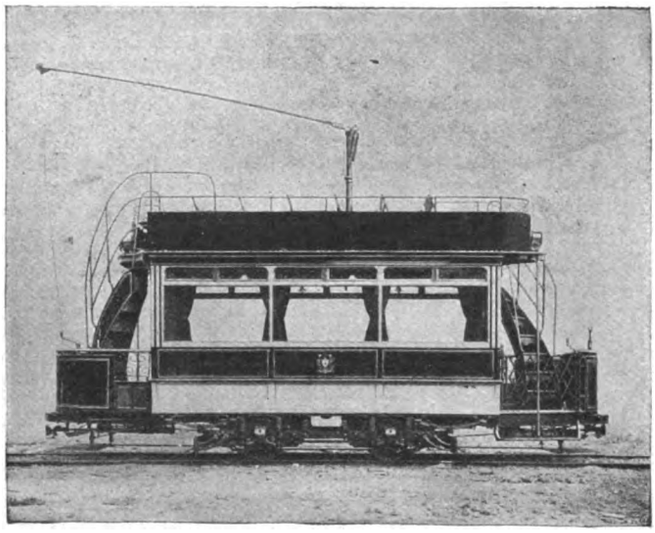
engages with the bottom jaw, being pulled down by tension springs. The series coil, S C^2, and carbons are then cut out and current passes to the compensating resistance, C R, and so to lamp terminal. The remaining lamps then continue to burn equally as there is no increase in voltage on them. The trigger, before leaving the upper contact strips entirely, engages with the lower jaw so that there is no spark or momentary flicker of the arcs. The fitting described, is manufactured by Messrs. Smithson, Sharpe & Co., of Chase Street, Manchester.

Liverpool Electric Trams.—The contractors for the electrical equipment of the Liverpool Corporation Tramways are pushing on with the work rapidly. As mentioned elsewhere in this issue, the Council has accepted the tender of Messrs. Dick, Kerr & Co., Limited, for 200 complete motor cars. This makes, with the orders already filled or in process of delivery by Messrs. Dick, Kerr & Co. for the Liverpool Corporation, a total of 304 cars with 620 motors of their standard type, which will have been supplied upon the completion of this new contract. This contract for 200 cars is notable as being the first large order placed by any English corporation for electric cars and equipments to be entirely of English manufacture. All the cars, motors, &c., will be manufactured



at Preston, the car bodies at the works of the Electric Railway and Tramway Carriage Works, Limited, motors, controllers, &c., at the new works of the Electric Equipment Syndicate, Limited, which are to be completed by December 31st of this year. Quarterly deliveries of 50 cars are called for during 1900 and it is satisfactory to note the new development by which British manufacturers are in a more favourable position to meet these somewhat severe conditions than their American competitors. As the new electric equipment shops at Preston, when in full operation, will easily turn out 3,000 tramway motors and 50,000 H.P. capacity in generators per annum, the sending of future contracts abroad should become unnecessary, at least, in so far as they are concerned.

New Electrical Works.—A Scotch paper says that a number of gentlemen from Glasgow visited Busby recently with a view of selecting a suitable place for the establishment of electric works. The Cart was in spate, and the two waterfalls were at their best.

Niagara Transmission Lines. — The Niagara Falls Power Company has just made an interesting announcement to the effect that it will at once commence the construction of a new power transmission pole line between the central power station in Niagara Falls and the city of North Tonawanda, and also that this transmission line will be extended to Lockport. When this new line is completed the present line will be used in transmitting power to Buffalo exclusively. As it now stands it supplies power to the North Tonawanda transformer station, while it is also tapped by a line running along the Buffalo and Lockport railway to Lockport. The new line will follow the route of the old one from the Falls to North Tonawanda, the Niagara Falls Power Company owning a right of way 30 feet wide. Next summer this new transmission line will be extended to Buffalo also, and thus Buffalo will have two transmission lines connecting it with the mammoth generators at Niagara Falls. On the present pole line there are six cables, or two three-phase transmission lines. The distance from Niagara Falls to Lockport by way of North Tonawanda is about 25 miles, and this will be the length of the transmission line to that place. However, below Lockport there are numerous thriving villages, all having factories, and in time it is probable the transmission line will be extended to serve them, finally reaching Rochester, no doubt.

Notice of Dividend.—The *London Gazette* gives notice of an intended dividend (first and final) of 17s. 3d. in the case of F. Marson, electrician and ironmonger, Leicester. The dividend was payable at the offices of the trustee, 52, Belvoir Street, Leicester, on October 12th.

Opaline Lamps.—The Improved Electric Glow Lamp Company's conical silvered reflector lamp has been favourably received, and the value of the correctly formed optical reflecting surface is stated to have led to such a demand, that the business of the company in these lamps has increased 50 per cent. each succeeding year from their introduction. The advantages of the silvered reflector are highly appreciated in theatres, hotels, factories, shops, and such places where the necessity of obtaining a bright and concentrated light is the first consideration, but to meet the demand for a softer and a more diffused light the company, after a year of careful experimental research, and many costly trials, introduced in 1898 their well-known half-opal glass reflecting conical lamps. The great difficulty experienced in the early stages of the manufacture of the half-opal glass reflector lamps, was the union of the clear glass of the under side of the lamps to the opal glass of the top side of the lamp. The unequal expansions of the two glasses, owing principally to their different thicknesses, caused the failure of something like 50 per cent. of lamps almost directly they were finished. It was only by most carefully apportioning the relative thickness of the two glasses to enable them to expand and contract equally when in use, and also by uniting the two glasses by means of a joint, that this great percentage of breakages was at length overcome, and although the half reflecting opal lamp is a beautiful lamp it has hitherto been costly to manufacture, and therefore not available in many instances. The Improved Electric Glow Lamp Company are now introducing a novelty in the way of a cheaper type of half opaline reflecting lamp, using their crystal clear glass conical bulbs, and coating the upper reflecting portion with an opal glass mixture, which, when applied, presents an inner reflecting surface indistinguishable from opal glass, and externally a smooth polished matt-white surface of such hardness that it is proof against cutting or scratching with a knife, is impervious to damp or moisture, is acid and heat proof, and to all intents and purposes permanent. It is said to be absolutely free from any tendency to get yellow in

use, and will, in fact, stand a temperature equal to bright red heat without in any way altering. Such a composition has been sought for by chemists and scientists for many years past, but hitherto without success. The reflecting surface gives great economy of lighting, and at the same time a well diffused and all-round light through the opaline part of the bulb, exactly as in the case of a half-opal glass reflector lamp. All this, however, at a great saving of cost and absolute reliability as to the burning of the lamp in actual use. The lamp is considered to represent one of the most important developments of recent years in the production of reflecting lamps, and is expected to be an even greater success, commercially speaking, than the other well-known products of this company.

Trade Announcements.—Messrs. Elliott Bros. have removed the whole of their manufacturing and testing works from their old address, 101, St. Martin's Lane, W.C., to their new factory at Century Works, Lewisham, S.E. It will greatly facilitate matters if all correspondence and goods, instruments for repair, &c., are sent to their address, Century Works, Lewisham, and goods to care of Pickford & Co., London.

Messrs. James Milne & Son, Limited, engineers and brassfounders, have completed extensive alterations at their showrooms at 60, Holborn Viaduct, E.C., where a larger and more varied assortment of gas and electric light fittings, bronzes, and manufactures will be open to inspection.

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ELECTRIC LIGHTING NOTES.

Aberdeenshire.—The Public Health Committee of the County Council has approved of the applications of Cults, Culter, Cuminestown, Waterton, and Dyce to form special lighting districts. The two last will be supplied by Messrs. Middleton & Co., Aberdeen, the electricity being generated by means of water-power.

Accrington.—The Board of Trade has decided not to revoke the Accrington provisional order of 1890 at present.

Barrow.—The Town Council has received the sanction of the Local Government Board to a loan of £9,028. The electricity works are already loaded up to their full capacity.

Battersea.—The County of London and Brush Company, in connection with the notice served by the Vestry to remove the mains laid in Trinity Road within 24 hours, caused an interim injunction to be served upon the clerk restraining the Vestry from removing or interfering with the mains until the hearing of a summons. At the same time the Vestry clerk was also served with a writ of claim for an injunction. The solicitor to the Vestry has been instructed to take all necessary steps in the matter.

Belfast.—The Local Government Board has sanctioned the Council's application for power to borrow £75,000 for electric lighting extensions.

Bexhill.—As there will be a deficit of £1,536 11s. beyond the amount borrowed for electric lighting, the District Council has agreed to apply to the Local Government Board for sanction to borrow a further sum of £5,000 to cover this deficiency and to extend the cables.

Cardiff.—Mr. H. Percy Boulnois, M.I.C.E., Local Government Board inspector, held an inquiry last week respecting an application by the Corporation to borrow £3,209 for electric light extensions.

The Electrical Committee was, last week, considering the details of the Corporation action pending against Messrs. Ferranti.

Messrs. Edwards & Armstrong, of Bristol, have secured a contract for the whole of the electrical work in connection with the Royal Hotel, at a cost of about £2,000.

Chelmsford.—Serious interruptions of the public electric lighting took place last week, the supply being cut off for three hours on one occasion.

Colchester.—The Local Government Board has sanctioned the borrowing of £6,500 further for purposes of electricity supply, the amount to be repaid within 25 years.

Crewe.—The Town Council has resolved that the original scheme be extended to include the whole of the streets in the borough within the lighting area. Sanction for a loan of £26,000 has already been obtained, and an additional £10,000 will be borrowed to complete the scheme.

Darlington.—The Board of Trade has approved the system for the supply of electrical energy under the Electric Lighting Orders of 1890 and 1898. A deputation from the Lighting and Tramways Committee is to visit London to confer with Prof. Kennedy and the representatives of the Imperial Tramways Company about the proposed supply of electrical energy to the tramway company.

Derby.—The Local Government Board has sanctioned the Council's application for a £25,000 loan for electric lighting extensions.

Dolgelly.—The District Council is considering the advisability of having the town lighted by means of electricity. A rough estimate of the cost of carrying out a scheme, using water-power, puts the expenditure at £2,600 for public lighting only, and £4,000 for both public and private supply.

Eton.—The District Council has accepted the tender of the Windsor Electrical Installation Company for lighting the public streets for a term of five years.

Exmouth.—The District Council has decided to apply for a provisional order.

Germany.—At the end of the last financial year the central station of the Stettin Electricitäts Werke Gesellschaft was supplying current to 32,211 incandescent lamps, 1,172 arc lamps, and 143 electromotors. The present station being incapable of further extension, land has just been acquired on which a second power station is to be established.

Hampstead.—The Vestry has resolved to apply to the London County Council for sanction to raise a loan of £97,177 9s. 6d. to meet capital expenditure on the electric lighting undertaking to March 25th last and the estimated cost of the proposed extension of the electric lighting station and plant.

The Lighting Committee announces that in future the charge for lighting each of the public arc lamps will be £28 per annum instead of £30, and that the charge for electric current to private consumers will be further reduced to 6d. per unit for the first hour and 2½d. afterwards. Last year the Vestry made a profit on the undertaking which was equal, after payment of interest and instalments of loans, to a net profit of 6·65 per cent. on the capital outlay.

Harrogate.—The Council has fixed the following charges for electric supply:—Under 15,000 units per annum, 6d. per unit for the first hour and 4d. per unit afterwards; over 15,000 units per annum, 6d. per unit for the first hour and 2d. per unit afterwards. For cooking, heating, and power, 6d. per unit for the first hour and 2d. per unit afterwards.

Hartford, Northwich.—The Parish Council has shown exceptional enterprise in introducing electricity for public lighting. The installation consists of 29 lamps, each of 16 C.P. The township contains 840 inhabitants, with an electorate of 170, and has a ratable value of £9,000. The estimated cost of maintenance is nearly £60 a year, and this it is proposed to raise by a rate of 2¼d. in the £ on houses, and ⅜d. in the £ on land. Hartford can claim, in the matter of electric lighting, to be one of the most progressive villages in the country.

Islington.—The Vestry is taking up a loan of £4,997 for the extensions of the mains to New North Road.

Kilmarnock.—A deputation from the Town Council visited Glasgow on Monday with the object of inspecting the electric lighting works of the Corporation.

Lewes.—The Town Council has adopted the recommendation of the committee to accept the offer of the Electrical Power Distribution Company, to instal the electric light as soon as the transfer of the provisional order has been approved by the Board of Trade.

Leyton.—An action has been brought by a Mr. Hawkes to obtain an injunction restraining the District Council from causing a nuisance by the noise and vibration of the gas engines. Steps are being taken to silence the engines.

Liverpool.—The North Haymarket has been lighted with 56 arc lamps in place of the old gas fittings.

London.—The Board of Trade has intimated to the Court of Common Council that it approves of the additional system of supply by continuous electric current proposed to be provided by the City of London Electric Lighting Company. Relative to an application by that company for permission to alter the standard pressure of supply to consumers from 100 to 200 volts, the Streets Committee has recommended the Court that it should be complied with subject to the company agreeing (1) to make at their own expense the necessary alterations to consumers' lamps, wires, or fittings directly or indirectly incidental to that change; (2) that the prices of supply should at no time be raised above those contained in the company's notice of July 26th; and (3) to establish concurrently with the alteration of the pressure proper means of testing the public and private supply. On the motion of Mr. Algar the report was carried. Applications were received from the Postmaster-General for permission to open all the main thoroughfares of the City for the purpose of laying conduits and providing manholes for access to the same in pursuance of the Telegraph (Telephonic) Communication Act, 1899, and were referred to the Streets Committee, who were also desired, at the instance of Mr. Hollington, to consider the desirability of providing subways in the principal streets.

A conference of the local authorities of Whitechapel, Mile End, Limehouse, and St. George's-in-the-East was held on Monday, according to the *Daily Chronicle*, at the offices of the Whitechapel District Board. These parishes are about to be merged in one borough, and it is felt there should be a uniform system of lighting. The Whitechapel Board is about to complete its electrical installation, but the other three parishes allowed the County of London Brush Company to obtain a provisional order to lay down mains. Two years have elapsed, and the company has only just given notice of its intention to begin operations. But one of the terms on which the order was granted was that the work should be begun within two years, or the Board of Trade could revoke the order. Limehouse and Mile End have consequently applied to the Board to revoke the powers, but the Board have replied to Limehouse that they do not intend to do so. A resolution was carried appointing a deputation to wait on the Board of Trade to demand that the order should be revoked, and affirming that the lighting of the East End should be carried out by the new municipal body. The London County Council intends to support the local authorities in their action, and has refused permission to the company to break open the roads.

Margam.—Mr. H. Percy Boulnois, Local Government Board inspector, last week held an inquiry into the application of the Margam District Council for power to borrow £6,500 for the purpose of laying down an electric light plant. The scheme was opposed on behalf of the Aberavon Corporation, who are the lighting authority for the Margam district, and also ratepayers in the parish of Margam. The scheme is one prepared by Mr. W. Hosgood, engineer to the Port Talbot Railway and Docks Company. It was stated that the Council had since come to the conclusion to increase the estimate to £7,000, so as to provide for three sets of plant. Mr. J. C. Howell, managing director of the Pontypool Electric Company, gave evidence that in his opinion the district was not suited for the electric light, being very scattered. He thought the scheme would never pay its way.

We are sorry to see Mr. Howell take up this attitude. There are many "scattered" districts where electric lighting is highly profitable, and we are certain that no other system of lighting from a centre can compare with electricity. There are important wet and dry docks at Port Talbot, as well as other large works, while 118 50-C.P. lamps would be installed for street lighting at the very commencement.

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Mr. Howell opposed an electric lighting scheme for Aberavon some years ago, with the result that gas lighting was adopted. We sincerely trust that his efforts will this time be frustrated.

Lytham.—The District Council has decided that Messrs. Medhurst and Page be retained to prepare and submit to the committee a full report on the electric lighting of the district at an inclusive fee of £25.

Morecambe.—The demand for electric current being far in excess of the supply, the District Council has resolved to apply to the Local Government Board for power to borrow an additional £25,389, with a view to extension of plant at the electricity works.

Nantwich.—The Urban District Council has passed a resolution requesting Mr. G. R. Peers, of Manchester, to prepare a report upon the proposed electric lighting of the town.

Newport (Mon.).—The Electricity Committee has selected the following candidates for the two vacant appointments as electricians:—Messrs. A. Howard (Tunbridge Wells), T. E. Slaughter (Reading), L. L. Forster (Coventry). Mr. Taylor, late assistant electrical engineer, has joined the staff of Mr. Hammond.

Newport.—The directors are maturing plans with a view to the reconstruction of the gas company, and to its supplying both gas and electric light to Newport, if this view commends itself to the shareholders.

Oldbury.—The Gas Committee is endeavouring to arrange terms with the Midland Electric Corporation for Power Distribution, Limited, to supply electricity in Oldbury.

Ramsgate.—The Town Council has approved of Mr. Valon's report on the proposed supply of electricity, and will apply to the Board of Trade for a provisional order to supply electricity within the borough. The initial outlay is estimated at £26,000, but probably a loan of £50,000 will be raised.

Rhyl.—Last week we mentioned that Messrs. Trentham and Preece have presented a report to the Council *re* electric lighting. This was an error, the correct names being Messrs. Trentham and Peers. The Electric Light Committee will recommend the Council to adopt a scheme for lighting the sea front and adjacent streets, at a cost of about £14,000.

Romford.—The District Council has resolved to apply for a provisional order for the supply of electricity within the parishes of Romford, urban and rural. Mr. W. C. C. Hawtayne has been requested to advise on the matter.

Ross.—At a ratepayers' meeting last Friday it was decided not to proceed with an electric lighting scheme at present.

St. Martin's-in-the-Fields.—The Vestry has come to terms with the Charing Cross and Strand Electricity Supply Corporation as regards the laying of mains, &c., in the parish.

Salford.—Last week Mr. G. W. Williams, an inspector under the Local Government Board, held an inquiry with reference to the application of the Corporation for sanction to borrow £10,500 for electric lighting purposes. It was stated that the Corporation would shortly ask permission to borrow a much larger amount—about £72,000—for the electric lighting scheme.

Shoreham.—The District Council has taken alarm at Brighton's projected extension scheme, and instead of seeking to obtain supply from the Brighton Corporation at a low price, is considering a proposal to join Portslade and Southwick in procuring a provisional order.

Shrewsbury.—The Town Council has decided to substitute 24 arc lamps, 60 or 70 yards apart, for gas lamps in the principal streets, at a cost of £850. Application will be made to the Local Government Board to borrow £3,080 for this and other extensions of the electric works.

Spain.—A number of the principal streets in Madrid are about to be lighted by electricity. The present estimates provide for the establishment of 286 arc lamps of 8 and 12 amperes. The cables will be laid in five circuits.

Stafford.—During the past month the consumption of electric light in the town has shown an increase of 38 per cent., and in view of future capital expenditure for extensions and alterations to meet the growing demand for the light, the Corporation have decided to apply for a provisional order to enlarge to the extent of £20,000 their borrowing powers for electricity purposes. The above sum would not be spent all at once, but only as required. At the present time the engines are running at their full load.

Tonbridge.—The Tunbridge Wells authorities offered to supply electric light to the adjacent village of Tonbridge, but have received a reply from the District Council that Tonbridge has a provisional order of its own.

West Bromwich.—The Town Council has approved of the committee's report on the electricity supply, and will apply to the Local Government Board for leave to borrow £30,000.

Whitby.—The Board of Trade and the Postmaster-General have approved of the scheme drawn up by Mr. Preece for the installation of the electric light.

Wigan.—The Town Council has resolved to put down a temporary installation for supplying electric light to a certain portion of the town at a cost of £1,000.

Witney.—A special meeting of the District Council was held last week for the purpose of granting consent to a provisional order for electric lighting to the Witney Electric Supply Company.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—Mr. William Dyack, burgh surveyor, and Mr. Moonie, the tramway manager, have prepared, for the Tramways Sub-Committee, a report on the proposed extensions to Torry, Ferryhill, and the Beach Bathing Station, and the reconstruction and electrical equipment of the existing lines. The report goes at length into the general question of routes and track construction, and sums up as follows:—

1.	Ferryhill route		£22,682
2.	Torry to Union Street *viâ* Market Street	£32,558	
2a.	Torry to Union Street *viâ* Guild Street and Bridge Street		35,816
3.	Bathing Station from Castle Street	£13,660	
3a.	Bathing Station from Crown Street		21,405
4.	Union Street from King Street to Crown Street	£7,745	
4a.	Union Street from Crown Street to Holburn Street		6,911
5.	King Street to Bridge of Don		35,579
5a.	Across Bridge of Don to Seaton Brick and Tile Depôt		3,255
6.	Circular route *viâ* Rosemount		28,874
7.	Albyn Place and and Queen's Road to Bayview		18,970
8.	Holburn Street to Bridge of Dee		24,547
9.	Great Western Road		22,157
10.	Extension at Woodside to city boundary		9,942
11.	St. Nicholas Street and George Street to Kittybrewster (renewal of line and bonding rails)		9,503
	Total		£239,141

We further estimate the number and cost of the cars which will be required in connection with these new and reconstructed lines as follows:—

Cars for three new routes, say 20	£11,660
Cars for re-construction, say 50	29,150
Total	£40,810

Aberdeen.—A local journal says that Messrs. Macartney, M'Elroy & Co. are pushing forward the electric tramway equipment, and it is thought that within three weeks or so all will be ready from Union Street to Kittybrewster. The length of the route is 2½ miles double track.

Bedford.—At a special meeting of the Town Council last week it was unanimously resolved to apply for a provisional order to construct and work municipal electric trams in the borough.

Belfast.—The committee which visited various cities and towns with a view of obtaining information on the method of construction to be observed in laying down tramway extensions inspected the lines in Dublin, the Isle of Man, Liverpool, Sheffield, Hull, and Glasgow. After carefully weighing the expert testimony given at these places, they had come to the following conclusion:—That a rail of 98 lbs. per yard would be the most suitable for the proposed lines; that the concrete foundations should be 6 inches in depth; that the use of Welsh square sets should be continued; that the rail joints be bonded with flexible "Crown" bonds; that it would be advantageous to place pipes for electric cables under the permanent way during its construction, the outlay on this being borne by the Corporation, and not by the tramway company. The deputation felt that the overhead system was the best and most suitable to public use. Councillor Andrews suggested electrically-welded rails instead of the ordinary bonding. The report was adopted, with the addition that the committee be empowered to consider the electric welding of the rails in place of the bonding suggested, but this was subsequently withdrawn.

Birmingham.—The Lord Mayor has conferred personally with the directors of the tramway company, with a view to re-opening the negotiations for improving the tramway system by the adoption of the electrical working. But the negotiations have failed. It seems that Mr. Ross and his friends are still determined in favour of the overhead trolley, to which Birmingham has long shown a most unreasonable opposition. For the present, therefore, no change can be contemplated.

Bournemouth.—Although the outlying districts are very favourably disposed toward tramways, the Bournemouth Council has again resolved to decline its sanction to an application shortly to be made for powers to construct tramways through various portions of the borough.

The promoters of the proposed line are the British Electric Traction Company, who contemplate commencing the Poole and Westbourne line almost immediately.

Cast-Weld Rail Joint in France.—The *Electrical World* digest mentions an article in *L'Eclairage Electrique* containing an extract from a report to the International Tramway Union concerning the application of the Falk joint in Europe. The general cost in France is $3 60 to $4.00 per joint, including royalty. On a line from Lyon to Oullins the cost of maintenance fell from $1,000 per year and per km. to about $20 after this joint was used. About 32,000 of these joints have been made on French lines. Some figures for the resistance are given.

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Derby.—The charge for power in future will be 3d. per unit for the first 12 hours per week, 2d. for the next 18 hours per week, and 1d. for all quantities after. The net profit on the electric light undertaking for the past year amounted to £912.

Derby—Ashbourne.—The Bridges and Highways Committee has reported to the Derbyshire County Council, having considered a report presented to the Board of Trade by two of their inspectors with reference to the proposed light railway along the main road from Derby to Ashbourne, and the attention of the Board of Trade has been called to points originally agreed upon between the promoters and the Committee. The Hon. F. Strutt accused the Committee of keeping the Council in the dark as to what was really going on. Colonel Cavendish admitted that the Committee had received a confidential communication, marked strictly private, and, therefore, they could not publish it. There would, however, be no objection to the members of the Council seeing the document as well as the objection of the inspectors, and they could also see the copy of the reply sent by the Committee. He might say that some very strong objections had been taken to the railway, and he did not know what the result would be. Beyond the fact that the communication was marked strictly private, there was no reason for secrecy.

Dublin.—The case of the Pembroke Urban District Council *v.* the Dublin Southern District Tramway Company, to which we referred last week, came before the Nisi Prius Court No. 1, Dublin, on 6th inst. After a lengthy hearing Mr. Justice Kenny reserved his judgment until the following day. Judgment was given on Saturday, the injunction being granted, the usual undertaking being given by plaintiffs as to damages, plaintiffs to give an undertaking to speed the action.

A hack car was smashed into by an electric car on the North Circular Road on 8th inst., with unpleasant effects to the occupants of the former.

Dudley.—At the last meeting of the Town Council the Mayor stated that the construction of the electric tramway between Dudley and Netherton was progressing too slowly, but it was promised that the line would be ready for Christmas.

There was a breakdown somewhere on the electric tram system on Thursday night last week, and the service was at a standstill for some hours.

East Ham.—On Tuesday Major-General Crozier held an inquiry on behalf of the Local Government Board into the application of the District Council for leave to borrow £41,490 for electricity supply. The Board of Trade has already sanctioned the construction of electric tramways, at a cost of £47,800, and the lighting and traction supply will be combined in one generating station. Powers have been obtained for 5·7 miles of single track, and 8 miles more will be equipped. The line, chiefly single, will run from the Albert Docks to Epping Forest. The contracts have already been let—the whole of the electrical equipment to Messrs. Dick, Kerr & Co., the boilers, pipes, condensers, &c., to Messrs. Babcock, Wilcox & Co., while the Callender Company will lay all the cables. It is not yet settled whether or not the track shall be laid by local labour. The whole of the plant will be of English manufacture.

Eccles.—The General Purposes Committee of the Eccles Town Council has confirmed the action of the representatives of local authorities who met in the Town Hall to consider the proposed construction of an electric tramway from Salford Docks to Prestwich and district by way of Eccles and Worsley. The conference recommended that the Councils interested consent to the promotion of a provisional order under the Tramways Act by the United Kingdom Electrical Tramways Syndicate on terms and conditions to be hereafter approved.

Elland.—There is a scheme on foot between the Elland, Huddersfield and Halifax authorities for working a continuous line of tramways. The Elland Council will allow the two other towns to bring their tramways into Elland under certain conditions, which they have just announced, among such conditions being one to the effect that "Elland shall have the right, if and when they choose to do so, to supply the power to run the tramcars over their own roads, at a price not exceeding the cost at which Halifax can produce and deliver it on the trolley wire at the Elland boundary." Arrangements are being pushed forward with equal activity for the application for a provisional order to supply electricity to the town. At the outset, the area of supply will be the centre of the town. If the two Corporations agree to the terms mentioned, a day load will thus be provided for the Elland electricity plant.

Glasgow.—A man was knocked down by an electric car on Saturday night, and he died on Sunday as a result of his injuries.

Greenock.—The Law and Finance Committee has prepared the conditions under which offers for leasing the tramways within the burgh may be made. The lease is to be for 28 years, and the lessees shall pay as from May 15th, 1900, the sum of £14,000 to the Corporation, and shall reconstruct and electrically equip the tramways for electric traction as a double line within the burgh. The Corporation shall have the option of taking over from the lessee the whole lines and electrical equipment at breaks of 14 or 21 years after May 15th, 1900. If the Corporation take over the lines and equipment at 14 years, they shall pay the value of the lines and equipment as then existing, as the same shall be fixed by an arbiter appointed by the Board of Trade, and shall in addition pay a sum not exceeding £22,500. If the town acquires the line at the end of 21 years, the purchase price is to be £11,250; and if it wait till the expiry of the lease, the tramways within the burgh shall become the property of the Corporation without compensation. The lessee will be required to maintain and renew the line, and to take the whole of the electricity required for the tramways within the burgh from the Corporation power station. A 10 minutes' service of tramways within the burgh, a fare of not more than 3d. for the whole length of 4¼ miles within the burgh, and ½d. fares for stages of not less than half a mile, are also conditions of the lease.

Hammersmith.—At the Hammersmith Vestry on Wednesday a long discussion arose over the question of electric traction in King Street, and Beadon and Glenthorne Roads. Ultimately the following paragraphs were passed:—(1) That it is not advisable to allow the trolley wires to be attached to the Vestry's electric lighting standards, or the Vestry's arc lamps to be placed on the company's posts; (2) That the Bristol design for the side and centre posts should be adopted; (3) That cut-out circuits shorter than half a mile lengths be insisted upon; (4) That where the company erect traction posts in the centre of the road, they be required to light them by means of two 100 c.p. glow lamps, and that the other traction posts be sufficiently lighted; (5) That the Vestry strongly urge the County Council not to insist upon an underground system as suggested, but to use its utmost endeavours with the Tramway Company to substitute the overhead trolley system for the conduit system.

Hull.—The Corporation is to purchase the undertaking of the Hull and Sculcoates Tramway Company for £15,500. This, of course, means electrical equipment directly.

Keighley.—At the meeting of the Keighley Tramways Company last week, it was stated that the directors desired to supersede horse haulage by electric traction, if it could be done at a less cost, and they were also prepared to meet the Corporation on the subject of hiring electrical energy from them, or on that of the sale of the tram undertaking to the Corporation, but not on the terms which the electrical department of the Corporation had formulated.

Leeds.—The Council has passed the Tramways Committee's proposals for equipping various lines (mentioned by us last week) on the electric trolley system. In moving the resolution, Mr. Smithson, chairman of the Committee, said:—

These lines included practically the remainder of the tramways now worked by horse and steam, lines in course of construction, and lines for which the Corporation had powers. The total street length of lines involved was 17 miles, equal to 34 miles of single track. The estimated cost was something like £160,000. The present electrically equipped system from Roundhay to Kirkstall, which had been worked for two years, comprised 14 miles of single track. The lines now in progress of electrical equipment, for which contracts had been let amounting to £80,000, were Headingley and Chapeltown, Hunslet, Dewsbury Road, Becket Street, and York Road. These represented a street mileage of 13½ miles, or about 26 miles of single track. The total capital expenditure on tramways account up to date amounted to nearly £600,000. That included liability on contracts already let, and not yet completed or paid for. He mentioned that sum of £600,000 because it might be thought that the £160,000 was a large amount. It was not a very serious amount when regarded as an addition merely to the actual expenditure already undertaken of £600,000. The expenditure of £160,000 would enable them to completely transform the tramway system, to dispense with the ancient steam cars, and to clear the streets of the slowly moving horse cars. They would be able, moreover, to give to every district of the city the same facilities and comfort in tramway travel now enjoyed by the residents on the Roundhay and Kirkstall lines. The Committee were able to bring forward this resolution with the knowledge born of the experience of a full year's working cost of electrical traction, as compared with a year's cost of steam and horse traction. For horse traction the cost was 9·44d. per car mile worked; for steam it was 9·36d.; and for electricity 4·42d. The receipts per car mile were 9·80d. for horses; 11·80d. for steam; and 12·35d. for electricity. It must be borne in mind, however, that the depreciation of electrical traction plant was very much heavier than that of the other two systems, and that the interest and sinking fund charges were considerably greater. But, allowing for this, the saving in working cost might fairly be set down at not less than 2d. per car mile, and the increase in receipts at 1d. per car mile. This, on the mileage worked by horse and steam cars alone last year (amounting in the aggregate to 1,469 098 miles) would represent a saving on the same lines (if they had been worked by electricity) of £18,363, without estimating anything for profit on the new lines which were included in the estimate for electrical equipment, but which had not yet been worked at all. The interest and sinking fund charges on the proposed outlay of £160,000 would amount to about £8,163 per annum, as against the gain resulting from the adoption of electricity of £18,000, which would show the Council that the committee, in making this recommendation, were proceeding on safe financial grounds, and proposing a sound investment. The committee considered this a reasonable time to bring forward the proposal, because the present electrical extensions were approaching completion, and the labours of the committee would in a short time be much easier than they had been of late. They thought it better to bring forward a scheme for the complete electrical equipment of the city rather than allow one ward to complain that another was getting the preference. He believe they might reasonably expect the whole of this work to be carried out within the next two years, and that then the tramway system would be one of the most complete in the kingdom.

Liverpool.—Messrs. Goldberg & Co., Paradise Street, have written to the Tramways Committee in regard to contemplated legal proceedings against the Corporation owing to the erection of a fuse box and electric car pole in front of their premises. The committee directed the town clerk to defend any action that might be taken. The Walton electric route is completed and a car was to run over the whole route on Tuesday, and the usual application to be made to the Board of Trade.

A 'bus and electric car collided here on 8th inst. The driver of the former was thrown from his seat, causing concussion of the brain, and the affrighted horses bolted.

A deputation of property owners and occupiers has waited upon the mayor to oppose the running of electric cars along certain thoroughfares close to the Exchange, which, in their opinion, are already sufficiently congested.

The recommendations of the Tramways Committee, mentioned in our last issue, have been passed by the Council.

Newcastle.—The city treasurer (Mr. Pace) has called the attention of the Finance Committee to the fact that money will shortly be required for the first portion of the tramway works—the erection of the power stations, car sheds, &c. £400,000 would be required. He desired the Committee's instructions as to what price the issue should be fixed at. A small committee was appointed to take the whole matter into consideration.

(*Continued on page* 603.)

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LLANDUDNO MUNICIPAL ELECTRICITY WORKS.

It is, perhaps, rather a matter for surprise that such an important and fashionable watering place as Llandudno should have had to wait until the end of last year for a general public supply of electricity. This may possibly have been due to a natural hesitation on the part of the authorities to embark on an enterprise which would at first sight appear to be remunerative only during the season; for Llandudno, as distinguished from most other large resorts of a similar nature, consists almost entirely of hotels, hydros, boarding houses, and lodging houses. The resident population is not much above 6,000, but during the season the visitors swell the total to about 30,000, and there is no doubt that the desire to lay down plant for the visitors had to be considered in conjunction with the prospect of the same plant lying practically idle during six months of the year. However, the former consideration out-weighed the latter, and having called in the assistance of Mr. A. H. Preece, and obtained the necessary loan, the Council proceeded, early in 1898, to lay down a scheme of public and private lighting, which was formally inaugurated on November 5th last.

The general situation of the town, which may be described as a crescent extending about 1½ miles along the bay and not more than one-eighth of a mile deep at any part, is eminently suitable for a high voltage system, as every probability exists that the town will extend in length rather than in depth. The scheme adopted by the authorities is a 440-volt three-wire system, with balancing cells and a balancing machine; and there is no doubt that no better system could have been suggested to meet the requirements of the district. A suitable site was found adjoining the Council's gasworks, situated about half a mile inland and in the centre of the bay; and the works are served by a siding from the railway station not far distant.

The chief feature in connection with the generating plant is the use of refuse destructors. With a shifting population the amount of refuse must be more or less directly proportional to the number of inhabitants and therefore to the light required.

The works comprise a red brick building, two-thirds of which are occupied by the boilers, destructors, pumps and tipping platform, the other third being utilised for the engine room and battery room. Over the latter are situated the offices, and under the tipping platform there are fan room and coal store, &c.

The main flue is built above ground, and has a semi-circular roof. The reserve flue is below ground, and is about the same size as the main flue. An inclined road, 15 feet wide from the outside, is led up to the tipping platform. This road has a gradient of 1 in 16.

The boilers, of which there are three, are of the Babcock-Wilcox 200 H.P. type, each capable of evaporating 5,000 lbs. of water per hour and working at 150 lbs. pressure. They consist of seven sections each, every section holding seven 16-feet tubes, and the drums, of which there are two to each boiler, are 36 inches in diameter. They have a grate area of about 36 square feet, and a heating surface of 1,741 square feet each, and two of them are built in conjunction with the destructors, the third being arranged for coal or coke firing only. This one is used continuously when full load is on, and stands in the centre, while the two outside boilers have their brick-work extended in front to form the walls of the destructors, as shown in our illustrations; these are of the well-known Beaman & Deas type, and each consists of two cells, each pair of cells having a grate area of 50 square feet. The refuse in the cells is manipulated from two furnace doors on each side of the destructors, which are served in the following manner: The refuse is shot on to the tipping platform at the back of the boiler house, this is about 10 feet high by 24 feet wide, and 76 feet long. It is then shovelled by hand into the refuse shoots, each one of which contains two charge hoppers, 37½ inches × 11½ inches, conducting into the corresponding cells. Through these it falls on to a fire-brick hearth set at an inclination of 52° and supported on T-irons, and thence on to a fire grate fitted with stationary firebars, which just allow the fine ash to pass through. As the refuse falls on to the grate it is manipulated by long firing tools ending in a kind of grappler, and when it is burnt out the clinker is removed by means of a clinker railway running round the destructors. The gases from the cells pass through a combustion chamber and thence to the boiler flues, from which they reach the main flue. These two boilers are, however, arranged for firing by coal if necessary by means of furnace doors in their sides should the supply of refuse fall too low to be of much use. The original average estimated amount of refuse destroyed was 5,800 tons per annum, consisting of 5,490 tons of house refuse and 310 tons of shop refuse, but in March the amount being dealt with was 15 tons per day, and at the time of our recent visit this figure had doubled itself. It would, therefore, appear probable that the original estimate will be exceeded. The first destructor was only started on January 23rd and the second on May 15th, but certain interesting information as to their working has now been obtained. The percentage of clinker is 30·5, although this would no doubt vary at times according to the nature of the refuse. The cost of destruction is 1s. 3¼d. per ton for labour for one destructor, and the amount consumed per hour per pair of cells is 1·6 tons; the amount of refuse burned per hour per square foot of grate area is 71·7 lbs., and the refuse burned per pound of water evaporated is 1·4 lbs. Sometimes when the refuse is wet a small amount of slack coal has to be mixed with it, but the cost of this is not much. The coke used for the third boiler costs 6s. 9d. per ton.

The forced draught is supplied by a motor fan made by Messrs. Wilson, Hartnell & Co., and running off the 440-volt bus bars. The power required to drive this motor is 7·4 KW. The motor is situated in a separate room under the tipping platform, and the draught is conducted underground and led up into the closed ashpits of the destructor cells.

As stated before there are duplicate flues from the boilers and also a bye-pass flue, so that one flue can be cleaned whilst the other one is being used.

There is a Green's economiser fitted with 192 tubes in one group and with deflectors at the back. A small motor of 1 H.P., taking current off the 220-volt mains, drives the scrapers.

The whole of the condensing, pumping, and feeding arrangements were supplied and erected by the Sunderland Forge and Engineering Company. The main steam pipe is of wrought-iron, 6 inches in diameter, with screwed steel flanges recessed and brazed, and it is fitted with Hopkinson's parallel slide valves. Geipel steam traps are connected to the water pocket of the T pieces, which are of cast-steel; the bends are of solid drawn copper with flanges brazed on. An auxiliary steam main is also provided and connected separately to each boiler, and this is connected at the ends to the main steam pipe with separators of cast-steel. This main is 2½ inches in diameter. The feed pipes are so arranged that the feed may go through the economiser or direct, and they are of wrought-iron with copper connections. The exhaust pipes are rigidly secured to the engine room wall by hangers. The main is 12 inches in diameter and is taken right past the battery room into the open, where it is provided with an automatic valve for exhausting either into the condenser or the atmosphere.

A small chamber next to the boilers is occupied by the pumps. The feed pumps, of which there are two, one being used as a standby, are of the Blake-Knowles type with cylinders 6 inches × 8½ inches stroke, and each one is capable of pumping 2,000 gallons of water per hour into the boilers. Here are also situated the air and circulating pumps, built by the Sunderland Forge Company. Both of these are in one casting, the air pump being double-acting and the circulating pump single-acting. The barrel of the former is 13 inches and of the latter 9 inches diameter. The air pump has a gun-metal plunger with Delta metal pump rods and the valves are of rubber with gun-metal seats and guards. The pumps are driven by a vertical compound engine with cylinders 5 inches and 9 inches, having piston and D slide valves respectively. Wrought-steel columns support the cylinders over the pumps; the pump rods are coupled direct to projections from the engine piston rods.

Outside the building, supported on a tank, is a Ledward evaporative condenser, capable of dealing with 7,500 lbs. of steam per hour. There are 360 tubes of oval section, which,

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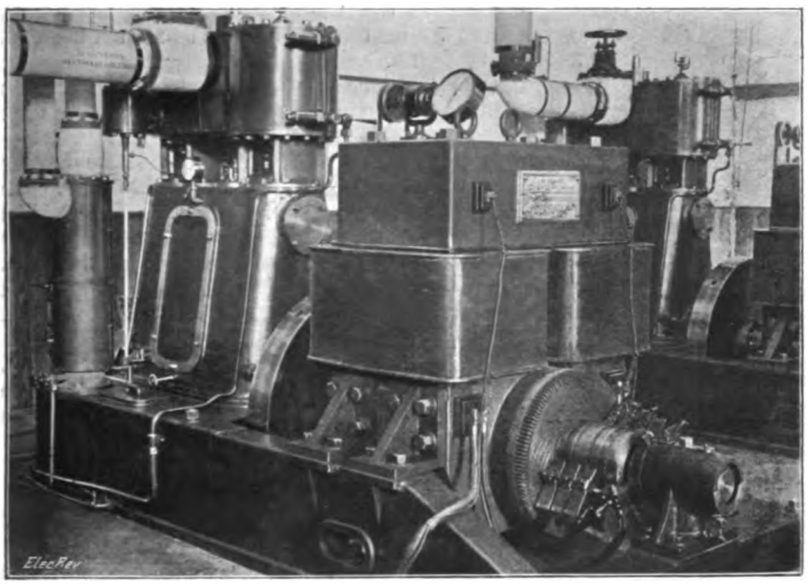
in order to assure better radiation, have fins cast on them. They are arranged in several groups, each group having a connection at the top to the exhaust pipe and at the bottom to the air suction. The tank, on which the condensers rest, is supported on brick piers, and has a capacity of 4,000 gallons. The circulating pump discharges the water from this tank into a pipe which passes over the condensing tubes, and branches of perforated wrought-iron pipe



Llandudno.—Generating Plant.

sprinkle the water on to the top of each tube, whence most of it trickles down into the tank again. An arrangement is provided for distributing the steam evenly over the inner surface of the tubes by means of an internal pipe which is fitted to the three top rows of tubes.

The engine room has a five-ton hand traveller of 25 feet span and 18 feet lift, supplied by the Sunderland Forge and Engineering Company. There are at present two Belliss E.C.7 standard compound two-crank enclosed engines, self-lubricating, and arranged to work either condensing or non-condensing, running at 450 revolutions per minute and working at 140 lbs. steam pressure. Each of these is direct coupled to a "Silvertown" S.D. 220 two-pole inverted shunt dynamo with drum-bar armature, having an output of 100 KW. at a pressure of 440 to 500 volts. One of these sets is shown in one of our illustrations. Besides these, there is an E.C.4 Belliss engine coupled direct to a 50-KW. "Silvertown" dynamo of similar pattern, but with ring-wound armature, capable of developing 50 KW. at 600 volts pressure when running at a speed of 530 revolutions per minute. For balancing there is an apparatus, also built by the same makers, consisting of two machines mounted on the same spindle and on one bedplate, each capable of carrying 100 amperes at from 220 to 256 volts, by means of which 25 KW. can be transferred from one side of the three-wire system to the other. These machines are similar in design to the generators. All the machines are shut down at 11.45 p.m., and then the town is supplied from the cells.

The battery room contains 256 cells of the Pritchetts & Gold type, arranged in two sets of 128. They consist of 19 plates each in glass boxes, and their output is 50 amperes for 10 hours or 200 amperes for one hour, but the average output is 90 amperes. They are mounted on wooden stands, and these and the copper rods running to the switchboard are all painted with anti-sulphuric enamel. The rods are supported from the roof by means of porcelain insulators.

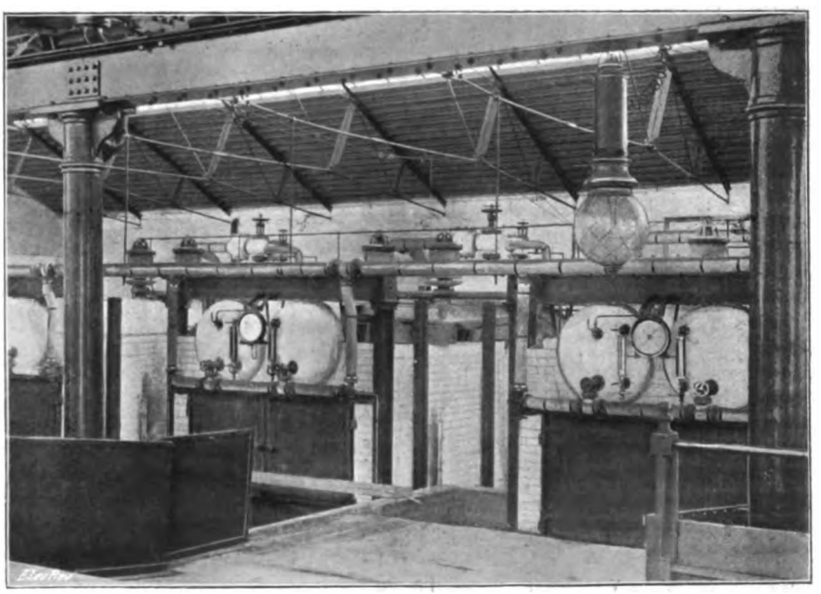
The switchboard shown on the next page is situated opposite the dynamos, and is mounted on a low platform. It is a handsome structure, of polished marble panels, screwed to a steel framework erected about 3 feet from the outside wall. The moulding between the panels and round the outside of the board is of polished teak, and an ornamental teak panel surmounts the board fitted with an 18-inch electrically-wound non-magnetic clock. The back of the board is enclosed by teak doors.

The centre panel is composed of three slabs, the top one being fitted with two Kelvin recording ammeters and two Kelvin recording voltmeters for the bus bars. The second slab contains two balancing ampere gauges, the balancer and middle wire fuses, the balancer motor starting switch, two single-pole switches for putting balancer to outers, and the shunt regulating switches for balancer. The third slab bears D.P. voltmeter switches and middle wire plugs.

The left of the board comprises three dynamo panels, each consisting of two slabs. Each top slab is fitted with a Kelvin sector ampere gauge, a double pole throw-over switch interlocked with a maximum automatic cut-out, a dynamo fuse, and a shunt regulating switch. The lower panels each contain battery charge and discharge meters and indicators. The right of the board consists of two panels, each comprising three slabs, one slab for a circuit. There are at present only four circuits, and each of these is fitted with two Kelvin sector ampere gauges—that is, one for each side of the system—and two single-pole fuses.

The teak panel at the top of the board contains one station and pilot voltmeter, two pilot voltmeters connected permanently to each side of the system, and the dynamo voltmeter.

A battery switchboard, mounted in similar manner, is fixed on the wall next the battery room and comprises three panels. Two of these are fitted with 30-way battery regulating switches, and the third contains two Kelvin engine



Llandudno.—Boilers.

room voltmeters connected between the "charge" side of the regulators and the middle wire, two switches, two recording ammeters, and two ampere gauges. The whole of the switchboard work was supplied by James White, of Glasgow, who also supplied all the connections between switchboards, dynamos, and battery. All the resistances in connection with the switchboards are fixed on the wall at the back.

The public lighting of Llandudno is well provided for.

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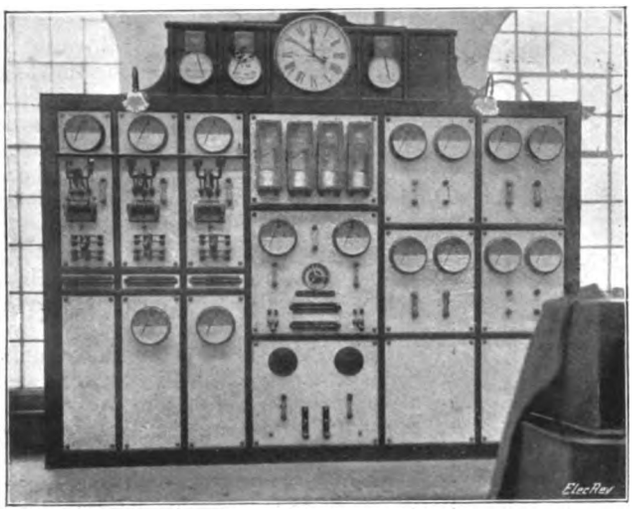
Along the front there are 27 arc lamps spaced 50 yards apart, and distributed in other parts of the town are another 21. The arc lamps are of the Crompton-Pochin type, taking 10 amperes, and burning 18 hours with one pair of carbons. They are fitted with opalescent globes, the centre of which is about 20 feet from the ground. The posts are fitted into handsome cast-iron bases, and those along the front and at certain other positions, are surmounted by carriers, the globe being in the centre and protected by a canopy. The remaining



Llandudno.—Switchboard.

posts are fitted with "snow-drop" brackets, and are fixed along the curb. The lamps are arranged in six groups of eight in series across the 440-volt mains. There are three controlling posts, into each of which one end of two arc lamp sections is brought—the post thus controlling 16 lamps. Besides containing a regulating resistance for each of the two sections it controls, there are also two switches and two fuses in each post, one set for each section. Each lamp is fitted with an automatic cut-out, and in the base of every post there is a short-circuiting switch, both in connection with an equivalent resistance, which, in the event of a lamp failing or requiring repairs, replaces the lamp and prevents the other lamps in that section from getting an undue pressure on their terminals. Four of the posts are provided with a couple of incandescent lamp brackets, containing 220-volt lamps connected in parallel across one side of the system. These are turned on at 11.30 o'clock when all the other lamps are extinguished.

The private lighting is making very satisfactory progress. When the station was first opened the maximum load was equivalent to only about 1,000 8-c.p. lamps, but this has now swelled to 9,000 8-c.p. lamps, or about 247 kw.; of this the private lighting is responsible for about 221 kw., and there are besides two electric lifts in operation. Since the opening of the works two feeders, having a section of 0·15 square inch, have been specially run to the eastern end of the town, one to Craig-y-don, and the other to the large Craigside hydro; the latter establishment will, it is estimated, take about 15,000 units per annum. The Pier Company are also very good customers of the District Council, having a very large number of incandescent lamps and several Jandus lamps. All the cables are buried direct in the ground, being lead-covered and armoured with steel tape. The feeders are triple concentric, insulated with paper, and the distributors three-core, laid up side by side, the insulation being in this case of impregnated fibrous material. The arc lamp cables are, however, insulated with pure and vulcanised rubber. These cables have all been supplied by Messrs. W. T. Henley's Telegraph Works Company.

A certain amount of earthenware conduit has been wisely laid down for future feeders, so as to avoid taking up the pavements again.

The meters employed in the town are mostly of the Ferranti type, although there are a few Bastian electrolytic meters in use. The general charge is 6d. per unit, but for those who prefer it, the "Brighton" system is adopted, the charge being 7d. for the first hour of maximum demand, and 3½d. per unit afterwards.

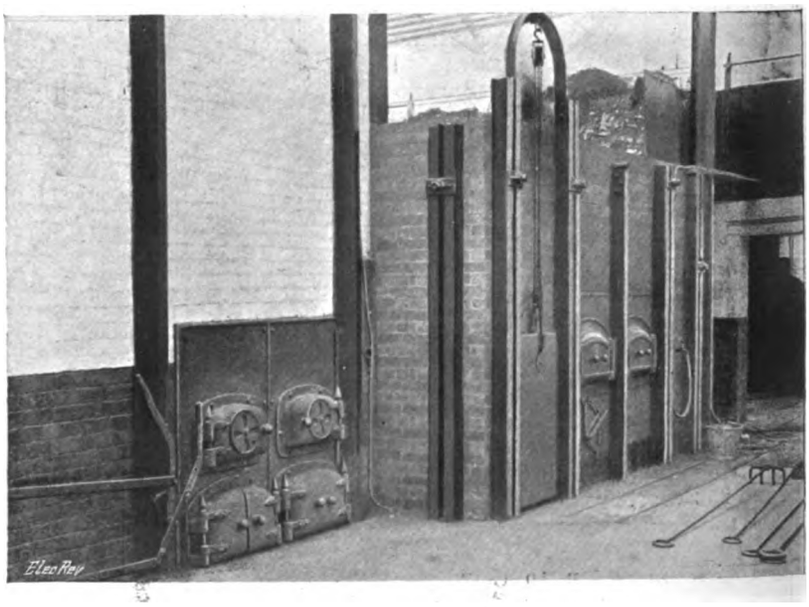
Owing to the great success of the scheme and the much larger demand which is expected next year, the Council have applied for a loan for a further extension of plant.

Another project is also in the air, a syndicate having been formed to run a light railway, 8¼ miles long, from Deganwy, through Llandudno, to Colwyn Bay. The Council have come to an agreement with the syndicate to supply electric power to this railway to the tune of 300 kw. This would, of course, entail the laying down of a special plant, and it is to be hoped that the matter will be carried through.

Our thanks are due to the resident engineer, Mr. H. Morton, for his courtesy and for the valuable assistance rendered us in getting together the information for this article.

DARWEN CORPORATION ELECTRICITY WORKS.

In no part of the country have the advantages of an electricity supply been more appreciated than in the industrial districts of Lancashire, where the enterprising spirit of the municipalities has been abundantly made manifest by their ready adoption of electric lighting and traction. One of the latest additions to the list is furnished by the Corporation of Darwen, a prosperous manufacturing town of 40,000 inhabitants. It is interesting to note that the then Corporation secured powers to supply electricity so long ago as 1879,



Llandudno.—Destructors.

though, with justifiable caution, no further steps were taken to carry them into effect at that too early epoch.

The matter lay dormant until early in 1896, when a committee was formed, and a consulting engineer, Mr. E. M. Lacey, was asked to report on the subject; a provisional order was obtained in 1897, and an Electricity Committee was appointed to carry out the scheme. The committee visited several Lancashire towns, and eventually reported in favour of a three-wire direct current system.

In October, 1897, Mr. Stanley Clegg, of Burnley, was

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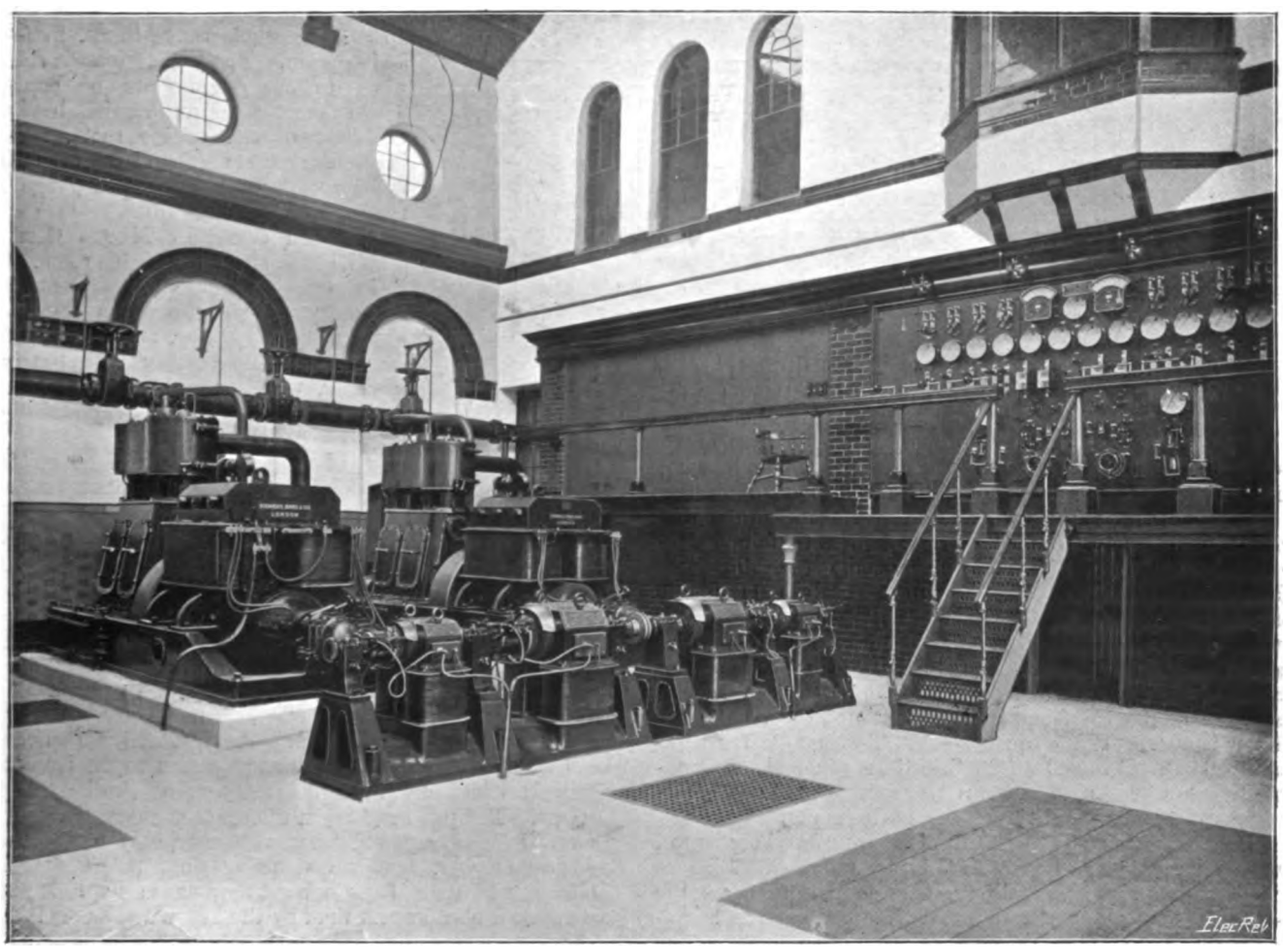
made borough electrical engineer, to co-operate with Mr. R. W. Smith-Saville, the borough engineer. These gentlemen drew up a scheme involving an expenditure of £30.000, which was approved by the Local Government Board in June, 1898, as well as by the Board of Trade. The works were erected on a site belonging to the Corporation, in a central position as regards the town, which is long and narrow, on the side of a steep bank; this has been cleverly made to lend itself to the requirements of the case in admirable fashion. The buildings consist of general office and stores, offices for the engineer and his assistant, and test room on the upper ground level, with accumulator room and workshop below. The engine room and boiler house are on the same level as these last, which is also the lower ground level.

The plant at present installed in the engine room comprises two steam dynamos, each of 150 KW. output, and a booster-balancer consisting of four machines coupled in line. The couplings are flexible, and the whole combination is mounted on a girder frame sunk into the concrete foundation. The set was manufactured by Messrs. Thos. Parker, Limited, of that company's usual upright pattern, with Eickemeyer windings.

All the dynamos are provided with automatic ring lubricators, while the engines have, as usual, a system of forced lubrication.

The boosters and balancers are separately excited from the bus bars, the regulating resistance switches of all the machines being fixed on the balustrade in front of the switchboard; this is apparently becoming a favourite methodof mounting the slides, and is decidedly both neat and handy.

Space is left in the engine room for three additional steam dynamos, each of 300—360 KW., one of which is already on order; the gable wall has also been left of a temporary character, so that it can easily be removed to allow of carrying out extensions.



Darwen.—General View of Engine Room.

The engines are of the compound two-crank double-acting enclosed type, made by Messrs. Belliss & Co., with single valve between the cylinders; each is capable of giving 220 B H P. at a speed of 390 revolutions per minute, variable to 250 B.H.P. at a speed of 418 revolutions per minute, with steam at a pressure of 140 lbs. per square inch, condensing. The dynamos are of Messrs. Siemens Bros.' manufacture, of the two-pole inverted pattern, with drum armatures, size H B $^{24}/_{36}$, and are rated at 300 amperes at 450—500 volts each. The dynamos were originally shunt-wound, but one of them has been provided with a series winding overcompounding to 550 volts, with a view to supplying the tramways, which are now under consideration, and the other will eventually be similarly modified. For the same reason the dynamos are provided with carbon brushes.

The booster-balancer consists of two motor-generators coupled together. The balancers, which act as motors, are rated at 100 amperes, 250 volts, at 850 revolutions per minute, while the boosters, which are used for charging the batteries, take 80 amperes each with a boost of 80 volts.

The battery consists of 250 cells of the Tudor type, of 600 ampere-hours' capacity at a five-hour rate, and with a maximum discharge rate of 250 amperes, or 125 KW. The cells are arranged in a single tier, on glass oil insulators, while double insulation is obtained by supporting the wooden baulks on which the cells are carried on large earthenware oil insulators.

The main switchboard, seen in our general view, is of the usual three-wire type, of simple and neat design; the instruments are almost all of the Kelvin pattern, and the board was made and fitted by Messrs. Thos. Parker, Limited. Four feeders are provided for, three of which are in use; the main fuses are of copper, and are duplex. There is room on the board for four more dynamos and two more feeders.

The field magnet windings of the balancers are joined to the bus bars with a resistance permanently in series; the slider of this resistance is connected with the middle wire, so that balancing is effected by this one slider, which, as it removes resistance from one side, inserts it in the other. Each battery switch has 14 contacts for regulating the pres-

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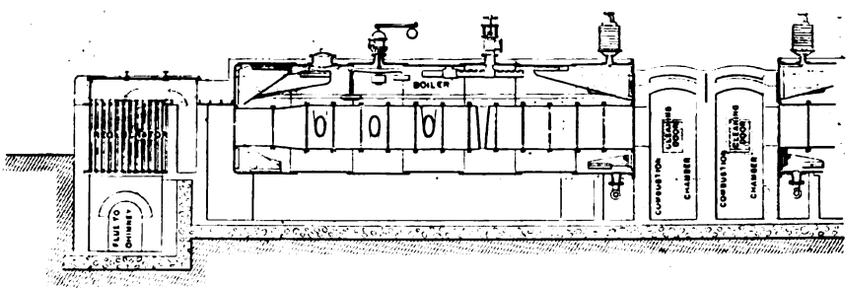
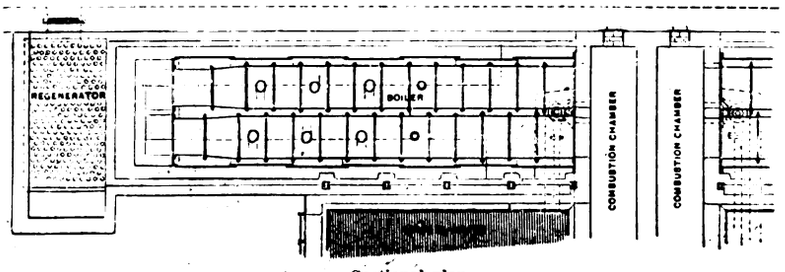
sure. Chamberlain & Hookham patent battery meters are used to record the performance of the cells; these are geared to run 10 per cent. slower in charging than in discharging, to allow for loss in the battery. There is also a meter on the middle wire earth connection, which is made by means of copper plates buried in wet earth at a depth of 80 feet. A triplex fuse is placed in series with this connection, and is provided with stepped fusible pieces, so that if an earth occurs in the network and the lightest fuse blows, heavier ones can be successively inserted.

Sectional elevation.





Sectional plan.

Meldrum "Simplex" Destructor.

The feeders and mains were made and laid by Callender's Cable and Construction Company, Limited; they are all single conductor cables, insulated with bitumenised fibre, lead sheathed and steel armoured. All the cables are laid direct in the ground, except where they gather near the works; they are there drawn into Doulton casings. There are three feeding points, one at each end of the town and one at the centre; the former are $\frac{3}{4}$ mile and 1 mile in length, and are of ·3, ·15, ·3 square inch sectional area, while the latter is of ·25, ·1, ·25 square inch. To each feeding point a three-core pilot cable, 7/20 S.W.G., is also laid. Disconnecting boxes are used in the network, which extends to distances of $1\frac{1}{4}$ miles and $1\frac{3}{4}$ miles from the works.

Public lighting is effected with Jandus enclosed arc lamps, supplied by Messrs. Drake & Gorham, of which 17 are at present in use. These are connected five in series across the 460-volt outers, and take a current of 6 amperes. Incandescent lamps are substituted for the arcs at midnight. The pillars were manufactured by Messrs. Lucy & Co., of Oxford.

There are 2,250 private glow lamps in connection, and the number is rapidly increasing.

The station is probably unique in the fact that it is entirely dependent upon refuse destructors for the supply of steam. These are of Messrs. Meldrum Bros.' patent "Simplex" type, of which we give sectional views showing the internal arrangements. On account of the formation of the site, the tipping platform is very conveniently arranged on the upper street level, while the destructors are on the lower ground level. The refuse, tipped into hoppers, is shovelled on large grates, whence the products of combustion pass into a large combustion chamber. The temperature of the chamber, as tested at Darwen, is often above the melting point of copper. In this space also light particles of dust, &c., settle and are collected.

The hot gases next pass through and round two 30-feet × 8 feet Lancashire boilers, made by Messrs. Yates & Thom, with cross tubes, and finally through regenerator tubes, in which air is heated to a high temperature before entering the furnaces. Meldrum's patent blowers are used to maintain a strong draught. An evaporation of $1\frac{1}{2}$ lbs. water per pound of refuse is obtained at Darwen, and the supply of steam is at present ample for all purposes. In the future, however, two additional boilers of the same size, fed with coal, will have to be installed, and the boiler house is already built for that purpose. These boilers will work at a pressure of 150 lbs. per square inch, whereas the destructor boilers work at 200 lbs.; the steam from the latter is therefore passed through reducing valves in the boiler house. Feed water is obtained from the town mains; ejector condensers are to be installed, and will be supplied with water from a stream which flows past the site. A large chimney stack is also being erected, which will be common to the destructor and the coal-fed boilers.

The steam pipes are of lap-welded steel, supplied by Messrs. J. Spencer and Co., with Fletcher stop valves, and are in duplicate from the boilers to the engines, which are a considerable distance apart; the whole range forms, in fact, a ring main. The bends from the steam pipes to the engines are of copper. The exhaust pipes are carried beneath the floor of the engine room, which is cellared round the foundations. There is a recording steam pressure gauge in the engineer's private office.

A 15-ton crane, by Messrs. Carrick and Ritchie, spans the engine room.

The tramway scheme is at present only in embryo; there is a steam tramway, about three miles long, already in operation, which will be converted to electrical working, while extensions are contemplated, amounting to five miles of line.

The formal opening of the works took place on the 27th ult., and was signalised by a ceremonial inauguration, followed by a banquet.

We are indebted to Mr. Clegg and Mr. Smith-Saville, as well as to their assistants, Mr. C. Garnet and Mr. S. S. Haywood, for their assistance in preparing this account. We have also to thank the various contractors for particulars of their work.

Magnetic Ore Separation.—An instructive paper on the use of finely divided ores was presented to the Iron and Steel Institute by Prof. J. Wiborgh, of Stockholm, in August. The powdered ore is the result of magnetic separation. Magnetic separation can, of course, only be practised on ground ores, but the resulting dust presents many difficulties in use. It is apparently more easily dealt with on the cold blast system than by the hot blast, but it is not altogether a success even with the former. Powdered ores tend to give rise to the evil of scaffolding. The methods of using fine ore are by pressing it into bricks and heating it until it agglomerates by the action of its own constituents, especially if it contain much fusible silicate, or by mixing such ores as do not agglomerate naturally, with powdered slag. But these methods are costly. Again, the ore may be damped and pressed into bricks, and kiln burned into masses of sufficient strength and coherence, or the ore may be mixed with lime and hardened by absorption of carbonic acid from the air. Again, the ore may be mixed with hydro-carbonaceous material and coked, or it may be mixed with powdered coal and coked in the usual way, when it has been found to stand quenching and considerable exposure before use. The method is simple, and if further trials prove its success the use of magnetically separated ore will increase. Needless to say, the magnetic separation removes much useless stuff and enables a good concentrate to be obtained from inferior ores, and waste in working can be much reduced. Given a satisfactory method of combination so as to enable the ore to be easily used, and an impetus will be given to the use of magnetic separation machinery.

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ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page 597.*)

London.—The *Times* says that at the instance of the Highways Committee of the London County Council a special meeting of the Council will be held on the 17th inst., when resolutions will be submitted in favour of an application being made to the Board of Trade for an order authorising the construction of certain light railways to be worked by electric traction in the county of London, chiefly to carry the existing tramways to the county boundary. Their total estimated cost is £635,100, whilst the cost of the acquisition of property for the necessary street widenings is estimated at £130,900. The scheme has been drawn up in consultation with Prof. A. B. W. Kennedy, F.R.S., with whom the Council, as stated in another column, was asked on Tuesday to enter into an agreement appointing him engineer in charge of the proposed works. According to Mr. Kennedy, the cost of light railways for underground or conduit electrical traction will amount to about £15,000 per mile of single line, and of overhead electrical traction would be about £12,000 per mile. For various reasons, fully set forth in the committee's special report, overhead traction will be employed only in the case of the North London line and in one other instance. It would have been adopted on some of the other proposed routes on the south side, but for probable objections on the part of the Government on the score of electrical disturbances at Greenwich Observatory. The northern railway is to be carried from the present tramway terminus, near the Archway Tavern, Islington, to the county boundary, the length of the double line being 3 furlongs. The total cost (including property) is estimated at £14,200. The construction scheme as it affects the suburbs on the south bank of the Thames may be summarised as follows:—

1. (*a*) From the present tramways at Clapham Common, south side, *viâ* Clapham Common, Battersea Rise, Wandsworth Common, north side, and East Hill to West Hill; and thence (*b*) *viâ* Kingston Lane to the county boundary, this section being overhead traction; total length, 5 miles 8 furlongs: total estimated cost of construction, £164,000.

2. (*a*) From the present lines at Deptford, *viâ* Blackheath Road and Hill, and Shooter's Hill Road, to the Herbert Hospital; and thence (*b*) *viâ* Woolwich Common Road, the road to the west of St. George's (Garrison) Church, into New Road, along Thomas Street and Green's End to Beresford Square, Woolwich, returning along New Road, Mill Lane, and Woolwich Common Road to the Hospital; total length, about 5½ miles; total estimated cost, £171,000.

3. From the present lines at New Cross Road, *viâ* Lewisham High Road, Loampit Hill and Vale, and Lee High Road to Eltham; total length, about 4½ miles; total estimated cost, £157,000.

These estimates do not include the cost of property to be acquired.

Manchester.—On Wednesday last week the City Council had before it the report of the Tramways Sub-Committee. The report dealt with the generation and distribution of electrical energy for the working of the tramways. After going into the matter with Mr. Wordingham, they recommended a combined lighting and traction plant. The question of charges to be made by the Electricity Committee for tramway current was then considered, and the committee's comments on this and other points are abstracted in the *Municipal Journal*, as follows:—

It is suggested that the charges per unit supplied shall be the actual cost of generating the current, with the addition thereto of a slight profit of 8 per cent. The energy supplied shall be measured at the sub-station end of the low-pressure feeders. In connection with the capital outlay on land and buildings at the generating works, it is acknowledged by the Electricity Committee that they will of necessity have to make much greater provision for extensions of plant required for lighting purposes than they will have to do for plant required for traction purposes, and consequently the special sub-committee recommend that the Tramways Committee be charged only in strict proportion to the space occupied for the traction plant, including a reasonable allowance for extensions of such plant.

The special sub-committee have given consideration to the question of the provision of the overhead equipment for the tramways and the bonding of the rails, and they recommend that the money required for the capital outlay in respect of this work be borrowed by the Tramways Committee from the Board of Trade. They are of opinion that it is desirable to let by contract the erection of overhead equipment, and that inasmuch as arrangements have now been made with the Electricity Committee for the Tramways Committee to have the services of Mr. Wordingham, and also seeing that the capital outlay in respect of this work will be provided by the Tramways Committee, the special sub-committee recommend that the placing of the contracts for the overhead equipment should be left in the hands of the Tramways Committee, and that the work should be carried out under their direction.

Lights on Tram Poles.—The special sub-committee also recommend that, as some of the poles for the overhead equipment will be used for lighting purposes as well as for traction purposes, arrangements should be made for the payment by the Electricity Committee to the Tramways Committee of an annual rental in respect of the poles used for the dual purpose, such rental to be calculated on the basis of a percentage (to be agreed upon between the two committees), on the additional cost which will be incurred by the Tramways Committee in providing poles suitable for the combined purposes of lighting and traction over and above what the cost would be if the poles were erected suitable for traction purposes only. The special sub-committee further recommend that the Tramways Committee should be furnished by the Electricity Committee with full information as to the steps they intend taking to prevent the possibility of the failure of supply of the necessary energy for the working of the tramways.

The foregoing report has been adopted by the Tramways Committee, and a copy forwarded to the Electricity Committee, who have expressed their approval of its terms. The two committees have also agreed to an arrangement whereby the Tramways Committee secure the services of Mr. C. H. Wordingham, the Corporation electrical engineer, as their electrical engineer and adviser, subject to the committee paying to the Electricity Committee £200 per annum as a contribution towards Mr. Wordingham's salary, until the expiration of his agreement with the Corporation.

The Corporation has adopted the recommendations of the Tramways Committee involving an expenditure of £860,000, as detailed last week in our columns. Application is to be made to the Board of Trade for a loan for this amount.

Manchester—Liverpool.—The *Sheffield Independent* says that measurements continue to be taken in the meadows at Eccles and Barton, on the north side of the Ship Canal, for the proposed new electrical railway between Manchester and Liverpool. It is stated that the width of the line will be 40 feet, and that it will be constructed on trestles sufficiently high—at least 20 feet higher than the overhead railway at Liverpool—to cross the Bridgewater Canal at Barton without in any way interfering with the waterway.

Niagara.—The Commissioners of the New York State Reservation at Niagara Falls have granted the application of the International Traction Company to be permitted to lay a track along the Riverway between Falls Street and Niagara Street, in order that the Canadian and American lines of the company may be connected at the New York end of the upper steel arch bridge, and thus complete the electric traction service about the beautiful gorge, this short piece of street being the only missing link. The matter will now go before the Commissioners of the State Land Office, and if they also approve, as no doubt they will, the company will soon be in possession of a franchise to make the desired connection, something street railway men have longed for several years to see. Under the consent, as so far ratified, the International Traction Company will, at its own expense, lay a single track through the centre of the Riverway.

Richmond.—A new scheme for constructing an electric tramway from Hammersmith Bridge, by way of Barnes and Mortlake, to Richmond, will shortly be submitted to the Richmond Town Council and the Barnes and Mortlake District Council. The promoters are the New Electric Traction Company, of 35, Parliament Street. They propose, says the *Times*, to construct, for the joint use of the tramways and the public, a new bridge over the railway at Barnes, and a street opening up a new approach to the bridge across the river at Richmond, and they are also prepared to grant favourable terms of purchase. The Richmond Town Council has already decided to itself construct any new tramways that may be required in the borough.

San Paulo.—The San Paulo Railway, Light and Power Company has closed a contract with the city of San Paulo for the supply of electricity for the tramways and for the supply of light and power. The concession is perpetual, and practically for the entire city. Work is already progressing, and the company expects to have several routes in operation by February next. Mr. McKenzie, of the Toronto Street Railway, and Mr. Pearson, chief engineer of the Metropolitan Traction Company, of New York, are largely interested in the undertaking.

Sheffield.—Sir F. Marindin's report on the electric tramway tracks, &c, at Sheffield is printed in the *Sheffield Telegraph* for October 9th. That of Mr. A. P. Trotter, who inspected the electrical power station equipment and overhead work, is also printed, and we reproduce it herewith:—

The overhead construction of the trolley line consists almost exclusively of centre pole and side pole work, only a short length of span work is used. Guard wires have been erected where necessary. The usual length of the arms of the side poles is 15 feet, but they are occasionally 18 feet in length. A novel mode of anchoring the trolley wires is in course of construction, the anchor wires being vertically over and in a plane with the trolley wire, avoiding a converging "trap" into which a free trolley might be guided and caught. Very few "pull-off" wires are used, and if a trolley leaves the wire it is not likely to injure the overhead work as at Dublin. Radial trolley poles are used, and in the case of single-decked cars they are mounted centrally, on the double-decked cars they are nearly central. The trolley pole has a stop which prevents the head from rising more than about 6 inches above the trolley wire in case it accidentally leaves it. There is ample clearance between the trolley head when thus risen, and the guard wires. Cords are used for working the trolley poles, and although accidents caused by meddling with these cords are unknown, it is intended to remove them and to use bamboos. I recommend that these cords until superseded should be provided with spring hooks hooking into rings or eyes on the hand rail, and thus dispensing with all unnecessary slack. Detachable trolley heads are not used, but in view of the clearance which has been arranged between the trolley head when standing at its highest position and the guard wires, and in the absence of span wires and of anchor wires forming traps, I do not consider that they are needed at present.

Three different kinds of brakes have been provided, viz., ordinary wheel brakes, electric brakes worked by the controller, and short slipper brakes, bearing on about 10 inches of the track. There are, in addition, Spencer trailing scotches. I made some tests with these brakes, and propose to make some more when speed indicators have been provided. Meanwhile, I am satisfied that with careful driving the brakes are sufficient.

The generating station is situated about 3,000 feet from the nearest point of the line, and an insulated return is used for this distance. I am informed that a current of 100 amperes gives a drop of 4 volts on this return. This drop is not included in the fall of potential defined under Regulation 7. Double Chicago bonds are used, and the result of the bonding appears to be satisfactory. It has not been found possible to secure a sufficiently good conductivity between the earth plates or between the earth plates and the boiler feed to comply with Regulation 5. Further trials are being made, but as the earth plates are in the river, I consider that they are sufficient for the present. The generating plant is substantial and sufficient, and the switchboard arrangements are satisfactory. I recommend that, subject to the suggestion of Sir Francis Marindin that opportunity should be given for drivers to be trained to manage the brakes on the Walkley route, the electrical working on the Nether Edge, Tinsley, and Walkley routes may be sanctioned.

The town clerk gave an undertaking that the matters mentioned in the reports should be attended to, and the Board of Trade, on receiving it, issued the necessary certificates.

Wakefield.—The Wakefield Omnibus Company proposes to proceed with an electric tramway scheme estimated to cost £200,000, and application is to be made to the Light Railway Commissioners for an order. Other companies, as well as the Council, have the matter in hand.

Wigan.—The Council has approved the recommendations of the Tramways Committee *re* application for provisional order for electric tramways, mentioned in our last issue.

Windermere.—Mr. F. Fowkes, of the Windermere District Electricity Supply Company, Limited, has submitted to the Bowness District Council for their approval plans of a proposed electric tramway to connect Bowness, Windermere, and Ambleside. The line will be worked on the overhead trolley system, and the passenger cars will be constructed so as to allow passengers to enjoy a good view of the scenery.

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Wolverhampton and Dudley.—Another step has been taken towards improving the tram service between Wolverhampton and Dudley. The tramway was recently acquired by the British Electric Traction Company, and the company have now deposited plans at the Edgley District Council offices for the reconstruction of the line. The company are desirous of substituting the overhead electric traction system for steam as soon as possible.

Worcester.—The City County Council have been advised by Messrs. Kincaid, Waller & Co. to take over the existing tramlines within the city, and work them by electricity. In two years the lease of the present tram company will expire, and the Council are investigating the methods and results of various electrical systems. On Tuesday last week they visited and inspected the Kidderminster and Stourport and the Dudley and Stourbridge lines, also the Stourbridge and Kinver light railway now in course of construction. They were the guests of the British Electric Traction Company, who were represented by Mr. Raworth (director) and Mr. Lycett (district manager). The British Electric Traction Company have indicated their readiness to transform the existing Worcester tramways, to make other extensions to suburbs, and to Kempsey and Ombersley, townships lying a few miles distant from the city. The Council have, on the other hand, shown a disposition to oppose the company's city projects out of a desire to keep to themselves the entire control of the city roads. The company entertained the visiting members of the Council to dinner at the Station Hotel, Dudley.

TELEGRAPH AND TELEPHONE NOTES.

International Telephonic Communication.—Provision is made in the Danish Budget, 1900-1901, for a sum of 150,000 kr. in connection with the projected establishment of telephonic communication between Copenhagen and Berlin *viâ* Gjedser.

Interruption of the Falmouth-Bilbao Cable.—The Direct Spanish Telegraph Company, Limited, notifies a temporary interruption of its Falmouth-Bilbao cable. Arrangements have been made by which telegrams for Bilbao, Madrid, and other places in Spain, can, during the interruption, be promptly forwarded by the Eastern Telegraph Company's route.

Klondike—Vancouver Cable.—Now that the cable from Klondike to Vancouver has been completed, Dawson City is in direct telegraphic communication with the rest of the world. The first cablegram ever dispatched direct from this far-off region to London was received on 5th inst. at the City offices of the Alaska Goldfields, Limited.

New Cable to the Cape.—The Central News says (we quote from the *Liverpool Daily Post*) that in view of the exceptional pressure which will be placed on the cables to South Africa in the event of a war with the Transvaal, it is satisfactory to find that a third cable, affording an alternative route, is about to be laid. The Telegraph Construction and Maintenance Company's steamer *Severn* is now on her way with 2,000 miles of cable to connect Cape Town with St. Helena, and another steamer will shortly sail with sufficient cable to carry on the submarine line from St. Helena to Ascension, and thence to St. Vincent, where it will join the existing extensive system thence to Europe.

Pacific Cables.—A Perth correspondent of a daily paper says that Mr. Duffy, the Postmaster-General of Victoria, has started for Sydney to confer with Mr. Crick, the Postmaster-General of New South Wales, in regard to the Pacific cable. South Australia is likely to accept the offer of the Eastern Extension Company to lay a cable *viâ* the Cape.

It is reported (says the *Electrical World and Engineer*) that a Bill is being prepared for the coming session of the Japanese Diet granting a subsidy to a cable company for a line across the Pacific to Japan and the Philippines, the promise being made that rates will thereby be reduced to one-half those now being paid.

Dalziel's agent at Washington says that President McKinley has determined to urge upon Congress the necessity for a trans-Pacific cable. The recent naval survey showed that the route selected is perfectly practicable.

The Paris—Berlin Telephone Line.—The *Financial Times* says that M. Mougeot, the French Under-Secretary of Posts and Telegraphs, announces that the agreement between the French and German Governments for the construction of a long distance telephone line between Paris and Berlin has now been signed. On the French side the line will be erected *viâ* Chalons-sur-Maine and Battilly to the frontier, and thence *viâ* Metz and Frankfort-on-the-Maine to Berlin. The tariff has been calculated on the basis of the zone system, each country being divided into two zones. The rate for three minutes' conversation has been fixed at 2 francs within the first zone and 4 francs in the second zone of each country, whilst the charge for communication between Paris and Berlin will amount to 6 francs. As Paris lies in the first French zone and Frankfort-on-the-Maine in the first German zone, the rate for conversation between the two places will be 4 francs, whilst the tariff for towns bordering on the frontier will, of course, be much lower. The construction of the German section of the line will be carried out at the expense of the Government, and that of the French section, which will be 330 kilometres in length, at the expense of a syndicate of French banks and Chambers of Commerce, which have advanced 750,000 francs to the Post Office authorities for that purpose. In return for this loan, which will be repaid in quarterly instalments out of the revenue, the telephone line from Paris to Berlin will be in continuous connection with the Paris Bourse during business hours, so as to obviate any of the delays that would arise from having to link up the main line during that period. The interest in this new long distance line, which is expected to be followed by the establishment of another main line between Paris, Rome, and Milan, has been so great in France that the work of construction was commenced before the signature of the agreement. It is expected that the new trunk line will be opened for traffic in January next.

The Telegraph Wire Export Trade.—The past month proved to be rather a quiet one as regards the exports from this country of telegraph wire and apparatus connected therewith, the value of the shipments during September only amounting to £44,512, which compares with £87,517 in the preceding month, and £35,411 in September last year. For the nine months ending with September last, the aggregate value of such exports is returned at only £731,337 as against £847,408 in the corresponding period of last year, with £746,875 in the first nine months of 1897.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Amazon Company's cable—		
Cable beyond Gurupa...	April 4th, 1898 ...	...
Latakia-Cyprus	June 20th, 1899 ...	...
Corea-Japan	August 7th, 1899 ...	...
Jamaica-Colon	June 30th, 1899 ...	...
Landlines.		
Lines from Haiti to Gonaives, Gros Morne, Port de Paix Plaisance, Cape Haitien, Port au Prince to Miribalais and Jacmel	August 18th, 1899 ...	...

Wireless Telegraphy.—The Central News says that Prof. Dolbear will, after the conclusion of the Cup races, seek an injunction to restrain Signor Marconi using wireless telegraphy in the United States. Prof. Dolbear patented a wireless telegraphing apparatus in 1886. The Exchange Telegraph Company says that Mr. J. T. Armstrong and Mr. Orling, who had been engaged for many years upon the question of wireless telegraphy, and have been for a long time past experimenting on limiting the direction of the waves sent, have now succeeded in sending waves to one direction only. It is stated that patents have been applied for.

CONTRACTS OPEN AND CLOSED.

OPEN.

Accrington.—The Council is to invite tenders for electric light cables shortly.

Barking Town.—October 24th. The District Council wants tenders for boilers, pipe work, two 100-kw. steam dynamos, switchboard, motor and trailer cars, trucks and electrical equipment, overhead equipment, underground feeders, conduits, road work, &c., for the Barking and Beckton light railways. See "Official Notices" September 1st.

Coventry.—October 23rd. A Corporation Committee is inviting tenders for wiring St. Mary's Hall for electric lighting. Specifications, &c., from Mr. L. Beard the town clerk, 10 Hay Lane, on payment of one guinea returnable as usual.

Darwen.—October 25th. The Corporation wants tenders for poles and overhead electrical equipment, also main feeder cables, for electric traction. See "Official Notices" October 6th.

France.—October 19th. The French Post and Telegraph Authorities in Paris are inviting tenders until the 19th inst. for the supply of 600 tons of copper wire in 12 lots. Particulars may be obtained from, and tenders are to be sent to, Le Sous Secretariat d'Etat des Postes et Telegraphes, 103, Rue de Grenelle, Paris.

Germany.—October 16th. Tenders are being invited by the municipal lighting and tramway authorities of Königsberg, Prussia, until October 16th, for the supply of six boilers required in connection with the extension of the electric power station, to supply steam to new engines aggregating 1,800 e.h.p. Tenders to be sent to Die Direction der Städt, Belenchtungswerke und der Electr. Strassenbahnen Kaiserstrasse 41, Königsberg, Prussia, whence particulars may be obtained for 1s.

Germany.—October 21st. Tenders are being invited until the 21st inst. by the municipal authorities for the supply of a 1,000-h.p. steam engine and multiphase dynamo at the local central station. Tenders are to be sent to Die Städtisches Electricitäts-Werke, 29, Silberstrasse, Dortmund, whence particulars may be obtained for 2s.

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Glasgow.—November 14th. The Corporation wants tenders for two 800-H.P. compound vertical auxiliary engines for the new tramway power station at Port Dundas. See "Official Notices" this week.

Glasgow.—November 20th. The Electricity Department want offers for 10 miles of 2 inch cast-iron pipes. See "Official Notices" this week.

Great Western Railway.—October 23rd. The Great Western Railway directors want tenders for the supply of 12 months' stores including electric light and telegraph sundries. See our "Official Notices" October 6th.

Holland.—October 23rd. Tenders are being invited until the 23rd inst. by the municipal authorities of Amsterdam, for the supply of the conductors and apparatus required in connection with an installation of electric lighting in the Entrepot Communal de Commerce. Tenders to be sent to L'Administration Communale, Amsterdam, whence particulars may be obtained.

Hoylake and West Kirby.—November 15th. The Council is wanting tenders for Lancashire boilers, superheaters, economiser, steam engines, alternators, motor alternator, crane, wiring, steam, &c., piping, switchboards (high and low tension), batteries, transformers, concentric mains, &c., &c. See "Official Notices" this week.

Islington.—October 25th. The Vestry wants tenders for a secondary battery of 60 cells (1,000 ampere-hours capacity). See "Official Notices" October 6th.

Leeds.—October 18th. The Council requires tenders for 50 electric tramcars. Particulars, &c., may be had on application to Thomas Newson, Esq., M.I.C.E., city engineer, Municipal Buildings, Leeds. Tenders must be to hand not later than noon, October 18th. See "Official Notices" September 23rd.

London.—October 23rd. The Post Office is inviting tenders for Swedish, Norwegian, or Finland red fir telegraph poles, and for creosoting them with 10 or 12 lbs. of creosote to the cubic foot. Particulars, &c., from Mr. C. E. Stuart, controller of stores, G.P.O., London.

Morecambe.—The Urban District Council wants tenders for boiler, steam dynamos, switchboard, transformers, mains, pumps and condensers, and storage batteries for electric lighting extensions. See "Official Notices" this week.

Peterborough.—October 19th. Tenders for the erection of electric generating station for the Corporation are now being invited.

Poplar.—The Guardians want tenders for Lancashire boilers, water-pressure drums and tanks, steam jet plant (ejector condensers, injectors, and jet pumps), also auxiliary pumping plant. The work is divided into several sections and copies of the conditions, &c., for each may be obtained from the consulting engineer to the Guardians, Mr. F. J. Warden-Stevens.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

Salford.—October 17th. The Corporation is inviting tenders for about 500 central and 100 side-arm or span-wire steel tramway poles. Tenders, with drawings, to the town clerk (*pro. tem.*) Mr. L. C. Evans, Town Hall.

Spain.—November 7th. The Spanish Ministry of Public Works in Madrid is inviting tenders, until November 7th, for the concession for the construction and operation of an electric tramway in the town of Cadiz. Particulars may be obtained from, and tenders are to be sent to, La Direccion General des Obras Ribleas, Madrid.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

Warsaw.—The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul-General at Warsaw, stating that tenders are invited by the municipality of that city for the construction of freezing chambers and electric lighting in the covered market halls. The latest date by which the tenders have to be sent in has not yet been fixed. Such particulars as have been received may be examined at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

Wigan.—October 25th. The Corporation wants tenders for feeders, mains, water-tube boilers, superheaters, stoneware conduits, steam dynamos, boosters, motor balancers, battery, inspection boxes, &c. See "Official Notices" September 29th.

Wigan.—October 25th. The Corporation wants tenders for cast-iron boxes, frames, &c., (about 30 tons); cast and wrought copper (about three cwt.); brass castings (about one ton). Particulars may be obtained from the borough electrical engineer (Mr. H. Collings Bishop) on payment of one guinea.

Wrexham.—November 8th. The Council wants tenders for boiler house plant, engine house plant, dynamos, switchboard, mains, posts, battery, meters, crane, and buildings for electricity works. See "Official Notices" this week.

CLOSED.

Accrington.—The Council has accepted the final tender of Crompton & Co. for switchboard work, &c., at £711.

Cardiff.—The Electrical Committee has accepted the tender of Messrs. Hardy & Padmore, of Worcester, for the supply of 17 electric lamp-posts for the sum of £204. The highest tender was £377.

Devonport.—Contracts have been placed by the Devonport and District Tramways Company for the construction and equipment of the electrical tramways, which are to be operated between that town and its suburbs. Mr. A. Foulks, Loughborough, is to carry out the construction of the permanent way, road bed, paving, and bonding, while the overhead construction is entrusted to Messrs. R. W. Blackwell & Co., 39, Victoria Street, Westminster. The total length of line is approximately 4½ miles of double track, and 1 furlong of single line.

Dundee.—A contemporary says that the Council has just given a contract to Messrs. Dick, Kerr & Co. for 10 double-decked single-truck cars, and 10 double-decked bogie-truck cars, the two classes of cars amounting to £5,500 and £6,250 respectively = £11,750.

Liverpool.—The Corporation has now accepted the tender of Messrs. R. W. Blackwell & Co. for supplying, erecting and maintaining in perfect working order the overhead electric trolley lines for the Stanley Road route, from the junction of the existing lines in Scotland Road to Commutation Row, the Aintree route from Spellow Lane to the termini at Aintree and Fazakerley, and the Everton Valley loop line, including Walton Breck Road, Oakfield Road, Breck Road, Breckfield Road North, and Robson Street, in accordance with the specification and general conditions prepared by the engineers, for the sum of £12,049 3s. 1d; and for the supply and delivery of 14 steel Lancashire boilers, at £760 per boiler, Messrs. Galloway, Limited; and that of Messrs. Dick, Kerr & Co. for the supply of 200 cars, at £525 per car, the contract to include a clause giving facilities for the inspection of the cars during their construction in this country.

London.—The Battersea Vestry on Wednesday evening accepted the following tenders in connection with the electric lighting station:—

Overhead travelling crane.—J. Spencer & Co.	£720
Batteries.—Hart Accumulator Company	2,480
Annual maintenance of ditto	124
Steam-pipes, &c. (Specification No. 6).—Edwards & Barnes ..	8,012

Perth.—The Town Council on 9th inst. adopted Mr. Hawtayne's recommendation that the following contracts be placed for the electricity works:—Water-tube boilers, fittings, economisers, feed pumps, &c., Messrs. Babcock & Wilcox, Renfrew, equal to £2,627; pipe work, &c., for engine and boiler house by the same firm, £1,464; service condensing plan, Messrs. Carruthers & Co., Glasgow, £772; steam dynamos, balancing, motor, generator, booster, vertical high speed engines (Bruce-Peebles dynamos), Wyllam Engineering Company, Edinburgh, £6,110; storage battery, Electrical Power Storage Company, £1,690; main switchboard connections, Messrs. Lowden Brothers, £848; overhead engine room travelling crane, Southgate Engineering Company, £321; underground mains, conduits, road work for public and private lighting, Messrs. Callender's Company, £8,465 14s. 3d.; station lighting, Mr. Peter Campbell, Perth, £36 13s. 9d.; making a total of £22,336 13s., against the estimate for this work of £23,350.

St. Annes-on-Sea.—The Urban District Council has recently placed the electric lighting contracts with Messrs. Willans and Robinson, for the engines; Messrs. T. Parker, Limited, for the dynamos; Messrs. Crompton for a booster. The boilers will be supplied by Messrs. Stevenson & Co., and the crane by Messrs. Spencer, of Hollinwood.

St. Helens.—The Klein Engineering Company, Limited, have received from the Corporation an order to supply an extension of Klein's patent chimney cooler, similar to the plant which they have already erected at the electricity works. The complete plant is to be capable of dealing with three times the quantity of steam previously condensed.

Southport.—The Council has accepted the tender of Messrs. Dick, Kerr & Co. to supply and lay the tram rails for £11,148 18s. 3d., and for the supply also of cars. The cost of a double-deck car was £540 6s., and of a single car £504. The tender of Messrs. M'Cartney, M'Elroy & Co. has been accepted for the overhead equipment for the new tramlines for £6,011. The time allowed for the completion of the contracts was eight months.

NOTES.

Lord Kelvin's Successor.—Prof. Andrew Gray, M.A., professor of electrical engineering and physics at the University College of North Wales, Bangor, has been appointed to succeed Lord Kelvin in the Chair of Natural Philosophy at the University, Glasgow.

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An Electric Tramway Exhibition.—Paris will not be the only place to which the electrical man will have to find his way next summer, for nearer home there is to be an 11 days' show, which promises to possess more of interest, from an electrical point of view, than anything of the kind held here during recent years. We refer to the International Tramways and Light Railways Exhibition, to be open from June 30th to July 11th at the Royal Agricultural Hall Exhibition. The primary object of the exhibition is to educate the municipal and other local authorities, also tramway directors and managers, as well as the general public, in regard to the various systems of mechanical traction. A circular has been issued, giving the classification of exhibits, which will comprise every kind of apparatus designed for tramways and light railways. The more important appliances which will be shown are:—

Electric trolley, conduit, and surface contact systems, cable systems, also electric, compressed air, gas, and steam self-contained systems. It is expected that short sections of track on the various systems will be laid down. Permanent way construction:—Paving, rails, points, fish plates, rail welds, "special track work," &c. Tunnel construction for underground lines:—Methods of ventilation, lifts, &c. Power station equipment:—Boilers, special furnaces, coal conveyors, mechanical stokers, pumps, valves, economisers, and motors for driving the same, engines, dynamos, boosters, motor-generators, accumulators, switchboards and switchboard appliances, such as voltmeters, ammeters, wattmeters, switches, lightning arresters, Board of Trade test instruments, &c., cable driving machinery, feeder cables and feeder pillars, wire and rail bonds. Rolling stock:—Tramway motor cars, cable cars, locomotives, and trail cars. Electric car equipments:—Motors, controllers, trolleys, switches, lightning arresters. Cable car equipment:—Grips, brakes, &c. Steam motor cars:—Various classes, such as the Dodge, Serpollét, &c. Trucks and wheels:—Four wheel, radial, and maximum traction trucks, &c. Brakes:—Hand, air, and electric brakes. Car fittings:—Lamps, sand boxes, hand rails, bells, gongs, seats, steps, car fenders and guards, track cleaners, track sprinklers, snow ploughs.

A small committee of prominent tramway managers has been formed to assist in furthering the objects of the Exhibition and to advise the management, but financially the Exhibition is promoted under the sole responsibility of the proprietors of the *Tramway and Railway World*. Plans and particulars may be obtained on application to Mr. Jas. W. Courtenay, managing director, Amberley House, Norfolk Street, W.C. Mr. A. M. Willcox is the secretary.

The Amazon Cable.—We intimated last week the probable abandonment of the Amazon Company's cable, laid in the Amazon between the city of Manaos, capital of the State of Amazonas, and the city of Para early in 1896. We are not aware of the exact cause which has rendered this step advisable or necessary, but a contemporary holds the presumption that the frequent changes in the river bed put strains on the cable which it is quite unable to bear, these changes also rendering repair work practically hopeless. We may be pardoned if, in this connection, we draw attention to our comments made when the prospectus of the Amazon Cable Company was before the public. In the ELECTRICAL REVIEW for July 12th, 1895, we said:—"We do not anticipate many engineering difficulties in laying the cable, but it occurs to us that the maintenance may be considerable, and, having regard to this fact, it is seriously open to question whether the £4,000 to be put aside for reserve fund, including repairs and renewals, will be sufficient. . . . . The dividends are not likely to be high," &c. That our criticism was reasonable and justifiable has been pretty clearly proved to be the case, if what has just been recorded is correct. The costliness of landlines in the district is said to have led the company to inquire into the possibilities of utilising wireless telegraphy for the present needs of the service.

Obituary.—We hear with great regret of the death of Mr. Alexander L. Fyfe, of Brixton. His name is well known in electrical circles in connection with the Fyfe-Main electric lighting system.

The death is also announced of Mr. B. H. Van Tromp, who was a director of the Brush Electrical Engineering Company, the County of London and Brush Company, the Dover Electric Light Company, and the Electric and General Investment Company.

"London's Lost Tunnel."—The stir which is now going on in the daily press concerning the so-called re-discovery of the tubes of the old Pneumatic Despatch Company is perfectly absurd. The existence of these cast-iron tubes, which have lain *perdu* because it would not pay to take up the roads to unearth them, has been known to not a few since the working operations of the company were suspended, but the newspapers would have us believe that something quite out of the common has been brought to light, because a gentleman, who only learned about four years ago that the tubes were still intact, has been labouring ever since to convert them to the purposes of electric traction. Not more than a month ago we had to correct certain gross misstatements as to the engine power (said to be 800 H.P.) which was used in the old system, and now we have the extraordinary statement of Prof. Carus-Wilson, if he is correctly reported, that "the inefficiency of the arrangements was such that no difference could be detected in the work done by the engine, whether the cars were running or not." Now, in the engine room there were two horizontal engines of 24 or 25 H.P. each. They could be used singly or together, *as required*, to drive the fan, 75 feet in circumference. We have seen the working of the pneumatic despatch in question on scores of occasions, with one engine and with two, according to the power demanded, and it would be interesting to know how the Professor became possessed of the above information, seeing that he has only recently been brought into the matter on the proposed electrical equipment of the old tubes by a new syndicate or company. Possibly Mr. H. F. Joel could give us some positive information on this and other points connected with the subject. A contemporary called attention last week to what it calls a wild cat scheme, and cautions investors against it. It questions whether the sorting office of the G.P.O. is to be continued on its present site or moved to Mount Pleasant. If the sorting office is to be moved, of what use will the tunnel be to the Government, says our contemporary, and before the investing public risk any money in the new concern will it not be well to be sure about this?

Electric Tramway Progress.—Electric traction is at last going ahead. The ball having been once set properly running has now gained considerable impetus. The Manchester scheme to which the Corporation has now finally committed itself, involves an immediate expenditure of over £800,000, and the indications are that the million sterling will be exceeded almost immediately by additional lines. The Glasgow system, which is wanted completed by the date of the Glasgow International Exhibition of 1901, will, we suppose, not come far short of that figure when everything is taken into account. The London County Council has commenced to develop electric traction in London by approving of surface contact and conduit sections, and on 17th inst. will hold a special meeting to consider the proposed expenditure of £766,000 upon a large light electric railway network for London, part conduit and part trolley presumably. But this is only a foretaste of L.C.C. things to come. Add to these the large undertakings of Sunderland, Leeds, Huddersfield, Liverpool, Newcastle, Aberdeen, and other important boroughs, and one sees that electric tramway traction is at last making real and substantial progress in the hands of certain municipal authorities. The cup is filled to overflowing if we mention the many miles of line which are being equipped by the British Electric Traction Company, the London United, and other important companies.

Electrical Work in Belgium.—The *Electrical World* digest prints from *L'Industrie Electrique* an abstract of a paper read before the Society of Electrical Engineers of the Institute Montefiore by Mr. A. Gerard, discussing the future of the industry in Belgium. Although not favoured by nature with water-powers, Belgium has developed large electrical installations, using more especially continuous current. For the future he urges that the energy of the vast quantities of gases escaping from the blast furnaces should be more fully utilised. A horse-power-hour can be obtained from 4 cubic metres of that gas of which the blast furnaces of Belgium produce an enormous quantity.

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The Electrical Industry and the Paris Exhibition.—In the interests alike of the nation and the electrical profession, it is to be sincerely hoped that English manufacturers will be strongly represented at the forthcoming Exhibition. We do not for a moment imagine that the Dreyfus agitation will leave any permanent effect on the minds of potential exhibitors, and the firmness displayed by the French Government ought to dissipate any lingering notions that there is an element of unsafety in sending valuable exhibits to Paris. If foreign exhibits and exhibitors do not meet with the very best welcome, it will be unfortunate for the French nation. For if the English are a nation of shopkeepers, it is the Frenchman who is the shopkeeper to the whole world, and no man has a keener regard for keeping on the best of terms with his customers. As we have said, there is not the slightest ground for anticipating any interference, and it is highly important that English manufacturers should leave no stone unturned in order to be at their best. In a sense, it is perhaps unfortunate that the period of preparation for the Exhibition coincides with an era of great prosperity. Workshops are more or less congested, and there is a difficulty in keeping within moderate distance of the demand. This, doubtless, will have material influence upon many manufacturers, and some will, on these grounds, refrain from sending any machinery. But it must not be overlooked that our prosperity may come to an end, and there is no telling how soon we may be engaged in a closer struggle for existence. It is during a period of depression that the powerful and the best known survive, and the Exhibition, which is distinctly a modern form of advertising, should not be neglected, because there will be attracted to it representatives of all nations, and if the display of English apparatus is less conspicuous than those of other countries, we shall undoubtedly suffer in years to come.

American Competition in Germany.—Germany and America are often ranged together as this country's greatest industrial competitors, but they are none the less keen competitors of one another. The more or less friendly rivalry which exists between us can hardly be expected to lessen as time goes on; in fact, an American Consul at Chemnitz has written home to the States to stir up the fire, by advising American manufacturers to do their utmost to secure some of the contracts for materials required in connection with the numerous electrical schemes which are now developing in Germany. It is true that the disposition to patronise home industries is very strong, but the Consul thinks that certain American things, once seen, will be favourably received for the future. He advises American houses to send experts familiar with electrical plants and their needs to study the situation not only at Chemnitz, but throughout the entire German Empire. An idea of the tactics followed by too many American firms is contained in his advice that an effort should be made to sell in the German market just now, "even at the risk of not making a great deal of money at the outset." If this is the guiding principle in the management of electrical manufacturing companies over there—and we believe it is in certain cases—we can easily understand why it is that some American works, having an immense turnover in the course of the year, manage not to earn sufficient net profit to enable a fair return upon the capital invested in them. Furthermore, it is not what one might strictly term fair competition.

Boiler Evaporation and Smoke-Consuming Tests.—Mr. E. V. B. Taylor, of Blackburn, writes to the *Mechanical World* agreeing with a previous writer that it would be a good thing if the London County Council were to take steps to have tests made similar to those made in France some time ago, for he fully believes that there are now furnaces on the market which not only effectually burn *all* the smoke, but at the same time effect a big saving in fuel. Only lately he has seen a patent furnace working on a Lancashire boiler 8 × 30 feet, and is told that before the furnace was applied they were burning 26 to 29 tons per week of slack at 10s.; now they are using slack at 8s. 3d., and burning 22 to 24 tons per week, and consuming entirely all the smoke.

The New Telegraphy.—It is, perhaps, unnecessary to say that the following, coming as it does from a "Daily," must be accepted for what such a communication is usually worth. The trials are stated to have taken place between Buda Pesth and Berlin:—"The messages to be sent off by the new system must be previously prepared—the signals being perforated upon endless paper slips, the Morse code being employed. This may be done by a great number of persons at the same time, so that a message of any length can be prepared in a quarter of an hour. The perforated paper band is then passed over a small cylinder worked by a little motor. Two brushes, one connected with the positive, the other with the negative pole of a battery, sweep the cylinder over which the perforated band is running. The signals are perforated in two distinct lines, and as one of the brushes touches the metal of the cylinder through the perforation a signal is produced at the other end of the line (with which the cylinder, of course, is connected) thus: A—the point being upward. The other brush, touching the metal through the second row of perforation, produces the reversed signal, thus: V. Out of these signals the alphabet is constructed on the Morse system. The signals are taken by the electric current to the receiving station, where they reach a telephone, the diaphragm of which is connected with a tiny mirror, this in turn receiving the impulses given by the current to the diaphragm. These impulses being scarcely perceptible, the mirror has to be fixed in such a way that their effect is exaggerated by it. The inventors attached a bit of soft iron to the back of the mirror and a permanent magnet to the telephone. One of the poles of the magnet is provided with a spring, which rests upon the diaphragm with the help of a tiny bar. As the current moves the diaphragm it approaches the magnet or withdraws from it, and this causes the mirror to move also, but of course much more perceptibly. The light of a tiny incandescent lamp falls upon the mirror, and the movements appear in the shape of a glowing thread, which is reflected upon sensitive paper, after passing through a lens which condenses it to a luminous point. The sensitive paper, fastened over a rotating drum, is encased in a hermetically closed cylinder, and as besides rotating it runs along a screw, the signs given by the vibration of the telephone diaphragm are photographed in spiral lines upon the sensitive paper. In the experiment between Buda-Pesth and Berlin messages of 220 words were given, and took exactly nine seconds to send and receive." As we have pointed out more than once, experiments of the kind are usually made with a total disregard of the ultimate effect of "K.R."; and also of the fact that signals received beyond a certain rate cannot be handled and written up with advantage by the clerical staff which has to transcribe them.

The Jacques Carbon Cell.—Already many experiments and endless discussion have been devoted to settling the question whether the electric current in the Jacques carbon element is a thermo-electric effect or due to the oxidation of carbon in the cell. The balance of the evidence has always appeared to us to be in favour of the former view. And now Langley reports in the *Journal of the Franklin Institute* on a series of experiments by Rosewater and Oldham, which appear to finally settle the point. The electrolyte in the iron pot was melted by a large gas burner, the heat from which could be exactly regulated. The temperature was measured by a Siemens pyrometer. Compressed air was forced into the electrolyte through a ¼-inch tube with perforations near the bottom of the pot. Experiments were tried with copper, iron, and carbon electrodes with and without an air supply. There were arrangements for regulating the temperature and exactly measuring the electrical quantities. Attempts were made to increase or reduce the oxidation of the carbon by the addition of nitre and coal-gas. By drawing diagrams of the results obtained, it was clearly shown that the current in the Jacques cell was thermo-electric, not voltaic. The colder the air supplied to the cell the higher the electromotive force. Coal-gas produced exactly the same effect as air.

Seismological Observatory.—We read in an Indian paper that the Kashmir State Government contemplates establishing a seismological observatory at Srinagar.

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Marconi Telegraphy.—Prof. Fleming, in a letter to a contemporary, states that during the recent demonstrations with the Marconi system at the meeting of the British Association, messages sent from Wimereux to Dover were occasionally received and recorded at the Marconi station at Chelmsford. Mr. Marconi's expert assistants have since then made careful tests, resulting in the transmission of excellent signals and messages from Wimereux to Chelmsford, without any increase in the length of the vertical wires at either station. The distance between these two stations as the crow flies is about 90 miles. This indicates a remarkable improvement in the efficiency of the transmitting and receiving instruments. The extension of the range of wireless telegraphy will emphasise the necessity of some method of selective working between any two given stations. It was currently reported some time ago that Mr. Marconi had discovered a means of attaining this desirable result, but the new invention did not make its appearance at the Dover demonstrations. The plan used in ordinary telegraphy of having a call for each station was made use of, a message sent from one station being received at all the rest. A wire cage of large dimensions was during some of the earlier experiments at Dover connected to the top of the vertical wire. But the only effect of this, as far as we could learn, was to make the Morse characters more distinct. The cage increased the capacity of the wire, but the advantage of larger currents obtained in this way would probably be neutralised by a reduction of frequency.

Electric Cabs in Berlin.—Electric cabs have recently started running for hire in Berlin. The difficulties to be overcome in designing a motor cab to comply with the police regulations in Berlin are considerable. Practically, all motors, except the electro-motor, are excluded; and the dimensions of the electric cab are required to correspond very closely with those of the horse cabs at present in use. It became, therefore, impossible to fix the motors in the most convenient position for transmitting power to the driving wheels. The only space available was the space beneath the driver's seat. Here two motors were fixed, each weighing 50 kilogrammes and developing 2 H.P. The voltage of the motors is 85, and the number of revolutions 1,100 per minute. Power is transmitted from the motors to two small pitch chain wheels, and from these by pitch chains to two large pitch wheels fixed on the two hind wheels of the cab. The two hind wheels are driven separately, one by each motor, thus dispensing with differential gear. One motor is capable of driving the cab at a reduced speed, in case the other motor should break down. The accumulator battery is placed in a box under the cab; and this box can be removed and replaced by another with fully charged batteries in about two or three minutes. The battery has a capacity of 60 to 70 ampere-hours, which suffices for a journey of 18 to 24 miles; and it consists of 44 cells. The necessary resistances are under the driver's seat, and the electric warning signal is worked by a treadle. The cab is fitted with both electric and mechanical brakes. The steering is done with the right hand, the left hand being left free to work the speed controller.

Electric Lighting Acts, 1882 to 1890.—We have received an important communication from the Board of Trade on the question of the transfer of powers. The Board have, in consequence of the passing of the Electric Lighting (Clauses) Act of last session, issued a revised model form of electric lighting provisional order, a copy of which we shall publish next week. It will be observed that the Clauses Act does not contain any provision empowering local authorities as electric lighting undertakers to transfer to others their powers, duties, and liabilities. The Board will not be prepared to insert in provisional orders any such provision save in circumstances of a very special character.

Personal.—The marriage between Mr. Charles Bright, F.R.S.E., and Miss Isabel Goaling is to take place on Thursday, the 26th inst., at St. Mary's Church, Farnham, Essex.

Appointment Vacant.—The Govan Burgh Commissioners want an electrical engineer to take charge of electricity works at £150 per annum. To-morrow (14th inst.) is the latest date for sending applications to the town clerk, Mr. A. Macdonald, Hillock House, Govan.

Lectures.—A course of 10 free lectures, arranged by the Technical Education Board of the London County Council, on "Electric Power and Lighting," illustrated by experiments and lantern slides, was commenced at Browning Hall, York Street, Walworth, last night. The lecturer was Mr. E. Halford Strange, M.Sc.

Personal.—In our recent notice of Mr. Lord's marriage, we said that that gentleman was a representative of Messrs. W. F. Dennis & Co. This, however, was an error, as Mr. Lord is a partner in the firm.

NEW COMPANIES REGISTERED.

B. R. Rowland & Co., Limited (63,698).—This company was registered on September 27th, with a capital of £6,000 in £1 shares, to carry on the business of mechanical, electrical, hydraulic, and general engineers, heat, motive power, and water supply contractors, iron and steel converters, stove makers, boiler makers, steel, iron and brass founders, engine builders, metal workers, millwrights, machinists, electricians, chemists, smiths, woodworkers, painters, metallurgists, motor car, bicycle, tricycle, carriage and vehicle builders, chemical manufacturers, &c. The first subscribers (each with one share) are:—Bartholomew R. Rowland, Holly Bank, Barry Road, Altrincham, engineer; Charles Scorer, Combe House, Lincoln, solicitor; Charles R. Scorer, Combe House, Lincoln, solicitor; Daniel Keeley, 31, Benthal Road, W., warehouseman; Frederick King, 97, Camp Street, Lower Broughton, Manchester, engineer; A. Sutton, 18, Princes Road, Heaton Moor, gentleman; and Robert Rowland, 92, Old Road, Hyde, manufacturer. The number of directors is not to be less than three nor more than five; the first are Bartholomew R. Rowland (governing director for life; special qualification, £3,000) and Robert O. Rowland; qualification of ordinary directors, £100.

Leicester Motor Car Company, Limited (63,700).—This company was registered on September 27th, with a capital of £30,000 in £1 shares, to acquire the business of the "Leicester Motor Car Company, Limited," of 31, Rutland Street, Leicester, and to carry on the business of auto-motor-car proprietors and agents, hirers and letters of motor coaches, omnibuses, cabs, vehicles, bicycles, tricycles, velocipedes, and cycles of all kinds, and to supply electricity, steam, and other motive power. The first subscribers (each with one share) are:—E. Pickard, 7, Salisbury Road, Leicester, gentleman; S. Faire, Ingledene, Stoneygate, Leicester, smallware manufacturer; F. W. S. Clarke, 48, Highfield Street, Leicester, printer; G. B. McCreedy, Fornton Lodge, Stoneygate Road, Leicester, gentleman; G. Fox, 74, Humbertson Gate, Leicester, china dealer; H. A. Clarke, 5, Severn Street, Leicester, cycle manufacturer; and G. F. Brown, Halford Street, Leicester, auctioneer. The number of directors is not to be less than three nor more than five; the first are E. Pickard, S. Faire, W. T. Rowlett, F. W. S. Clarke, and G. D. McCreedy; qualification, £300; remuneration as fixed by the company. Registered office, 13, New Street, Friar Lane, Leicester.

Electric Coin-Freed Meter Dimming Syndicate, Limited (63,713)—This company was registered on September 28th, with a capital of £5,000 in £1 shares, to acquire patent No. 17,523 of 1897, granted to F. J. Beaumont for improvements in coin-freed electrical meters, and to carry on the business of electricians, mechanical engineers, suppliers of, and workers in, electricity, &c. The first subscribers (each with one share) are:—G. H. Whitaker, 12, Warwick Lane, E.C., publisher; G. H. Shepherd, 540, Oxford Street, W., licensed victualler; R. Hallows, 5, Manor Grove, Beckenham, merchant; F. J. Beaumont, 21, Albany Road, Stroud Green, electrical engineer; Mrs. G. Whitaker, Lindrick House, Finsbury Park, N.; A. W. Herve, 309, Green Lanes, N.; screw manufacturer; and R. T. Glover, 68, Dartmouth Park Road, N.W.; gas meter manufacturer. Registered without articles of association.

World Gas and Electric Syndicate, Limited (63,725).—This company was registered on September 29th, with a capital of £3,000 in £1 shares, to carry on the business of an electric light and power and gas company in all its branches, and the business of electricians, electrical, water, gas, and general engineers, suppliers of electricity, &c. The first subscribers (each with one share) are:—J. A. Kelman, 51, Highbury New Park, N., solicitor; H. Yuill, 5, Stradbroke Road, Canonbury, secretary; S. Gibbs, 17, Royal

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Parade, Blackheath, accountant; D. Shuter, 22, Dorothy Road, Lavender Hill, S.W., secretary; G. E. Eedes, 85, Isledon Road, Finsbury Park, N., clerk; E. D. Sinclair, 11, Leconfield Road, N., clerk; and E. A. King, 39, St. John's Avenue, Harlesden, N.W., secretary. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification, 50 shares.

Irish Electric Railways Company, Limited (63,753).—This company was registered on October 3rd, with a capital of £2,000 in £1 shares, to carry on the business, in Ireland or elsewhere, of railway and tramway contractors and operators, electricity producers, users and dealers, quarry owners, miners, smelters, calcium, carbide, and chemical manufacturers, woodworkers, wood-pulp manufacturers, &c. The first subscribers (each with one share) are:—S. G. Fraser, M.I.C.E., 53, Evelyn Gardens, South Kensington, engineer; L. Hough, 11, Pancras Lane, E.C., gentleman; G. Greenbank, 300, Camden Road, N., contractor; G. Wilson, Lyndhurst Gardens, Hampstead, N.W., engineer; O. Ellis, 51, Holly Street, Dalston, N.E., clerk; L. Wilson, Belsize Cresent, N.W., landowner; and Alice M. Stuart, Abercorn, 3, Bolingbrooke Grove, S.W. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, 200 shares; remuneration as fixed by the company.

Prism Globe Company, Limited (63,796).—This company was registered on October 7th, with a capital of £50,000 in £1 shares, to carry on the business of glass manufacturers, glass blowers, prism globe manufacturers, manufacturers of any articles of use or ornament made from glass or any other substance, mechanical and chemical engineers, electricians, suppliers of electricity, manufacturers of electrical apparatus, and producers and suppliers of light, heat, sound and power by electricity, galvanism, magnetism, or otherwise. The first subscribers (each with one share) are:—Edward W. McBride, 48, Chorlton Road, Manchester, gentleman; Herbert M. Styler, 10, Slade Lane, Longsight, Manchester, cashier; Parkin S. Booth, Crumpsall House Cottage, Middleton Road, Higher Crumpsall, Manchester, solicitor's clerk; Arthur S. Brewis, 60, King Street, Manchester, chartered accountant; Thomas Chadwick, 36, Legh Grove, Ardwick, Manchester, accountant's clerk; James H. Pontefract, Woodville, Davenport, cashier; and Charles F. Brierley, 41, John Dalton Street, Manchester, estate agent. The number of directors is not to be less than three nor more than five; the Manchester Contract Company may nominate two so long as they hold 1,000 shares, others to be appointed by the subscribers; qualification, £250; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

British Electric Works Company, Limited (61,640).—This company's annual return was filed on September 9th, when the entire capital of £135,000 in 50,000 preference and 85,000 ordinary shares, all of £1 each, was taken up. £1 has been called on each of 50,000 preference and 45,000 ordinary, resulting in the receipt of £95,000. The remaining 40,000 shares are considered as fully paid.

British Electric Transformer Manufacturing Company, Limited (57,293).—This company's annual return was filed on August 29th, when 20,000 vendors' and 15,000 ordinary shares were taken up out of a capital of £50,000 in 20,000 vendors' and 30,000 ordinary shares, all at £1 each. £1 has been called up on the ordinary shares, resulting in the receipt of £15,000. The vendors' shares are considered as fully paid.

CITY NOTES.

Ayr Corporation Electricity Accounts.

Public lighting and private supply.

The electricity supply undertaking at Ayr has not yet reached the position of paying its way, but the deficiency is only about two-thirds of the net loss in 1897. In that year the maximum load was 146 KW., and the street lighting was represented by 28 arc lamps and 55 incandescents; in 1898 the load had gone up to 210 KW, and the street lighting to 73 arc lamps and 65 incandescents.

The general position of the undertaking may be stated thus:—

	1897.	1898.	Increase.
Total capital expenditure ...	£35,978	£43,897	£7,919
Number of units sold	161,093	297,420	136,327
Total maximum demand ...	146 KW.	210 KW.	64 KW.
Gross revenue	£2,445	£3,901	£1,456
Gross profit	£478	£1,280	£802
Average price per unit sold ...	3·52d.	3·08d.	—·44d.

The total revenue is small, and the price received per unit sold is very low for a business of the size. The net result would have been considerably worse had not the engineer, Mr. Fuller, managed to keep his total costs down to about 2⅛d., and as this shows a reduction of over ¾d. per unit on the figures for 1897 he deserves to be congratulated upon the results. "Coal" remains at the same low figure per unit; the principal decreases are shown on "Wages" and "Management, Salaries, &c.," thus clearly indicating that the prosperity of the undertaking will be assured when the demand for supply increases and the people of Ayr do more to support their Corporation works. The experiment made some time ago in Ayr with a complicated system of rebate does not seem to have borne much fruit of a satisfactory kind; the present scale should tell in favour of the business shortly.

REVENUE STATEMENT.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current ..	£2 363	3 52d.	£3,812	3·08d.	—·44d.
Meter rents	...	...	...	...	...
Supply of lamps ..	...	...	2	...	...
Sundry (rent of property, &c.)	82	·12d.	87	·07d.	—·05d.
Gross revenue	£2,445	3·64d.	£3,901	3·15d.	—·49d.

It is a little surprising to find nearly a halfpenny drop in the revenue received per unit. The item for current alone stands at a fraction over 3d., a most moderate charge, and those who may be inclined to cavil at the deficit charged to the Police Revenue account of the burgh should remember that if the business does not *pay*, it at least affords a supply at a phenomenally low rate, considering its size. As a rule the consumer pays more than he need do, and assists the general ratepayer. Here the general ratepayer seems to be willing to reverse this operation and put his hand in his pocket to enable the consumer to get his light at a lower rate than most large undertakings can afford to levy.

COST OF PRODUCTION.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal	£456	·63d.	£847	68d.	...
Oil, waste, water, and engine room stores.	61	·09d.	60	·05d.	—·04d.
Salaries and wages incurred in generation and distribution.	845	1·26d.	924	·75d.	—·51d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	121	·18d.	211	·17d.	—·01d.
Works' cost	£1,483	2 21d.	£2,042	1·65d.	—·56d.
Rents, rates and taxes ..	91	·14d.	107	·09d.	— 05d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	275	·41d.	299	·24d.	—·17d.
General establishment charges, stationery and printing, law charges and insurance	101	·15d.	106	·09d.	—·06d.
Other expenses	17	02d.	67	·05d.	+·03d.
Total costs ...	£1,967	2 93d.	£2 621	2·12d.	—·81d.

The profit statement shows that while the gross profit has gone up about £800, the provision for sinking fund and for interest has increased by about £400; the difference between these two amounts accounts for the reduction of the deficiency by £400.

PROFIT STATEMENT.

	1897.	1898.
Interest on loans	£1,052	£1,178
Sinking fund for repayments	581	849
Net profit *	—1,155	—747
Gross profit	£478	£1,280

* Deficiency charged to rates.

Willans & Robinson, Limited.

On 4th inst. the annual meeting was held at Rugby.

Mr. Mark Robinson, who presided, said that while they were keeping up the increased interest on the ordinary shares, they also maintained the increase in the reserve fund, besides making the proper proportionate contribution to the debenture sinking fund. They were also carrying forward £1,200 more than last time. Orders continued plentiful, and the shops were full of work, but at last they were able to keep pace with the orders, and the early provision for extensions, which the late increase of capital made possible, enabled them to look forward to increasing trade without fear. The new shares had been taken up almost entirely by the existing shareholders or their nominees. The premiums received amounted to £29,773. The applications for shares were so numerous that there was considerable difficulty in allotting them in a manner calculated to give general satisfaction. The contract drawings for works extensions were prepared, and some of the new buildings would be in use by next summer. The buildings would probably be finished before the tools were ready to occupy

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them, for tool makers were among the busiest and most backward of the engineering trades. After delays in securing the Chester site for the new boiler works, they had the drawings well advanced, and would place the contracts as soon as the land was in their possession. In the course of remarks on the balance-sheet, Mr. Robinson said that the "work in progress" and the "materials and stores and own-manufactured articles" have increased in value, largely through the exceptional number and value of practically finished, though technically unfinished, engines, which were standing there in June last waiting for the dynamos, which the electrical firms could not turn out fast enough. In the profit and loss account there were some decreases in expenses and more increases. All that had been said before as to the great growth to be expected in electrical industry was in fair way of fulfilment. As was mentioned in the last report, the number of 1,200-H.P. engines on order (1,500 H P. is their extreme load) had risen from one, 18 months ago, to four, 12 months ago, and to 16 at the date of the last meeting, six months ago. When one's orders increased in geometrical progression, especially with a radix of four, the time must come when the pace grew too rapid. A few years of this kind of thing would fill the world with Willans engines, and he had to acknowledge with regret that they had not this time scored 64 of this useful standard size, but they have risen from 16 to 28, which was as large an increase as the previous rise from 4 to 16, so they might be well content. The question of very large engines had not yet advanced, but it would do so.

The adoption of the report and accounts was carried.

Dividends were declared at the rate of 6 per cent. per annum upon the preference shares, and at the rate of 10 per cent. per annum upon the ordinary shares.

The Western and Brazilian Telegraph Company, Limited.—The directors recommend a dividend of 4s. per share, free of income-tax, on the ordinary shares for the half year ended June 30th, 1899. In the case of shares which have been divided into preferred and deferred, the 4s. per share now recommended will be payable, viz., 3s. 9d. per share to the preferred shareholders, and 3d. to the deferred shareholders. The balance of the account, subject to audit, is carried forward. For the purpose of paying the above dividend on the 24th inst., the register of members and transfer books will be closed from 17th until 24th inst. inclusive.

Brazilian Submarine Telegraph Company, Limited.—The directors have, after transferring £20,000 to the reserve fund, decided to recommend a final dividend of 3s. per share, making, with previous distributions, a total dividend of 6 per cent. for the year ended June 30th, 1899, and also the payment of a bonus of 2s. per share, both free of income-tax. The balance of the account, subject to audit, is carried forward. For the purpose of paying the above dividend and bonus on the 26th inst., the register of transfers will be closed from October 17th to 25th, both days inclusive.

St. James's and Pall Mall Electric Light Company.—The amount of electricity sold by the St. James's and Pall Mall Electric Light Company, Limited, for the quarter ending Michaelmas is returned at 734,763 units, estimated to produce £13,317, as against 583,034 units, which actually produced £11,490 for the corresponding period of last year.

Isle of Man Tramways and Electric Power Company.—The directors have declared interim dividends for the six months ended June 30th last at the rate of 6 per cent. per annum on the preference shares, and at the rate of 7½ per cent. per annum on the ordinary shares.

New Zealand Electrical Syndicate, Limited.—The directors have declared an interim dividend of 7½ per cent. on account of the year 1899.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending October 7th, 1899, were £422 6s. 11d.; receipts for week ending October 7th, 1898, £578 19s. 9d.; aggregate for half-year to date, £17,958 7s. 7d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending October 6th, 1899, were £2,948 10s. 3d.; corresponding period, 1898, £2,974 7s. 4d.; decrease, £31 7s. 1d.

The City and South London Railway Company.—The receipts for the week ending October 8th, 1899, were £1,019; week ending October 9th, 1898, £962; increase, £57. Total receipts for half-year, 1899, £14,183; total receipts corresponding period, 1898, £14,249, decrease, £66. Miles open, 8½.

The Dover Corporation Electric Tramways.—The receipts for the week ending October 7th, 1899, were £202 7s. 7d.; week ending October 8th, 1898, £201 13s. 4d.; increase, 14s. 3d. Total receipts to date, 1899, £8,075 1s. 7d.; corresponding period, 1898, £6,618 9s. 8d.; increase, £1,456 12s. 11d. Miles of track open, 1899, 3; 1898, 3. Car miles run, 1899, 4,728, 1898, 4,234. Number of cars, 1899, 11; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, October 6th, 1899, were as follows:—D. U. T. Co., horse cars, £1,044 11s. 4d.; ditto, electric cars, £1,951 11s. 8d.; D. S. D. Co., electric cars, £720 6s. 6d.; total, £3,714 9s. 6d.; corresponding week last year—D. U. T. Co., horse cars, £2 594 1s. 4d.; ditto, electric cars, £446 9s. 6d.; D. S. D. Co., electric cars, £932 0s. 9d.; total, £3,912 11s. 7d.; decrease, £198 2s. 1d. Aggregate to date, £62,845 18s. 8d.; aggregate to date last year, £61,343 5s. 9d.; increase to date, £1,502 7s. 6d. Worked:—The mileage open is 25 miles electrically, 19 miles by horses, as against 13 miles electrically, and 30 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending October 8th, 1899, amounted to £1,462; corresponding week last year £1,399; increase, £63.

The Halifax Corporation Tramways.—The receipts for the week ending October 8th, 1899, were £643. Miles of track open, 10. Car miles run, 11,566. Number of cars, 21. The receipts for the week ending October 12th, 1898, were £260. Increase, £383. Miles of track open, 3¾. Car miles run, 3,549. Number of cars, 10. Total receipts to date, 1899, from April 1st, 1899, £16,393; total receipts to date, 1898, from June 29th, 1898, £4,224.

The South Staffordshire Tramways Company.—The receipts for week ending October 6th 1899, were £702 15s. 8d.; aggregate receipts for 40 weeks, £26,665 0s. 1d.; week ending October 7th, 1898, £668 6s. 2d.; aggregate receipts for 40 weeks, £25,281 0s. 6d.

STOCKS AND SHARES.

Wednesday Evening.

A more robust tone has cheered the markets of the Stock Exchange this week, and the announcement that the Boer Government had sent an ultimatum was the signal for a general rise in nearly every department. The House prefers anything to a state of suspense, and if hostilities are to come, let them, and get the thing over as soon as possible. That is the prevailing sentiment, and that it is generally accepted is shown by the strength of markets as contrasted with the extreme weakness of a week ago, when everything was in a condition of bewildering uncertainty.

Electrical descriptions were among the first to participate in the better feeling. Chelseas and Metropolitans both went better, the latter being assisted by what are considered its excellent prospects, to which we called attention at the end of last month. The company's negotiations with the Marylebone Vestry are hanging fire for a time, but have not been permanently shelved by any means. A larger amount of business is being done in these shares than in any other of the electrical supply list. Brompton and Kensington Electric—the former House-to-House—are quoted at 8 middle, the 7 per cent. Cumulative Preference being 9½.

Provincial and foreign shares are quiet, and orders come very slowly into the lifeless market. Blackheath and Greenwich are steady at ⅞, Bournemouth and Poole at 13¼, and Calcutta Electric at 6. Nor is there much change to be noted in Oxford Ordinary at 7 or River Plate Electric Light and Traction Debenture Stock, the price of which is 87½. Royal Electric of Montreal shares have recovered the deduction of the dividend, and are again 170, and the 5 per cent. bonds of another American company, the Chicago Edison, can be bought in the neighbourhood of 105.

The manufacturing and industrial list has not shared in the revival to any appreciable extent. In fact, beyond a rise of 5s. in the price of Brush Preference, quotations scarcely mark a change at all, which is due to the fact that, for so many issues in this department, the market is one of the most limited.

Electrical railway stocks do not recover from their depression, the effect of a high Bank rate being sufficient to check both speculation and investment in these securities. To anyone on the look-out for a cheap investment, and one more likely to improve in capital value than in present dividend-paying capacities, City and South London stock might commend itself, but the market is narrow, and dealings more or less a matter of negotiation. The traction department is dull, with nothing doing. Anglo-Argentine trams keep round about 4, and Buenos Ayres and Belgrano are 2¾, the Preference being 4⅜ and 5⅜ for the "A" and "B" shares respectively. New General Traction are 4, and Potteries Ordinary 14, Preference 10¾. Tramways Union shares can be purchased under 9, at which figure it is almost possible to sell Calcutta Trams, which are again a good market. British Electric Traction Ordinary are still 17½, but the Preferences have been in quiet request, and a 5s. rise in price is the result.

The telegraph section is the liveliest of the electrical group. Eastern Ordinary heads the rise among its kindred stocks, but Anglo-American are also to the fore, the "B" stock scoring an advance of a point. To this the renewed activity in the Yankee market has mainly contributed, but the Stock Exchange argues that the yacht race will be an excellent thing for the company, particularly if each of the five events has to be sailed for as many times before attaining finality. Globe Telegraph and Trust Ordinary have picked up the leeway of a week ago, being strengthened by the declaration of a one-and-ninepenny interim dividend. The Preference shares have also risen a quarter.

National Telephone shares developed dulness early in the week, and now stand at a trifle over 5. The price seems to thrive best when the company is under the fierce light of publicity in the papers. The market is afraid of competition by the Government, but this has been a factor so long, that there is nothing fresh in the proposal.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Oct. 4th.	Closing Quotation, Oct. 11th.	Business done during week ended Oct. 11th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	61 — 64	61 — 64	62	61¾
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	111½—112½	112½—113½	113½	112
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	13½— 14	14¼— 14¾	14⅜	14⅛
205,151	Brasilian Submarine Telegraph	10	7 %	7 %	...	14⅜— 15¼	14⅜— 15¼	15⅛	14¾
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	185 —190 xd	185 —190	...	...
1,332,533£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —104 xd	102 —104	103⅜	102½
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5 xd	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10 xd	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3¼%	3½%	11½— 12 xd	11½— 12	...	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	140 —145	146 —150	148	142
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	99 —102	99 —102	101	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,483,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	118 —123	118 —123	118	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	13⅜— 14¼	14 — 14½	14⅛	13¾
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,040, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
330,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	117 —122	117 —122	...	...
85,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —105%	102 —106%	...	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	5½%	10½— 11	10⅜— 11¼	11⅛	10¾
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	14⅜— 15¼	15 — 15½	15¼	14⅞
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	...	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5⅛%	6 %	6 %	5⅛— 5⅜	5 — 5¼	5⅛	5
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	13¼	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5¼	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	99 —102	99 —102	101	99
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅜— 1	⅜— 1	1⅛	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,889	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	7¾	...
3,881	Submarine Cables Trust	Cert.	...	...	...	130 —135	130 —135	...	...
56,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	4⅜— 5¼	...	...
151,733£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	104½	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	99 —102	99 —102	100½	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,009	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	102 —105	102 —105	...	...
389,521	Western and Brasilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph	10	1 %	2%	...	1¼— 1½	1¼— 1½	...	...
34,568	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10¾	10½— 10⅝	10⅝	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	9⅛	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	104 —107	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7½— 8½	7½— 8½	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	10 — 11	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
84,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7 — 8	7½— 8½	8	7⅞
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	110 —112	110 —112	110	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11 — 12	11 — 12	11⅜	11⅛
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13½	13 1/16	12⅞
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10⅜— 11¼	10⅜— 11¼	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	13¼	13⅛
220,000	Do. 4½% Deb. Stock, Prov. Certs (£30% to be paid) Rd.	...	...	...	...	81 — 84	81 — 84	...	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5⅛	5 — 5⅛	5	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3⅛— 4	3⅛— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6¼— 6⅜	6¼— 6⅜	6 5/16	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	105 —107	106	105⅜
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	14½— 15½	15 — 16	15½	15¼
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14 — 15	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	16 — 17	16 — 17	16⅜	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 10	9⅝	9½
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3⅞— 4⅛	3⅞— 4⅛	3⅞	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½— 15½	14½—15½	15⅜	15

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Oct. 4th.	Closing Quotation Oct. 11th.	Business done during week ended Oct. 11th, 1899. Highest.	Lowest
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2¾— 3¼	2¾— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100 xd	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	17 — 18 xd	17 — 18	17½	17
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13½— 14	13¾— 14¼	14⅛	13⅞
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	125 —128 xd	125 —128	127¾	126½
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6¾	6½— 6¾	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	8	nil	3 %	5 %	1¾— 2	1¾— 2	2	1⅞
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2 1/16	2⅛
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	109 —113	109 —113	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —106	104 —107	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13½— 14½	13½— 14½	14¼	13⅝
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	10 — 10½	10¼	10⅛
178,303	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,083	Do. do. Pref. half-shares	5	...	...	...	4½— 5	4½— 5	...	..
71,447	Do. do. Def. do.	5	...	...	...	5 — 5½	5 — 5½	5⅛	...
630,000£	City and South London Railway	Stock	1 1/16 %	1⅛ %	2⅛ %	63 — 66	63 — 66	...	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6½— 6¾	6½— 6¾	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	3 1/16	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½ %	6 %	6 %	2 — 2⅛	2 — 2⅛	...	...
17,189	Do. do. do. "A" Shares, 01—017,189	5	5½ %	6 %	6 %	4 — 5	4 — 5	...	...
344,028	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2½— 2⅝	2½— 2⅝	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000 ...	2	...	...	...	⅜ — ⅝	⅜— ⅝	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	110 —113	110 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104 xd	100 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅜ %	3¼ %	3¼ %	8½— 8⅝	8½— 8⅝	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13¼— 13⅜	13¼— 13⅜	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	38½	37
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9⅜	9¼— 9⅜	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6 xd	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	100 —103	100 —103	101½	100½

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
British Aluminium, Ordinary, 9—10; 7 % Pref., 10—11.
Brompton and Kensington, 4½ % Debentures of £100, 105—108.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 1—3.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12¼—13¼; 1st Preference Cumulative 6%, £5 (fully paid), 7—7½. Debentures, 105—108. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 18⅜.

* From Birmingham Share List.

Bank rate of discount 5 per cent. (October 5th, 1899).

MARKET QUOTATIONS, Wednesday, October 11th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
" Nitric .. .. .. per cwt.	22/-	22/-	..
" Oxalic .. .. .. per cwt.	32/-	32/-	..
" Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	35/-	35/-	..
a Ammonia, Muriate (crystal) .. per ton	£25	£25	..
a " " .. .. per ton	£23	£23	..
a Bleaching powder .. .. per ton	£5 15	£5 15	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Bensole (90 %) .. .. .. per gal.	7/-	7/-	..
a " (50/90 %) .. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25 10	£27	30s. dec.
a Lead, Nitrate .. .. .. per ton	£24	£23 10	10s. inc.
a " White Sugar .. .. per ton	£31	£31	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks .. per lb.	3½d.	3½d.	..
a " Caustic (75/80 %) .. per ton	£24	£24	..
a " Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a " Recovered .. .. per ton	£5 10	£5 10	..
a " Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a " Crystals .. .. .. per ton	£8	£8	..
a " Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£224	£224	..
b " Sheet, in ton lots .. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8½d.	..
c " Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c " Wire, basis .. .. per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f " Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g " Wire (basis price) .. per lb.	10½d.	10½d.	..
g " Sheet .. .. .. per ton	£88	£88	..
g " Rod .. .. .. per ton	£88	£88	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/2½ to 4/5	4/2½ to 4/4½	½d. dec.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i " Pig (Cleveland warrants) per ton	68/11	66/7	2/4 inc.
i " Forgings, according to size per ton	From £11	From £11	..
i " Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8 .. per ton	£14 5	£14 5	..
g Lead, English Ingot .. .. per ton	£16 10	£15 15	15s. inc.
g " " Sheet .. .. per ton	£18 10	£16 10	£2 inc.
m Manganin Wire No. 28 .. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 17 6	£8 12	5/6 inc.
d Mica (in original cases), small per lb.	2d. to 6d.	2d. to 6d.	..
d " " " medium per lb.	1/9 to 2/6	1/9 to 2/6	..
d " " " large per lb.	3/6 to 7/-	3/6 to 7/-	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd str'p & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 10	£3 10	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£150 10	£150	10s. inc.
g " foil .. .. per lb.	1/9	1/6	3d. inc.
n " wire Nos. 1 to 16 .. .. per lb.	1/11	1/11	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7¾d.	7¾d.	..
j " Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j " Hemp, 8 ply 10 lbs. .. per lb.	8½d.	8½d.	..
j " " Russian, 10 lbs. per lb.	4½d.	4½d.	..
j " Jute, 180 lbs. rove .. per ton	£13	£13	..
j " Manila, 24 thread .. per ton	£42 10	£39 10	£3 inc.
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£27	£27	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakespeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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ELECTRIC WIRING SYSTEMS.

By J. D. F. ANDREWS.

(*Concluded from page 577.*)

For several circuits in one electrolier an outlet is provided with a joint in the upper end, the same as those already described for twin wiring. There is, however, only one trunnion, in addition to the one carrying the tube, situated on one side of the box, and this is of elongated form, so as to take the requisite number of cables, or single cable with several conductors, or a conduit tube may be employed to take them all.

No contacts are provided in these multiple circuit outlets, the wires of the electrolier being carried up into the joint box, where the joints are made with porcelain thimble insulators, as already described. This outlet is applicable to either concentric or twin wiring, by simply drilling out the trunnions to suit.

When it is necessary to fix a ceiling rose in conjunction with any of these outlets, or a fitting that must be insulated, a wooden block is attached to the end of the tube by a suitably shaped nut (fig. 11).

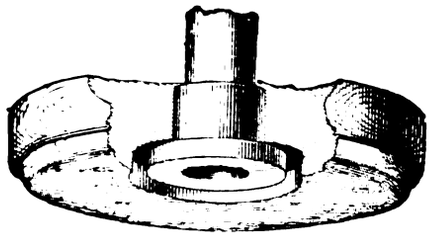

Fig. 11.

For switches the outlets are of two kinds. One (fig. 12) is intended for places where it is necessary to provide against damp, or for sinking in the plaster. It consists of a box with a trunnion, into

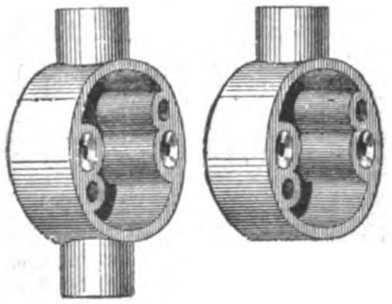

Fig. 12.

which the conduit or the armouring of the cables is soldered, the inner wires being bent towards the open side of the box, and into the terminals of the switch when it has been attached to the outlet. This outlet is fixed by screws passing through the walls of the box into plugs in the wall, by which any possibility of moisture entering by screw holes is avoided. Outlets of this type are made oblong to suit several switches, and they are applicable to concentric, conduit, and twin armoured wiring. The second type of switch outlet (fig. 13)

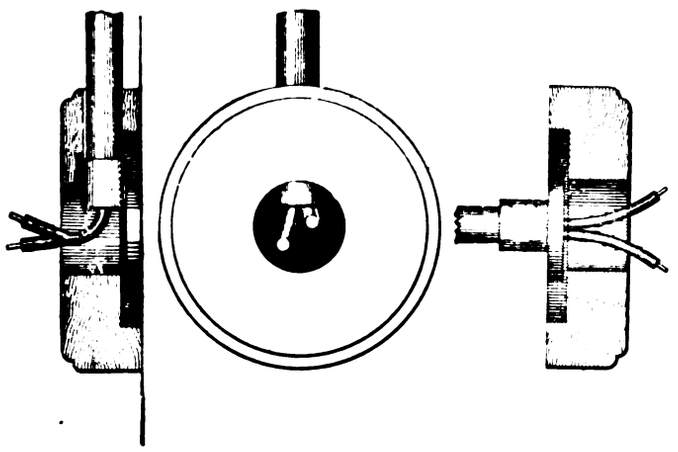

Fig. 13.

consists chiefly of a terminal and means of fixing the end of the conduit or armouring of the cable, the outlet being adaptable to any of them. For several switches an outlet of this type is made as shown in fig. 14, and consists of a piece of angle sheet-iron, galvanised, to which brass trunnions for the cables or conduits are attached by screws. The switches, with these outlets, are fixed to wooden blocks attached to the outlet by B.A. screws or to the wall.

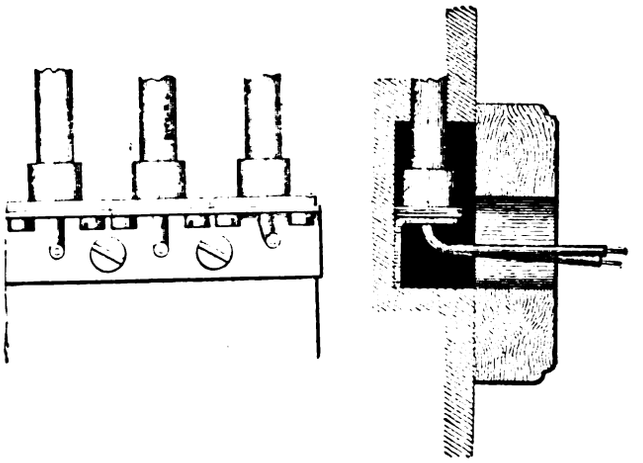

Fig. 14.

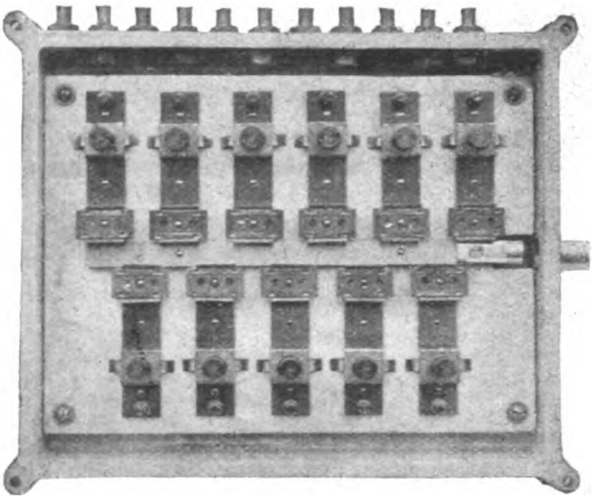

Fig. 15.

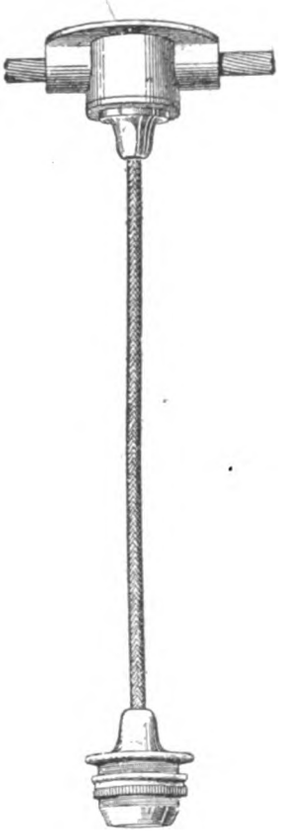

Fig. 16.

The distributing boards (fig. 15) to be used in conjunction with the above wiring appliances are provided with trunnions to receive the

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conduits or the outer conductor or armouring of the cables, as shown in fig. 14.

As in the other appliances of the series, there is no difference in the construction of the distributing boards for use with either con-

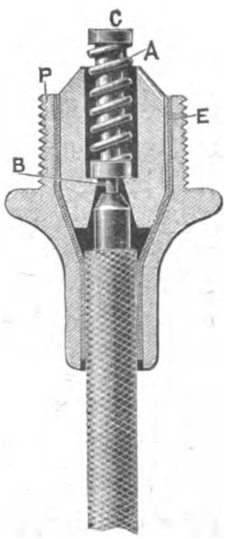

Fig. 17.

centric or twin wiring. Fuses for each wire are used in the case of twin wiring but only for the centre wire in concentric.

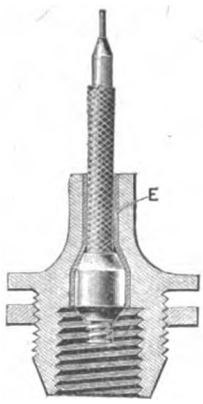

Fig. 18.

The fittings for twin wiring in the writer's system are the same as those generally in use. The fittings in the concentric system, however, are necessarily different as regards wiring. In this

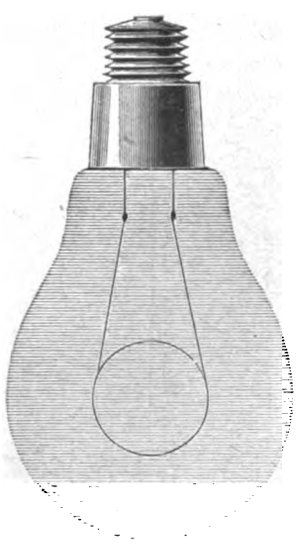

Fig. 19.

system the brass work of the fitting is used as the return, and for flexible pendants a conducting cord is made with one vulcanised I R. insulated conductor with a bare lacquered braiding of copper wires on the outside.

To effect the connection of the fittings with the outlets a union is provided with a spring contact inserted in a porcelain insulator, held in a brass nipple, attached to or forming part of the fitting, ⅝-inch outside gas thread, as shown in fig. 17, in which A is the spring contact to which the conducting wire, B, is attached by soldering into a central tube of the contact, C. This is easily effected by compressing the spring contact until the tube protrudes at the end, then applying a small soldering bit, the conductor having first been tinned with solder and inserted. The spring being arranged on the exterior of the contact instead of within, as is the case in all other spring contacts, the use of a larger wire is possible, and a carrying capacity

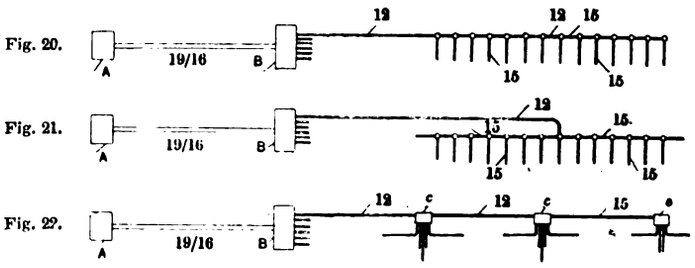

Diagram of System.

can thus be obtained up to 8 or 10 amperes, or even more. The lampholder, fig. 18, for concentric wiring consists of the same spring and insulator, but they are recessed within a ⅝-inch internal screw. The holders and also the nipples are adapted to suit any class of fitting made by any maker, and they may be easily attached by the contractor. For flexible pendants the unions and holders are somewhat modified as shown in figs. 17 and 18.

In addition to the nipple, D, there is a brass husk, E, upon which the nipple is free to turn. The outer conductor of the concentric flexible is soldered into the husk, and the soldered portion is hidden by the brass union. The lampholders are similarly constructed, but they have an internal screw.

The lamps for the concentric system are provided with a ⅝ screw with fixed central contact, as shown in fig. 19.

Notice should be taken of the interchangeability of the parts in the concentric system.

The connector insulator is the same for joints and outlets, and there is only one size. The insulator of the lampholder is the same as for the unions of the fitting and extension sockets. The one thread, ⅝ inch gas, is used for lamps, fittings, unions, and outlets. The outlet described in fig. 8 may be used to carry any fitting, pendant, or bracket, or used as a wall plug for flexible cord, the cords being the same as for pendants, with the union bell-mouthed to prevent chafing.

The system of distribution is similar to that commonly in use. No fuses are provided, except on the distributing boards, whether for twin or concentric wiring. The standard circuits are 8 amperes with 100 volts, or for 12 to 14 16 C P. lamps, or 4 amperes with 200 volts and the same number of lamps.

The series of sizes of conductors employed for these standard circuits are as follows, whether for twin or concentric wiring. It will be observed that the current capacities of the larger conductors are multiples of the smaller ones:—

Amperes at 1,000 per square inch.	Maximum amperes allowed by Institution rules.	Conductors for cable wiring, twin or concentric.	Conductors for conduit wiring, twin or concentric.	Conductor of flexible cords to be used with cables corresponding.
2	4·2	18	3/22	35/38 2·5
4	8·2	15	7/22	62/38 4·5
8	12	12	7/19	110/38 6·8
				172/38 9·8
16	...	7/17	7/17	...
24	...	7/16	7/16	...
32	...	7/14	7/14	...
48	...	19/17	...	...
64	...	19/16	...	...
76	...	19/15	...	...
96	...	19/14	...	...
120	...	37/16	...	...
150	...	37/15	...	...
180	...	37/14½	...	...

Above are three diagrams of circuits based on the standard circuits and appliances referred to. Fig. 20 is, perhaps, the most common, and represents a distribution board, B, of six 8-ampere circuits, with six switches and fuses, or one switch and six fuses, or in the case of twin wiring, six fuses on each pole, supplied by a feeder from the house main switch and fuses, A.

It will be observed that No. 12 conductor is used as trunk with branches No. 15.

In diagram No. 21 the arrangement is modified by connecting the trunk into the centre of the network of branches, from which point No. 15 only is used. If cheapness prevails over quality, something can be saved by doubling the number of circuits and using No. 15

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wire as trunk with 4-ampere fuses, and No. 18 as branches. In instances where efficiency is of the greatest importance, the distribution box system may be introduced throughout, terminal boxes without switches, but provided with a joint for the trunk, are then adopted, as illustrated in diagram No. 22.

The diagrams represent the most common instances of distribution. Many modifications may be made of these, and provided the conductors, Nos. 12, 15, and 18, are the sizes employed, all other appurtenances will be found to fit.

EXPERIMENTS ON RAIL BONDS.*

By Prof. HENRY H. NORRIS, Cornell University.

The importance of the subject of rail bonding is evidenced by the increasing extent of the papers and discussions about it. Although, compared with some of the more showy parts of the railway equipment, its place is very humble, yet the rail bond has the ability to do a great deal of harm in a quiet way.

The use of the ground for the return of the power current is out of the question. If the current does not return to the station on the rails, it is probably not coming in through the ground, for that has a resistance much too great for this purpose. The experiments of Mr. J. H. Holt (*Electrical World*, Vol. xxiv., p. 290) show that the earth may, and does often have, a very high resistance, which is much more than is usually supposed. Between good ground plates, 3,000 feet apart, the resistance was found to be from about 70 to over 500 ohms, depending upon the number of terminals in parallel. In street railway work the resistance will depend largely upon the condition of the surface of the soil, but is usually less than the figures just given on account of the larger surface exposed to the ground by the rails. The rails are universally used for the return, or are ostensibly so used, for sometimes it is difficult to find the current in the rails when it is supposed to be there. It is as important to have plenty of conducting metal in the rails as to see that there is enough in the main feeders.

A common effect of the poor quality of the return circuit is the destruction of metal pipes in the vicinity, and it is this trouble more than any other that has drawn so much attention to the matter of rail bonding. If an easier path is to be found by some other route than that through the rails the current is bound to take that path, or, at least, enough of the current will do so to make the fall of pressure along the shunt path equal to that in the rails. But with the high resistance of the earth it should not be possible for any great quantity of current to leave the rails unless there is trouble with the bonding, for the rails have carrying capacity enough for most cases.

The difficulty in keeping the bonding in good condition is that there are so many electrical contacts to maintain and that they are so inaccessible. When a bond is put in it should be of the best quality in every way so that repairs will be seldom necessary. The requisites of a good bond are both mechanical and electrical. They must not be able to work loose, for a loose bond is of very little use. To this end flexibility is important, for joints will "give" under the weight of cars and the space between the ends of the rails will vary with the temperature. From the electrical standpoint, the conductivity must be good, especially at the joints. The copper resistance of the bond may be first class, but with a joint of small area and insufficient pressure between surfaces, the results will be unsatisfactory. In addition, there must be no chance for oxidation of the surfaces.

The effect of poor bonding is very far-reaching. The power lost, and the corresponding drop in pressure in the cars, amount to something, but the unseen destruction of pipes and cable coverings is more. Even the loss of power is enough to pay for some attention to the matter. The consumption of power should not be calculated from laboratory tests of the bonds, or even of road tests when the rails are newly laid, but when the joints have been subjected to the hammering action of the cars and the weather has had a chance to oxidise the contacts if it can.

It would seem unnecessary to state that a frequent inspection of the bonding of a road is desirable, but it is a fact that in a great many roads the matter is not thought of after the rails are once installed. Yet bonds have been found so hot that they could not be touched, dissipating energy at a rapid rate. Of course the trouble with bond inspection is that ordinarily it is difficult on account of the immense number of the connections, and from the fact also that it is not considered as important as some other matters. In the test which will follow, bonds have been found with a resistance of upwards of 2 millichms. With 100 amperes this would mean a drop of ·2 volt in the one joint with an expenditure of 20 watts, if such current would flow across it. Of course it would not usually do so, but would flow out into the ground in search of a more attractive path. This was a very bad joint, but in the road tested there were several of them. With a possibility of cases like this occurring an inspection of the bonding, if it can be made simply, will prove a good investment of time and money.

The resistance of the rails and bonding of a road should be made both as a whole and bond by bond. By a measurement of the resistance of the whole track return any considerable number of bad bonds may be detected. It is usually the case that bonds will become loose at a section of the road where there is a great deal of racking, and a number usually become loose at once. Such sections would naturally be especially watched.

If individual joints can be examined, the results are much more satisfactory. The measurements are very simple, and if there were but few, the matter would be easy to arrange for. The method used in the tests to be described was to measure the current and drop in the joints while the road was in operation. It would have been better to have drawn through them a current by means of a water or other rheostat, and then on a pair of millivoltmeters to have measured the current and the drop caused by the resistance of the joint. By connecting one voltmeter between two points on the rail separated by some little distance, the drop will be proportional to the current if the distance between the contacts be kept constant. The contacts may be brushes or sharp joints fixed on the ends of a wooden rod. In order to translate the readings into amperes, it will be necessary either to know the resistance of the rail, or to calibrate the voltmeter by taking readings when a known current is flowing through the rail. Simple as the method is, it is difficult to apply, on account of the great amount of time required for its performance. The tests should be made very rapidly, so that the testing apparatus will not interfere with the schedule runs. Where there are thousands of bonds, as is usually the case, it would be almost impossible to make the tests. Mr. Parshall calls our attention to the items making up the joint resistance as the resistance of the copper bond itself; that of the contacts between bond and rail, and the extra resistance due to the "gathering in" of the current around this contact. After the bonds have once been installed the question of the conductivity of the conductor becomes of comparatively little importance, but that of the resistance of the contact is the main item. A measurement of the joint as a whole will tell the whole story.

It is easy to estimate the return resistance which a given road should have, as the resistance of the rails will be about 0·45 ohm per inch mile. Then if the specific gravity of rails be taken at 7·8, the weight per square inch per yard is 10·2 lbs. If the weight of rail per yard be known the area is obtained by dividing this by 10·2. A single track road of rails weighing 45 lbs. per yard and having a length of 5 miles should have a resistance of about 0·25 ohm, the two rails being connected in parallel. This is on the assumption that the resistance of the bonds is equal to that of the corresponding length of rail, which is the ideal case. Often the resistance of a joint is less than that of a similar length of rail on account of the assistance afforded by the fishplate, but it is not safe to count on this. If the road cited gave a greater resistance than this the trouble would be in the bonds. The resistance, as actually measured, will usually not be as high as it should be, on account of the assistance afforded by neighbouring pipes and the moist soil itself, but a test will show in a general way the state of affairs. This test can be readily made by sending a current through the rail and making voltmeter contacts at the ends of the line, a feeder or telephone wire being used for the connecting wire.

The following tests of individual bonds were made by Messrs. P. H. Little and R. L. Reynolds under the direction of the department of electrical engineering of Sibley College. The tests were made on a road of good average construction, the newest part of the track being about two years old, while most of it was much older. The bonds used were of copper wire of two sizes; No. 000 and No. 0, B. and S. gauge. They were riveted into the web of the rail and were about 33 inches long. Such bonds would have resistances of about ·175 and ·3 milliohm respectively at summer temperature.

Two Weston millivoltmeters were used, one much more delicate than the other. One would answer the purpose if a resistance were used in series with it for large readings. Strictly it would be better to use two voltmeters, one for the current and one for the pressure measurements, for the current varies rapidly and it is difficult to shift the voltmeter connections quickly enough. By means of spring clamps, the voltmeter terminals were connected to points on the rail, the distance between them for current readings being 15 feet. As readings were made on upwards of 500 bonds, it will only be possible here to summarise the results. For location marks the poles were principally used, but any other convenient and permanent objects also served this purpose.

The sample from the log shows the general method of procedure.

Log of Individual Bond Test.

Bond.	Location marks.	Drop on rail, millivolts.	Amperes in rail.	Drop on joint, millivolts.	Resistance of joint, milliohms.
387	...	21·1	121·5	11·4	·09
388	...	4	23·5	50	2·13
389	...	·5	3	23·5	7·68
390	...	5·5	32	4·1	·13
391	Pole 60	10	58	19·5	·34

It appears from the results that the joints vary in quality from a resistance less than that of the bond itself to more than 10 times that value. On one section of single track of less than one mile in length, the sum of all bond resistances was over 0·5 ohm, there being 302 bonds in this distance. By repairing one-quarter of the bonds this amount could have been reduced about 85 per cent. Even by repairing but 27 bonds the resistance could have been improved to one-third its former value.

The plan of procedure followed in these tests would be out of the question with most large roads, and the attempt has been made many times to make the measurements more quickly. The matter is simplified by the fact that if a bond is bad it is likely soon to be

* Paper read before the New York Street Railway Convention, 1899.

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much worse and might as well be repaired at once. For this reason it is not usually necessary to know its exact resistance, but rather to know that the resistance is high. The resistance of the bonds will never be uniform, but a certain deflection of the voltmeter can be taken to mean a bad bond. If the contacts be pushed rapidly over the track a throw of the voltmeter needle will show a bad bond if it can be carefully watched. There are various difficulties connected with this plan, but none that cannot be overcome. These difficulties are: (1) to operate the device fast enough to work in with a regular schedule; (2) to make a proper note of the bad joints; (3) and to operate with few observers. The apparatus, also, must be simple and within a reasonable cost.

The easiest plan that can be devised is that invented and operated by the electrical engineer of the United Railways and Electric Company, of Baltimore, Md. A small quantity of paint is squirted on the track by compressed air through a valve controlled by the observer. Another scheme is to make a permanent record of the test by the use of a recording voltmeter, which, instead of being run by clockwork, is driven from one of the car axles. The writer has planned an apparatus which he ventures to suggest, in closing, would do the work, while being simple and cheap. A small platform is suspended from the rear of the car, and resting on a flanged wheel travelling on the rail. This wheel drives the cylindrical drum of a recording voltmeter. The drum is given a spiral motion along its axis by having a screw thread cut into one bearing with the shaft threaded to fit. In case any location marks are desired on the drums the voltmeter needle can be given extra movement by a current sent through it from a cell of primary battery. The contact with the rail is provided by means of brushes pressed on the rails from the ends of the platform.

LABOUR AND PRODUCTION.

It is hardly necessary to say how much the production of English workshops is dependent upon the labour factor. Since the engineering strike, however, there has been a comparative calm, and it is hardly likely that trouble will arise again in a hurry. Criticism is generally useful, and it is interesting to note the criticisms of outsiders on the conditions that prevail in this country. Quite recently an American correspondent, in the course of a communication to the *Iron Age*, set forth with some skill the weak points of our labour system, when compared with that of the United States. The writer mainly addressed himself to questions of wages and hours of working; but he pointed out the effect of the holiday system on the rate of production. Even to one familiar with the customs in vogue in this country, it is almost startling to find how much time is taken up in holidays in the course of 12 months. It may be true that England is the land of strikes and holidays, and we are probably approaching the Irishman's idea of a working day which was to be from 12 to 1, with an hour for luncheon. The matter of holidays, however, has its serious side, and in view of the manufacturer's difficulty in meeting foreign competition, it is interesting to examine whether his inability to meet foreign rivalry is due to the curtailing of the hours of labour. Although there may be a greater degree of freedom in this country in regard to holidays and hours of labour, we could hardly preach the doctrine that is followed so consistently in America and Germany. In the latter country, a labouring man is stated to work like a machine, and in the former, a machine is stated to work like a man. The writer says that the English manufacturer must allow for about 14 days at Christmas and New Year, when his men will not work; then he must subtract 10 days at Easter, when shops close for all practical purposes. Every Saturday in the year must be excluded from the working list, because engineering works and manufacturers of plant generally give the men a half-holiday on Saturday, and the aggregate result of a half-day cannot be much. "But, to be absolutely impartial," says the writer, "let us deduct only 52 half-days, or 26 working days, this including bank holidays, and in each district the number of local celebrations (which are only locally recognised), and the master can count upon about 250 days in the year, when he must turn out his products and expect to make money." Now, outside criticism is undoubtedly very valuable, and probably it may serve a useful purpose even when it is somewhat exaggerative; and we are afraid it will be impossible to acquit the writer of the *Iron Age* of exaggeration in the foregoing statement, because we know of few manufacturing industries—even in this country of holidays—where the men are fortunate enough to get 14 days holiday at Christmas and the New Year; we know, for a fact, that the holidays at Christmas and the New Year do not, in many cases, amount to more than two days. When the writer attacks the half-holiday, he is tilting against the very bulwarks of our constitution. The art of making money is a very desirable accomplishment, but if one can only obtain a proficiency in that art by never having a holiday, then we do not see much in money-making. The American, and the Englishman, approach the question from two different standpoints; the American obtains his pleasure by making money; and the Englishman makes his money to obtain his pleasure. If the prosperity of a country depends upon the masters and the men working without intermission, we are not admirers of prosperity. We may overdo our holidays, but it is difficult to judge English conditions from those prevailing in America. In the first place, our industries are not subject to the violent reactions which one has witnessed so frequently across the Atlantic. Our achievements, industrial and otherwise, may be less brilliant than those of our American cousins, but we flatter ourselves that we have a little more stability. America is a great nation, but we do not want all their methods imported into this country. Their workshop management and organisation is a model to the whole world; at the same time, the relations between capital and labour are less acute in this country, in spite of our strikes, than they are in America. Admitting that we may overdo the holidays, and that the men have too much freedom, it is worth mentioning those firms which demand the least from their men are among the most prosperous in the country. We do not say, for a moment, that prosperity is due to short hours of labour, but we advance this statement because we think the holiday question has not such an important bearing on production as the writer in the *Iron Age* would have us believe. It is apparent that the writer judges as national, what is purely local. He quotes one instance, which is intended to serve as a practical illustration. "On the second week in August there was a race meeting at Stockton-on-Tees (it is a yearly fixture), and the races last for three or four days. According to a time-honoured custom, the ship yards, boiler works, rolling mills, furnaces, and manufacturing plants close down at this period, to give the men an opportunity either to go to the races, or to have a holiday. The district affected by this is large in area—Stockton, Thornaby, Middlesborough, and other less important towns. The losses to the men and the manufacturers, and the many indirect and under-surface losses necessary to the act of blowing out fires, and banking furnaces, cannot be translated into dollars." We are not seeking to defend this apparently flagrant break in the year's work, but we cannot accept it as in any way representing general practice. It is well known that at certain holidays (particularly August bank holiday) many works close for a whole week, but this is done as much in the interests of the masters as of the men, for it gives an opportunity of going over the machinery, cleaning out boilers, examining engines, and such like necessary work. Yet, according to the writer, the British manufacturer cannot understand why he is being distanced by American and German rivals. We are told that the Atbara Bridge went to America because it was urgently wanted, and the American builders promised a shorter delivery. Now, with all the resources of America, it will be interesting to watch the progress of their industries, and see whether the very quick deliveries, about which we hear so much, can be maintained. Many attempts have been made to dazzle us with the Atbara Bridge, but we can show instances of unfulfilled delivery which more than balance the account. America and Germany may be distancing us in the markets of the world; but scarcely at any period of our magnificent history were English trades in such a prosperous state as they are to-day. As we have said before, we admire a good deal in the American industries, but we cannot hope to import foreign labour conditions to any great extent into this country.

Moreover, in dealing with American criticism of workshop methods, it should not be forgotten that there is one thing in our system that an American does covet, and that is an English workman. He has probably in the past exhibited a weakness for agitators, and he may be generous to himself in the way of holidays, but when he gets down to his work he is probably the finest workman on earth. Not for a moment do we wish to defend the many differences that occur between masters and men. Many are deplorable, and we can quite understand a shipbuilder telling the writer that if work had progressed in his shops without interruption, he could have added at least 6,000 tons to the total output a-year. While speaking of English workshop methods, we do not think sufficient attention has been paid to the improvements that can be effected in the heads of the establishments. For years we have striven to improve our workmen, and surely some thought might be bestowed upon how we can reform the methods that prevail in the management of our great industrial concerns.

ELECTRICAL FEATURES OF A UNITED STATES BATTLESHIP.

The New York *Electrical Review* describes the electrical equipment of the U.S. battleship *Kearsarge*. This is claimed to be the first battleship in the world to be provided with a complete electrical power transmission plant. The *Kearsarge* is a new 11,500 tons seagoing battleship, one of the finest battleships in the world, and embodies in her design many features of novelty and interest, particularly to electricians. For the first time the idea of operating all, or practically all, of the numerous auxiliaries of the ship by electric motors has been carried out. This means the abolition of all steam pipes and steam engines in the enclosed compartments of the vessel, increasing both the comfort and safety of her people by the absence of these hot and dangerous appliances. It also reduces the size of openings through the water-tight bulkheads, very small holes sufficing to carry the electrical conductors.

The *Kearsarge* is 368 feet long, 72 feet 2 inches beam, and at a draught of 23½ feet displaces 11,525 tons. Her belt armour is from 9½ to 17 inches thick, and her deck plating has a maximum thickness of 5 inches. Her main engines are expected to develop 11,000 I.H.P., and it is believed that the forthcoming trials will exhibit a speed of at least 17 knots.

Just aft of the main engines is the central power plant for the ship. Owing to the exigencies of battleship design the space allotted to the electrical machinery is very small, necessitating a curiously original installation. Seven generating units, each of 50 KW. capacity, compose the plant. Each consists of a six-pole direct current dynamo, giving 80 volts, direct coupled to a vertical single cylinder high speed steam engine. Both engines and dynamos were built by the General Electric Company, of Schenectady, as were also the numerous motors on the ship.

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On account of the small space the seven generating sets are mounted in two tiers, four below and three above. On each machine is a circuit breaker in the lead to the bus bars of the main distributing board, which is located on the starboard side of the upper gallery of the generator room.

This board controls the majority of the ship's circuits, but not all, seven other distributing boards being scattered about the ship on what are virtually prolongations of the main bus bars. This arrangement is due to the crowded condition of the generator room, space enough for a complete main switchboard not being available in it.

All the circuits of the ship are wired on the three-wire system, with 80 volts between neighbouring wires, and 160 volts outside. The motors are connected across the outside, but most of the larger ones are arranged to be connected across one side of the system when low speeds are desired. The incandescent lights, of which there are about 800, are connected to the 80-volt mains, as are also the four large searchlights.

There are 55 large motors on the ship, every auxiliary, with the exception of the windlass and the steering gear, being worked by electric power. The circuits are led through steel conduit tubes for the most part, though some of them consist of lead-covered wire in fireproofed wooden moulding. The fittings are of bronze, of the usual water-tight pattern in use for marine work.

In each of the two large superimposed turrets are motors for turning the turret, and others for elevating and depressing the guns. The turret moves as a whole, the upper part being bolted fast to the lower, so that the two 8-inch guns above and the two 13-inch guns below point always in the same direction. The immensely heavy turret, with its four guns, can be completely revolved in about 40 seconds, some 28 H.P. being required for the purpose.

The rammer heads for the 13-inch guns, boat and ammunition hoists and small windlasses are operated by series motors, shunt motors being used for the ventilating fans, pumps, &c. Every motor is protected by at least three safety circuit-opening devices, one of which is the main circuit breaker on the dynamo.

Motors on the exterior of the ship, for example, those on the boat hoists, are of the enclosed waterproof type, while the majority of those inboard are of the open multipolar slow-speed variety, giving easy access to their working parts.

It is expected that two dynamos in constant operation will provide for the lighting of the ship and the ventilating fans. Two more will be required when boats are hoisted, &c., while six will furnish current enough for any emergency. This leaves one generating unit of the seven always in reserve. No tests have yet been made upon the efficiency of the plant as a whole, or upon its steam consumption, but tests of the various auxiliaries showed that they operate in a highly satisfactory manner.

Among the other electric auxiliaries of the ship are the usual Ardois signal lights, telephones connecting the armoured conning tower with the various departments of the ship, thermostatic and other fire alarms, and signal bells of various kinds. The steering gear is provided with an ingenious automatic electric arrangement for returning the rudder to the amidships position in case of failure of the hydraulic control mechanism by which the valves of the steam steering cylinders are worked.

The ship has the least possible quantity of woodwork aboard, all of it being fireproofed. The steel walls and partitions are coated with cork paint, to avoid "sweating."

Our contemporary adds that probably the finest, as she is certainly the most modern battleship afloat, the tests of the *Kearsarge* will be awaited by naval men with anxious interest. The electrical operation of auxiliaries has been discussed at great length for several years, and this new ship embodies most of the advanced ideas upon this important subject. It is not unsafe to predict that the new system will show an enormous gain in efficiency over the time-honoured method of steam-driven auxiliaries, with their innumerable steam pipes, high consumption and wasteful performance.

SIGNALLING WITHOUT CONTACT.

The following is a copy of a report prepared by Mr. James Swinburne, M.I.C.E., &c., on Mr. W. S. Boult's system of railway signalling, which was described in his paper read before the Dover meeting of the British Association. The paper has appeared in the last three issues of the Electrical Review:—

"*February 28th*, 1899.

"Boult's Railway Signals.

"I have carefully considered Mr. Boult's system of magnetic train signalling, and have also examined the apparatus.

"For many years engineers have tried to work out something safer and more efficient than the present system of semaphores. Many electrical systems have been worked out more or less, but, so far as I know, none of them have been successful, the difficulty being to make an efficient contact when the train moves at an express speed. Mr. Boult has overcome this difficulty by using magnetism as his means of connection to the engine. His system is ingenious, and, I think, new, and seems to me to solve the difficulty very satisfactorily.

"Boult's system has many advantages over the present system. In the first place, it is equally good in fogs. It thus completely removes difficulties of fog signalling.

"There are no exposed working parts either on the line or on the engine. In fact, there are no working parts on the line at all. All the present systems of levers, wires, and rods, with their up-keep and chance of breaking down are removed, and the only working parts that are necessary are the hand contacts in the signal cabin and the contacts and indicators on the engine, which are all properly and easily protected. On the track there are only insulated wires which pass from the boxes and are wound round the electro-magnets on the permanent way.

"The Boult system is thus independent of the weather, and cannot be put out of order by snow, sleet, or wind, and is not rendered invisible by fogs.

"It is in the very nature of things much simpler and cheaper than the present semaphore system.

"It avoids all chance of the engine driver mistaking the signals, as he only reads the signals on his own line; he cannot confuse them with signals to some other line. Accidents due to mistaking lines or mistaking the signal arm are thus avoided.

"There is only one system of signals for day, night, and fogs.

"The train can be made to signal its position to the cabin, as well as to receive the signals sent from the cabin.

"Not the least of the advantages of Boult's system is that it can be introduced gradually. A new system that involved a simultaneous change of all the signals in the kingdom would have no chance of success. Boult's system can be put down by degrees, working in conjunction with the present system without altering anything at the cabin. Each semaphore can work its magnetic signal by the simple addition of an electric contact, so that any railway company can try Boult's system, and if satisfactory, can gradually introduce it side by side with the existing system without any trouble or complication, and when found satisfactory, the semaphore system can be taken out. It involves no new system for the signalman. It ought to be introduced at once as a system of fog signalling, and I think it will stay as a system of signalling to supersede the present comparatively barbarous system."

SOME ILL-TEMPERED AMERICAN CRITICISM.

There is a certain class of American technical journal whose editors appear to be ever on the look out to pick quarrels. Such is the *Western Electrician*. Probably no journal has done more than our own to point the virtues of American plant, and we hold ourselves equally free to condemn where such condemnation is merited. Our ill-tempered contemporary has ignored all we have ever said favourable to American productions, and falls foul of us because we have criticised the Glasgow business. We should not have minded if our critic had stuck to facts, but it has not done so.

The *Western Electrician* looks on our criticism as insinuating possible collusion between the engineer and one bidder—meaning the Allis Company. Save me from my friends, surely Mr. Parshall will now exclaim. No charge has been made in any English journal that the coincidence between Mr. Parshall's dimensions and the dimensions of Allis engines was a proof of collusion. It has remained for the *Western Electrician* to raise such a point. Obviously such conduct would be most dishonourable, and we do not believe many American engineers would be guilty of it. We need not stay to dissect our worthy contemporary's argument that it was fair to give £20,000 extra to the Allis Company because they promised to adhere to the specification. Before arguing in this way, our contemporary should have taken the trouble to ascertain facts, and the facts are that Mr. Parshall specially separated the dimensions from the specification, and then used the Allis Company's adherence to these dimensions as an argument to give them the order. It was very natural that the firm who had patterns to fit the dimensions should have been able to promise quickest delivery. We have nothing to say here of Mr. Parshall's ability. We have already expressed ourselves as favourably of the electrical part of the specification as we have spoken unfavourably of the steam section and the general methods. We are, moreover, strongly of opinion that there is not a single reputable technical journal in the whole of the United States that would not endorse all we have written were they in possession of the facts as known on this side.

It is extremely funny to find the *Western Electrician* weeping over our slow mental processes, and so very unwilling to allow English criticism of American methods and design. Years ago English engineers led the way in electric lighting plant. They simplified it altogether. Yet it is too early even at this late hour for us to be able to say that American engineers have come up to the same methods. They still spread acres with belting and jack shafts, and only a few of them have tardily followed English methods of direct connection and high speeds; and though there may not be much electrical traction in England, we do not need to go to American engineers to learn how to generate electricity. In this branch, again, Americans have gone in for slow lumbering engines and unnecessary weights.

Compare, for example, the 5,000 H.P. engines of Mr. Parshall's design, which are said by the Allis Company to be good American practice, with the two 13,000-H.P. engines of the despised marine

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engineering of the Clyde as in the *Powerful*. These engines run at 114 revolutions per minute, with cylinders 45, 70, 76, and 76 inches diameter. For small powers like the Glasgow engines the speed of revolution would be 150 as in a second class cruiser, and it accords with English practice to run 3,500 H.P. engines with cylinders of 54 inches at 220 revolutions per minute.

Now, who that is not absolutely blinded by excessive partiality can quarrel with our criticism of little engines of 5,000 H.P. being run at 75 revolutions only? It is ridiculous. Nor is it only in warships that high speed is found. The same applies to the merchant service. Indeed, not a day passes but what some sample of Clyde engine building enters or leaves New York Harbour, and yet the *Western Electrician* in Chicago would have it that the Allis Company alone is fitted to supply tramway engines. We think we have already fully exposed the fallacies which prevail on the question, and which have been so successfully exploited to cover the out-of-date policy of clumsiness and low speed which still hold for so much American traction work. No amount of bluff or abuse of English over-conservativeness will ever make it good practice to adopt a style of construction which complicates stresses.

Electrically, too, it is a mistake to run slow and large dynamos. They cannot be increased beyond a given size without rapid increase of the internal losses due to heating. Large masses lose the power of rapid cooling, because their cooling surfaces do not increase with their bulk. How is it that English marine engines will run at speeds of 150 or 200 revolutions, and 75 is a top speed for American tramway engines of less power? Before a claim to superiority can be made, this question requires an answer. Or we might adduce French practice in the case, for instance, of the cruiser *Guichen*, which has three sets of engines of a total of 24,000 H.P., or 8,000 H.P. each, which run at 125 revolutions.

We fear that in resenting our criticism, the editor of the *Western Electrician* is not practising that virtue which he now professes to admire, namely, alertness of mind. Let him take a journey to New York, where he may see any week over 100,000 H.P. of British engines, on the excellence of which many thousands of his better informed countrymen do not hesitate to embark their lives under circumstances and stresses to which tramway stresses are a bagatelle.

AMERICAN MACHINERY.

A GREAT deal is heard of the excellence of American machinery, and one Hy. B. Binsse writes on the question in *Cassier's Magazine*. Americans themselves are apt to assume that their rapidly growing trade in machinery is due to its excellence. This is a great error. Anyone who has used American machinery knows that it is by no means super-excellent all round. Americans pride themselves on their locomotives, for example. There is no special cause for this. They have exalted opinions of their lathes, yet parts of an American lathe are useless in English practice, notably the paltry and inefficient tool holder and its base. American machinery is seen so often over here because it can be purchased and received in short time, and has been accepted because it would do, or was better than nothing. Its presence is rather proof of the excellence of American systems than of American productions. But in saying this we would not be thought to decry American productions. They often fall short of our ideas of excellence, but they also frequently go beyond the ideas of some of our own manufacturers. Mr. Binsse, however, lays stress on methods of manufacture, especially in regard to interchangeableness, and there can be no doubt that Americans have pushed this well, but they have not excelled many of our own people. No American firm, for example, equals that of Messrs. Willans & Robinson in its methods, and the firm has reaped the benefit of its system, which is admitted as perfect even by critics.

One influence of American methods will become more and more marked as time goes on. The action of the Midland Railway in accepting ordinary American finish must have its effect on our own builders of machinery. There will be less expenditure on mere finish, and probably closer attention to ratings. Americans rate their productions more closely than is the custom here. A 100-KW. generator begins to warm up uncomfortably when pressed very little above its rating, much more than a similarly rated English machine, and this is due to closer design. Copper is economised. Why sell a 120-KW. machine at 100-KW. rating? Some of our own makers, while giving huge margins on one hand, have, however, done a great deal to help forward certain classes of American machinery by the use of inferior materials. In nothing has this been more marked than in motor construction, the insulation of which is, in some examples we have seen, markedly cheap and inferior, and utterly unfitted for the everyday stresses to which motors are put.

The idea of modern manufacture consists in a close adherence to the system of limit gauges. If a large number of wheels are required to run on a certain size of shaft, the wheel is bored and the shaft is turned to limit gauges. The limit gauges of the wheel will consist of a carefully ground and hardened plug, one end of which is a small fraction larger than the other end. The two ends are simply parallel plugs, and when the wheels are bored they will all pass for correct if one end of this gauge plug can be pushed into the bore and the other end cannot. The bore is then correct within the gauge limits. If one gauge is $\frac{1}{1000}$th of an inch larger than its nominal size and the other end is the same amount smaller, the wheel cannot err by more than $\frac{1}{1000}$th of an inch from its correct bore. Similarly for the shafts their limit gauges are two ground and hardened holes of such size that the larger one must be less than the smaller of the plug gauges, while the smaller one must be as little less as can be practically worked to. The limits of sizes must be such that if the largest bored wheel happens to be sent out of stores with the smallest turned shaft there shall be no serious shake, nor must the smallest wheel, if put to the largest shaft, be unduly tight. If every piece thus passes into store after such an inspection with limit gauges, the supply of spare parts and the rapid production of machinery are much facilitated, and American machinery of all classes has been made on these lines. Their best productions are thus turned out and so are their inferior productions, which are, of course, made with less precision, but accurate within the selected limits. The universal application of the system has, of course, led up to other efforts to reduce cost and increase rapidity of manufacture, and these efforts have been carried so far that special care is taken in selecting material. Soft grades of steel and any docile cast-iron rendered still more docile by pickling have been adopted, often to the sacrifice of durability. Everything has been done for the producer and not much thought has been given to the user. Deterioration is probably greater, and the excellence claimed for American machinery is to such extent exaggerated. At the same time, in all machinery liable to be superseded before it is worn out, an excessive durability at the expense of great cost need not be sought. In English practice it is likely that much has been sacrificed to durability. In American practice a good deal of nonsense has been talked about the rapid supersession of old machinery simply to cover up undue rapidity of wearing out.

Mr. Binsse writes at length about American willingness to profit by criticism. It is very doubtful indeed if Americans are much more open than our own people. Take, for example, the American lathe. For years Americans have been told by both Englishmen and their own people how very paltry and insufficient certain details of their lathes are. Yet nothing has yet been practically done by any American makers to remedy these defects in exported machinery. The American system has undoubtedly fostered the art of refined mechanism; it has given them their many excellent small tools and gauges, and has done very much to give them a large trade in small machinery. They will certainly improve in their larger machinery, but so far are by no means so good in large as in small machinery, Nor do we think American competition need be at all feared if our own manufacturers will only look more wisely after their own interests. In electrical work, from track bonding and overhead equipment right through generators, boards, cars and motors, our manufacturers will have to make a great effort if they are to regain the ground which has been lost while they have been devoting all their attention to the development of electric lighting. Failing this great effort it would almost appear that English-made traction material were more than likely to be made by domiciled American houses. Municipal enterprise has not been altogether beneficial to our own makers. The labour clauses have told heavily in favour of the foreigner, from whom no guarantees were asked. Those who have the welfare of their country at heart would do well to use their best endeavours to prevent the extravagancies of municipalities from overrunning all bounds.

POPULAR SCIENCE.

PROF. FLEMING'S lecture on "The Centenary of the Electric Current" to the members of the British Association at Dover, may be said to have reached the high-water mark of attractive popular exposition with mechanical aids. By using two magic lanterns, an explanatory diagram of each experiment and the experiment itself were projected, side by side, on the same screen. The modern developments of the magic lantern, in the skilful hands of Prof. Fleming, enabled him to convey clearly to a non-technical audience a greater amount of information than even a master of the lecturer's art, like Tyndall, could have done by the use of mere words.

But a careful consideration of the learned professor's lecture, with all its brilliancy and specious lucidity, gives rise to doubts as to the real value of popular lectures on an abstruse science, which can only be got satisfactorily into the brains of the student by years of hard pounding. There is a great temptation to the popular lecturer to make use of some striking experiment, which apparently proves his thesis, when in reality he knows it does not. Take, for instance, an experiment with the Leyden jar made use of by Prof. Fleming to prove that the energy of the electric field resides in the dielectric and not in the metal coatings. He says:—"An important question arises upon this subject, and that is, Where is that energy stored up? You will notice that we have in a Leyden jar two conducting plates separated by what is called a non-conductor, or dielectric, and I want to show you how it is stored up in the non-conductor. Here we have two large tumblers, and they are provided with jackets, into which they fit, and with interior jackets of tin. If we connect the inner and outer coatings of one of them with a

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battery, we charge up the Leyden jar. The question then is, Does the energy of the charged jar reside in the metal jackets or the glass? To find out the energy, we simply take the two jars to pieces and change the two glasses. If the energy is associated with the glasses it will go with them; if, with the plates, it will go with the plates. We simply change the position of the glasses and now we put it together again. Now where is the energy? Has it gone with the plates, or is it with the glasses? The energy was transferred to the glass, and this spark shows that the greater part of the energy goes to the non-conductor, and every cubic inch of the non-conductor is stored with energy, just as every cubic inch of gun-cotton; and that energy exists stored up in the dielectric, and the displacement takes place along certain lines of strain." Now we venture to think that nobody knows better than Prof. Fleming that this experiment does not prove that electrostatic energy resides in the dielectric. If the dielectric had been air, instead of glass, how would the experiment have answered? The result obtained in Prof. Fleming's experiment is due to the incidental circumstance, that the metal coatings of his Leyden jar discharged part of their electric charge on to the surface of the glass tumbler, which retained it when the coatings were removed. Such experiments only bamboozle the audience.

Prof. Fleming pictured to his audience the magnetic flux of lines of force as an actual flow of something in the magnetic field. This is quite a legitimate analogy, and the lecturer applied it very ably to explain to his popular audience the somewhat complicated reactions of currents and magnetic fields. The tendency for a magnetic needle to lie along a line of magnetic force was compared to a flag indicating the direction of the wind. But to make the analogy strictly accurate we require a current of wind which will make two flags on the same pole wave in diametrically opposite directions. And such a current as this is hard to imagine. Of course the analogy was doubtless intended as a rough one, but it might puzzle the earnest student of popular science.

Apart from these pitfalls, this lecture on "The Centenary of the Electric Current" gives an excellent *résumé* of the great steps in the evolution of the electric current, since its discovery by Volta exactly a hundred years. No more striking contrast could be found in the history of any branch of the century's engineering than between the insignificant pile of Volta and the enormous generators which at the present day supply electric energy for lighting, power transmission, and other ever-extending uses. The discovery of Oersted paved the way for Faraday, and the developments of Faraday's great discoveries are not even yet exhausted.

ELECTRIC LIGHT STATION BUILDINGS.

By E. K. SCOTT.

It is becoming more evident every day that a considerable number of electric light station buildings have been designed much too small. In making out a preliminary report to a Town or Urban District Council, the engineer tries to keep down the total cost, and to do this the item for buildings is often cut.

In the provinces, temporary corrugated iron ends are allowed, which admit of extensions being made comparatively cheaply, but in London and several other places, the authorities insist on a proper wall being built, which is all the more reason why the floor space of the building should be viewed in a liberal way at the commencement. It is not only the floor space, however, which is skimped, but it is a regular thing for the head room under the crane to be too low. At such a large station as Bankside for example, it has only just been possible to get the new Ferranti units clear of the crane, whilst at another well-known London station the cranes and roof will have to be raised several feet in order to admit the proposed new sets. In fact, with the units of 2,000 KW. and upwards coming into use, the ample proportions of the Deptford station do not appear to be so far out after all.

The accumulator room and the room for the pumps, condenser or heater, are particularly faulty in the respect of floor space. It is especially troublesome in the latter case on account of the difficulty in arranging the connecting up pipes with decent sized bends.

The question requires attention, because stations are now in hand in which the mistakes of the past bid fair to be repeated. Engineers should get rid of the Little Peddlington spirit with which they appear to be overtaken when settling the dimensions of electric light station buildings. If money is short the artistic (?) efforts of the local architect in the way of terra cotta tiles, &c., might be toned down, and the money spent on plain bricks, mortar and concrete.

Roof lights in the engine room ought to be kept to the engine side of the station or else dispensed with altogether. It does not look well to see alternators and dynamos running under tarpaulin sheets.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

19,261. "Improvements in electrically-operated clocks." The British Thomson-Houston Company, Limited, and F. Holden. Dated September 25th.

19,285. "Improvements in rail bonds for electric railways." T. J. McTighe. Dated September 26th. (Complete.)

19,354. "Improved thermaphor with electric heating arrangements." I. Timar. Dated September 26th. (Complete.)

19,384. "Improvements in or connected with electric clock systems." J. G. Lorrain. (H. A. Macdonald, France.) Dated September 26th.

19,440. "Improved apparatus for periodically producing electric current by means of irregular motive power." M. Gehre. Dated September 27th.

19,445. "Improvements relating to electric lighting systems." A. Blondel, G. Weissmann, and A. Wydts. Dated September 27th.

19,515. "Improvements in electric igniters for internal combustion motors." W. J. Crossley. Dated September 28th.

19,530. "A new and improved adjustable reflector for electric and other lamps." J. W. Fenn and A. R. F. Eversheb. Dated September 28th.

19,535. "An improved method of winding transformers for alternating electric currents." A. Blondel, G. Weissmann, and A. Wydts. Dated September 28th.

19,537. "Improvements in switches and switch holders for incandescent electric lamps." R. J. Liebisch. Dated September 28th.

19,539. "Improvements in automatic circuit breakers." B. Hopkinson and E. Talbot. Dated September 28th.

19,595. "An improved electric telegraph hand transmitter for Morse code." B. McDermott. Dated September 29th.

19,619. "Improvement in laminated armatures for dynamo-electric machines." J. Burke. Dated September 29th. (Complete.)

19,631. "Improvements in electrical converters." A. Soames. Dated September 29th.

19,640. "Improvements in electro-magnetic wave apparatus." J. T. Armstrong and A. Collins. Dated September 29th.

19,646. "Appliance for generating electricity to be utilised in propelling machinery and for other purposes." W. Sunter. Dated September 30th.

12,672. "Improved insulator for supporting telegraph wires, telephone wires, and (or) electrical mains." T. Malkin and W. F. Malkin. Dated September 30th.

ELECTRICAL PATENTS OF 1885 EXPIRING IN OCTOBER, 1899.

We are informed by W. P. Thompson & Co. that about 95 applications for electrical patents were filed in October, 1885. Of these some were never completed, and of those that were only three have been maintained to run their full term, viz., 14 years, and being of considerable interest, we give short abstracts of them below:—

11,800. "Improvements in and pertaining to the manufacture of metal tubes, cylinders, rings, pans, boilers, containers, receptacles and so forth." F. E. Elmore. Dated October 3rd, 1885. Relates to improvements upon the inventions described in Specifications Nos. 1,737, 4,199, 8,707 and 10,451, A.D. 1885, and especially to the manufacture of articles of copper directly from impure copper, copper mattes, or liquors by a process of electro-deposition, the copper being refined in the process. A tank, or a series of tanks, is arranged to contain anodes of impure copper, &c.; the electrolyte, preferably a liquid in which the impurities are insoluble, may be an acid solution of copper sulphate or the washings of copper ores. The cathode is made with the surface corresponding with that of the article to be made, and is preferably caused to rotate with a burnishing or like tool pressing against it. The tanks, when worked in series, are provided with shunts, consisting of removable copper sheets, which may be hung in to receive the deposit when the current is larger than necessary for the core mould in any particular tank. In some cases, when the liquid contains impurities, such as bismuth, &c., it is aerated in a spraying device, or by forcing air through it, to oxidise and render them less soluble, when they may be filtered off. The specification mentions the application of the process in the manufacture of tubes, cylinders, rings, pans, boilers, and other containers or receptacles. 4 claims.

12,681. "Improvements in arc lamps." J. Brockie and B. Pell. Dated October 22nd, 1885. Relates to arc lamps. A rocking lever which is pivoted actuates a clutching device by means of a link, is jointed at one end to the movable core of a series electro-magnet or solenoid, the other end of the lever engaging with a slot in the core of a shunt electro-magnet; the core of the latter is suspended by a link. The arc is struck by the lifting of the core of the main solenoid, the lever moving freely along the slot until it reaches its lower end; when the arc

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becomes too long the shunt core is attracted upwards, raises its end of the lever in opposition to the pull of the main coil and allows the upper carbon to fall. As the shunt coil does not act until the arc is at or near its normal resistance it does not oppose the lifting of the lever by the main coil, and may be far more powerful than the latter: the regulating spring or weight may be attached directly to the core of the shunt coil instead of the lever. In order that the lever may be more readily influenced by any downward movement of the shunt-solenoid core, the lifting-pin is made of iron so that it may be attracted by the bottom of the slot, the other three sides of which are lined with a non-magnetic substance. In modifications, a collar embracing the core may be substituted for the pin and slot, and the two solenoids may act on the same end of the lever. 1 claim.

12,994. "An improved method of and apparatus for the working of metals and metalloids by the direct application of electric currents." N. de Benardos and S. Olszewski. Dated October 28th, 1895. Relates to a method of and apparatus for (1) the union of metals by hearing them at various points or in a continuous line to supersede riveting; (2) the disunion by cutting or detaching parts; (3) the formation of apertures as rivet holes; (4) combining metals in layers, steeling objects, filling up cracks, and incrustating plates for ornamentation. A voltaic arc is formed by the approach of carbon to the part of the metal operated upon, the carbon usually forming the positive pole and the metal the other pole. The carbon, which may be solid or hollow, is fixed in an apparatus. The frame having a jointed lever to lower the carbon is insulated and supported on the plate or held in the hand. The frame may have wheels running on rails, and when making holes in the plate a rack having the same pitch as the holes receives the wheels. The work may be supported on an insulated plate electrically connected. When two plates are to be attached together they may have holes with headless rivets inserted: the rivet is then welded by the current, or the current may act directly on the plates and weld them together, at points or in a continuous line. It is stated that by this means several corrugated plates may be combined to form beams, &c., for building purposes, and also that armour plates may similarly joined together. For forge work a pair of tongs are jointed to an anvil so that the object held may make contact with a carbon pole; the tongs may be electrically connected or the current may pass between two adjacent poles of an electric apparatus, having two parallel carbons which are held in sockets to jointed bars, the upper ends of which are provided with rollers bearing upon a taper bar which, suspended by a spiral spring, passes through a solenoid. When a current passes the bar is drawn down partly overcoming the spring and separating the poles. The table for supporting the work is formed into an electro-magnet to attract the current. When metalloids or metals are treated, gases or powdered carbon may be passed into the arc, by holding an insulated stick of metal in the electric arc. A coloured glass screen is provided to protect the eyes of the workmen. 8 claims.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1899.

165. "Improvements in cord grips of electric lampholders." C. T. Briscoe, E. Jones and T. S. Jones. Dated January 4th, 1899. According to this invention the cord grip is made with a round or circular upper parts so that the cap or cover may be screwed on to the holder and the lower part of the grip is made square or angular and fits into a corresponding angular recess in the lamp holder, the cord or wire is thus securely fixed to the lampholder and the cord grip and the cord therein is prevented from turning or twisting. 2 claims.

710. "Improvements in or relating to apparatus for electrically controlling mechanical movements" P. E. E. Rasorot and P. F. L. Belly. Dated January 11th, 1899. The receiving mechanism consists of a field magnet with rotary field excited by continuous currents of various strengths, of an armature excited by a continuous current and of an elastic coupling with an electric contact abutment. In combination with the receiving mechanism, the process of supplying from a distance its rotary multiphase field by means of brushes turning simultaneously around the collector of a dynamo at work. Automatic resistance is introduced consisting of an electro-magnet with double windings and a resistance now in series, now short circuited by the automatic control of the armature of the electro-magnet, for the purpose of controlling the strength of current in a given circuit between particular limits. 8 claims.

813. "Improved electrical signalling and telegraphic apparatus." J. C. Schafer, E. Renz and P. Lippold. Dated January 18th, 1899. Consists in surrounding the receiver of a Hertzian wave system by a material impervious to the rays, in all but one direction. By the introduction of a resistance in the transmitting circuit the distance between the two vessels or other stations may be calculated. The exact locality of the transmitting station is therefore made known to the receiving station. 8 claims.

864. "Improvements in electric arc lamps." W. J. L. Sandy and T. Geer. Dated January 18th, 1899. The upper carbon of the lamp is free to slide in a tube, its motion being controlled by a clutch. Parallel with the carbon is a rod free to slide vertically. At the upper end is a dash-pot, and to the lower end is pivoted the clutch which controls the carbon. The rod passes through a solenoid, and has attached to it an iron core. The clutch consists of a plate having a hole in it through which the carbon passes, and when the plate is not horizontal the car cannot move. 4 claims.

1,234. "Improvements in electro-capillary treatment of woody and other fibre, and apparatus therefor." A. L. C. Nodon and L. A. Bretonneux. Dated January 18th, 1899. Relates to Specification 13,242, 1897, and 18,728, 1897. A solution of borate and resinate of soda is made and the wood placed in it. A current of about 50 volts E.M.F. is then passed through resulting in the exclusion of all the sap, and gives the wood complete dessication, toughness, homogeneity, imputrescence, impermeability, sonority, &c. 3 claims.

3,318. "Improvements in or connected with electrically propelled and (or) controlled vessels." R. B. Painter and W. H. Bainbridge. Dated February 14th, 1899. Electricity is substituted for steam power so as to economise space and to have a maximum number of propellers. It also describes an electrical rudder gear. Consists mainly in having a separate electric motor for each propeller shaft, which is worked by a dynamo and engine in the body of the ship, thereby saving shafting. 10 claims.

4,954. "Improvements in electric clocks." J. Satcher. Dated March 7th, 1899. Relates to clocks wherein the clock is actuated by a weight raised at intervals by the automatic closing of an electric circuit through an electro-magnet. Consists of means whereby an electro-magnet is allowed to work the usual mechanism. 5 claims.

5,262. "Improvements in electrical tumbler and other switches." R. F. Hall. Dated March 10th, 1899. Relates to Specification 5,255, 1899. The contact piece is mounted on a rotating carrier made of insulating material and adapted to work between the separated poles of the switch. 6 claims.

5,640. "System and apparatus for loading and unloading storage batteries from motor vehicles." G. H. Condict. Dated March 17th, 1899. (Date claimed under Sec. 103, Act 18-3, October 19th being date of application United States.) The vehicle can be forced into any position, so that it comes level with the tray of batteries in the loading apparatus. For this purpose the floor is movable and other suitable mechanism can move it horizontally. The carriers are so arranged that they can be slid into or drawn from the vehicle to the loading apparatus by means of hooked rams. 25 claims.

6,027. "A method of and means for regulating the supply of current for illuminating bodies or filaments composed of second class conductors (electrolytes). V. L. Feeny. (Allgemeine Elektricitats Gesellschaft, Germany.) Dated March 20th, 1899. Relates to the lighting of lamps with second-class conductors. Consists in inserting a resistance of a material having the highest possible temperature coefficient, and which is heated prior to the lighting of the lamp. 3 claims.

6,439. "Improvements in combined telephone jack and call indicators." Siemens Bros. & Co., Limited. (Siemens & Halske, Actien Gesellschaft, Germany.) Dated March 24th, 1899. Relates to improvements in call indicators combined with exchange switchboards. Consists in effecting the call by causing an electro-magnet to actuate an axially arranged indicator, which is caused to be protruded by spring power. 2 claims.

6,693. "Improvements in holders for electric incandescent lamps." W. P. Thompson. (M. Meyberg, United States.) Dated March 28th, 1899. Relates to keyless switch sockets for incandescent lamps. Consists of a combination with a plate of a sleeve secured thereto, the sleeve being provided with spring tongues for engaging with the sloping wall of the lamp to normally press it outward, and interlocking means for holding the neck axially within the sleeve and allowing a partial rotation. 9 claims.

6,847. "Improved safety device for use with overhead collectors on electric tramways and the like." L. Huber. Dated March 30th, 1899. Relates to a safety device for use with overhead collectors on electric tramways and the like, in which a vertically reciprocating weight operates in conjunction with a spring actuated brake lever. Consists of a trolley rod and reversing rope, a vertical guide bar, a weight adapted to reciprocate on the guide-bar, the weight being provided at its upper extremity with a prong, a brake lever pivoted in the prong, and the under extremity of which being connected with the reversing rope, a spiral spring connecting the brake lever with the weight and means for lengthening the spring. 8 claims.

7,277. "Improvements in or connected with apparatus for measuring and recording electric currents." H. Aron and Aron Electricity Meter, Limited. Dated April 6th, 1899. Relates to apparatus for measuring and recording electric currents. Consists of a clockwork arrangement by which at different periods of the day the meter registers on different dials. 4 claims.

7,369. "Method of operating typewriting, composing, or similar machines, by means of electro-magnetism." E. Trowe. Dated April 7th, 1899. The type, which is connected with a contact piece directly or by means of a lever or other device, is acted upon magnetically by means of the current circulating in a solenoid, in such a manner that on closing the electric circuit the type is pressed against the respective surface during the period of the closure of the circuit. In composing machines the type is simply released. 3 claims.

7,494. "Improvements in or relating to electrically controlled valve gear for gas and other motors." A. J. Boult. (D. W. Payne, United States.) Dated April 10th, 1899. Relates to valve gear operated by electro-magnets. Consists of a commutator contact plate in circuit with the valve controller, a commutator brush also in circuit, one stationary and the other revoluble, and a centrifugal governor carrying the brush. 6 claims.

7,527. "Improvements in thermo-electric batteries or piles." J. Matthias. Dated April 10th, 1899. Consists in arranging the fragile and easily melted electrode which requires protection, in such a manner that it rests on a projection of the other electrode on the side which is turned toward the source of heat, and is thus withdrawn from the direct action of the radiating heat. 3 claims.

7,579. "Improvements in distributing electricity and switches therefor." J. Liddle. (J. Cleos, United States.) Dated April 11th, 1899. Relates to switching apparatus. Consists of switch parts and circuit changing portions for including the mains of the loop circuit in series with the feeders and removing the mains from circuit with the feeders, the switching apparatus being so constructed that when properly manipulated the circuit through the feeders is never broken. 6 claims.

7,654. "A method of and apparatus for starting alternating current electro-motors, or bringing them up to synchronism." W. D. B. Duddell. Dated April 11th, 1899. Consists of a combination of the motor with a cam driven by the motor and a contact actuated by the cam. 2 claims.

7,656. "Improvements in current collectors for electrically driven vehicles." R. E. Carroll. Dated April 11th, 1899. Relates to trolleys for electric cars. Consists of the trolley pole and trolley wheel support on the end with arms pivotally mounted on the opposite sides of the trolley wheel support provided at their upper extremities with angularly arranged concavo-conical guide and guard discs, and means for spreading the upper ends of said arms apart to disengage the discs from the line wire. 4 claims.

7,756. "Improvements in magneto-electric generators or dynamos." Sir W. Arroll and T. B. Murray. Dated April 13th, 1899. Relates to the armatures of dynamos. Consists in making the core one or both poles, and the journals or end spindles in one piece. 1 claim.

7,925 "Improvements in and connected with globes for electric arc lamps." H. Stenz and J. J. Weyer. Dated April 15th, 1899. Consists in a globe composed of prism or ribbed glass, and which has a movable section constituting a door which can be turned aside. 3 claims.

7,953. "Improvements in and relating to mechanism for automatic or coin fred machines for the sale of electricity, gases or liquids." A. G. Brookes. (Dr. S. Soll, Germany.) Dated April 15th, 1899. Comprises apparatus for controlling the rate of supply of the commodity, which, after the insertion of a coin, may be turned in one direction, and is then automatically turned back by an appliance for measuring the amount of electricity, &c., which has been supplied. A combination of a lever system serving to make electrical contact or to open a valve with mechanism for supporting or arresting the same, which is adapted to be thrown into engagement by the apparatus controlling the supply and which is released by the measuring instrument when the controlling apparatus is turned back so as to deprive the system of its support whereby the contact is broken or the valve closed as the case may be. 5 claims.

8,060. "Improvements in electrical furnaces." D. Lanes, R. L. E. de Bourgade, and L. Schmitz. Dated April 17th, 1899. Relates to Specification No. 6,582, 1899. Instead of arranging close to the furnace walls a series of vertical conductors, as in the above Specification, two helically arranged conductors in communication with each other through which the current flows continuously are provided. 2 claims.

8,140. "Improvements in electricity meters or measuring apparatus." Siemens Bros. & Co., Limited. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated April 18th, 1899. Relates to a device by which meters are subjected automatically to slight vibrations to overcome starting friction. The axle of the instrument is pressed either by gravity or a spring against a foot bearing mounted on a spring which is actuated by a make and break device. 3 claims.

8,564. "Improvements in combined joint or service boxes and face-boxes for concentric and other electric cables." A. J. Lawson, J. G. Childs and J. D. Dallas. Dated April 24th, 1899. A cast-iron box lined with insulating material which will keep it watertight is provided. An insulating partition divides the box into two compartments. The outer conductor of the cable is connected to terminals in these compartments, and the inner passes through a hole in the partition, the hole being completely closed up. A hole is provided in partition at a point remote from the supply terminal for the escape of explosive gases. 4 claims.

8,586. "Improvements in electric brakes." G. H. B. Hooper. Dated April 24th, 1899. Consists of a brake shoe having the major portion of the magnet formed on a circle having a less arc than the contracting pole ends which are formed concentric to the centre of the wheel and extend out entirely beyond the wound portion of the magnetic shoe. 3 claims.

10,340. "Improvements in electric meter." H. O. Swoboda. Dated May 16th, 1899. Relates to maximum current meters. Consists of a strip of metal having a known coefficient of linear expansion when traversed by an electric current, a lever actuated by a spring under tension, and a loosely mounted index needle arranged to be moved by the lever to such a position on the scale as will indicate the maximum electric current transmitted through the meter within a given period. 4 claims.

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THE

ELECTRICAL REVIEW.

VOL. XLV. OCTOBER 20, 1899. No. 1,143.

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THE

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STORAGE BATTERY INVENTIONS.

THE motor car movement has greatly stimulated the efforts of inventors to produce a storage battery of great capacity per unit of weight, and not a few batteries have been put on the market professing to be of much less weight for equal output than the older forms. An examination of these new batteries and of the specifications reveals the fact that the inventors have not succeeded in making any departure from the essentials of the Faure or Planté cells, lead and lead salts alone being successfully used. The plates consist of lead salts held in or upon a lead grid or electrode.

In stationary batteries there are no objections to constructing the grids substantially enough to perform the two functions of supporting the active materials and collecting the current therefrom, thus producing cells of considerable weight, 6 or 7 watt-hours per pound weight of battery being a fair result in capacity. Such batteries are well understood and are durable and reliable, but for successful traction work batteries of such weight are not suitable.

Most inventors endeavour to reduce the weight by increasing the proportion of lead salts to the weight of the grid; in heavy batteries we may find the lead grid equal to twice the weight of lead salts used in making up the plates, while in some recent cells we find it claimed that the grid is only half the weight of the salts.

So long as lead is used in batteries, the only invention possible is in the direction of reducing the mass of lead in the cell, sufficient being left simply to collect the current. The supporting of the active materials being no longer trusted to the grid, the inventor then devises supports of ebonite, glass, acid-proof paper, and other materials, much lighter than lead, which are applied in two different ways.

One uses a grid of vertical lead wires threaded through horizontal strips of ebonite, forming shelves, which carry the active materials and support them. Another takes glass rods as a weft interwoven with lead wires, the glass giving stiffness and resilience to the plates. A third employs very light perforated grids, and supports them by plates of light acid-proof paper, also perforated. Others prefer envelopes of celluloid or ebonite to hold the paste on extremely thin grids.

In all this there is not much invention. Still, if by some means a battery of great capacity and small weight can be produced, it is worthy of a patent.

It is claimed for some of these cells that 15 to 16 watt-hours per lb. of battery, at a discharge rate of 1 ampere per lb. of battery, has been obtained. We have failed, however, to find any independent confirmation of a capacity in any battery exceeding 10 to 11 watt-hours per lb. We are convinced that all these high-capacity light-weight cells will require very frequent renewal of plates; the negatives rapidly decline in capacity in continuous work, and the positive

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grids soon corrode right through, the internal resistance increasing as these changes go on.

The renewal of cheap plates as soon as the capacity falls below a certain amount should be provided for in all battery traction projects, renewals forming a large part of the cost of battery traction. Plates which were expensive to renew would be no improvement over cheap plates of the same capacity.

In judging traction batteries, it is not, therefore, sufficient to find the capacity per lb. weight only. It is necessary to find how long that capacity is maintained in continuous working. Say, a battery starts with a capacity of 12 watt-hours per lb., how many full charges and discharges will it stand before the capacity falls to 10 watt-hours per lb., and what will be the cost of renewal? These questions are rarely answered in descriptions of new cells.

In connection with road traction by batteries, we find that most vehicles for that purpose carry 80-volt batteries. Why 80 volts? We have never been able to find out the reason for this singular voltage; why not use larger cells and fewer of them?

The battery is so near the motor, that loss in the leads is negligible. As only 100 to 120-volt circuits can be used for charging 80-volt batteries, probably 80 volts was selected in the days when 110 volts was the usual pressure; but nowadays 200 to 250 is becoming so common, that batteries to be used on supply from street mains must be raised to 160, 180, or 200 volts pressure, although small cells do not give quite as high a capacity per lb. as larger ones.

On the whole, inventors have not much room for improvements in lead cells. When they have reduced the grid to a minimum, and supported the active materials by something lighter than lead, their efforts are exhausted, and a possible capacity of about 14 watt-hours per lb. is obtained for a time.

Competition in Electricity Supply.

The question of municipalisation of the electricity works is receiving consideration at Ottawa, Canada, at the present moment. The purchase of the company's plant, goodwill, &c., has been suggested at about £250,000. We do not know the terms of the company's concession (presumably it has one), but looking at the matter afar off it is somewhat unfair that a scheme should be produced for the municipality to put down "a brand new up-to-date plant, including water-power and buildings, transmission facilities, and all other necessary adjuncts for the sum of £100,000, which is £150,000 less than the company asks for an antiquated plant." A certain alderman comes forward with this proposal, to carry which into effect he says he can find the capital in New York if the Council concludes to go into the lighting business. The advanced municipal characteristic of unfairness seems not to be confined to English local authorities. Favourably disposed as is our Parliament toward municipalisation of public works, it would not favour the establishment of a competitive service unless the owners of a concession had very signally failed to fulfil the terms of the agreements entered into. Our own large power schemes, for which there is far greater justification than for ordinary lighting competition, have been disallowed because of their possible injury to municipal interests, and if the same justice is to be meted out to both sides, we ought not to allow a municipality anywhere in this country to compete unjustly with an existing company which has borne the burden and heat of the day. Bad as some of our municipalities may be, we hardly think they would be guilty of adopting so unworthy a procedure; but even if they were to do so the Board of Trade and Parliament would doubtless not grant the competitive powers unless there were very exceptional reasons for doing so. In the City of London competitive powers have been granted to a company for reasons which have been repeatedly stated in our own and other columns, but there have lately been feelings that the intending competitor may not have such a bed of roses as was earlier supposed would be the case. That the present company is playing its cards well so far as reduced charges, &c., are concerned, there is not the least doubt, and its growing continuous current system gives it an additional weapon wherewith to wage war if it ever comes to that. All efforts of this kind put forth in the interests of consumers are perfectly justifiable as a means for gathering all the city into the Bankside net while the course is clear. The future line of action of the competitive company is not at present known. Some reports say that the company is jubilant and certain of success, while others hint that the powers may never be carried into effect at all. There is a danger that the present progressive policy of the City Company may be considered to be only a temporary one with a view to forcing the other party to relinquish its order, and that in the event of that coming to pass the City Company would revert to its shell again. We cannot see that such a policy would be to the advantage of anybody after all that has been said and done in connection with this matter, and we believe that the recent progressive action of the City Company will bring such a reward that the company will not be desirous of reverting to the higher charges, whatever may come to pass under the head of competition.

Electric Tramway Mishaps.

It is necessary to emphasise our recent comments on this question, for every week now there are quite a number of more or less serious accidents reported from different provincial towns. The public is not likely to forget that it has been informed by experts that an electric tramcar is the easiest thing in the world to control, that it can be stopped within its own length, and that the likelihood of accidents occurring has been exaggerated. In the interests of electric traction it ought to be stated that some recent instances of speedy stoppage are on record which would hardly have been possible with any other traction system, and trespassing pedestrians have marvellously escaped being run over; but on the other hand, we cannot help regretting that so many collisions with other traffic are occurring. We suppose a certain time should be allowed for the ordinary traffic to get used to the new tram system, and as with the automobile, too high a speed ought not to be permitted until such an opportunity has been afforded. We do not know whether car drivers are culpable in any of the recent cases, or whether opposition traffic has caused obstruction as frequently happens where an up-to-date competition in traffic facilities is introduced, but tramway managers ought to warn their employés to exercise the greatest caution and not give way to recklessness through the novelty of their position. The questions of control and speed appear to have been outside the scope of the recent Board of Trade inquiry at Dublin; but if there are many more accidents, particularly of the kind reported this week from Liverpool, we may expect the Board of Trade to make investigations into the whole question. A reduction in permissible speed is quite undesirable, for a locality does not take very long to get used to the conditions of electric traction, but too ambitious a speed at first may not be altogether a blessing from the point of view of the spread of rapid electrical transit.

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MEASUREMENT OF THE INTERNAL RESISTANCE OF ACCUMULATORS.

By E. C. RIMINGTON.

It is well known that to obtain with a fair degree of accuracy the internal resistance of an accumulator is a matter of considerable difficulty, and unless proper precautions are taken the result may easily be wrong by several hundred per cent.

The writer has lately had occasion to accurately determine the internal resistance of an accumulator whose value was about 0·005 ohm.

The first method employed is shown in fig. 1. The cell

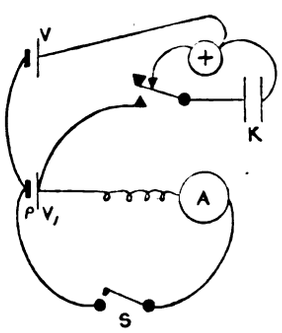

Fig. 1.

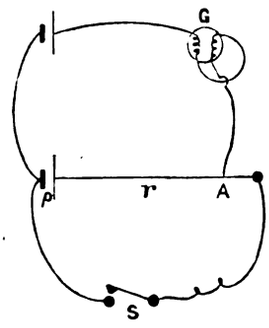

Fig. 2.

to be tested is circuited through a resistance, an ammeter A, and a switch S. A similar cell is connected as shown, and arranged with a condenser, K, and a galvanometer to read the potential difference between the points V and V_1, the value of the throw in volts being determined by obtaining the throw from a Clark or Carhart standard cell. Instead of the condenser and galvanometer, a galvanometer shunted and put in series with a resistance so as to act as a voltmeter may be employed.

The current, C, is read on the ammeter, then if P be the potential difference of the cell under test, E its E.M.F., and ρ its internal resistance—

$$\rho = \frac{E - P}{C}.$$

Now, the E.M.F. of the auxiliary cell is also E, hence $E - P = V - V_1$, and is obtained from the throw on the galvanometer. This method would give accurate results if the E.M.F. of the cell under test remained the same when giving the current, C, as when an open circuit, but unfortunately even with accumulators, there is a slight falling-off of E.M.F. due to polarisation. Now, this lowering of E.M.F. may make a very considerable difference in the value of $E - P$, since P will not be very much less than E. Suppose when the current is C the E.M.F. of the cell under test to become $E - e$. Then the true value of

$$\rho = \frac{E - e - P}{C} = \frac{E - P}{C} - \frac{e}{C}.$$

That is, it equals $\rho^1 - \frac{e}{C}$ where ρ^1 is the value obtained in the supposition of no polarisation. So that ρ^1 is always larger than ρ the real value. A better result may be obtained in the following manner: after having observed the throw due to $E - P$, depress the key so as to charge the condenser, break the circuit by the switch and at once let up the key, this will give a throw due to $E - (E - e)$, or e, subtract this throw from the first and we shall obtain the throw due to $E - e - P$, find the value of the throw in volts and divide by the current. The result will be considerably nearer the true value of ρ, but probably still rather higher than the true value, as the instant the switch is broken the E.M.F. begins to recover from polarisation. In the above, as the throw from the standard cell will be much higher than either of the throws for the test, it will be advisable to use enough capacity to make the throw due to $E - P$ as large as the scale will allow, and shunt the galvanometer with an Ayrton and Mather universal shunt, using a multiplying power for the standard cell.

The above suggests a method of dispensing with the ammeter and turning a deflection into a balance or zero method.

The connections are as in fig. 2, G is a fairly high resistance differential galvanometer and r an adjustable resistance, it may with advantage be a stretched piece of platinoid wire, A being a slider moving on it. Obviously, if G represents the resistance of each coil of the differential galvanometer, the current through one coil is $\frac{E - P}{G}$, and that through the other $\frac{C r}{G}$, and as there is no deflection

$$\frac{E - P}{G} = \frac{C r}{G}, \quad \text{or} \quad r = \frac{E - P}{C} = \rho.$$

Again, the error due to polarisation is present, since the conditions of a balance are $E - P = C r$, while the real value of ρ is

$$\rho = \frac{E - e - P}{C} = r - \frac{e}{C}$$

so that the true value of ρ will be less than the value obtained on the supposition of no polarisation.* As a differential galvanometer may generally be replaced by an ordinary galvanometer and a Wheatstone bridge arrangement, the above method leads to the following, shown in fig. 3.

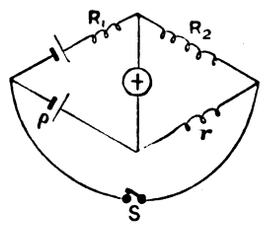

Fig. 3.

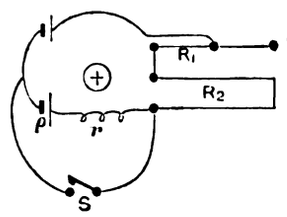

Fig. 4.

R_1 and R_2 are resistances, R_1 must be high enough to allow of the internal resistance of the auxiliary cell in series with it being neglected, about 10^ω will be found a convenient value; R_2 will in general be greater than R_1 and should be capable of adjustment, r is a resistance of thick wire capable of carrying the current that the cell gives in its normal discharge, it may conveniently be about 10 times the resistance of ρ.

Adjust R_2 until there is no deflection on the galvanometer† when the switch is closed, then if the E.M.Fs. remain the same

$$\frac{\rho}{r} = \frac{R_1}{R_2}, \quad \text{or} \quad \rho = r \cdot \frac{R_1}{R_2}$$

by the principles of the bridge. The effect of polarisation will, however, be similar to its effect in the differential galvanometer method, and make the apparent value of ρ greater than its real value. Thus by Kirchhoff's laws calculate the current through the galvanometer due to each E.M.F. separately, the other being supposed zero, the real current will be the difference between these when both E.M.Fs. act simultaneously. Calling the E.M.F. of the auxiliary cell E, and that of the cell under test $E - e$, we have current in galvanometer

$$= \frac{E \{F (r + R_2) + R_2 (\rho + r)\} - (E - e) \{F (R_2 + r) + r (R_1 + R_2)\}}{\Delta}$$

The denominator Δ being composed of terms involving all the resistances, but whose value it is unnecessary to determine for the present purpose. F is the resistance of the branch containing the switch.

Now, if the current in the galvanometer is zero the numerator must be zero, and this gives

$$\rho = r \frac{R_1}{R_2} - \frac{e}{E} \left\{ F \left(1 + \frac{r}{R_2} \right) + r \left(1 + \frac{R_1}{R_2} \right) \right\}.$$

So it is seen that ρ is less than its apparent value by an amount that depends on e, the loss of E.M.F. due to polarisation.

* The term $\frac{e}{C}$ cannot be much reduced by making C large as e will be a function of C, increasing as c increases.

† There should be a key in the galvanometer branch.

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If now, however, this method is worked in a similar way to Mance's method, of which it is obviously a modification, we can eliminate the effects of polarisation and obtain accurately the real value of ρ.

Having connected up as shown in fig. 3, the switch, S, being open, there will probably be a small deflection in the galvanometer due to the two E.M.Fs. not being exactly equal in value. On closing the switch a large deflection will be probably obtained either to the right or left; by altering R_2 it can be found whether this deflection means R_2 is too high or too low, and R_2 must be adjusted until the deflection is the same whether S is open or shut, or rather until this would be the case if there were no polarisation.

Suppose R_2 to be thus adjusted, let us consider what will happen if the cell being tested polarises. On the instant of closing the switch the galvanometer index will move in a direction showing a downward current through the galvanometer in the figure, since the E.M.F. of the cell to be tested diminishes. Now, it will be found that if R_2 be diminished, the effect is to produce a deflection in the opposite direction to that due to polarisation. Hence, R_2 must be diminished until a kick in this direction is produced, this kick will be immediately followed by the movement of the index in the opposite direction, due to polarisation, as the switch is kept closed. R_2 must now be gradually increased until this kick in closing the switch *just* disappears, and this value of R_2 will be the correct one to use in the formula

$$\rho = \frac{R_1}{R_2} \cdot r.$$

This method, as before stated, is a modification of Mance's test, by putting a balancing E.M.F. in one of the arms, this E.M.F. being in series with a resistance high enough to make its internal resistance negligible. It will be found, however, greatly superior to Mance's as regards ease of working, as the galvanometer is worked near to its real zero instead of to a very large false zero, only to be obtained by strong controlling magnets; and, moreover, a sensitive d'Arsonval galvanometer can be employed, which could not be done with Mance's method except by a large twisting of the torsion head to the great detriment of the instrument.

Fig. 4 shows the actual connections, the resistance r, is preferably wound non-inductively and must be of large enough wire to carry the current that goes through it when the switch, S, is closed. R_1 is one of the ratio arms of a Wheatstone bridge, and R_2 the adjustable arm of same. The reason why all the resistances should be non-inductive is that the kick on the galvanometer due to R_2 being too small, would be confused by a kick due to self-induction, if any of the resistances were wound inductively.

In the case of a test made by the writer, $R_1 = 10^{\omega}$, $r = \cdot086^{\omega}$ of No. 10 platinoid wire, and a balance was obtained when $R^2 = 185^{\omega}$, giving

$$\rho = \frac{10}{185} \times \cdot086 = \cdot0046^{\omega}.$$

The current given by the cell when the switch was closed would be about 15 amperes, and when open practically nothing.

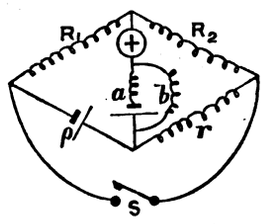


Fig. 5.

The galvanometer used was a sensitive d'Arsonval of the N.C.S. latest pattern, with an Ayrton & Mather universal shunt (total resistance $10{,}000^{\omega}$) on it, the shunt switch being at multiplying power 10; the whole is in series with $10{,}000^{\omega}$.

Another modification which would probably work nearly, if not quite as well, is shown in fig. 5. The shunt, b, on the auxiliary cell, is to be adjusted until the deflection on the galvanometer is practically *nil* when the switch is open, a resistance, a, is put in series with the cell before shunting it to increase its internal resistance, and allow its apparent E.M.F. to be diminished easily without using a shunt of very low resistance. The working of this method will be exactly the same as that last described, and, of course, as before

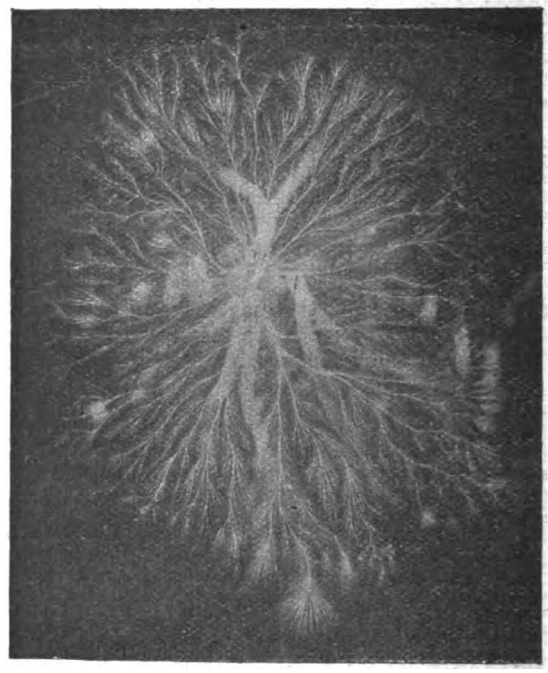
$$\rho = r. \frac{R_1}{R_2}.$$

ELECTROGRAPHS, MADE WITHOUT A CAMERA, OF THE ELECTROSTATIC CURRENT.*

By Prof. ELMER GATES.

During a recent storm here in Washington several men took shelter near some trees, and the bench upon which they sat was struck by lightning. One of the men afterwards found upon his body what he called the "picture of a tree."

Fig. 1.—An Electrograph.



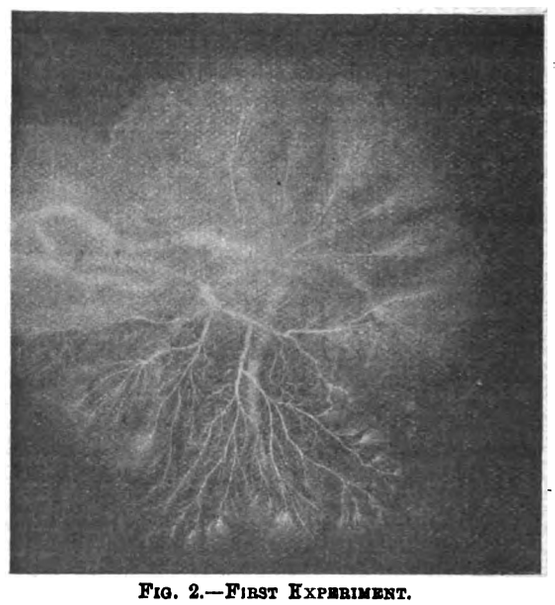


Fig. 2.—First Experiment.

People in speaking about it, and newspapers in writing about it, spoke of it as a photograph of a tree made on his body by lightning. An examination of the photographs of the electric spark herewith presented will make it evident that

* *Scientific American.*

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it was not a picture of a tree which was found upon his body, but a picture of the path taken by the current in spreading over the surface and through the skin. This popular belief that the lightning photographs a tree upon the body of a person struck by a current must, therefore, be abandoned.

I had often photographed the spark—and brush—discharge by means of a camera, but it recently occurred to me to try the action of the spark and current of a frictional machine directly upon the sensitive film under such conditions as would enable me to determine certain facts about the path of the current through a conductive surface. Accordingly I placed a 14 × 17 Cramer isochromatic plate in between the two poles of my 10-plate 32-inch static machine

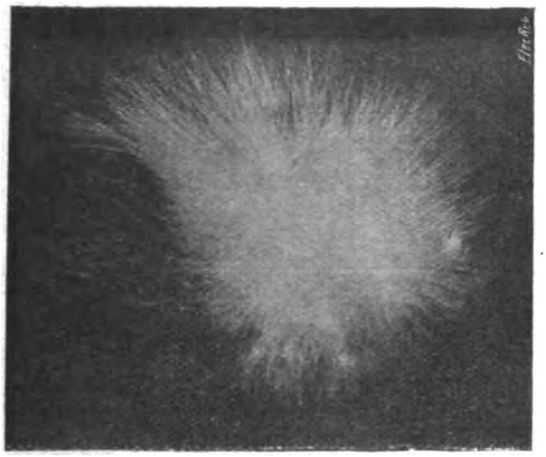


Fig. 3.

Fig. 4.

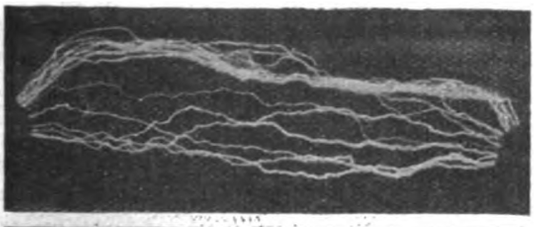


Fig. 5.

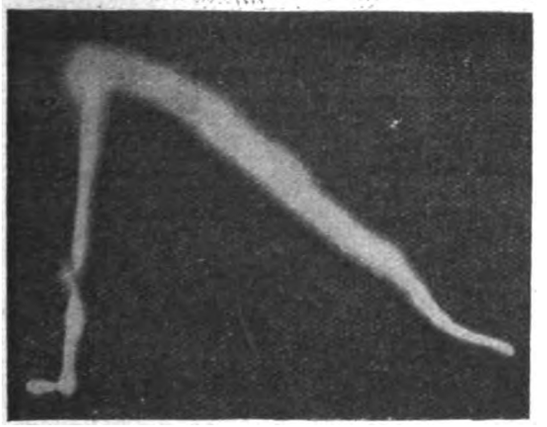
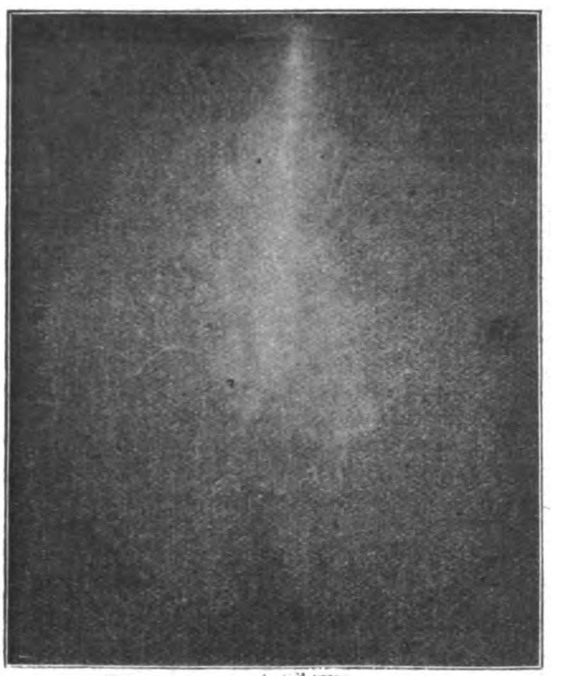


Fig. 6.

Fig. 3.—Brush Discharge.
Fig. 4.—Discharge in Air.
Fig. 5.—Multiple Discharge between Terminals.
Fig. 6.—Discharge around Rubber Plate, Photographed with Camera.

while in full action, and directed the spark directly against the sensitive plate placed within a light-proof envelope, thus allowing the current to photograph its path through the film. The machine was made to run at such speed as to give a rapid succession of sparks at about half its full sparking distance. Then the knobs were drawn farther apart until, at the speed at which the machine was running the sparking ceased, and in its place there occurred a brush discharge. The envelope-covered sensitive plate was then placed vertically between the poles, transversely across the path of the spark, and nearer to the negative than to the positive pole, with the film side toward the positive pole. The positive terminal was then moved toward the sensitive plate until one spark passed, and then quickly drawn back so as to prevent the machine from delivering a second spark. The plate, on being developed, showed in a most interesting manner and in its natural size the path of the current. The sensitive film is a much better conductor than the glass upon which it is placed, the latter being one of the best non-conductors. Hence the current spreads through the film instead of going through the glass, and leaves traces of its path by depositing the silver that lies in its course. In fig. 1 the spot where the spark struck the plate is shown at *x*, from thence the current diverges in all directions, like the branches of a tree; the branches diverge into twigs, the twigs into leaflets, the

Fig. 7.—Discharge on Plate between Shellacked Glass Plates.



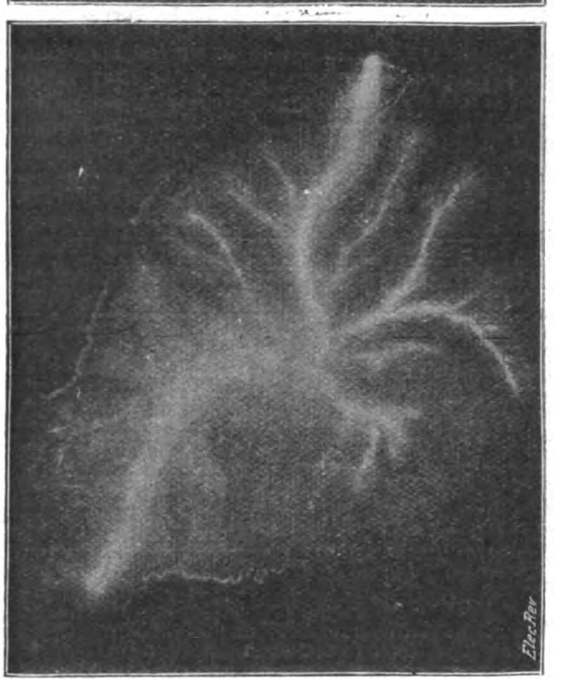


Fig. 8.—Sensitive Plate placed between Shellacked Plates.

leaflets into filaments, and so on, with indescribable complexity of detail. Every part of the current seemingly tends to get farther away from every other part of itself, but this would be a wrong interpretation of the phenomenon. As is well known, when two currents of electricity pass near each other, and in the same direction, they mutually attract each other. It follows, therefore, that the branching of the current, as shown in the picture, is not due to any repulsion between parts of itself, but to its tendency to take paths of least resistance in going through a conductor. The film on the glass plate

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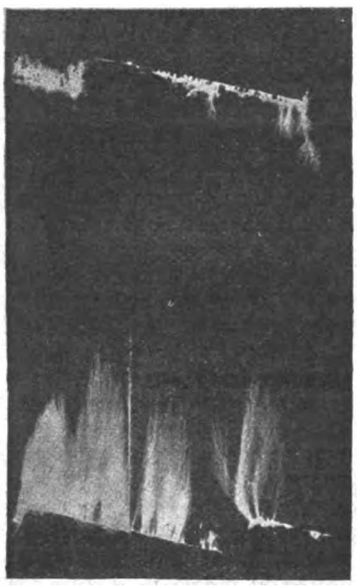
is a conductor, but the glass is not. A conductor has less resistance in proportion as its cross-section is larger, and more resistance as its cross-section is smaller. It is evident that where the spark strikes, the film has but little area of cross-section as compared to the larger concentric surface toward which it spreads. The spark on striking the film first touches a small spot, as at x, and thence it spreads in all directions radially outward from that spot, because the farther it gets away from the spot, the larger the cross-section of the film through which it travels, and consequently the less the resistance. If you use spot x as the centre, and circumscribe a circle 1 inch in diameter, and a concentric circle 2 inches in diameter, you will understand that when the current has reached, in its radially outward course, the limits of the outer circle, it will be traversing a greater cross-section of the film than when it was at the inner circle. From any given point in a concentric circle around the spot first struck by the spark, the direction of least resistance for the current is radially outward. This is why the current splits up into so many branches, and these again into smaller branches, and so on. But the mutual attraction of currents going in the same direction also influences the branching process. The abrupt changes in direction in any one of these branches can doubtless be attributed to local differences of resistance in the film itself.

Fig. 9.—Discharge on Celluloid Film.



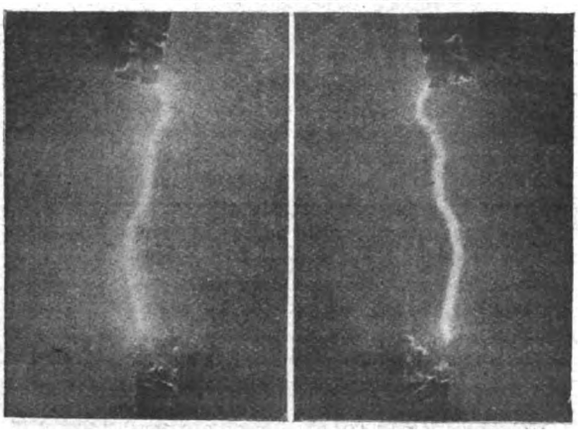


Fig. 10. Fig. 11.

Discharge between Plates facing each other.

The branching paths of the current in the film are not due to areas or lines of conductive substances scattered throughout the film and having less specific resistance than the rest of the film, but to the fact that the conductor grows larger in cross-section most rapidly when the current goes radially outward in all directions, thus making the path of constantly lessening resistance.

In several places branches may be seen approaching each other and uniting thereafter; but sometimes they cross each others' paths without uniting. In the latter case I judge that one of the currents had passed before the other one had arrived. The current in passing over the film precipitates the silver, and the result is a picture of its path made by the spark itself, and without a camera! When the current strikes the centre of the film, as at x, it tends to spread equally in all directions radially outward, and if the sensitive film had uniformly the same specific conductivity throughout its whole surface and substance the current would still divide up into branches and twigs, because of the fact that radial lines of current would still be produced by paths of least resistance, and these paths would be radially outward. If the spark would strike the plate in the exact centre, if the plate were exactly transverse to the path of the current, and if the film had a uniform resistance in all parts of itself, we may believe that the picture of a spark made by itself would be symmetrical in its branchings. But differences of resistance in the film would destroy this symmetry, and render the paths crooked, as is shown in some of the branches of fig. 1. In some of the figures the spark was not wholly conducted by the film; hence it jumped over the top of the plate, leaving a broad white path produced by the light of the spark and a branching figure produced by the current. Fig. 2 is the first electrograph the writer ever made, and it is quite interesting. It shows how one spark, x, went wholly around the plate, and how another spark divided, part going around the plate, leaving a light effect in the shape of a white streak, and part being conducted through the film, leaving a beautifully branched tracing of its path.

When the knobs are too far apart to permit sparking, the result is a brush-discharge, and when a sensitive plate is held vertically therein, the result is as shown in fig. 3.

We sometimes hear it asserted that the course of lightning is not crooked, but straight, and that the crooked appearance is due to the irregular background of clouds. That such is probably not the case is shown in figs. 4 and 5, natural size, made of sparks 16 inches long, with a camera using a Zeiss 12 × 15 anastigmatic lens. In fig. 4, at o, is shown a portion of the current separating from itself. It is evident that an electric current through the air takes a crooked course.

Fig. 6, made with a camera, shows the spark passing around a rubber disc, thus taking a much longer course through the air in preference to going through hard rubber, which is a much poorer conductor than air. The spark is seen to go straight to the centre of the disc, which was held vertically between the poles, straight up to the vertical edge of the disc and parallel to its surface, around the upper edge, and then taking a straight path for the other pole. This gives an idea of the tendency of the current to follow paths of least resistance; the current went almost twice the distance through the air in order to avoid going through a $\frac{1}{16}$th inch thickness of hard rubber.

In figs. 7 and 8, I placed the sensitive plate between two glass plates coated with shellac, and allowed the current to enter through the centre of one of the plates by means of a small hole in which a metal conductor was placed. Thus, allowing the spark to strike the centre of the sensitive plate, on the film side, and thence to spread radially outward toward a circumference of tin-foil placed on the outer edge of the same plate, through which the hole was made. The effect of thus confining the film between two glass plates is quite unexpected—the appearance is characteristically different from that of all the other photographs herewith sent, and I do not attempt to explain the strange marble appearances in the picture. Fig. 9 is also most interesting. The picture was made by making a cylinder an inch in diameter out of a sensitive film such as used in a kodak with the film side outward. A strip of tin-foil was then rolled over the ends of this cylinder so as to cover the film for the distance of an inch from either end. Around this cylinder was rolled another strip of sensitive film with the sensitive surface inward; and around this was rolled light-proof paper. The roll was then held lengthwise between the knobs of the static machine and a single spark was allowed to pass. Figs. 10 and 11 were made by placing the ends of metallic conductors between two sensitive plates with the film sides facing each other.

When a plate is placed within a light-proof envelope there is a comparative absence of the marble effect which is found

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when the film is between two good non-conducting surfaces.

The peculiar interest that attaches to these pictures is that they are not photographs, but electrographs. These pictures, except 4, 5, and 6, were made by the direct action of the electric current, and not by the light of the current. The light effects are the broad white streaks, but the branching effects are due to the direct action of the electrostatic current.

THE MECHANISM OF THE WEHNELT INTERRUPTOR.

A painstaking investigation by Voller and Walter in *Wiedemann's Annalen*, Vol. 68, p. 526, goes a long way towards explaining the various processes, physical and electrochemical, to which the remarkable action of the Wehnelt break is due. It certainly disposes, once for all, of certain favourite theories that have been advanced by some of our great authorities.

What led to the investigation was an observation by Walter that the flames about the anode, when the break was working, gave a very decided hydrogen spectrum. The occurrence of hydrogen at the anode would, of course, be impossible in normal electrolysis. In order to make certain whether hydrogen was present in any considerable quantity, the gases from the anode were collected in a tube and tested; when both hydrogen and oxygen were found to be present in proportions varying considerably according to circumstances.

We shall not describe in detail the apparatus used by Voller and Walter. It will be sufficient to say that the electrodes of the Wehnelt cell were so arranged, that the gases could easily be collected from either of them in explosion tubes. The primary coil of a 30-cm. Kohl induction coil was placed in circuit with the Wehnelt. This coil could be removed from its own secondary, and placed in the secondary of a 50-cm. Kohl. The discharge of sparks was found to be much stronger in the second case, showing, what has been already noted, that, to get the best results with a Wehnelt, the relative proportions of the primary and secondary must be very different from those that are best in the ordinary induction coil.

The gas collected from the anode of the Wehnelt was always found to be an explosive mixture of oxygen and hydrogen. The relative quantities of the exploded and the residual gases varied considerably in different experiments. The proportions changed not only with the length of the anode wire and the strength of the applied current, but also with the magnitude of the inductance of the primary coil in circuit. The greatest difference was found between the results when the primary coil was lying free on the table, and when it was inserted in the largest secondary coil. For example, in the latter case, 45·5 ccm. of anode gas left, after explosion, a residue of 37·4 ccm., while in the former case, *ceteris paribus*, 51 ccm. of anode gas left a residue of 10·8 ccm.

On the assumption than the anode gas consisted entirely of a mixture of oxygen and hydrogen, and that after the explosion pure oxygen only was left, it is easy to calculate from the above figures that, in the first case, the anode gas contained 11·9 per cent. of hydrogen, and in the second case 52 6 per cent. The above percentages can only be looked upon as approximate, since the residual gas, when tested, was found to contain 2 or 3 per cent. of nitrogen derived from the gases dissolved in the electrolyte, and a considerable proportion of ozone was also found to be present. But the differences made by these corrections would not be great.

The anomalous presence of hydrogen in the anode gas of the Wehnelt cell might of course be due to the presence of oscillating currents. But if such were the case, a corresponding quantity of oxygen ought to be found in the cathode gas. To test this, a quantity of the cathode gas was collected. It was found to be non-explosive, but as this might have been due to oxygen being less than one-seventh of the total volume, a more direct test was applied. A quantity of the cathode gas was shaken up in a tube with an alkaline solution of pyrogallic acid. A very small percentage of oxygen gas was found in this way, but this was shown to be derived, like the nitrogen, from the gas dissolved in the electrolyte, by making a duplicate test with the wire anode replaced by a platinum plate anode. In the latter case the same percentage of oxygen was found in the cathode gas. These experiments completely upset the theory of the existence of oscillating currents in the Wehnelt cell.

It became thus highly probable that the anomalous electrolysis in the Wehnelt interruptor occurred only at the anode, and further observations on the volumes of gas evolved at the respective electrodes appeared to establish this beyond doubt. Suitable apparatus was arranged to collect and measure the gases evolved, and to measure at the same time the mean current strength. As an example, the data obtained from one such experiment are here given. The 50-cm. coil, with its own primary, was used in the experiment. The quantity of anode gas obtained was 441 ccm., of cathode gas 387 ccm., the mean current was 9·4 amperes, and the duration of the experiment 6 minutes. The quantities calculated by Faraday's law ought to be, at the anode 196 ccm. of oxygen, at the cathode 393 ccm. of hydrogen. The volume of the cathode gas, within the limits of accuracy here attainable, agrees with the theoretical quantity, while the volume of the anode gas is 2¼ as much as it ought be in the normal electrolysis.

It was found, moreover, that this excess of the volume of the anode gas depended very much on circumstances. As extreme cases, the results of two experiments may be given, in one of which the 30 cm. primary was placed first outside (free, on the table), and secondly, inside the 50-cm. secondary. In the first case the volume of the anode gas was 3·7 times as much as the theoretical amount; in the second case it was only 4 per cent. greater. But this second quantity of anode gas was by no means pure oxygen, but contained enough hydrogen to render it explosive. It was found, moreover, that in the first experiment the anode gas, besides its large quantity of hydrogen, contained 78 per cent. too much oxygen, and, in the second experiment, it contained 6·1 per cent. too little.

A simple demonstration that the anomalous electrolysis takes place entirely at the anode was obtained by placing in circuit with a Wehnelt cell a normal cell, the same in every respect, except that the wire anode was replaced by a platinum plate anode. The following were the volumes of gas obtained:—

	Normal cell.	Wehnelt cell.	Theoretical (calculated).
Anode ...	226 ccm.	475 ccm.	229 ccm.
Cathode ...	457 „	452 „	458 „

A comparison of these figures shows distinctly that the anomalous development of gas occurs at the anode of the Wehnelt only.

The authors tried some experiments to determine whether the anomalous electrolysis took place at the anode of the Wehnelt cell when the self-induction coil was removed from the circuit. This they found to be the case. There was not the same excessive volume of gas developed at the anode, but the anode gas was found to contain from 9 to 11 per cent. of hydrogen. The experiments were made by placing a normal cell in the same circuit as the Wehnelt cell, as in the experiment described above. The best results were obtained by using a high E.M.F. (216 volts).

By reversing the current in the Wehnelt cell, it was found that brilliant spectra of the metals forming the wire electrode (now the cathode) could be obtained. The lines of sodium and hydrogen were also found on the spectrum, but that was considered an advantage, as they formed useful datum lines. The platinum wire was replaced by wires of other metals, which all gave brilliant and characteristic spectra.

Having established the existence of anomalous electrolysis at the anode of the Wehnelt cell, and completely demolished the theory of the existence of oscillatory currents, Voller and Walter proceeded to determine the time curve of the current between two successive breaks or interruptions of the current. In passing, they point out that the existence of high E.M.Fs. in a circuit in shunt with the break is not peculiar to the Wehnelt break, but occurs equally in all breaks, as a consequence of the self-induction of the primary coil. As this experiment is chiefly relied upon by those who maintain the existence of oscillatory currents in the Wehnelt, they are brought face to face with the *reductio ad absurdum* that oscillatory currents must be produced by the ordinary break, even when a condenser is absent.

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The rise of the current, after the circuit is made, follows exactly the same law in the Wehnelt as in the ordinary break. This is expressed by the well-known formula—

$$i = \frac{E}{R}\left(1 - e^{-\frac{R}{L}t}\right)$$

where i is the current at any time t, E is the applied electromotive force, R is the total resistance of the circuit, L its coefficient of self-induction, and e the base of natural logarithms. The curve representing the rise of the current is what is known as a logarithmic curve.

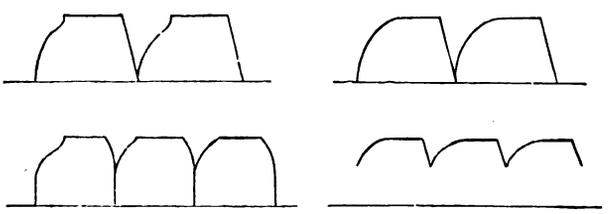
So far the action of the Wehnelt and the action of the ordinary mechanical break are identical. But one characteristic peculiar to the Wehnelt here comes in, namely, that the interruption in the Wehnelt cell always takes place when the make-current has reached a certain value which is greater, the greater the surface of the anode wire is. This fact is best demonstrated by gradually reducing a resistance in circuit with an inoperative Wehnelt, till it just begins to work. It will be found that this always takes place with the same current strength, and that this critical current strength is proportional to the surface of the anode wire exposed to the electrolyte.

The following explanation for this peculiar phenomenon is put forward by the authors. The layer of fluid in contact with the platinum wire has the highest specific resistance of any part of the circuit. The Joule heat (C^2 R) generated there will, therefore, produce the quickest rise of temperature, and convert the layer of fluid into steam. This layer of steam is then electrolysed or dissociated into a mixture of oxygen and hydrogen, which drives back the fluid electrolyte and breaks the circuit.

D'Arsonval has put forward the view that the envelope of steam around the platinum wire is generated by heat communicated from the wire to the surrounding liquid. But direct observation with the eye, and also with the spectroscope, proves that the platinum anode does not become white hot; the high temperature must, therefore, first arise in the liquid itself. Voller and Walter think that after the envelope of steam is formed, a discharge takes place across it of the same nature as the electric arc. But this point evidently requires further investigation.

Interesting results were obtained by the authors from an experimental investigation of the current time-gradient in a primary circuit containing a Wehnelt interruptor. The experiments were made by means of a Braun tube, in which the deflection of a fine stream of cathode rays is made use of to indicate the changes of the magnetic field and the primary current. The changes of the magnetism of the core were shown by placing the tube at right angles to the axis of the core. But since the magnetic field of the core is not a strictly accurate measure of the primary current, this was measured separately by another Braun tube placed at right angles to the axis of a solenoid in circuit with the primary coil.

By means of this apparatus, the time gradients of the primary current and of the magnetic field of the core were drawn. The results obtained are shown in figs. 1, 2, 3, and 4. Fig. 1 shows two cycles of the primary current when



Figs. 1, 2, 3, and 4.

there is no discharge between the terminals of the secondary coil, *i.e.*, the secondary coil has no more influence on the result than if it were not present. The steeper inclination of the curve, just before the current becomes constant, is probably due to the change of resistance caused by the formation of the envelope of steam round the platinum anode. What causes the current suddenly to become constant, and to remain so for about half of a complete cycle, is difficult to explain. Voller and Walter's view appears to be that electrolysis or dissociation of the steam is taking place. The final interruption of the current may be due, as in the electric arc, to over separation of the electrodes.

Fig. 3 shows the curve of the magnetism of the core, corresponding to the current curve fig. 1.

Fig. 2 shows the time gradient of the primary current when a discharge is taking place between the terminals of the secondary. The rising gradient of the current is steeper, on account of the reduction of the induction. The experiments described above showed that, in this case, a smaller volume of the mixed gases was given off. This appears to correspond to a shorter duration of the constant current.

Fig. 4 shows the variations of the magnetism of the core under the same conditions as in fig. 2.

It is evident that the falling gradient of the magnetic field, fig. 3, is steeper than in fig. 4, and experiment showed that the break tension in the first case was 200 volts, while in the second it was only 150. The authors think the greater volume of mixed gases liberated at the anode in the former case has something to do with this.

While the admirable investigation of Voller and Walter has thrown much light on the mechanism of the Wehnelt interruptor, much is still left to be explained.

ELECTRIC TRACTION IN THIS COUNTRY

We have a good deal of sympathy for the newspaper correspondent. Concealed behind a cloud of initials, or shrouded in the mystery of an unintelligible *nom de plume*, he thinks to move heaven and earth and all that in them is in favour of "movements," noble and ignoble. But he is doomed to disappointment, so cruelly are the fates against him; and particularly is that so if he has a real grievance to air, or a reasonable remedy to propound. Generally, we suppose, no one is any the better or much the worse for his perpetual flow of lucubrations, although an occasional check administered by those able to dispel a fallacy may have a healthy effect. Were one, however, to attempt to correct every erroneous impression that obtains currency regarding technical subjects, a special staff of shorthand writers and typists might be necessary. Now, "H. S. S.," whoever he may be, writes to the *Westminster Gazette* on the timely topic, electric traction. So many funny things have been said about this important matter, and have had the effect of hindering progress, that we do not care to allow the letter to pass unnoticed. The writer has visited Milan, Genoa, and Bâle, and praises sky-high what he has seen there, but, like many another Englishman, he seems to have admired the foreign glories before he has made himself acquainted with what is to be found in his "ain countrie," and he therefore returns home with a wrong notion of the relative positions of his own and other lands in the progress of civilisation. He contrasts the backwardness of this country in the matter of street electrical locomotion with Continental cities. He wants to know why "we laggards" can't go and do likewise, now that the problem has been solved for us years ago! He then shunts off on to another track, and grumbles at the hideous designs of motor cars, in which, for the most part, we agree with him, as also with his advocacy of "cleanly electricity" for their propulsion. He does not mince his words, for he is down upon "beastly steam" and "stinking petroleum," and then assuming the *rôle* of prophet, he says "there are millions in *the* electric motor carriage of the future." He advises some of the cycle companies, now in such low water, to turn their inventive powers in this direction, with a view to finding financial salvation! We pity the poor inventor of *the* electric carriage if he happens to come within the circle of *some* cycle companies or promoters. A broken down cycle company would be more likely to ruin the inventor and the electric carriage too, and the millions sterling would be—where? But as usual, the sting is in the tail, and the most important point of the letter is in the postscript: "Dover has set a good example at home with its excellent little electric tramline." It looks as though the writer had just discovered, after signing his letter "H. S. S," that we are not completely "laggards," as Dover has a trolley system. Surely, everyone

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has heard of the great success at Dover! He apparently knows nothing about the electric tram systems now operating at Liverpool, Glasgow, Sheffield, Bradford, Leeds, Dublin, Cork, Plymouth, Dudley, Ashton, Blackpool, Bristol, Hull, Kidderminster, and a number of other towns, and he is also apparently quite in the dark as to the enormous extension schemes, representing millions of pounds sterling, which are developing in nearly all of these places, as well as the score of other schemes which have arrived at the track construction and contract-placing stage. And above and beyond all these, he seems to know nothing of the recent decisions of the London County Council, whose backwardness, we suppose, is the real *raison d'être* of his epistle. His sin is a sin of ignorance, and his little learning is a dangerous thing. To understate the case is almost worse than exaggerating it in this instance.

To deplore the want of progress in electric traction work in this country was all right a short time ago, but anyone who has made a serious inquiry into the dimensions which such development has now assumed can hardly say that our movements during the past few months are "laggard." We drew attention to this matter in a "Note" last week, and we repeat that electric tramway work is now progressing at a most satisfactory rate. Whatever we may have done or left undone in the past, let us now profit to the fullest possible extent by the costly experiences of our foreign *confrères*, and see that the work we take in hand is done thoroughly and well. Better thus than to continue hugging ourselves in our disconsolate state, and shedding a lake of tears over what might, or even ought to, have been.

LONDON COUNTY COUNCIL.

The Council on Tuesday decided that, in consequence of the condition of the money market, the rate of interest on loans advanced to local authorities for electric lighting and other purposes shall in future be 3¼ per cent, irrespective of the amounts. This decision will affect the £10,000 which it was resolved to lend the Whitechapel Board of Works for electric lighting purposes, but a proposal to advance £25,000 to the Fulham Vestry for similar purposes was referred back to the Finance Committee, in order to allow the Fulham members to place their views before the committee in regard to the increased rate of interest on this the second instalment of a total loan of £168,166 on this account.

The Appointment of Prof. Kennedy.

The special report of the Highways Committee, which was referred to in our last issue, was again brought forward in relation to the proposed agreement with Prof. Kennedy in connection with the electrical equipment of the Westminster Bridge-Tooting tramways between Rushey Green and the Crystal Palace, and between Camberwell and the tramway terminus at Vauxhall.

Mr. Melville Beachcroft asked the chairman of the Committee whether the Board of Trade had declined to grant a license to the Council to employ mechanical traction on the tramways. In reply, Mr. Benn stated that some dispute had arisen, but that he had had an interview with Sir Courtenay Boyle, and that the Board had promised to grant the license.

Colonel Ford contended that there was no indication in the Committee's report as to the time that would be occupied on the work.

Mr. Gilbert said that from a calculation he had made it was proposed to pay Prof. Kennedy about £30,000 in connection with 50 miles of line. That gentleman was an expert on electricity, but the speaker was not aware that he had constructed any tramways before. Continuing, Mr. Gilbert suggested that the Council should establish an electric tramways department and carry out the work on its own account, whilst a large amount of money would be saved if the tramways were put out to public tender.

Mr. J. W. Benn stated that that was no light undertaking, and that before being completed it would mean an expenditure of several millions of money for London. It was therefore necessary to obtain the best possible advice, and the Highways Committee sought the views of Sir Alexander Binnie, the Council's engineer. That gentleman expressed the opinion that it would be advisable to engage a separate engineer from the Council's staff, and he said that he knew of no more competent engineer than Prof. Kennedy. Having detailed what work the consulting engineer would have to carry out, the speaker stated that it was proposed that he should prepare drawings and specifications for each special case, and that tenders would then be invited and the whole of the contracts, if possible, placed in this country. Mr. Gilbert did not appear to know sufficient about Prof. Kennedy. Lord Russell was a member of the Highways Committee, and he had placed that gentleman's name at the top of his profession. Mr. Benn further stated that the committee had been careful to ascertain what name would be acceptable and bear weight with the Board of Trade. As to work carried out by the consulting engineer, Prof. Kennedy had acted as joint engineer with Mr. Galbraith for the Waterloo and City Railway, and he had also acted in conjunction with Prof. Unwin in regard to the electrical equipment of the Central London Railway; whilst he had also advised in connection with tramway alterations at Edinburgh, Ipswich, and other towns. The speaker considered that the Council would see that the committee had done their best to secure the best man for the work, and he hoped the Council would give the committee the competent advice for which they asked.

Mr. Balian proposed that the recommendation of the Committee should be referred back, in order that a maximum sum should be fixed, beyond which the Council should not go.

The amendment having been seconded by Colonel Ford, some further discussion ensued, when, on a show of hands, the amendment was rejected, only 16 hands being held up in favour of it. After a farther amendment had been disposed, the report of the Committee was adopted by a large majority, deciding to enter into an agreement with Prof. Kennedy on the lines of the heads reproduced in this Journal last week.

Light Electric Railways.

After a long discussion, the Council resolved by a large majority to apply to the Light Railway Commissioners for an order to construct the following light railways, to be worked by electric traction:—

(*a*) From the present tramway terminus near the Archway Tavern, Archway Road to the county boundary. (*b*) No. 1.—From the present tramways at Clapham Common, south side, *viâ* Clapham Common, Battersea Rise, Wandsworth Common, north side, and East Hill, to West Hill; and No. 2.—From West Hill, *viâ* Kingston Lane, to the county boundary. (*d*) No. 1.—From the present tramways at Deptford, *viâ* Blackheath Hill and Road and Shooter's Hill Road to the Herbert Hospital; No. 2.—From the Herbert Hospital, *viâ* Woolwich Common Road, the road to the west of St. George's (Garrison) Church, into New Road, and thence along Thomas Street and Green's End, to and along three sides of Beresford Square, Woolwich, and returning along New Road, Mill Lane, and Woolwich Common Road to the Herbert Hospital. (*e*) From the present tramways at New Cross Road, *viâ* Lewisham High Road, Loampit Hill and Vale, Lee High Road and Eltham Road, to a point near Wellhall Lane at Eltham.

The Council also resolved to authorise the Highways Committee to take all the necessary steps in order to give effect to the application to the Light Railway Commissioners.

In connection with the proposed light railways, the Finance Committee submitted a special report on the financial bearings of the schemes. The Committee stated that—

On each of the lines a five-minute service would be run, although the manager of tramways is strongly of opinion that on some of the lines, or sections of them, a more frequent service will be required, and that the traffic receipts would average 11d. per mile run, and the working expenses 6d. per mile run, leaving a gross profit on working of 5d. per mile run. The present receipts over the whole system now worked by the Council average about 10¼d. per mile, but this includes the omnibus takings, which are at a lower rate, and the unprofitable line from Camberwell to Vauxhall. Out of the estimated profit of 5d. per mile, the interest on, and sinking fund for the capital outlay, will have to be paid.

Electrical Legislation During 1899.

In the course of the report of the Parliamentary Committee showing the legislation affecting the Council in the session of 1899, reference is made to the following instances, together with the results which are worthy of being placed on record:—

Electric Power and Lighting Bills.

Central Electric Supply	Petitions presented in both Houses. Certain amendments as to accounts and other matters obtained. Bill passed.
County of London and Brush Provincial Electric Lighting Company, Limited	Petition presented. Council appeared by counsel. Bill rejected by Select Committee.
General Power Distributing Company (suspended from last session after passing House of Lords)	No action necessary. Bill rejected on second reading in House of Commons.
Kensington and Notting Hill Electric Lighting	Petition presented. Amendments adjusted. Bill passed.
St. James and Pall Mall Electric Lighting Company, Limited	Bill watched. No action necessary. Bill passed.
St. Marylebone Vestry Electric Lighting	Solicitor instructed to negotiate for amendments. Bill withdrawn before first reading.

Electric Lighting Provisional Orders.

Battersea and Fulham District ..	Not proceeded with.
Bermondsey	Included in Electric Lighting P.O. (No. 3) Bill and passed.
Bethnal Green Blackheath and Greenwich District (Extension)	Included in Electric Lighting P.O. (No. 15) Bill and passed.
City of London	Included in Electric Lighting P.O. (No. 20) Bill and passed.
City of London, St. Luke, Middlesex, Holborn City of London (East) City of London (South-East) Kensington Vestry	Not proceeded with.
Lewisham District	Included in Electric Lighting P.O. (No. 15) Bill and passed.
Metropolitan Electric Supply Company, Limited (City of London)	Not proceeded with.
Plumstead Vestry	Included in Electric Lighting P.O. (No. 15) Bill and passed.

Light Railway Orders.

Crystal Palace	Council resolved to oppose, but scheme withdrawn.
Finchley, Hendon and District Hampstead, Finchley and Edgware	Council appeared by counsel in opposition to schemes. Light Railway Commissioners refused to grant orders in consequence of opposition of local authorities.
Highgate, Finchley and Wood Green	Council resolved to oppose, but scheme not proceeded with.
London United Tramways (Extensions)	No action taken by Council. Order refused by Railway Commissioners.

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THE SHOREDITCH INSTALLATION.

Discussion of the Annual Accounts.

The members of the Vestry at the meeting on Tuesday were occupied for over an hour in discussing the accounts of the electric light and refuse destructor undertaking for the year ended March 25th last. According to the accounts, there appears on paper to have been a deficit on the destructor of £3,616 during the year, and a paper profit of £5,632 on the lighting installation; but, if the former sum is deducted from the latter, the combined undertaking seems to show a surplus of £2,066 on paper.

Mr. N. Moss, chairman of the Lighting Committee, in moving the adoption of the accounts, said the Vestry ought to be congratulated upon having an accountant who had taken so much trouble to dissect the accounts and place almost every item, as far as possible, under the right headings. Perhaps most of the discussion would deal with the allocation of the large surplus, but he hoped that question would be left over for future consideration. It had been said to him that although a large surplus was shown certain matters ought to have been charged to the lighting department. There was a great deal that ought to have been credited to the undertaking which had not been. The enterprise was one of the finest for Shoreditch, and it mattered little whether it was from the lighting station or dust destructor, the fact remained that there was from the ratepayers' point of view a surplus down to the present of £6,463.

Major Wenborn, who seconded the motion, observed that unless the question of allocation was raised he did not see where the opposition would arise.

Mr. Smither asked where the £6,463 surplus was. Tradesmen taking stock and fancying they had so much money would rather have the money in the bank.

Mr. E. Adams (the accountant) referred the speaker to the general balance-sheet, showing, among other matters, stores at £549 and sundry debtors at £4,522, the latter money having now been received.

Mr. H. Winkler remarked that the whole parish had been misled by a statement made in some paper that a profit of £7,000 had been made, and the Vestry had also been misled by an assertion that if the undertaking had belonged to a company the latter would have paid 8 per cent. to the shareholders. That reminded him of certain financiers who manipulated figures and showed such a glorious success that poor people were suffering from their operations to this day. If they turned to the balance-sheet, it was found that the total loss on the refuse destructor for the year was £3,616, and the net profit on the electricity (trading) account was £4,415, and if the former was deducted from the latter the net profit of the two undertakings amounted to £799 for the past year. Let them, then, take the £6,463 mentioned by Mr. Moss as the total profit of the lighting station from the beginning, and compare it with the dust destructor figures as shown in the annual reports for the past two years. The losses on the latter amounted to £8,120, and by deducting the profit of £6,463, the net result was a loss to the parish of £1,657. Where was the glorious success? He hoped before long the loss would be converted into a profit, and that the expenditure in connection with the destructor would be largely reduced. In conclusion, he asked whether Mr. Adams could contradict any of the figures he had quoted.

The Accountant, in reply, stated that that was a correct statement of the figures of the combined undertaking in conjunction with the public lighting account.

Mr. H. E. Kershaw agreed with the last speaker that more profit would be realised if the expenses of the destructor could be diminished. He said that he had prepared a balance-sheet, and a few facts which it was impossible to give in the accounts. The profit of £6,400 was an inflated one, but he denied that there had been a loss of £1,657. With regard to the loss of £3,616 on the destructor, let them add to it the sum of £1,375 as the cost of coal, and then they arrived at the total expenditure for raising steam for various purposes. Out of that £5,000 the sum of £3,215 should be charged to the electric lighting account arrived at on the basis of ¾d. per unit sold; £536 was chargeable to the baths for steam and £100 to the library. Another point was that the scavenging department had saved 1s. per ton over the former cost of barging refuse, or £1,150, and the final result was that on the refuse destructor there was a profit of several pounds on the other side of his balance-sheet. There was an expenditure on electric lighting account, according to the accountant's figures, of £8,938, to which should be added £3,215 for the steam from the destructor, making a total of £12,153. The income from the sale of electricity was £16,417, which with £1,375 for coal made the total of £17,792. By deducting the former total from the latter they arrived at a gross profit of £5,538, which, after providing £2,146 for interest on debt and £916 for repayment of capital, showed an absolute trading account profit of £2,476 on the joint undertaking.

Mr. Adams, who asked permission to criticise the new balance-sheet, said that the figures submitted by Mr. Kershaw were a statement on paper. The facts which he had previously corroborated were taken from the printed accounts.

Mr. Howlett, who expressed the belief that the accountant's figures were perfectly correct, contended that the destructor was the real source of profit of the whole undertaking. It was about to place £1,317 in the Board of Trade return as the cost of coal when they had sold over 1,000,000 units, and he thought that the alleged loss on the destructor should have been charged to the lighting department.

Other members having spoken, Mr. Moss replied to the discussion. The chairman of the Lighting Committee stated that as he had anticipated, the discussion had turned on the allocation of the surplus. Mr. Hodder had said the committee desired to show a profit out of the work of other committees, but the speaker thought the destructor had not been fairly treated by other committees. Mr. Kershaw contended that the refuse was being burned at an economy of 1s. per ton over barging, but he found that as much as £2,100 should be credited to the destructor on that account, and that had not been done. The speaker was convinced that Mr. Winkler's figures were perfectly fallacious. No doubt there had been exaggerations, but the undertaking should not be allowed to suffer for that reason. If they went on in two opposite factions, he felt sure they would never get along at all. In conclusion, Mr. Moss expressed the opinion that the Vestry would have a very fine undertaking of lasting importance to the parish, and also be the means of assisting the rates in the future.

The adoption of the accounts then concluded the proceedings.

CORRESPONDENCE.

Electrical Transmission of Power in Factories.

Even Jove occasionally nods, and I venture, with the greatest deference, to suggest that the editorial mind cannot have been quite awake to the wiles of the "well-known maker" who is cited as an authority on page 582 of your issue of October 13th.

His quotation for a 4 H.P. motor at 300 revolutions per minute is £112; the actual price at which several other "well-known makers" supply this is somewhere in the neighbourhood of £67. Can it be that the well-known maker is among those who have been unsuccessful in the attempt to produce a satisfactory slow speed motor?

I would further suggest that in comparing the cost of a slow speed motor for direct connection, with that of a high speed motor driving the same shaft by belt, you should, to arrive at an accurate comparison, add to the price of the high speed motor the value of slide rails, belt, pulley on line shaft, and foundations (the latter not being usually required for direct connected motor).

You will then find that the cost of the high speed motor—accepting your figure of £43 for the motor itself—is about £50, or, say, £25 per cent. less than that of the slow speed motor.

Experience of large numbers of motors in use for long periods is as yet insufficient to show exactly what difference there is in the repairs required by the two classes, but it is certain, at least, that during the first few years the attention required by the slow speed motor is infinitesimal compared with that which is necessary to keep in good order the brushes, belt and lubrication of its high speed brother.

I have already intruded too far on your space to admit of mentioning more than one point further, namely, that experience of many hundreds of drum-wound motor armatures does not bear out the statement that drum winding is inferior to Gramme winding (both being, of course, in slots). The fact that drum-wound motors are produced by the great majority of manufacturers would seem to show that the principle of the survival of the fittest has asserted itself in this instance, as those of us who can remember the preponderance of Gramme armatures in the early days of motor work will agree.

Thanking you in advance for your kindness in affording space to the above.

Lente.

London, *October 16th.*

The Pneumatic Despatch.

In your issue of the 13th inst. referring to the working of the tube of the old Pneumatic Despatch Company, you quote an "extraordinary statement" that I am reported to have made, to the effect that "the inefficiency of the arrangements was such that no difference could be detected in the work done by the engine, whether the cars were running or not," and you go on to say that it would be interesting to know how I became possessed of the above information.

The actual statement to which you refer was that "the inefficiency of the arrangements was such that little or no difference could be detected in the work done by the engine, whether the cars were running or not," and my authority is a report by Mr. W. H. Barlow, who made a series of experi-

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ments with the express object of ascertaining the conditions under which the pneumatic tube was working, and who had access to the results of experiments made by other observers.

In his report Mr. Barlow writes :—

"The remarkable feature of these experiments is that with the same number of revolutions per minute of the engine and the same pressure, a very large increase made in the load produces a comparatively small decrease in the speed.

"The most striking features exhibited by these experiments are, that whether the tube is closed at both ends (*i.e.*, Euston and G.P.O.), or closed at one end and a carrier inserted and fixed at the other, or whether a train is moving or not, and again whether each tube is put in connection with the fan at the same time, in all these cases there is little variation in the number of strokes required to maintain the given pressures."

Mr. Barlow's explanation of these phenomena was the inefficiency of the fan, and he states his opinion thus :—

"It was evident that so much of the work performed was due to the fan itself, that the difference of operating on one tube alone, or both together, did not produce a large effect on the work done by the engine."

What the conditions were under which, as you assert, the engine power was increased "as required," I must leave those who were present to explain, and to reconcile with the conditions of the experiments from which Mr. Barlow drew his conclusions.

Chas. A. Carus-Wilson.

October 16*th*, 1899.

[The problem stated in Prof. Carus-Wilson's last paragraph is so transparently easy that we can hardly take it seriously. Indeed, the quotations from Mr. Barlow's report themselves furnish the required explanation — with little credit, however, to Mr. Barlow's ability to interpret his experimental results. It is there stated that the engine was driving *a fan*, and that whether the tubes were closed, or a train in motion, the speed varied but little. No other result could be expected. An engine, controlled by a governor, will run at almost constant speed, whether loaded or unloaded; a fan of given construction, running at constant speed, will maintain a nearly constant pressure whether it is blowing into a closed chamber or propelling a train through a tube, but in the former case it will be running *idle*, absorbing but little power; in the latter case it will be running *loaded*, and will call for a corresponding driving power. The work done by the engine can only be judged by means of a transmission dynamometer, or by taking indicator diagrams. Who would dream of taking the speed as a criterion?

Mr. Barlow has apparently confused the action of a fan with that of a reciprocating air-pump—a totally different thing. His experiments, in fact, merely show that the governor of the engine was in good order!

The first quotation we may add is singular, in that "with the same number of revolutions per minute," there was "a small decrease in the speed"! This "remarkable feature" is to us an entirely new phenomenon.—Eds. Elec. Rev.]

"London's Lost Tunnel."

With some of the remarks made by way of Editorial Note in your last issue upon the subject of the old Pneumatic Despatch Tube (which you have seen fit to identify under the above title), I am in sympathy, but with others I am not.

So far as Prof. Carus-Wilson's statements are concerned, I leave that gentleman to defend both them and himself; but with regard to the clamour that has arisen over a journalistic phrase, which, curiously enough, you yourself deem worthy of repetition, though quoted, that agitation was none of my seeking, nor have I ever questioned the fact as I have often heard it said, "every engineer in the country knew of the existence of the tube, and all about it." Possibly they did; but seeing the amount of public interest awakened by the "re-discovery," as it is called, it is a reflective and instructive commentary on their (the engineers') universal lack of enterprise to leave it to me, and those associated with me, to be the pioneers of the tube's re-equipment and re-utilisation electrically. Surely, with such a common knowledge, some one of the multitudinous engineers with electrical qualifications might ere this have turned his information to account, and have forestalled my connection with the project.

The truth, however, again is affirmed of every man's knowledge being no man's knowledge, and hence the fuss now arising. On that score I am content to let your remarks pass.

What I do most strenuously protest against, however, is the quotation of a contemporary's recent "Leaderette" as a caution to investors. This, I contend, was unnecessarily gratuitous, especially as in a recent issue you inserted an article upon the very subject, and must, therefore, have thought something of the scheme.

But your contemporary has been a "little too previous" with his philanthropic advice. Investors are not invited nor sought in the matter at all. We have all the money we want, privately subscribed. Not one word has ever been spoken or implied that the case was otherwise. Consquently, though I passed by the stupid admonition of your contemporary for the value it was worth, I am not disposed to permit its quotation by representative journals, as though warranted by any statement, hint or suggestion that could or would be construed as a financial appeal. Let me make the situation absolutely clear and unequivocal. We want no money beyond that which we possess; and I trust you will give this fact the same prominence as afforded your contemporary's magnanimous care for the "wild cat" speculator.

G. Threlfall.

Single-Phase Motors.

I have to thank Mr. C. E. L. Brown for his letter in your issue of the 13th inst. on the subject of my recent article on the Heyland single-phase motors. I have drawn Mr. Heyland's attention to it, and he will probably give us his views in due course.

Doubtless, in common with most other people, I supposed every detail of these motors to be new, as it is, of course, only possible to form an opinion on such matters based upon machines actually constructed and put on the market. But, after all, the main point is that we can build these Heyland motors in any size, and under guarantee, to start against full load, even for 100 cycle circuits, and can also guarantee the current consumptions. This is a result that has been attained by no one else *anywhere*.

Under these circumstances it would appear to be a waste of time to start a discussion on one feature of an entirely new design.

A. C. Eborall.

October 17*th*, 1899.

The Hastings Accident.

It certainly would appear that Mr. Andrews will have to return to his opinion that the sudden failure of his alternators was due to a break in the exciter shunt; at all events, in the absence of a better explanation, this should not be discarded.

It is not very clearly proved that the extinction was absolutely instantaneous.

For our part, we had an opportunity here of seeing the exciter shunt accidentally broken, and the effect on the lights *was sudden enough for anything*; in fact, it was universally agreed that they went out as if switched off.

I have not the least doubt now that had we repeated the operation as an experiment in cold blood we should have seen that it is as Mr. Andrews says—the lights went out more or less gradually.

As regards the trouble with the circuits, and the machines flashing to earth, I feel sure nearly all this would disappear if a one-to-one transformer were interposed in the public lighting circuit, for I take it that the Hastings arc circuits, like many elsewhere, test the worst, and consequently put a strain on the other circuits, although I do not quite follow the reasoning as to a difference of potential higher than 2,000 volts; this, however, is sufficient.

Geo. Marshall Harriss,
Urban District Electrical Engineer.

Bray, *October* 17*th*, 1899.

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BUSINESS NOTICES, &c.

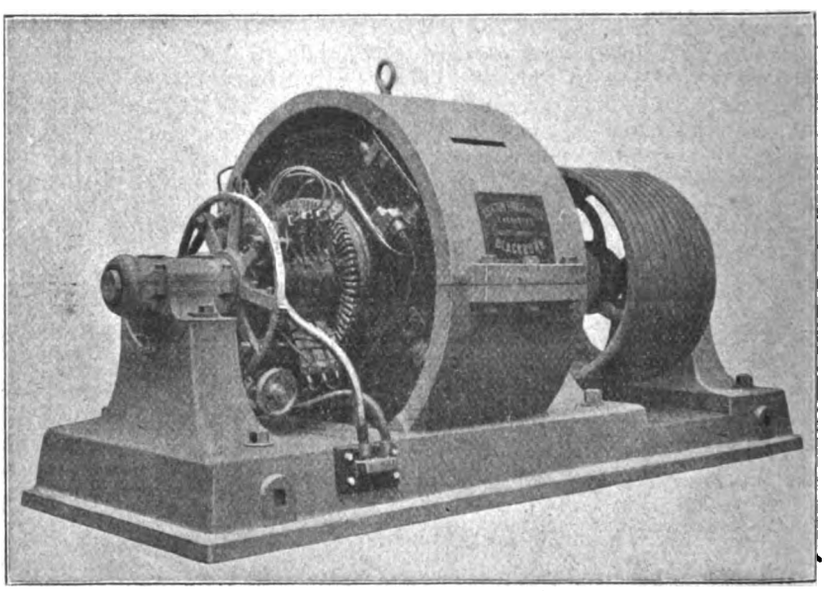
Electrical Wares Exported.

Week ending Oct. 18th, 1899.		Week ending Oct. 17th, 1899.	
Adelaide	Value £5,189	Alexandria	Value £29
Aden	900	Amsterdam	97
Alexandria	72	Bombay	104
Algoa Bay	149	Brussels	18
Amsterdam	97	„ Teleg. mat.	300
Antwerp. Elec. fuse	551	Buenos Ayres	351
Bombay	139	Calcutta	84
Boulogne	57	Cape Town	307
Brisbane	77	„ Teleg. cable	334,000
Buenos Ayres	288	„ Teleg. wire	467
Bushire	3	Christchurch	27
Calcutta	18	Christiania. Teleg. wire	29
Cape Town	670	Colombo	19
Chinde	1,113	Copenhagen. Teleg. wire	10
Copenhagen	45	Durban. Electric light cable and appliances	1,041
Delagoa Bay	235	Fremantle. Teleg. mat.	62
Durban	182	Halifax. Teleg. mat.	6,506
Fremantle	92	Hamburg. Teleg. mat.	250
Ghent	83	Malta	20
Hamburg	400	Melbourne	462
Hong Kong	15	Montreal	15
Kobe	111	Otago	85
Liban	87	Perth	34
Malta	75	Port Elizabeth	110
Melbourne	220	Rotterdam	69
Montreal	40	Shanghai	7
Naples	26	Singapore	100
Port Elizabeth	188	„ Teleg. mat.	179
Rio Janeiro	310	Stockholm. Teleg. mat.	76
„ „ Teleg. mat.	44	Sydney	962
St. Petersburg. Teleph. mat.	40	Townsville. Teleg. wire	375
Shanghai. Teleg. cable	1,157	Vladivostock	31
Stockholm. Teleg. cable	716	Wellington	154
Spezzia	121	„ Teleph. mat.	160
Sydney	678	Yokohama	206
„ Teleg. mat.	590	„ Elec. cable	2,583
Trieste. Teleg. mat.	20		
Wellington	132		
Yokohama	56		
„ Elec. cable	973		
Total	£15,914	Total	£349,266

Foreign Goods Transhipped.

Calcutta	Value £48	Havre. Elec. mach.	Value £120
Halifax	16		
Sydney	50		
Total	£114	Total	£120

New Dynamo.—We illustrate a four-pole 80-KW. dynamo made by Messrs. Ashton, Frost & Co., Limited, of Blackburn. This machine was designed to give 110 volts 720 amperes at 500 revolutions per minute. On its trial test it was run for 7 hours at 110 volts 850 amperes, and the speed was found to be 475 revolutions per minute; the rise in temperature above the surrounding atmosphere was found to be:—Fields, 45° F.; armature, 59° F.; commutator, 10° F.; and the commercial efficiency to be 94 per cent. The angular lead required between no load and 20 per cent. overload was 6°, and at any time 200 amperes could be thrown on or off without sparking and without alteration of lead. The machine has been built for Messrs. Richard Thompson and Sons, Alma and Britannia Mills, Padiham, and we are informed that the above tests were carried out by their consulting engineer, Mr. A. Kelly, of Liverpool. The armature is of the makers' slotted drum type, with a helical lap winding. The holes cast in the bedplate shown in the illustration are for the tightening bolts, the slide rails and screw gear being of Ashton, Frost & Co., Limited, special type, requiring only one lever to be operated for the forward movement of the whole machine. The magnets and yoke are built of cast-steel and arranged with an inch slot through each magnet carried through the yoke parallel to the shaft, a device the makers have found of considerable service in large machines.



New Dynamo.

Bankruptcy Proceedings.—At Liverpool on 12th inst., before Mr. Registrar Cooper, Benjamin Wild and John Henry Clarke, trading as Wild, Rothwell & Co., general and electrical engineers, Atlas Works, Southport, came up for adjourned public examination. Mr. Jones (Brighouse & Jones) appeared for the trustee, and examined Mr. Wild upon various matters, amongst them as to the number of executions that had been put in the firm's premises. He admitted that they were over 50, but he did not think they were 100 in number. Several had been in at one time in May last. He did not remember having, the night before the receiving order was made, said to a Mr. Gregson that he was a £1,000 to the good. He denied having asked Mr. Gregson for a loan of £1,000. He had, however, asked for £40 or £50.—The examination was closed.

The first meeting of creditors in C. F. S. Pilling, electrician, is to be held at 16, Wood Street, Bolton, on October 20th, and the public examination at the Court House, Mawdsley Street, Bolton, on November 7th.

The first meeting and public examination of William Upton, electrician, Bridge Street, Banbury, are arranged for October 20th and 25th respectively, the former at the Official Receiver's office, 1, St. Aldates Street, Oxford, and the latter at the Town Hall, Banbury.

Liquidation Notices.—Creditors of the Superheated Steam Power Company must send their names and the usual particulars to the liquidator (Mr. T. L. Hurry, 8, Queen Anne's Gate, S.W.), by November 13th. A meeting will be held at that address on November 16th to hear an account of the winding up proceedings.

Creditors of the Prism Globe Syndicate must send particulars of debts, &c., to the liquidator, Mr. J. H. Bardsley, 60, King Street, Manchester, by December 1st.

Books Received.—"La Télégraphie Sans Fils," by André Broca. Paris: Gauthier-Villars, 1899. 3 francs 50 cents.

"The British Electric Traction Company in South Staffordshire"; an interesting pamphlet giving maps and notes of the company's schemes. We hope to refer to this at length next week.

Catalogues, &c.—Messrs. Brioschi, Finzi & Co., of Milan, are circulating a list, with letterpress in Italian, in which they illustrate and give a few notes of three-phase generators, high-tension alternators, and motors for electric tramway and other work.

From Mr. G. Braulik, of Upper Thames Street, we have received his latest incandescent lamp list, in which is shown a great variety of lamps of all shapes and sizes and for different voltages. The London standard "Philips" lamps and other types, from 8 to 100 C.P., special patent lampholders for high C.P. lamps, conical lamps (half opal), the patent round, flame, tubular, tramway, and other lamps are among those illustrated and priced in the list.

The Langdon-Davies Electric Motor Company, Limited, send us a revised price list for insertion in their catalogue. It has been considered desirable that motors should be run at lower speeds than their standard pattern motors where small size and highest efficiency are not of so much importance, and the list before us gives prices, &c., of special low speed pattern motors.

Yorkshire College Engineering Society.—The syllabus for the 1899-1900 session is printed, and includes the following items:—

Monday, October 23rd, 1899.—President's address and inaugural paper: "Workshop Training with Technical Education," by Wilson Hartnell, M.I.Mech.E.

Monday, December 18th.—"The Generation, Transformation, and Distribution of Multiphase Alternating Currents for Tram and Railway Work," by G. D. Aspinall Parr, A.M.I.E.E.

Monday, January 29th, 1900.—"Evaporative Condensers," by W. H. Roy (Klein Engineering Company).

Monday, February 12th.—Results of experiments made in the engineering laboratories of the Yorkshire College, by the Students.

Electricity for Newspaper Presses.—The Bullock Electric Manufacturing Company, of Cincinnati, are issuing a new list (September, 1899) of their electric power system for operating newspaper presses. Among the pictures are a type E Bullock motor direct connected to Hoe sextuple press with colour attachment, a motor direct connected to a Cottrell perfecting magazine press at a Berlin factory, and a view of the press room of the Munsey Magazine Company (equipped with Bullock motors). The Bullock method of supplying current to the motor is said to result in efficient control and economy of current consumed, there being no waste of power in regulating the speed of the motor, or heavy draughts upon the source of supply when starting. By means of curves this is shown in the list before us. With the Bullock "Teaser method" the starting current is shown to be but 30 per cent. of the current at full load, an economy which would be impossible with rheostatic control. Steadiness of operation is claimed as an advantage of the Teaser method, as against a tendency toward uneven, jerky movement with rheostatic control, which it requires constant manipulation of the rheostat to overcome. The

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Bullock press controller and switchboard, and E type motor, are illustrated. It appears that the Bullock "Teaser" method is employed in the production of English papers as follows:—The *Manchester Sporting Chronicle*, five Hoe newspaper presses; the *Belfast Evening News*, one "Victory" printing press; London *Daily Mail*, two Hoe newspaper presses; *Nottingham Guardian*, one Hoe newspaper press; *Birmingham Daily Post*, one Hoe newspaper press; *Aberdeen Free Press*, one Hoe newspaper press; *The Scotsman*, four Hoe newspaper presses.

The new premises now in course of erection for the *Scotsman* will contain "Hoe" quadruple and four-reel fast rotary presses together having a capacity of turning out, printed, cut, and folded, 96,000 copies of a 16-page *Scotsman* per hour, or 192,000 copies of an eight-page paper per hour. The 50-H.P. electric motors which will drive these presses have been constructed at Cincinnati, U.S.A., specially for the work.

Messrs. W. & G. Baird, Limited, of Royal Avenue, Belfast, have just added in their new litho-room the latest type of Furnival machine, driven by electric power. The motor was supplied by the Bullock Company.

The Copper Situation.—The *Times* London Market Report of 16th inst. has the following *re* the copper market:—

Prices opened 6s. 3d. lower and receded further, which induced good buying and a recovery of 5s., the movement being helped by a decrease in the Liverpool and Swansea stocks of 2,739 tons, due to further shipments of Chili bars to America, while a leading house took 250 tons in a line at the best price of the morning. American shipments for last week only totalled 1,853 tons, and there were expectations of a favourable statistical return. Sales 900 tons, cash and near dates going at £75 10s., 8s. 9d., 11s. 3d., 10s., and 12s. 6d., and three months at £76, £75 15s., and £76. In the afternoon, on the visible supply showing a substantial decrease, values hardened fully 2s. 6d., with transactions passing at £75 13s 9d. and 15s. for cash, and £76 2s. 6d. for three months. The depreciation on the day is 8s. 9d. per ton. Total turnover 1,300 tons. Settlement price, £75 12s. 6d. Messrs. H. R. Merton & Co., Limited, give the total receipts for the first half of the current month as 8,670 tons, and the deliveries 10,834, making stocks in England and France on the 15th inst. 20,614 tons, against 23,978 tons on September 30th, and 24,877 a month ago. The visible supply now totals 26,164 tons, and compares with 28,328 on September 30th, and 31,527 a month ago. The shipments for the fortnight from Chili were 750 tons.

The last issue of the New York *Electrical World and Engineer* to hand says:—

Copper, as we anticipated, is already a shade lower, and was quoted last week at 18¾ cents for Lake, although even at that price customers apparently did not want any of it for the present. There are so many reports as to possibly cheaper copper, due to new production, people begin to believe them. But as the price falls, the demand will rise, so that a sharp decline can hardly be expected.

Durham College Old Students.—We have received the second annual report of the committee of the Durham College of Science Old Students' Union for the 1898-99 session, together with a list of students.

An Electrical Engineer's Defalcations.—On 12th inst. Herbert H. Hall was charged at the Liverpool City Police Court with having, on September 22nd, stolen the sum of £12 6s. 10d., the property of the Walsall Electrical Engineering Company; also with having, on three days in September, obtained by false pretences the sum of £72 6s. 3d. Prisoner was electrical engineer at the Liverpool branch of the Walsall Company. It appeared from the evidence given that his defalcations, covering several months, amounted to over £500. He was sentenced to six weeks' hard labour on each of four charges, six months in all.

Factory Driving.—Messrs. D. Bruce Peebles & Co. have received the contract for the complete equipment of plant for electric driving and lighting at Messrs. Ogdens' tobacco factory. There will be 360 H.P. in generators, 300 H.P. in motors, switchboard and booster. Messrs. Sloan & Lloyd-Barnes, 34, Castle Street, Liverpool, are the consulting engineers.

Fire. — We are informed that the statements which appeared in the daily press that a large fire occurred at the works of W. T. Henley's Telegraph Works Company, Limited, on 13th inst are misleading. The fire was of so trivial a nature as to cause no inconvenience or interruption to any portion of the business. The services of the public fire engines were not required.

For Sale.—The School Board for London is offering for sale two 32-KW. dynamos, direct coupled to two Parsons' steam dynamos, also switchboard, cable, &c. See "Official Notices" this week.

Infringement. — The Wireless Telegraph and Signal Company notifies in our advertisment pages that proceedings will be taken against those who sell, buy, or use certain instruments which are infringements of the Marconi patents.

National Telephone Company, Limited, v. Bowra.—In the Chancery Division of the High Court of Justice on Wednesday, October 11th, Mr. Justice Darling, sitting as Vacation Judge, had again before him the matter of the National Telephone Company, Limited, *v.* Bowra, which was an application by the plaintiff company for an injunction against the defendant to restrain him from interfering with a telephone pole, stay wires, and appliances connected therewith, on certain premises at Streatham Hill. Defendant appeared in person. Mr. Cassell, who represented the company, said that an interim injunction had been granted on September 22nd, and last week the motion stood over, the injunction being meanwhile continued. Since then the solicitors representing the landlord of the premises had filed an affidavit to the effect that defendant had no longer any interest in the place through non-payment of rent. Defendant denied that such was the case, and claimed that the lease was still in force. His Lordship, after hearing defendant at considerable length, ordered the injunction to be continued pending the hearing of the action.

New Journal.—The interests of the automobile industry are being well looked after in this country, judging from the number of journals which have been brought out during the past few years, since the passing of the 1896 Act. The latest addition to the family is the *Motor Car World*, a 3d. monthly review, of which the first number is now before us. It is crowded with news from all parts, but also has articles on motor car management, steering gear, and reviewing the world's press. An important article, and seemingly a very necessary one, gives advice of what to do when the motor won't work. Messrs. Hay, Nisbet & Co., Limited, of 25, Bouverie Street, E.C., are the publishers.

Rashleigh Phipps v. Ford.—In the Westminster County Court on Friday last his Honour Judge Lumley Smith, Q.C., had before him the case of Rashleigh Phipps & Co. *v.* Ford. This was an action brought to recover the balance of an account of £170 for work done at the house of the defendant in Bolton Street, Piccadilly. The only question was as to an item of £7 for the repair of the ceiling of the dining room. The defendant urged that in the course of the work of fitting the house with electricity, the plaintiffs damaged the ceiling to the amount of £7, and gave him instructions to have the work done. Plaintiffs denied they or their men caused the damage, and they gave no authority for the work to be done. They were, however, willing to pay one half, and had offered to do so.—His Honour, after a hearing, found that no damage was done by the plaintiffs. As they were willing to allow the moiety, and that having been paid into Court, he found against the defendant with costs.

Staff Dinner.—The annual staff dinner of the Electrical Power Storage Company was held on Monday last, at the Holborn Restaurant, when a company of 48 sat down to dinner under the presidency of Mr. J. Irving Courtenay, the chairman of the company, who was supported by Mr. Frederick Green, a director of the company. After dinner, the usual toasts were drunk, interspersed with instrumental and vocal music, several items of the programme being contributed by the members of the staff themselves, and altogether a very pleasant evening was spent. A letter was received from Sir Daniel Cooper, Bart., regretting his inability to be present.

Trade Announcements.—We learn that Mr. Archibald Campbell, of 28, Gray's Inn Road, W.C., has been appointed agent for the old established cable makers of Messrs. G. B. Unsworth and Sons, Limited, of Derby. He holds stocks of cables, flexibles, silk covered wires, and insulating material.

We last week recorded the registration of the Prism Globe Company, Limited, and also the liquidation of the old syndicate. The new company has a much larger capital than the syndicate had, and the reason for the increase is found in the growing business which is anticipated, now that the company has the patent rights for Europe and the Colonies, South Africa, and South America—indeed, for all parts of the world excepting the United States. The cheerful outlook, therefore, has rendered necessary or desirable the putting down of triplicate machinery for manufacturing the company's specialities both here and abroad.

A Zinc Combine.—*Money* has the following comments regarding the rumoured spelter combine:—"The syndicate which touched copper and turned it into gold has been credited for some time past with a desire to form a zinc trust. The difficulties in the way, however, if not insuperable, have been so many, that the whole thing is still in the air. Now comes news that the Continental and American producers, who so far have altogether failed to agree on terms, are getting nearer a settlement, and that we may see zinc controlled by a syndicate after all. So far America is not a very large producer of zinc, and exports have latterly been on a smaller scale. It is known, however, that the industry there has been in the throes of consolidation, but, as the *Financial Times* has pointed out, the Continental producers feel that it would be dangerous to form a Trust which did not include Yankee interests. Of a total output of 460,000 tons, German, Belgian, and American producers could control about 350,000, which would give it a fine grip of the market. With small stocks and low prices to give it a send off, a Trust of these dimensions could easily manipulate the market. It will, however, take a lot of negotiation to arrange the deal."

ELECTRIC LIGHTING NOTES.

Bangor.—The municipal electricity works are expected to be completed about the end of the year.

Basingstoke.—The Town Council has decided to proceed with its application for a provisional order.

Bath.—Colonel A. G. Durnford, Local Government Board inspector, held an inquiry into the application of the Urban Sanitary Authority for power to borrow £26,000 for electric light purposes. Mr. R. Hammond, electrical engineer, explained how the items were composed:—For additional plant, for the laying down of a low tension network, for extension of public and private lighting mains, coal trucks, &c. Mr. Metzger, city electrical engineer, estimated that £82 a year would be saved by purchasing their own coal trucks, and the arrangement with the Great Western Railway for tipping direct into the arches below the line. There was no opposition.

Belfast.—The report of the electrical engineer, Mr. McCowen, to the Electricity Committee shows that the department is making good progress, and the revenue last quarter was 61½ per cent. greater than for the corresponding period last year.

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Bootle.—The price of electricity is to be reduced from 7d. to 5d. per unit for the first hour and 3d. afterwards. The Council will take over the station to-day, 20th inst., on certain conditions.

Bradford.—The City Council has resolved to extend the electricity works at a cost of £10,000. Figures were given at a recent meeting showing the working of the electricity department for the half-year ended June 30th. The total income had been £13,256, as compared with £9,565 for the corresponding period, or an increase of £3,690. The total expenditure had been £11,523, as against £7,907, a difference of £3,616. The profit was £1,733, as against £1,658, an increase of £74 on the last corresponding period. The number of consumers was 965, an increase of 34 per cent. The total profit since the opening of the works was £22,616, the total amount written off being £10,556 for depreciation, leaving £12,059 to be appropriated. The trade profit had been £4 3s. 11d. per cent. on a capital outlay of £180,129, with a net profit of 19s. 3d. per cent.

Carlisle.—The Electric Lighting Committee of the Town Council has accepted tenders for extending the electric lighting plant, at a cost of about £2,000.

Chadderton.—The District Council has decided to instruct the General Purposes Committee to take into consideration the advisability of obtaining an order for electric lighting.

Cheadle.—The District Council has decided to apply to the Board of Trade for a provisional order authorising the Council to supply electricity in the district. It has also resolved to appoint Messrs. Medhurst & Page, of Manchester, engineers to the Council in obtaining the provisional order.

Cleethorpes.—The Electric Lighting Committee recommended the District Council that the township be lit with the electric light, and that Mr. V. Brown, of Lincoln, be appointed electrical expert to the Council, to inspect the district and report. The Committee's recommendations were adopted.

Cork.—The Committee of Management of the Cork District Lunatic Asylum has resolved to light the new buildings with electricity, to be generated by means of a gas engine.

Cresswell.—The Parish Council has decided to adopt the Lighting and Watching Act of 1883, with a view to the electric lighting of the village.

Ealing.—The District Council has resolved to increase the salary of the electrical engineer (Mr. Knight) to £400 per annum, with an annual advance of £50 to £500.

East Ham.—In regard to our "Traction Note" under this heading last week, it seems that what the *Essex Times* describes as a "new and important decision" was given out by Major-General H. D. Crozier, R.E., at the Local Government Board inquiry held last week in reference to an application of the Council for sanction to borrow £41,499 for electric lighting. We print the following account of the discussion which arose between the inspector and the Council's officials, as it may possess a certain interest for municipal engineers in different parts of the country:—

The Surveyor: The doings of the Council are thoroughly well known, and there has been no opposition.

The Clerk: Our proceedings are thoroughly well known, and we have authority from the Board of Trade for these works.

The Inspector: They don't sanction loans.

The Clerk: It is an anomaly having to go to one board for power to establish electric trams, and to another for sanction for a loan.

The Inspector: No, it is not an anomaly at all, because the Board of Trade are looking after the use of electricity and the safety of the public; but the local loans are entirely in the hands of the Local Government Board, and they are responsible to Parliament.

The sanction of the Board of Trade was produced by the clerk.

The Inspector: This is curious. I was not aware of this. There is no particular object in sending this up. I see they have sanctioned two sums. It is the first time I have come across this. It is quite a new thing. It will lead to trouble in the future. Are you going to do this work yourselves?

Mr. Ullman (the electrical engineer): Yes.

The Inspector: How are you going to get the men?

The Surveyor: So far the Council have decided to do without contractors as far as possible. It is not definitely settled. Eventually they may go to the contractors. Up to the present they have decided to do the work without them.

The Inspector: Where are the workmen coming from? Are you going to do it?

The Surveyor: No.

The Inspector: I mean are your men going to do it?

The Surveyor: No. I am relinquishing my post at Christmas.

The Inspector: That is talking personally as surveyor. The Council have decided to do as much as possible without the aid of the contractor, laying of cables, &c. In what way, Mr. Ullman, are you going to do it? Are you going to set up a staff? You cannot do it yourself.

Mr. Ullman: If the Council decide that I shall do it, I shall have to get a staff together.

The Inspector: Are you giving to him a separate staff? Can I say that you will do it by men entirely independent of the Council? That you will not draw upon the Council's workmen? You understand my point, Mr. Clerk?

The Clerk: Yes, I understand your point well enough, but I cannot answer it.

The Inspector: Understand my point. You are going to borrow the money, and you cannot employ any man on your permanent staff under the Public Health Act to do this work on borrowed money.

The Surveyor: I have done it for years. Do you mean to say that that is illegal?

The Inspector: You are not to employ men in the permanent employ of the Council to do this extra work on borrowed money. That is the law. I want to know exactly how you are going to do it, because if the electrical engineer says he will have a separate staff for the work that puts an end to the matter.

The Surveyor: There is nothing to prevent me from putting men in my employ to the work if I think fit. The matter is going to be considered further, and the Council may alter their present intentions.

The Inspector: When work is done out of borrowed money it is not to be carried out by persons in your regular employ. That does not agree with your opinion, but it is the law.

Handsworth.—The District Council has appointed a sub-committee to deal with the question of electric lighting.

Edinburgh.—At a meeting of the Electric Lighting Committee of the Town Council last week a report was submitted by the engineers on the progress of the Dewar Place and M'Donald Road stations. The report states that this time two years ago the number of lamps (equivalent to 8 c.p.) connected in the city was 109,000, and the evening load (continuous current) was 6,080 amperes at 230 volts. By Christmas, 1897, these numbers had increased to 127,000 lamps and 8,770 amperes. Twelve months ago there had been a further increase to 177,000 lamps and 8,403 amperes, and for about three weeks near the end of October last year there was great difficulty in getting up the electric pressure—a difficulty only overcome in November by the erection for temporary use of two large fans and an iron chimney in connection with the boiler flues. With these and with the plant on order, a portion of which was delivered just in time, the station delivered last Christmas as its maximum load (on the continuous side) 11,300 amperes, the number of lamps then connected being 184,000. Of the four large new Sterling boilers one is now at work, the second is nearly ready, and the third is far advanced. There is now, happily, no doubt that all these will be in working order for the winter's load. The temporary fans and chimney have been used during the summer as required. Without them it would have been impossible to set free the main chimney for the purpose of making the connection of the two large permanent fans which are being erected by Heenan & Froude. The present maximum load on the station (continuous current) is 10,700 amperes, or very nearly as much as the Christmas load of last year. There are now connected 245,000 lamps, and the maximum load corresponds to nearly 40 per cent. of these being alight at one time. The increase of lamps since the beginning of the year has been enormous, being at the average rate of over 1,500 per week for the past nine months. By the end of the year the lamps connected will be about 265,000, and the maximum total load will probably reach 17,000 amperes. The supply will in future be delivered from Dewar Place to the west and central parts of the city, as well as such outlying districts as are supplied by alternating current, the bulk of the city, as the demand grows, being supplied from the M'Donald Road station. Strenuous efforts have been made to get the M'Donald Road station ready in time for the winter's load. Seven boilers have been delivered and tested. Two smaller engines, with their dynamos, have been completed, and the first large (1,200 H.P.) steam engine and dynamo, which were fully tested in the makers' works before delivery, were started successfully in the station. Each of the large M'Donald Road machines can supply 3,200 amperes, and each is, therefore, of sufficient power to keep about 24,000 lamps alight at once. The smaller machines are about a fifth of the size of the large ones. With the work in this condition, there is no doubt the two stations will be able to work together for the winter as intended, and there will be ample power for the winter's demands, although the actual number of lamps has increased far faster than even the most sanguine could have anticipated. The report is signed by Prof. Kennedy and Mr. Newington.

Gainsborough.—The District Council has consented to receive a deputation from the Northern Counties Electric Supply Company in connection with a proposed scheme of electric lighting.

Glasgow.—The Machinery and Electric Lighting Committee of the 1901 Exhibition have so far decided to accept combined engines and dynamos from the following firms:—Messrs. Alley & MacLellan, Glasgow; Scott & Mountain, Limited, Newcastle; Mavor & Coulson, Limited, Glasgow; Edison & Swan Co., Limited, Glasgow; Bruce Peebles & Co., Edinburgh; Wm. Sissons and Co., Gloucester; Robey & Co., Limited, Lincoln; Ruston, Proctor & Co., Lincoln. Negotiations are proceeding with others.

Harwich.—The Council has received a cheque for £300 from the English Industrials, Limited, for the transfer of the provisional order to a new company, to be known as the Harwich Electric Lighting and Tramways Company. The Council was recommended by committee to grant leave to the company to lay their electric tramlines along a number of specified thoroughfares. The lines will run to Dovercourt. This part of the scheme was referred to committee for further information as to system, &c.

Hexham.—The District Council has decided to oppose the proposed application of the Northern Counties Electricity Supply Company for a provisional order for lighting the district.

Holborn.—The Holborn Board of Works has received complaints from tradespeople and others in the district that the electric lighting companies are doing injury to their businesses by opening the roads for laying mains, and asking that the companies be compelled, if possible, to continue operations during the night as well as by day, so as to complete them as rapidly as possible. It is thought, however, that the Board has no power of interference. The Works' Committee is inquiring as to the company's power under its Act.

Jarrow.—The proposal to provide the district with electric lighting and power has been remitted to a special Committee of the Town Council. Offers have been received from various companies. It was agreed to call in an expert to advise the Council.

Leigh.—The District Council will commence to supply electricity to consumers in November or December, and will probably decide upon an extension of the original scheme.

Leith.—The Electric Lighting Committee has resolved to reduce the price of electrical energy by 1d. per unit from January 1st next, and in view of the increased demand, to obtain estimates for a new combined engine and dynamo.

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Lewes.—The *London Gazette* of the 17th inst. contains notice of the transfer of the Corporation's electric lighting order (1898) to the County of Sussex Electrical Power Distribution Company.

Loftus.—Representatives of the Northern Counties Electrical Supply Company, Newcastle, waited upon the District Council last Friday with respect to a proposal which that company has placed before the Council, to instal a system of electric lighting in the district. It was agreed that the Council should discuss the question at a special meeting.

Ludlow.—The Electric Lighting Committee of the Town Council has the question of proceeding with an electric lighting scheme for the borough under consideration.

Maidstone.—The District Council has decided to raise a loan of £30,000 to carry out a scheme of electric lighting combined with a dust destructor.

Mr. H. Boot, the electrical engineer at Tunbridge Wells, addressed a meeting here under the auspices of the Maidstone Ratepayers' Association, on 16th inst., on the advantages of municipal electric lighting.

Manchester.—A Local Government Board inquiry was held at Manchester on Tuesday last with reference to an application by the Corporation for power to borrow an additional sum of £22,000 for the purchase of land required for extensions. The following particulars were given showing the commercial success of the electricity undertaking of Manchester, which has been a success almost from the beginning. Work was commenced in August, 1893, and at the end of the first eight months there was a deficit of £209. At that time the charge was 8d. per unit, the maximum amount allowed to be charged under the order of the Board of Trade. At the end of the following year (1895), with the increased number of lamps and plant at the disposal of the Committee, the surplus net profit was £5,709, after paying interest on moneys, transferring an amount to sinking fund, and in addition a sum of £4,000 to renewals account. At the end of 1896, the price having been reduced from 8d. to 6d per unit, there was a net profit of £11,128. An amount was transferred to the renewals account of £3,491, and there was paid to the city fund in aid of rates £6,963. At the end of the following year—1897—the net profits amounted to £16,812, the price remaining the same. A sum of £2,307 was transferred to renewals account, and £10,000 was paid to the city fund. In 1898 the prices were reduced from 6d. to 5d. per unit for short-hour consumers, with reductions to long-hour consumers. The net profits in that year were £13,522, and £10,000 was paid to the city fund. In the year 1899, the prices remaining the same, the Committee made a net profit of £17,188. A sum of £3,344 was transferred to renewals account, and £12,000 was handed over to the city fund in aid of the rates. The financial year ended in March. In March this year there was a balance to renewals and suspense account of £12,794, and to the credit of the reserve fund £23,197, making a total to the credit of the Committee of £35,992. The prices charged by the Committee bore very favourable comparison with prices charged in other cities; indeed, taking the average price upon the whole of the charges, they are the lowest in the kingdom. Mr. C. H. Wordingham, electrical engineer to the Corporation, added that the electrical undertakings of the Corporation had attained very large dimensions, and great developments were about to take place. The present area supplied by the Corporation was, approximately, 16 square miles. They were under obligations very shortly to increase that area to 45 square miles, roughly, and there was a likelihood that that would be considerably augmented. That included not merely the city, but outside districts such as Moss Side, Levenshulme, and Withington. Upwards of 500 men were at the present time employed by the Committee in the laying of mains and the maintenance of those already laid, and that number would have to be added to very shortly.

On Wednesday morning an electric main box explosion occurred in Market Street, lifting the flagstones, &c., in the usual way.

Mexborough.—Colonel A. J. Hepper, R.E., Inspector of the Local Government Board, held an inquiry last week in regard to an application by the District Council for powers to borrow £1,428 for the purchase of land for plant for electric lighting and for other purposes.

Mossley.—The Town Council has appointed a sub-committee to inquire into and report upon the advisability of obtaining Parliamentary powers to supply electricity in the borough, both for lighting and motive power, and either alone or jointly with any neighbouring authority.

Neath.—A private meeting of the Town Council was held on Thursday last week to consider proposals respecting an electric light installation, made by Messrs. Lewis & Fletcher, of Cardiff. After the discussion, during which it was pointed out that the gas undertaking, of which the Corporation are the owners, was yielding excellent results, it was decided to reject the proposals. We trust that the promoters will not be discouraged by such a lame excuse.

Newington.—The Vestry has resolved to instal two additional boilers and a 400-KW. steam dynamo in the electricity works, and to apply to the County Council for a loan of £15,500, repayable in 42 years. Cables are also to be laid in certain side streets.

Perth.—The Police Commissioners last week had under consideration the recommendation of the Electric Lighting Committee to accept offers for the new electricity supply works, recommended by the engineer, Mr. Hawtayne. It was agreed to accept the offers recommended, and Mr. Hawtayne was instructed to issue specifications and take in offers. The meeting also agreed to make payment to Mr. Hawtayne of £500 on account for his services. The offers accepted amount to £22,336 13s. The original estimate for these works by Mr. Hawtayne was £23,350.

Pendleton.—The Salford Corporation proposes to provide an electricity generating station in Strawberry Road, Pendleton. Sanction has already been obtained to the loan of money for the purchase of the site, and the Corporation has applied for permission to borrow £10,000 for the provision of the necessary buildings and meters. An inquiry into the application was made by Mr. G. W. Williams, an inspector of the Local Government Board, at the Town Hall, Bexley Square. It was stated that the present application was especially urgent, as electric power would soon be required for the tramways. The Corporation would shortly ask permission to borrow £72,000 for the electric lighting scheme. The buildings in respect of which the present application was made would be used as a low tension generating station and battery substation.

Fort William.—The Electric Light Company has given notice that on and after November 1st next the charge for current will be at the uniform rate of 6½d. per Board of Trade unit, instead of the differential rates of 9d. and 4½d. at present charged. It is also stipulated that the minimum charge for light per quarter will, in all cases, be 5s.

Portmadoc.—At a special meeting of the Town Council last week, a long discussion took place with reference to the advisability of lighting the town by electricity. The matter was adjourned to the ordinary meeting of the council.

Portslade-by-Sea.—The District Council has set on foot inquiries *re* electric lighting, with a view to applying for a provisional order.

Prestwich.—The District Council has resolved that application be made to the Board of Trade for a provisional order authorising the Council to supply electricity for public and private purposes within the whole of the district, and also for power to construct tramways along Middleton Road, Bury Old Road, and Bury New Road.

Rochester.—At the Corporation meeting on Wednesday last week, the Estates Committee read a letter from the Chatham, &c., Electric Lighting Company, asking the committee to receive a deputation to express their views upon the subject of the application of the Electric Power Distributing Company's application for a provisional order to supply electric current for light, heat, &c., within the city. It was resolved that the town clerk reply that the committee will be pleased to receive a deputation so soon as it is known that the Electric Power Distributing Company intend to proceed with their application.

Ruislip.—The Parish Council is negotiating with the Uxbridge and District Development Syndicate, Limited, with a view to the inclusion of the parish in the area for which electricity supply powers are about to be obtained by the company.

Sale.—At the last meeting of the District Council it was reported that in case the Manchester Corporation came to an arrangement to supply Stretford, they would be willing to supply Sale in bulk at 3d. per unit. The Altrincham Electric Supply, Limited, are willing to connect their cable with School Road, but the price to be charged would be 6d. per unit. It was decided to apply to the Board of Trade for an extension of the time for carrying out the order, explaining the circumstances.

Singapore.—*Indian Engineering* says that the Colonial engineer has reported in favour of lighting Singapore with electricity, on the ground that it is cheaper than gas.

Sittingbourne.—The District Council of Sittingbourne, Kent, is taking steps towards obtaining the necessary powers under the Electric Lighting Acts for the introduction of electric lighting into the town.

Slough.—The District Council last week discussed a motion that application be made to the Board of Trade in the forthcoming session for a provisional order authorising the supply of electricity in the urban district. It having been stated that the Board of Trade has decided to omit from any provisional order granted to a local authority under the Electric Lighting Acts, 1882 to 1890, the power of the local authority to transfer their undertaking, save in exceptional cases, where very special reasons can be shown, it was decided to wait until the waterworks and other schemes are completed before obtaining the order.

Southampton.—The Town Council has resolved to apply to the Local Government Board for leave to borrow £55,000 for electric lighting purposes.

Southport.—Last week the Mayor of Southport, Councillor O. E. Austin, started the new steam alternator at the electricity works, in the presence of a large number of guests. It was stated that the total capacity of the engines at the works is now 2,000 I.H.P., and at the present time connections are being made at the rate of 10,000 8-C.P. lamps per annum. There are 600 consumers, with upwards of 40,000 lamps of 8-C.P. The capital expenditure amounted in March last to £90,000, and more has been incurred since then. The income for last year exceeded £9,350. The profits have advanced to over £2,000 in the last 12 months, after all liabilities had been met. At the same time the price has been reduced from 6·96d., in 1896, to 4·07d. last year, or a diminution of nearly 3d. per unit in three years.

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Stamford.—The Town Council has decided to engage an electrical expert, at a cost not exceeding £25, to assist the Sub-committee of the Electric Lighting Committee to prepare a report on the question of electricity supply. Letters have been received from Messrs. Edmundson's Electricity Corporation, Limited, pointing out that the Board of Trade will no longer permit the transfer of provisional orders, and offering favourable terms of purchase, &c., if the company be permitted to obtain an order.

Street-box Explosions.—Accidents are reported from the Strand, London, and from Carlisle, each of which was due to an explosion of gas which had accumulated in the conduits. The whole of the supply was temporarily interrupted in the latter case, but no personal injuries were sustained at either place.

Trowbridge.—A London company has asked the support of the District Council to a provisional order for electric lighting in the urban district; a meeting of that Council on Monday last decided in favour of any such scheme being carried out by the Council.

Whitechapel.—On Monday last a conference of representatives of the Whitechapel, Limehouse, Mile End, and St. George's, East, district authorities was held at Whitechapel, to discuss the question of electric lighting in connection with the formation of the new municipality. It was resolved that the London County Council be asked to assist them in preventing the County of London and Brush Company from carrying its provisional orders into effect.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—The Tramways Sub-Committee has had under consideration the report by Mr. Dyack, burgh surveyor, and Mr. Bell, electrical engineer, with reference to the extension of the system to Torry, Ferryhill, and the Bathing Station, and the electrical equipment of the existing routes. We have already stated that the total cost is estimated at about £280,000. After discussion, the sub-committee resolved to recommend that the whole of the existing system should be electrically equipped. The estimated cost of this, with the reconstruction of the tracks, is £182,933. Taking up next consideration of the proposed extension to Ferryhill, the sub-committee discussed the matter at some length, there being a good deal of difference of opinion as to the route that should be selected. The estimated cost of this extension is £22,684, and the sub-committee eventually resolved to recommend that it should be carried out, the track to be laid double from Union Street along Crown Street, Ferryhill Terrace, Bon-Accord Street, and Ferryhill Road, and a single line thence along Whinhill Road to the railway bridge. This would afford a service to Duthie Park. With respect to the extension to Torry there was less difference of opinion, and it was decided to recommend that the extension should be proceeded with, the route—a double track—to be *viâ* Market Street. This would, as a matter of fact, form an extension of the Woodside and George Street route, and the whole could then be worked as one section, an economical arrangement in respect that one depôt, one repairing shop, and one set of men would suffice for the entire route from Woodside to Torry. The Ferryhill extension would be practically a separate route, but the Corporation has plenty of ground for the necessary depôt. The estimated cost of the extension to Torry by Market Street is £32,552. There has to be added to the cost of the extensions a proportion of the outlay necessary for new cars, which may be kept at £7,772, making the total expenditure on the works recommended £245,941. The sub-committee will this week consider the question of an extension to the Bathing Station.

Bradford.—At last week's City Council meeting Alderman Cowgill moved the adoption of the minutes of the Tramways Committee, which stated that the Committee had reconsidered the question of the tender of Messrs. V. Demerbe & Co., for the supply of rails for the proposed tramways and light railway on their patent principle. In accordance with instructions, the city surveyor had sent a communication to Messrs. Demerbe and Co., asking them if, in case they obtained the contract for rails, they would undertake to have the rails made in England. In reply, Mr. G. Francken, a representative of the firm, had attended before the Committee, and said that the company were prepared to have the rails rolled in England, provided satisfactory arrangements could be made. If, however, time was of importance, it would not be feasible for the rolling to be done here, as neither of the English firms doing this work would undertake to deliver within any reasonably short period. After considerable discussion, it was resolved that the Council be again recommended to accept Messrs. Demerbe & Co.'s tender for the supply and laying, on the "Demerbe" system, of the proposed tramways to Lidget Green, Whetley Hill, and Thornbury, and the light railway to Stanningley. The Council, by a very narrow majority, has adopted the minutes.

Cambridge.—The Special Tramways Committee has reported to the Council advising the promotion of a Bill to alter and extend the tramways, and to adapt them for mechanical traction as soon as purchased, and other incidental powers. Extensions to Chesterton and Ramsey Town (length, 4 miles 860 yards) are suggested. The length of the existing system is 2 miles 953 yards. The report has been adopted, and Messrs. Kincaid, Waller & Manville are to prepare plans, together with an estimate of the cost of construction and equipment on the overhead electric trolley system.

Canary Islands.—La Société des Tramways Electrique de Teneriffe (Iles Canaries)- et Extensions, is the title of a company which has just been formed in Brussels with a capital of £60,000.

Cardiff.—A deputation from the Cardiff Corporation, including Mr. Harpur, M.I.C.E., borough engineer, has just been to Glasgow to inspect the tramway system.

Cardiganshire.—It is stated that a representative of an electrical firm will shortly visit Cardiganshire to report of the feasibility of connecting Newquay and Llandyssil by means of an electric railway.

Chester.—The Town Council on Wednesday passed a resolution in favour of taking over the undertaking of the tramways company.

Cleckheaton.—The General Purposes Committee has come to the conclusion that it would not be desirable to promote a Bill in Parliament for power to lay down a system of electric tramways in the Spen Valley, under the auspices of the local authorities, but that at the proper time all necessary steps should be taken to secure the insertion in the order for similar powers, which is being sought by the British Electric Traction Company, of clauses for the protection of the interests of Cleckheaton.

Devonport.—The Devonport and District Tramways Company has been absorbed by the British Electric Traction Company. It seems, however, that the old name is to be retained. The company has offered to take a transfer of the powers acquired by the Corporation to construct and work a line to the suburb of St. Budeaux. The Corporation have not yet replied to the offer, but, on the other hand, have decided upon the extension of their proposed lines to Crown Hill, and have in contemplation other developments.

Doncaster.—On 11th inst. at the Board of Trade, Mr. J. F. S. Hopwood, C.B., C.M.G., assistant secretary of the Board of Trade, heard the objections to the amendments proposed by the Great Northern Railway Company to the Light Railways Order of the Corporation of Doncaster.

Dublin.—In the action of Maher *v.* Dublin United Tramways Company last week, an application was made at the Dublin Courts for the case to be remitted for trial before the Recorder. Plaintiff claims damages for injuries sustained through negligence on the part of the defendants' servants. He was run into while leading his horse and coal dray down Mount Bank one day last month. The application was granted.

A tramcar of a novel and picturesque design has just been built by the Dublin United Tramways Company at their works, Inchicore, and is intended for work on the Clontarf line, says a Dublin paper. It is of the vestibule type and affords shelter for both driver and conductor. The platform staircases are enclosed within the vestibules. Access to the roof is made through a "hatchway" above the vestibules. The roof seats are provided with a cover, which will at all times provide a dry seat. This improvement is the invention of a young Dublin citizen.

On 10th inst. the trial trip took place over the new portion of the electric tram line from Kenilworth Square to Ball's Bridge.

The Harold's Cross line was worked by electricity for the first time on Monday. Electric traction was also introduced last week on the Rathmines-to-the-sea line. The work of electrical equipment on the remaining horse car lines is steadily progressing, and the North Quays, Glasnevin, Drumcondra, Sandymount, Palmerston Park, Dolphin's Barn, and Westland Row to Hatch Street lines will be run by electricity on pretty early dates.

Dudley.—On 17th inst. objections were raised at the Board of Trade to the Dudley and District Light Railways Extensions on appeal from the order of the Light Railway Commissioners. The Worcester County Council and the Stourbridge Urban District Council desired certain street widenings to be carried out, but Sir Courtenay Boyle thought, though they might be desirable, they were not a necessity.

Electric Railways.—A *Financial Times* correspondent says that the formation which has just taken place in Berlin under the most favourable auspices possible of the Studien Gesellschaft für Elektrische Schnellbahnen, is a remarkable indication of the determination of the leading German financial institutions, engineering firms, and scientists, not only to advance far beyond the practice of the so-called electric railways in the United States, the electric railways in England, and the somewhat similar projects in Belgium, France, and Italy, but also of their firm intention to ascertain what can be accomplished by means of high speed electric railways for main line and long-distance traffic. To appreciate the force of this statement, it is only necessary to mention that among the formidable and lengthy list of founders and members of the Administrative Council are included such well-known names as the National Bank for Germany, Fred. Krupp, of Essen, the General Electricity Company, of Berlin, and A. Borsig, of Berlin locomotive fame; Siemens and Halske, Dr. Schultz, president of the Imperial Railway Department, Dr. George Siemens and A. Gwinner, directors of the Deutsche Bank, Jacob S. H. Stern, Frankfort-on-the-Maine, and others too numerous to mention. The object of the company is to make experiments with high speed electric railways, in order to determine their financial and technical possibilities to the extent of ascertaining what prospects exist of such main lines yielding interest on an unusually large amount of capital, so as to provide for repayment of principal, and dividends to the shareholders. It is considered that the German railways, as is shown by the increasing use of the lines during the night, have practically reached their full capacity of dealing with traffic,

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and it is thought that electric railways, with trains running at much higher speeds than those now obtaining, as, for example, between the cities of Berlin and Hamburg, would probably meet the growing needs of the present day. It is not intended to deal with secondary or local lines, where the low density of the traffic would produce unfavourable financial results, but with main lines where both goods and passenger traffic would be likely to lead to a satisfactory and encouraging revenue.

Glasgow.—Boiler makers and engineers are again protesting against the height of the trolley wires which they want raised so that there may be a free passage for large boilers and pieces of machinery. The Tramways Committee has arranged to leave the wires at the present height, but has resolved that engineering firms may have the wires temporarily removed early in the morning for the transport of their boilers, &c. This offer does not altogether afford satisfaction.

Gomersal.—There is a suggestion that the Bradford Corporation should extend their system from Dudley Hill to Gomersal, and the British Electric Traction Company, which is now seeking powers to serve the Spen Valley, proposes laying down a branch which will serve the village.

Halifax.—The Mayoress of Halifax on 13th inst. performed the duty of starting two turbines which have been erected at the Corporation electricity works. They are of 400 H.P. each, and have been supplied by Messrs. Parsons, of Newcastle, at a total cost of £7,000. It is intended to use them for the tramway service. The chairman of the Electricity Committee (Alderman Woodhead) stated that the enlarged premises would give accommodation for machinery equal to 25,000 H.P. in place of the existing 2,500 H.P.

Hull.—Last week's total takings on the Anlaby Road and Hessle Road, two of the main thoroughfares which have been completed for tram running by electricity at Hull, constituted a record. During the seven days, the total number of passengers carried reached 323,612, and the receipts were £1,348 7s. 8d.

Lancaster.—The Morecambe District Council on Tuesday considered proposals of the Lancaster Town Council for the acquisition of the joint working of the Lancaster and District Tramway Company's undertaking. A sub-committee was appointed to deal with the matter. The scheme is said to include the contemplated working of the cars by electricity in place of horses.

Liverpool.—On Tuesday evening a somewhat serious accident occurred on the electric tramway lines in Upper Parliament Street. A fully loaded 'bus was about to turn round a corner when an electric car, coming behind, crashed into it and turned it on to its side. The occupants were thrown all of a heap, and it is reported that nine persons were more or less seriously injured. The car itself was forced off the line and turned half round.

The city engineer and other Corporation officials have made a trial trip on, and an inspection of, the Walton electric tramway. The Board of Trade sanction is now being sought. The street works from Spellow Lane to Preston Road have been completed ready for the overhead equipment, and the laying of the lines from that point to Aintree is well advanced.

At last week's Council meeting there was a general discussion as to the new lines which are to be constructed, and most of the lines which had been recommended were approved, but the business not being concluded, the meeting adjourned until Wednesday.

An adjourned special meeting of the City Council as to tramways was held on Wednesday for the following purpose:—

To consider, and, if thought expedient, to approve of powers being included in the provisional order authorised by the Council to be applied for to the Board of Trade for the construction of the following additional tramways, viz.:—Tramway No. 40 Great Howard Street, Oldhall Street, Tithebarn Street, and Exchange Street East. The length of this tramway will be about 660 yards double line and 620 yards single line, or equivalent to a length of 1 mile 180 yards of single line. Tramway No. 45 Water Street: The length of this additional single line will be about 600 yards. Tramway No. 48 Chapel Street, Tithebarn Street, Marylebone, Gardner's Row, and Bevington Hill: The length of the single line will be about 1 mile 90 yards. Tramway No. 44 Fontenoy Street: The length of this proposed single line would be about 550 yards.

London.—It is stated in a daily paper that trains may run on the short electrical section of the Metropolitan underground line at Kensington by the end of the month, and be employed for public service two or three weeks later.

Musselburgh.—The Town Council have been asked by the agents for the promoters of the electric tramway between Musselburgh and Portobello to pass a resolution in favour of the scheme. They state that their terms with the Council would practically be, generally speaking, the same as in the case of the light electric railway scheme. The committee were instructed to inquire as to the terms and report.

Newcastle-on-Tyne.—The City Council has considered a report by the new Tramways Committee as to the arrangements for working the tramways after November 11th (the date of the expiration of the present leases) and during reconstruction. The tramways company will work the service from that date to March 1st next, at the present rental of £4,222 per annum, and from the latter date, when the reconstruction will commence, and during the reconstruction and electrical equipment upon other specified terms. The report has been adopted. The committee recommends that tenders for 100 cars be invited, also for street pillars of an ornamental character, similar to those at Leeds and Liverpool, and a car shed at Byker Hill.

Newport.—The Lighting and Traffic and Electricity Committees have decided to take steps for obtaining the permission of Parliament to adopt electricity as motive power on the Corporation tramways. It was tentatively decided that the new power station should be in Friar's Fields, adjacent to the present central station for lighting purposes; and it was resolved that the joint committee report fully upon the whole question. To this end it was decided to call in the services of Mr. Horace Parshall, the adviser of the Thomson-Houston Company.

North Wales.—The Rhyl and Prestatyn Light Railway Company have issued a Parliamentary notice to the effect that they propose making an alteration of the line of route of the electric railway to be constructed between the East Parade, Rhyl, and Prestatyn. It is calculated that about £60,000 will be spent by the company in the Rhyl district on extensions and constructive works.

Nottingham.—A deputation from Nottingham, consisting of Mr. Arthur Brown, city engineer, and Mr. J. Aldworth, manager of the city tramways, has been in Glasgow inspecting the tramway systems.

Oldham.—The Manchester Carriage Company has asked the Tramways Committee to agree not to run the new tramcars until after the expiration of their lease. The committee disagreed to the proposition, but agreed to do as little damage as possible to the company's lines, and to pay compensation for any damage to rolling stock or loss of traffic. The committee will have a conference with the Electric Lighting Committee regarding the work to be undertaken by each committee in connection with the construction of the tramways. A deputation to Liverpool and Birkenhead, to inspect the various tramcars in operation there, has reported having inspected seven or eight different types and designs of cars. Councillor Spencer remarked that from what was said it was time they were putting the matter in form. Everybody seemed to be busy, and the sooner the committee made up their mind the better. The chairman said that one of the builders stated he had refused an order for 250 cars on account of want of time to make them. The borough surveyor will submit at the next meeting a design of a tramcar.

Plymouth.—The Town Council has decided upon a further extension of the electric tramways. This will open up a developing suburb approached from Hyde Park Lane. This extension is likely to be delayed for a few years by the necessity for certain works of street widening, and the Ratepayers' Association are asking that precedence shall be given to an extension of the lines through the town. It is a significant fact that the extension now asked for was, before the advent of electric traction, opposed and defeated by the Association which now wants it carried out.

Portsmouth.—The Tramway Committee has carefully considered the question of the gauge to be adopted for the tramways in the borough, both in the reconstruction of the existing lines of tramway, and for all extensions that may be carried out, and has come to the conclusion that it would be better to maintain the existing gauge of 4 feet 8½ inches. The Council has adopted a recommendation to this effect.

Portugal.—The *Electrical World and Engineer* says that a representative of the firm of Wernher, Beit & Co., bankers, of London, has just been in New York for the purpose of purchasing apparatus and material for the electric equipment of Portuguese tramways. W. B. Rommel has been appointed chief engineer and general manager of the Carros de Ferro del Lisboa (Lisbon Tramways Company). All the requisite equipment and material will be bought in the United States at a cost of $1,000,000. He has already placed contracts with the Lorain Steel Company, of Lorain, O., for 2,500 tons of rails, which will constitute half what will eventually be required for the Lisbon road. The General Electric Company, of Schenectady, will furnish 75 car equipments, and the J. G. Brill Manufacturing Company, of Philadelphia, will supply 120 car trucks. The question of the cars themselves has not yet been decided, and other portions of the electrical equipment are undecided at the moment.

Preston.—A special committee of the Corporation has presented a special report suggesting that the overhead trolley system be adopted in Preston, and that the tramway system be taken over and worked by them.

Rhondda.—The District Council will oppose the application of the British Electric Traction Company, who contemplate running electric trams in the Rhondda Valley, as they have refused to guarantee that certain roads should be widened and the Cymmer Bridge strengthened.

Rothesay.—The Town Council will, at its next sitting, have before it a resolution to approve of the promotion of a tramway or light railway from Rothesay to Kilchattan Bay, *viâ* Scalpsie Bay, by the British Electric Traction Company, reserving settlement of questions of detail.

Russia.—An electric tramway on the Siemens and Halske system has just been completed and put in operation in the town of Shitomer (Volhynien Government). The power station comprises three boilers and three vertical compound engines, each coupled to a 150 KW. continuous current dynamo.

Sedgley.—The British Electric Traction Company have deposited plans at the District Council offices for the reconstruction of the tramlines between Dudley, Sedgley, and Wolverhampton. More than two-thirds of the line runs through the parish of Sedgley, and the British Electric Traction Company, who have acquired the line, are desirous of altering it and substituting overhead electric traction for steam as soon as possible.

Sheffield.—There was a 40 minutes' breakdown of the electric tramway system on the evening of the 16th inst. It is reported in the *Sheffield Daily Telegraph* that the stoppage was due

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to a temporary deficiency of boiler power. The available plant at the Kelham Island station is taxed to its utmost working capacity. It seems that it was necessary to overhaul one of the three boilers, and but for the unusually heavy traffic on the cars the two boilers would have sufficed. It is said that the steam-power decreased, the fans went slower, and the pressure could not be recovered. Mr. A. L. C. Fell, the city electrical engineer, was at Kelham Island, and about 8 o'clock he deemed it advisable to shut off the current altogether, in order that the boilers might have a fair chance of recovery. The pressure had then got down to about 40 lbs. to the square inch, and although one or two cars might have been kept running the service would have been defective all night. It was unfortunate that the extra call upon the current came when a boiler was undergoing repair, for if that had been available the difficulty would have been overcome in a few minutes. As it was, all the cars suddenly stopped for 40 minutes. By ten minutes to nine a pressure of 140 lbs. to the square inch on the boilers at the station had been obtained, and the current was on again. The laying down of new boilers at Kelham Island has made good progress. Two will be ready for use in about a month.

Southport.—On Tuesday Mr. A. P. Trotter, Board of Trade inspector, held an inquiry at Southport into an application of the Corporation for power to borrow £66,000 for the purpose of providing permanent electric tramways, and their equipment within the borough. Mr. E. S. Harper, deputy town clerk, explained the nature of the application, and suggested the repayment of the loan in a period of 30 years. Mr. C. D. Tait, electrical engineer, stated that they proposed to lay 7,173 yards of single line, and 1,936 yards of double line. The total expenditure for electrical equipment would be £20,364. There would be 15 cars altogether, nine double-deckers, and six single-deckers. Mr. R. P. Hirst produced the plans of construction. When the Corporation acquired the lines of the Birkdale and Southport Company, they would have a circular route. Mr. Harper stated that the estimated cost of the 7,173 lineal yards of single line would be £20,981; the 1,936 yards of double line £12,438 16s.; alterations to roads, footpaths, and drains, £1,800; car sheds and offices, £6,000; contingencies at 10 per cent., £4,416 3s. 6d.; electrical estimate, £20,364; total, £66,000. At the request of Councillor Travis, the inspector promised to present his report to the Board of Trade as soon as possible, so that the work of construction might be begun at the earliest possible moment.

Surbiton.—The Council has been sitting in committee to consider the questions of electric light and tramways.

Swansea.—In view of the opposition of the local authorities, the Light Railways Commissioners will not grant the Swansea Tramways Company's application for an order to carry out certain extensions.

Switzerland.—The United States Consul at Marseilles reports that the Paris, Lyons, and Mediterranean Railway Company, headquarters at 88, Rue St. Lazare, Paris, has undertaken the construction and operation of an electric railway between Fayet and Chamounix, at the foot of Mont Blanc. The line is, says the *Society of Arts Journal*, to be in operation within 20 months, and it is to be presumed that the company will be interested in propositions for machinery and equipment. Power is to be furnished by the River Arve. The cars are to be automobiles, each supplied with its own motor. The contract for building the road proper and providing the water-power has been divided into two parts and awarded to Gagner & Frères, of Annecy, and Richard & Meynard, of Avignon.

Wakefield.—At their meeting last week the Corporation, on the recommendation of the General Purposes Committee, decided to proceed, by way of a private Bill to be introduced in Parliament during the forthcoming session, for powers to construct and operate electric tramways, and at the same meeting appointed Mr. Robert Hammond, M.Inst.C.E. (who laid down the municipal electricity works there), to prepare the plans and estimates and to undertake the customary Parliamentary work in connection therewith. The scheme embodies about 15 miles of tramlines, and embraces the principal outlying districts and neighbouring towns and villages.

Wolverhampton-Bridgnorth.—The promoters of the Wolverhampton and Bridgnorth Light Railway Company have failed to secure the approval of the Light Railway Commissioners, and the scheme must, therefore, fall through. The Earl of Jersey and Colonel Boughey held the necessary inquiry on Thursday last week. The scheme was supported by the municipal authorities of Wolverhampton and Bridgnorth, and by the local authorities of Claverley, Seisdon, Sedgley and Bilston; but it was opposed by the London and North Western and the Great Western Railway Companies, and by the Earl of Dudley. Lord Dudley's opposition did not apparently count for as much as the opposition of the North Western and Great Western Railway Companies, who put forward various objections to the making of connections between the new line and their respective systems. These objections were put so strongly as to lead counsel for the promoters to argue that even without connections, the line would be better than nothing, the district at the present time being practically without any railway communication. The Commisioners, however, thought otherwise, and hence they decided not to recommend the Board of Trade to grant an order. This has caused general regret throughout a wide district, which has for years stood in need of such a railway as that suggested.

TELEGRAPH AND TELEPHONE NOTES.

The American Pacific Cable.—A Washington telegram states that President McKinley has determined to urge upon Congress the necessity for a trans-Pacific cable. The recent naval survey showed that the route selected is perfectly practicable. We are also informed that the next Japanese Diet will be asked to subsidise the cable company which proposes to lay a line across the Pacific from the United States to Japan and the Philippine Islands. This company undertakes to make a 50 per cent. reduction on the present charge for telegrams.

The Anglo-American Telegraph Company and its Rivals.—We make the following extract from a contemporary:—

"Anglo" shareholders are viewing with something like dismay the progress of the German Atlantic cable now under construction by Messrs. Siemens Bros. & Co. When the "Anglo" loses the traffic from Germany, which will probably be within a year from date, it is calculated that the loss in gross traffic receipts may reach £150,000. Of this we may assume that 25 per cent. would be clear profit. Thus the company stands to lose £50,000 per annum by the loss of traffic from one source alone.

As to the accuracy of the figures given above we have no means of judging; but it is inaccurate to hold Messrs. Siemens Bros., & Co. responsible for making the German cable referred to, and which we assume is that about to be laid from Emden to the Azores. This cable is, we understand, to be made by the Telegraph Construction and Maintenance Company, who, in conjunction with the Eastern Telegraph Company, the Brazilian Submarine Telegraph Company, and a German Company, have already laid one cable from Germany to the Azores, touching at Vigo and Lisbon. It appears now that for some reason another cable direct from Emden to the Azores is required.

Germany and Submarine Cables.—The *Westminster Gazette* says that "at the end of the current month the first cable steamer ever built to German order will be launched at Port Glasgow. When she is completed, a new industry will be added to the already numerous industries of the Fatherland. Hitherto, Germany has played practically no part in the work of laying submarine cables. Henceforward, however, she will probably figure conspicuously in this department of human activity. It is proposed to lay a cable which shall connect Emden directly with New York *vid* Vigo, and cable connection with German South-West Africa is also in contemplation. Further, German firms are under contract to lay cables along the coast of the Balkan Peninsula. The *Cologne Gazette* rejoices exceedingly at the prospect of Germany owning her own lines.

Cable Communication Restored.—The Direct Spanish Telegraph Company, Limited, announce that direct cable communication with Spain, *vid* Bilbao, is now restored.

A Hint to the Commission for Inquiring into Communication with Lightships.—We learn that a successful installation of wireless telegraphy has been established on one of the most dangerous parts of the Ushant coast, between lighthouses some 35 miles apart. The preliminary experiments, says a Brest telegram, have been carried out by Lieut. Tissot, of the French Navy, on behalf of the Government, and the installation connects the lighthouse on the Isle of Ushant with the new lighthouse constructed on the Ile Vierge. Many wrecks have occurred in this vicinity, and the establishment of a wireless telegraphy installation at such a dangerous point must prove of the greatest importance to shipping. Other lighthouses on the French side of the Channel are to be connected in the same way. It is authoritatively stated that up to the present time no definite action has been taken by the English authorities in giving effect to any such precautionary measures between lightships and the shore.

Proposed Iceland Cable.—As may perhaps be remembered, writes a correspondent of the *Financial Times*, the Great Northern Telegraph Company has already expressed its readiness to lay a cable between Denmark and Iceland, a connection which has been discussed for a considerable time past. It is estimated that the cost of installation would amount to 10,000,000 kroner, and the company asks for a subsidy for the maintenance of the cable. The Iceland Althing has already agreed to contribute 35,000 kroner yearly for this purpose, whilst the Danish Government has offered an annual subsidy of £54,000 kroner for a period of 20 years. In addition to these both the Russian and German Governments have agreed to subsidise the cable, but England and France, which are said to be the most largely interested in the scheme by reason of the fishing industries near Iceland, have stood aloof from the project altogether. The scheme has now assumed a new phase, it being at present proposed to lay the cable *vid* the Shetland and Faroe Islands to Reikiavik, and to connect the latter by means of land lines with the most important points on the east and north coasts. It is expected that this plan would necessitate an additional expenditure of 500,000 kroner, but the company is willing to adopt it with the omission of Reikiavik and the substitution of an east coast landing place, whereby the length of the submarine cable would be reduced. Though the modification is not approved in Iceland, it is said that the new scheme will probably be carried into effect.

Pacific Cable.—The *Times* says that Mr. Hogan intended yesterday to ask Mr. Chamberlain whether he is in a position to report any effective progress in the negotiations for the construction of the Pacific cable from Canada to Australia, or of the proposed alternative cable from South Africa to Australia.

(*Continued on page 643.*)

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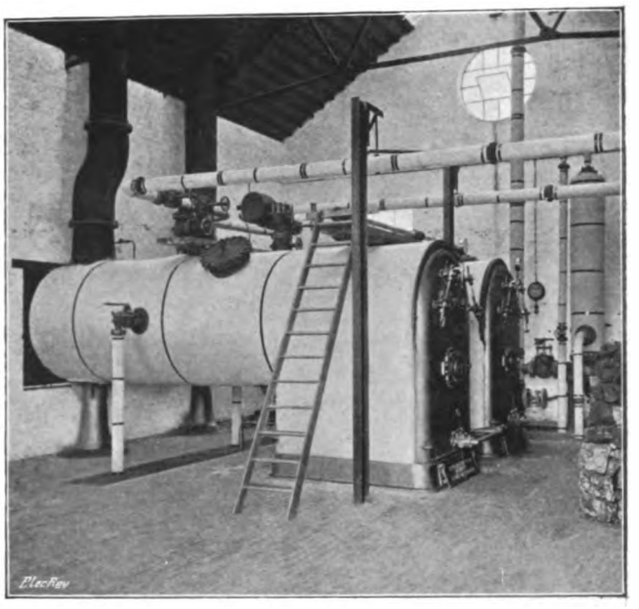
ALDERLEY AND WILMSLOW ELECTRICITY WORKS.

Few of our readers will be acquainted with the district of Alderley Edge; it was formerly known by the name of Chorley. Owing to a town in Lancashire bearing the same name, and to the inconvenience occasioned thereby, the local authority of the district deemed it necessary to change the name, and it was by the consent of the Local Government Board designated "Alderley Edge."

It is a fashionable suburb situated in Cheshire, between Manchester and Crewe, and is readily accessible from either of these towns, the distance from Manchester being about 13½ miles and from Crewe 17 miles. The "Edge" stands some 500 feet above sea-level, and some 300 feet above the surrounding plains, thus affording views of the most pleasing districts of Cheshire.

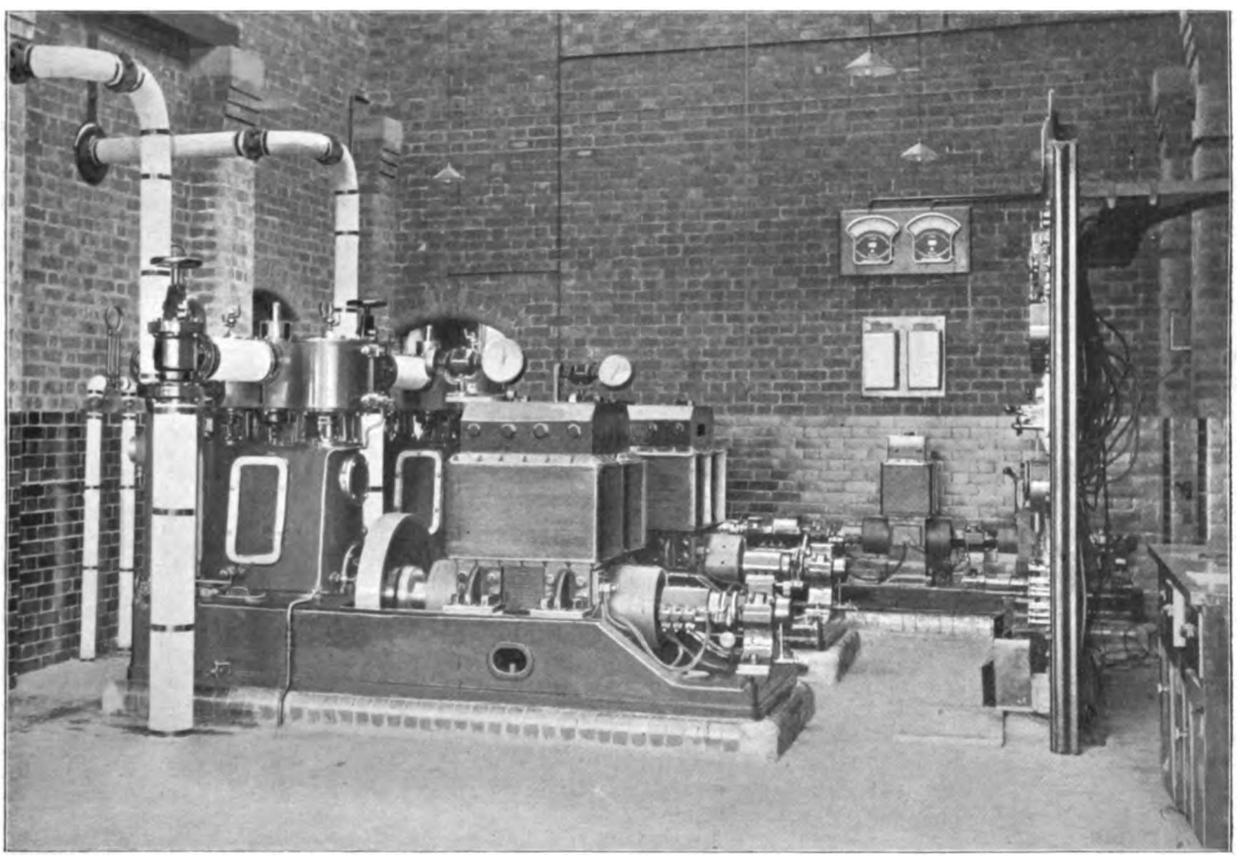
The development of Alderley Edge has been rapid. Since the London and North-Western Railway Company placed the district within easy reach of Manchester and other places, many of the merchants and manufacturers of Manchester have settled there. The business part of the district has also grown considerably, owing to the large increase of residents in the neighbourhood.

The introduction of electric lighting into Alderley Edge so seriously kept back electrical enterprise in the smaller towns and districts in these islands. The Council itself pro-



Boilers.

cured an order, only to transfer it a year later to the same people, who formed a company—the Alderley and Wilmslow



General View of Engine Room.

and Wilmslow was first seriously considered in the year 1889. Nothing, however, was at that time actually done in the matter. In 1894 a proposal was made by a few local gentlemen that an application should be made to the Board of Trade for a provisional order for the supply of electric light to the district, but it was opposed by the Urban District Council, with the same dog-in-the-manger policy which has

Electric Supply, Limited—for the purpose of carrying out the order.

Only a small amount of capital was subscribed when the company first started; they, therefore, placed the contract for the works in the hands of Messrs. Edmundson's Electricity Corporation, who have found practically all the capital for the establishment of the works, and have designed

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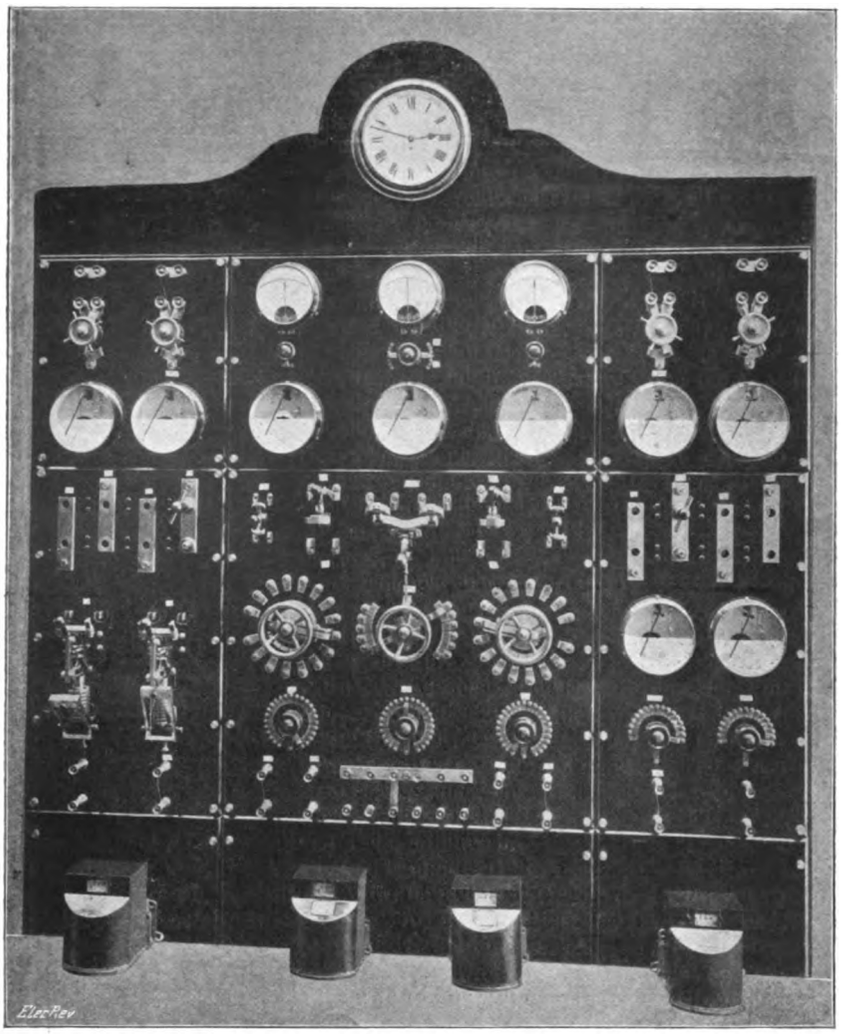
and executed them throughout in their usual simple but substantial manner.



Main Switchboard.

The district is a compact one, but it was not found possible to obtain a site for the works, except at a considerable distance from the centre, entailing a heavy outlay on feeders; the site was otherwise very suitable, there being ample room for extensions, and water for boiler feed purposes, as well as for condensing, if desired.

The buildings, which were erected by a local firm—Messrs. Isaac Massey & Sons, under the supervision of Mr. W. C. Hardisty, of Manchester—are of a neat and handsome appearance, well lighted and finished. As the roofs consist solely of iron, slate, and glass, and the window sashes of iron, the whole of the buildings are fireproof; even the wiring has been done in iron barrel, so that except for the teak moulding round the switchboard and the doors, there is nothing inflammable inside the walls.

The plant at present installed consists of two Davey-Paxman locomotive type multitubular boilers, of which we give an illustration. Each of these has 610 square feet heating surface, and is capable of evaporating 2,500 lbs. per hour. The fireboxes are of steel, and there are 100 tubes of 2¼ inches external diameter in each boiler.

The steam piping consists simply of a connection between each boiler and one engine, with a cross connection to provide against breakdown. Each boiler is provided with a steel chimney 48 feet high, not because these were preferred to a suitable brick chimney, but on account of objections which were raised to the latter.

The rest of the boiler house equipment consists of two Worthington steam pumps and a Wright's feed heater.

The whole of the steam pipes and boilers are covered with Magnesia non-conducting composition, and the flanges are enclosed in special boxes.

The generating sets consist of two Ediswan dynamos of 46 KW. output at 420 to 460 volts, direct coupled to Belliss engines running at 550 revolutions per minute.

The electrical system is the same as that in use in all Messrs. Edmundson's stations, the supply being on the three-wire system, with 210 volts at the lamps; the main dynamos give 420 to 460 volts, a balancer and a battery taking care of the balance of the system, and the cells are charged direct from the bus bars through boosters.

The balancer is composed of two similar machines coupled together, each armature being capable of dealing with 50 amperes at 210 to 230 volts, and the output of each is regulated by a resistance transferred from the shunt winding of one machine to that of the other by a single multiple-point switch.

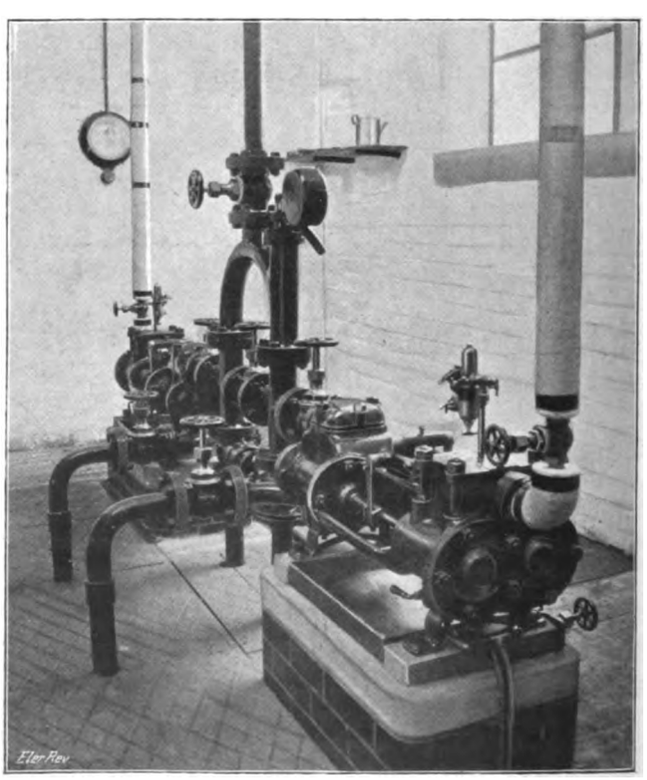
To either end of the balancer are coupled the boosters, each of which is capable of carrying 55 amperes with a boost of 70 volts, a regulating resistance being provided for each field magnet.

An enamelled slate switchboard of Messrs. Edmundson's standard type, composed of three main panels, is placed opposite the present generating sets, and bears the usual switches and fuses for the feeders, dynamos, accumulator, and the starting of the balancing and boosting set. The regulating resistances are placed on the wall at the back of the board, and very ample room has been left for getting at all the connections.

The battery consists of 230 cells of the D.P. type, having a capacity of 60 amperes for nine hours and 90 amperes for four hours.

The whole of the feeders and distributors are of Messrs. Callender's lead-sheathed and steel-armoured type of cable, with extra heavy lead on all sections.

The feeders consist of triple concentric cables; there are at present two feeders



Feed-Water Pumps.

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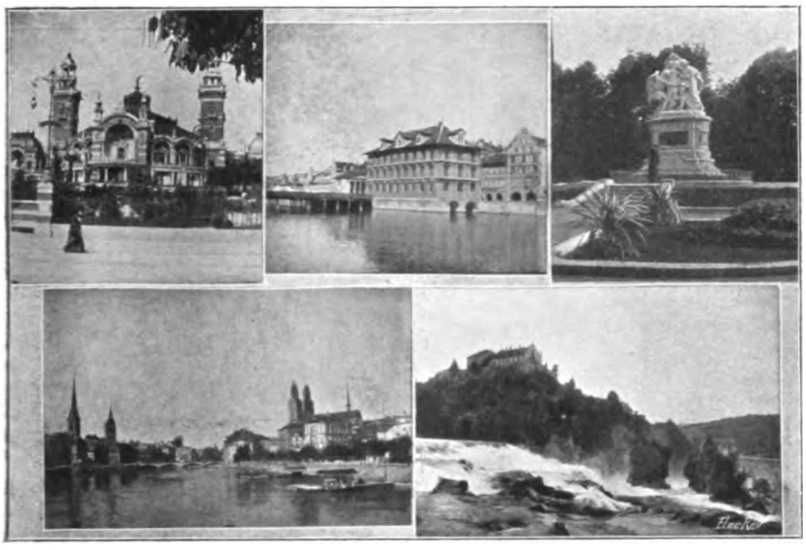
in use, one 1,133 yards in length, of ·1, ·06, ·1 square inch, and the other 1,536 yards long, of ·2, ·1, ·2 square inch cross section.

The distributing network consists of three-core cable, insulated similarly to the feeders, but with the cores laid up side by side instead of concentric. There are about 5,000 yards of ·075, ·05, ·075 square inch laid at present.

Tonhalle, Zürich. Rathaus, Zürich. Group of Statuary, Bâle.



View in Zürich. Schloss Lauffen and Falls of Rhine.

SNAPSHOTS FROM THE SWISS TOUR.

The feeder and network boxes are of Messrs. Callender's standard type, with connecting links, fitted in brick pits under the pavement.

The house services consist of two-core lead-sheathed and armoured cable, connected on the consumer's premises with Reid's patent fuse boxes.

The charges for supply are based on the "maximum demand" system, at the rate of 7d. per unit for the first hour and 4d. afterwards.

The works were formally inaugurated on the 5th inst.

We are indebted to Mr. H. W. Watts, the resident electrical engineer, and Mr. W. E. Rowcliffe, the secretary of the company, for kindly furnishing us with particulars and photographs of the works for the purpose of this article.

THE ELECTRICAL ENGINEERS' SWISS TOUR.

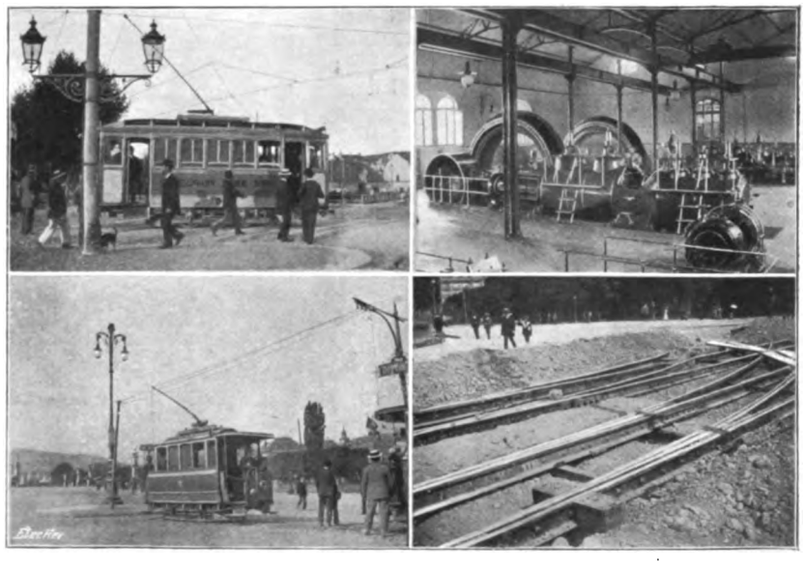
(*Concluded from page* 589.)

WITH this, the last instalment of our narrative, we reproduce a few photographs taken during the excursion—not so much for their artistic merit, as for the purpose of giving some idea, however feeble, of the places and scenes visited by the party. For many of these we are indebted to friends, who have kindly lent us photographs.

An early start was made on Thursday, September 7th; the unwelcome *reveillé* was sounded at 5.30 a.m., and the party embarked on a steamer at 7.15 a.m. After a pleasant, if chilly, voyage up the lake (Lucerne) to Stanstad, the special trains which were to take us up to Engelberg were boarded and the journey resumed. The line is worked on the three-phase system, with two trolley wires; the current is collected by means of a bow, divided into two parts by an insulating piece. With this form of collector the trolley wires need not be strained at all tightly, and the suspending wires, often in duplicate, are quite slack. The difficulty of ensuring that both wires shall make proper contact when rounding curves is met by clamping them to iron bars of a suitable shape. The rails are of light section, with Chicago bonds, and are carried on iron trough sleepers at metre gauge. The supporting poles are of wood; the suspending wire is generally carried through a hole near the top of the pole, and fixed to a small tightening ratchet, forming a very simple arrangement. The rolling stock consists of seven long bogie cars, each carrying two induction motors of 35 H.P. each, with single reduction gear. The speed is regulated by resistance inserted in the rotor circuit. There are also three locomotives for use on a section of the line laid with Riggenbach rack rails, on a gradient of 1 in 4; each of these is fitted with motors of 150 H.P., and three kinds of brake. The gear can be made single or double reduction, as required. There are two collector bows on each locomotive. The ordinary cars are capable of performing the whole journey unaided, but the locomotives are used to assist them over the steep section.

A halt was made at Obermatt to inspect the generating station and locomotives. There are three generators coupled to high pressure horizontal Bell turbines, with centrifugal governors, running at 550 revolutions per minute. Each generator is of 180 H.P., and is of the rotating armature type, with tunnel winding. There are six poles, and the air gap is about ·5 inch in depth. The generators work at 750 volts, which is applied direct to the trolley wire. For the remote end of the line the pressure is transformed up to 5,000 volts, and reduced to 750 at two transformer stations. All the conductors are overhead, those working at the higher pressure being enclosed in a cage of guard wires where they cross railways or public roads. No oil insulators appear to be used in Switzerland, ordinary double-shed porcelain insulators being considered quite satisfactory.

Zürich-Höngg Tramway. Central Station, Zürich.



Zürich Tramways. Track Construction, Zürich.

SNAPSHOTS FROM THE SWISS TOUR.

Besides circuit breakers in circuit with the trolley line, an automatic device is fixed in the station to break the exciter circuits in the event of a heavy short on the line.

The switchboard, as usual, is very simple, with abundant space at the back; this, with all the electrical plant and rolling stock, was made by Messrs. Brown, Boveri & Co.

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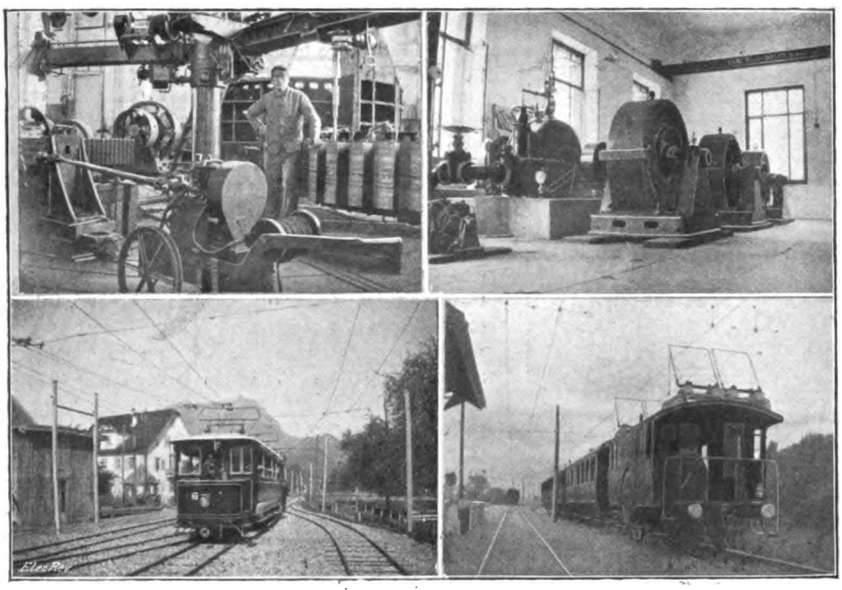
The journey itself was the first of the series of delightful trips which formed the climax of the tour. Commencing on Lake Lucerne, it led us through the Vale of Stans, rich in historical associations, up wooded ravines alternating with open glades—little huts, or *châlets*, planted everywhere—to the pretty town of Engelberg, sheltered by the mighty Titlis!

Radial Drill and Portable Motor, Oerlikon. Power Station at Obermatt.



Stansstad-Engelberg Railway. Burgdorf-Thun Railway.

SNAPSHOTS FROM THE SWISS TOUR.

No lingering, however, was possible. The journey was resumed at 12.45, and ended at 9 p.m. at Interlaken.

A brief halt at Stansstad, waiting for the steamer, gave opportunity for a worthy dame to reap a small fortune by providing refreshments, in a state of frantic excitement lest the chance should be wasted! The steamer soon brought us to Alpnach, under the very flank of Mount Pilatus, where a more protracted delay took place; much interest was shown in the rack railway up the mountain, the first, we believe, ever built in Switzerland. The next section of the route was one of the most charming; it led past Lake Sarnen, over the Brünig Pass, to Brienz, through scenery whose grandeur we do not presume to describe. A large part of this stage was accomplished by means of rack railway; the steam engines on the Swiss lines unfortunately burn briquettes, and emit dense volumes of yellow smoke, which remain, obscuring the landscape long after the cause has disappeared.

The steamboat journey from Brienz to Interlaken took place almost entirely in the dark, which was, however, relieved by lightning flickering about the tops of the mountainous banks of the lake, while rain fell steadily.

Next morning, with our usual energy, we set out at 8 o'clock to visit the Jungfrau Electric Railway. At Lauterbrunnen the power station was visited; here there are one 800-H.P. and two 500-H.P. three-phase generators, coupled direct to Girard horizontal turbines, running at 380 revolutions per minute. The generators are of the inductor type, with heavy rotors, and are insulated from the turbines and from the earth. Although the turbines are fitted with automatic governors, the speed has to be controlled by hand. The generators work at 7,000 volts, at which pressure power is transmitted to the electric railway, 4½ miles distant, and nearly a mile higher in level. The pressure is reduced to 500 volts for the trolley lines, and 120 volts for lighting and for the boring machinery. The water supply is derived from the White Lütschine, at a point 2,500 yards distant, with a head of 130 feet. The conduit consists of steel pipe 6 feet in diameter.

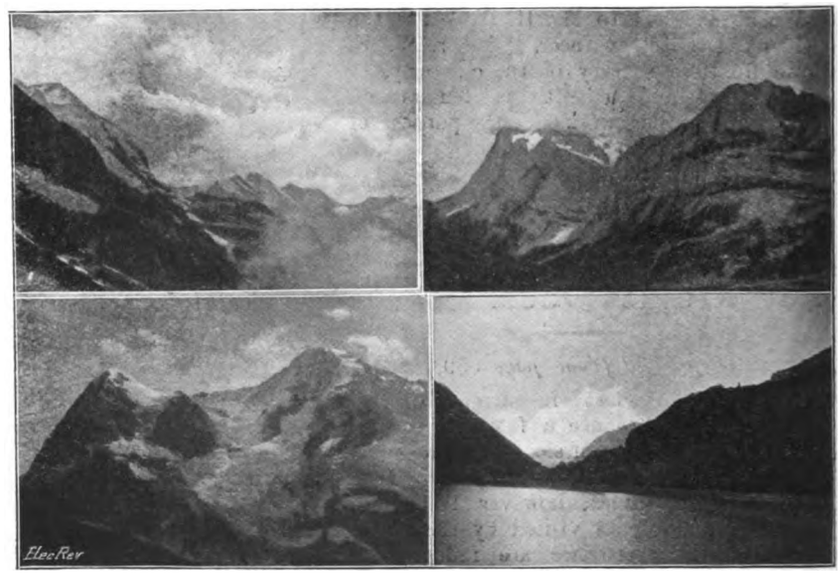
Before leaving Lauterbrunnen the entire party was photographed. The journey to Wengern, the junction of the electric and steam railways, occupied about 1½ hours, and was keenly enjoyed by all. Here the party divided, one half going to lunch, and the other proceeding on the electric railway to the Eiger Glacier, a distance of about two miles. As usual, the overhead work consists of two trolley wires, supported by span wires attached to wooden poles, except in the tunnel. Chicago bonds are used for the rail return. The rack is of a pattern designed by Mr. E. Strub. The gradient is 12 per cent. in the open and 25 per cent. in the tunnel. There are four locomotives, each equipped with two 200-H.P. motors, and four trolley poles, two to each wire; these push the passenger cars before them up the gradient. The later locomotives, one of which we saw in Messrs. Brown's shops, are more powerful by 100 H.P. than those first used.

The transformers consist of three vertical cores joined by horizontal yokes; the low pressure winding is inside the high pressure coils. Standing in a sub-station, one realised that, beyond all doubt, the Swiss engineers had "made things hum!"

Arrived at the working face, the visitors obtained access through a side tunnel to a ledge in the face of a precipice, and looked down upon a magnificent rainbow, while an imposing panorama was spread before them. Most of the party scaled the cliff, and reached the top of the Rothstock, a pinnacle of rock, affording a splendid view on all sides; the Jungfrau proper was, however, hidden by the nearer Eiger. The descent was made over a sloping surface of damp snow, not always in the attitude which man regards as his special attribute!

After inspecting the boring machinery, where percussive electric drills are used striking 400 blows per minute, the first section of the party returned for lunch, while the second section proceeded to follow in their footsteps. Here a difficulty arose, owing to the "personal element;" several of those who, as arranged, should have lunched first, before proceeding to the Eiger Glacier, had elected to reverse this order, with the result that about a score of the legitimate members of the first party found themselves compelled to wait nearly an hour before seats at the table were available. This would have mattered little, had it not been that some

View from Wengern. Wetterhorn from Grindelwald.



The Eiger Glacier. On Lake Lucerne.

SNAPSHOTS FROM THE SWISS TOUR.

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of our Swiss friends who were invited to join in the repast, after waiting some time, went away in despair. The apparent slight thus cast upon them was most regrettable.

The same spirit of insubordination, which is the bane of organised visits of this kind, was manifested on other occasions; for example, some members apparently believed that by stubbornly refusing to come off the drivers' platforms of electric cars or locomotives when the time came for starting they could secure those coveted positions for the journey. Much delay, and, we regret to say, not a little annoyance to the courteous officials, was caused by this unseemly conduct.

The return journey from the Scheidegg was made *vid* Grindelwald, affording a series of magnificent views of the Wetterhorn and the valley of the Black Lütschine.

The morning of Saturday, September 9th, broke somewhat dismally, not only on account of the steady drizzle which was falling, but also because it was the last day of the tour for many of the party. Fortunately the rain ceased before noon.

The first item on this day's programme was a visit to the Kander power station, on the way to Thun. This is a very new station, having been opened last June; it is operated with water-power from the River Kander, and supplies light and power to the towns of Bern and Burgdorf, as well as to the Burgdorf-Thun railway.

The whole river is available, being led through an open canal and a tunnel, each nearly half a mile in length, to a steel pipe 6 feet in diameter. The available head is over 200 feet, and the normal power amounts to 4,500 H.P.

There are four 900-H.P. horizontal reaction turbines, by Escher, Wyss & Co., running at 300 revolutions per minute, and coupled direct to three-phase generators by Brown, Boveri & Co. The latter have rotating field magnets, with tunnel armature, and generate at 4,000 volts pressure, 40 frequency. The exciters are coupled to the generator shafts, and are themselves separately excited by two dynamos driven by turbines.

Automatic governors are to be installed, but at present hand regulation is used, no less than five men being constantly employed in this way.

The power and lighting circuits are kept distinct from one another, the switchboard being specially arranged so as to permit of any generator being thrown on either circuit, and to facilitate repairs without interruption of the supply.

Distribution within a radius of six miles is effected at 4,000 volts; for transmission to greater distances the pressure is raised to 16,000 volts; it is reduced at Bern to 3,000 volts, at Burgdorf to 500 volts, at Münsingen to 4,000 volts, and on the railway to 750 volts. The transformers, of 300 KW. each, are all of the single-phase type, in oil, with water cooling arrangements.

The high pressure lines are carried overhead on porcelain insulators, partly on iron towers, partly on wooden poles. The greatest distance of transmission is nearly 80 miles, and the total weight of copper used is about 100 tons. The whole of the electrical plant, lines, &c., was made by Messrs. Brown, Boveri & Co.

On leaving here the party proceeded to Thun, where lunch was served; afterwards a meeting was held in the Kursaal, this being the last occasion on which all the members would be together. Prof. Threlfall moved a vote of thanks to the President for the gentle, yet firm, and tactful manner in which he had so successfully conducted the tour, and had upheld the dignity of the Institution. Mr. Trotter seconded, and Mr. Raworth having spoken, the motion was carried with great enthusiasm. Prof. Thompson briefly expressed his sincere thanks for the ovation. Mr. Ferranti next moved a vote of thanks to Mr. McMillan, pointing out his untiring energy and skill in organisation, whence he drew happy auguries for the future success of the Institution; the secretary was ably assisted by Mrs. McMillan, who denied herself some excursions for that purpose. Mr. Ferranti also included Mr. Rolph, honorary assistant secretary, who, he said, had been of the greatest assistance.

Mr. Mordey, in seconding the motion, said that Mr. Ferranti knew nothing about it; he (Mr. Mordey) *did* know, and said that Mr. Ferranti was quite right, and was to be congratulated on such good guessing. The President claimed the privilege of joining in the recognition of the enormous amount of work which fell upon the secretary, whose duties were discharged in a manner beyond all praise; the initial suggestion of the trip came from Mr. McMillan himself in committee. The vote was carried with acclamation, followed by choral honours.

Mr. McMillan, in reply, expressed his deep gratitude for the kindness with which he had met, and referred to the untiring assistance he had received from Messrs. Rolph and Tree (the latter of whom had spent many hours overtime), as well as from Mrs. McMillan, who had denied herself sleep for that purpose. Mr. Rolph also replied as well as he could, his voice being, in fact, "used up" with constant answering to questions and shepherding his flock!

The last item consisted of a visit to the Burgdorf-Thun railway, the special characteristic of which is the fact that it is a full-gauge railway, used for some distance in common with steam locomotives, and is operated with three-phase currents. The line is in all 25 miles long, with a maximum gradient of 2·5 per cent.; the rails weigh about 75 lbs. per yard, and are laid on iron sleepers for one-third the length, the rest being wood.

There are two overhead wires, supported by span wires at intervals of 40 yards; these are connected with transformer stations, 14 in number, each of which contains transformers of 150 KW. capacity. There are two electric locomotives, each equipped with two induction motors of 300 H.P., and six bogie motor cars, with motors of 240 H.P., and 66 seats; current is collected by four contact bows, two to each overhead wire.

The speed, which does not exceed 23 miles per hour, is regulated by means of variable resistance inserted in circuit with the rotors. Westinghouse air brakes are used, the pumps being driven by induction motors.

The passenger trains are made up of motor cars and ordinary carriages, the rolling stock being interchangeable with that of the Swiss standard railways. The locomotives are used for goods trains, running at a lower speed. The whole of the electrical plant was made by Messrs. Brown, Boveri & Co.

So like an ordinary railway is this, that the trains blow whistles, and are sometimes—*late!*

Here ended the Swiss tour of the Institution of Electrical Engineers. True, many happy individuals and family parties were able to remain and rest after their exertions, but officially, the tour was over, and the party broke up.

It only remains to express our sincere thanks to the numerous kind friends who assisted us in numberless ways. To them we raise our pen, and cry "Lebe hoch!"

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 638.)

A National Cable System.—The following letter, which was recently addressed to the editor of the *Toronto World*, expresses the views of Sir Sandford Fleming concerning the proposed cable extensions which have recently been so much before the public. Sir Sandford has taken a broad-minded view of the subject, which is in strong contrast to the attitude assumed by the group of cable monopolists who for so long have opposed—ineffectually, we are glad to say—all attempts to serve public convenience by the establishment of a system of cables, which at moderate rates will admit of the ready use of the telegraph throughout our scattered Colonies for social, as well as for business purposes. The letter runs as follows:—

The Lodge, Halifax, *September 26th*, 1899.

Dear Mr. Maclean,—I have the greatest satisfaction in receiving your letter, and on reading the editorial in the *Toronto World* of September 21st, on the subject of a national cable system. The subject is of far more importance than at first sight appears, and I rejoice to know that you have assumed towards it an appreciative attitude. Making telegraphy as cheap as possible, and as free as possible to all classes will not only prove of great public utility in disseminating news for the press, in conferring social advantage, and in promoting the development of trade and commerce, but it will constitute a prime factor in building up, in unifying, and in strengthening our world-encircling Empire.

Less than a year ago I addressed a letter to the Right Hon. Joseph Chamberlain, Secretary of State, on the subject. It appears in the document relating to the Pacific cable, printed last session of the Canadian Parliament. Allow me to refer you to the letter (page 22) in which you will find set forth in brief the history of the land telegraph of the United Kingdom, now an adjunct of the Post Office Department. I pointed out what would result if the same principle of State control, which in that instance has proved such a marvellous success, should be applied to the whole Empire. I think I made it

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clear that it is a matter which concerns every British community to be placed in possession of this means of communicating the one to the other, free from the burden of high charges.

The views expressed were most favourably commented on by the whole British press (see pages 31—32 blue book), and it was easily seen that the key to such a system of State-owned cables as that suggested to encircle the Empire was the establishment of the Pacific cable, the great initiatory link in the chain. The pressure of public opinion which followed gave the Pacific cable a decided impulse, and eventually had the effect of increasing the attitude of the Home Government towards the project. Its enemies are, however, very powerful. The Eastern Extension Telegraph Company, finding themselves at last defeated in the Mother country, are now actively engaged in Australia and are making strenuous efforts to frustrate the scheme. By the last mail I learn that this rich monopoly has made overtures to the Australian Government with the view of estranging them from the proposed State-owned Pacific cable. They have formally submitted a proposal to lay a new cable from England to Australia by way of the Cape of Good Hope without any subsidy or assistance, and they further promise to lower charges on all messages. This proposal is put in the most tempting aspect to Australians, and it will be difficult for them to decline it. My own opinion is that while a cable so laid should not be accepted as a substitute for the Pacific cable, the proposal is of great importance and should not be declined. The Australian Governments should, however, reserve the right to take possession of the new cable at a valuation, so that it would be in their power to bring it under State control.

Should the Eastern Extension Company lay a cable across the Indian Ocean under this condition, good would come out of it. At any future time, by giving notice and making payment of its value, the cable could be transferred from the monopolists to government control. It would then with the Pacific cable constitute a large portion of a complete system of State-owned cables round the empire, it would lead to cheap telegraph transmission from the United Kingdom and Canada to the Cape, India and China, as well as to Australia and New Zealand.

You will gather from these few words how much importance I attach to the subject discussed in the *Toronto World's* editorial. I feel that every effort made to nationalise the telegraph system of the empire is in the right direction, and must tend to beneficial results. —Yours very truly,

SANDFORD FLEMING.

P.S.—I have said nothing about a State cable across the Atlantic. I have confined my remarks to the larger question, which embraces every ocean. Yet the Pacific cable safely under way, the other will quickly follow as a matter of course.

Reduction of Rates to the East.—On the question of the cable rates from India to Europe, the Hong Kong Chamber of Commerce has adopted the following resolutions:—

This Chamber having been asked to accord its support to the effort now being made by Chambers of Commerce in India and other Eastern countries to secure a reduction in the cost of telegrams between the East and Great Britain, is heartily in sympathy with the movement and hereby records the following resolutions: (1) That the rate from India to Great Britain, which is now 4s. per word, is excessive and admits of substantial reduction. (2) That the Chamber is of opinion that a reduction of the tariff would be followed by a sensible increase in the traffic. If there is any hesitation on this account, the Government should, as was done in the case of the Australian Colonies, give the Telegraph Companies a limited guarantee against loss of revenue. (3) That the principle of cheap telegrams should follow the concession of a penny post, as it is certain to prove a powerful factor in promoting trade with the Mother Country; and that, so soon as the time seems ripe, an all-British line should be constructed between the United Kingdom and its great colonies and dependencies either by laying a cable the whole distance, touching only at British ports or by completion of the existing landlines.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Bilbao-Falmouth	... Oct. 12, 1899	... ...
Cayenne-Pinheiro	... Oct. 11, 1899	... ...
Corea-Japan	... Aug. 7, 1899	... ...
Jamaica-Colon	... June 30, 1899	... ...
Latakia-Cyprus	... June 20, 1899	... ...
Trinidad-Demerara (1871 original)	Oct. 11, 1899	... Oct. 13, 1899 (Subject delay.)
Do. do. (1891 duplicate)	Oct. 6, 1899	... ...
Landlines.		
Lines from Haiti to Gonaives, Gros Morne, Port de Paix, Plaisance, Cape Haitien, Port au Prince to Miribalais and Jacmel ...	... Aug. 18, 1899	... ...
Communication with Mafeking	... Oct. 14, 1899	... ...
Puerto Plata-San Domingo	... Aug. 23, 1899	... Oct. 14, 1899
Nicaraguan Government line to Bluefields destroyed ...	... Oct. 6, 1899	... ...
Communication with interior of Venezuela	... Sept. 23, 1899	... ...

London Telephones. — At the last meeting of the Vestry of St. Martin-in-the-Fields, the Postmaster-General forwarded notice, with plan, showing certain streets in the parish in which it is intended to lay new conduits for telephone wires under the powers of the Telegraph Acts, 1892 and 1899. The surveyor was directed to inform His Grace that the Vestry earnestly hoped that the laying of the conduits will be carried out by night, as well as by day, so as to lessen, as much as possible, the inconvenience caused to the public thereby.

At the Strand Board of Works last week, on the question of overhead wires, the Works' Committee recommended that no permission be given to the National Telephone Company to erect wires or spans to infringe the law, but that owing to the inconvenience likely to be caused to the public by the removal of existing wires, it would be advisable to defer further proceedings for three months, for a report as to whether the company are performing their undertaking to proceed with all speed to place wires underground.—The report was adopted.

Rochester Telephones.—Messrs. Bennett and Ward Thomas have asked the Council to support their application for a telephone license, but the Council is not prepared to do so.

CONTRACTS OPEN AND CLOSED.

OPEN.

Accrington.—The Council is to invite tenders for electric light cables shortly.

Barking Town.—October 24th. The District Council wants tenders for boilers, pipe work, two 100-kw. steam dynamos, switchboard, motor and trailer cars, trucks and electrical equipment, overhead equipment, underground feeders, conduits, road work, &c., for the Barking and Beckton light railways. See "Official Notices" September 1st.

Birkenhead.—November 14th. The Corporation wants tenders for 13 single-deck and 31 double-deck electric motor cars, also for boilers, economisers, mechanical stokers, steam dynamos, booster and battery. See "Official Notices" this week.

Coventry.—October 23rd. A Corporation Committee is inviting tenders for wiring St. Mary's Hall for electric lighting. Specifications, &c., from Mr. L. Beard the town clerk, 10 Hay Lane, on payment of one guinea returnable as usual.

Darwen.—October 25th. The Corporation wants tenders for poles and overhead electrical equipment, also main feeder cables, for electric traction. See "Official Notices" October 6th.

Glasgow.—November 14th. The Corporation wants tenders for two 800-h.p. compound vertical auxiliary engines for the new tramway power station at Port Dundas. See "Official Notices" October 13th.

Glasgow.—November 20th. The Electricity Department want offers for 10 miles of 2-inch cast-iron pipes. See "Official Notices" October 13th.

Great Western Railway.—October 23rd. The Great Western Railway directors want tenders for the supply of 12 months' stores including electric light and telegraph sundries. See our "Official Notices" October 6th.

Holland.—October 23rd. Tenders are being invited until the 23rd inst. by the municipal authorities of Amsterdam, for the supply of the conductors and apparatus required in connection with an installation of electric lighting in the Entrepot Communal de Commerce. Tenders to be sent to L'Administration Communale, Amsterdam, whence particulars may be obtained.

Hoylake and West Kirby.—November 15th. The Council is wanting tenders for Lancashire boilers, superheaters, economiser, steam engines, alternators, motor alternator, crane, wiring, steam, &c., piping, switchboards (high and low tension), batteries, transformers, concentric mains, &c., &c. See "Official Notices" October 13th.

Islington.—October 25th. The Vestry wants tenders for a secondary battery of 60 cells (1,000 ampere-hours capacity). See "Official Notices" October 6th.

Llandudno.—November 6th. The Council wants tenders for three 150-kw. high speed engines and dynamos, also motors and boosters. See "Official Notices" to-day.

London.—October 23rd. The Post Office is inviting tenders for Swedish, Norwegian, or Finland red fir telegraph poles, and for creosoting them with 10 or 12 lbs. of creosote to the cubic foot. Particulars, &c., from Mr. C. E. Stuart, controller of stores, G.P.O., London.

Maidstone.—November 6th. The Corporation wants tenders for steam dynamos, balancers, boosters, boilers, economiser, surface condenser and feed pumps, switchboard, &c., battery, crane, mains, arc lamps and posts, and electricity meters. See "Official Notices" this week.

Middlesbrough.—November 22nd. The Electric Lighting Committee wants tenders for condensing plant and pipe-work for the electricity works. See "Official Notices" this week.

Morecambe.—The Urban District Council wants tenders for boiler, steam dynamos, switchboard, transformers, mains, pumps and condensers, and storage batteries for electric lighting extensions. See "Official Notices" October 13th.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

St. Pancras.—The Vestry wants offers for the supply of temporary generating plant for the Regent's Park electricity works. See "Official Notices" this week.

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Spain.—November 7th. The Spanish Ministry of Public Works in Madrid is inviting tenders, until November 7th, for the concession for the construction and operation of an electric tramway in the town of Cadiz. Particulars may be obtained from, and tenders are to be sent to, La Direccion General des Obras Ribleas, Madrid.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

Warsaw.—The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul-General at Warsaw, stating that tenders are invited by the municipality of that city for the construction of freezing chambers and electric lighting in the covered market halls. The latest date by which the tenders have to be sent in has not yet been fixed. Such particulars as have been received may be examined at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

Wigan.—October 25th. The Corporation wants tenders for feeders, mains, water-tube boilers, superheaters, stoneware conduits, steam dynamos, boosters, motor balancers, battery, inspection boxes, &c. See "Official Notices" September 29th.

Wigan.—October 25th. The Corporation wants tenders for cast-iron boxes, frames, &c., (about 30 tons); cast and wrought copper (about three cwt.); brass castings (about one ton). Particulars may be obtained from the borough electrical engineer (Mr. H. Collings Bishop) on payment of one guinea.

Wrexham.—November 8th. The Council wants tenders for boiler house plant, engine house plant, dynamos, switchboard, mains, posts, battery, meters, crane, and buildings for electricity works See "Official Notices" October 13th.

CLOSED.

Carlisle.—The Corporation has placed the contract for switchboard extension with the Electric Construction Company, at £995; that for the steam piping extensions has gone to Messrs. T. Piggott & Co., at £1,028.

Glasgow.—The Electric Tramways Committee have accepted the offer of the Gloucester Carriage and Wagon Company, Limited, to supply 80 bodies for the double-decked electric cars which are being constructed at Coplawhill. The car bodies are to be delivered gradually during the next 12 months.

Glasgow.—The Corporation Tramways Committee, with its usual patriotism, has placed the contract for steel work for the Port Dundas electric power station with Messrs. Ritter, Conley and Co., of Pittsburg, U.S.A. They were the lowest tenderers, the amount quoted being £25,000. It seems that the other offerers were from British firms, who quoted £32,484, £35,085, and £39,650 respectively. We suppose the fact of the matter is, that British steel manufacturers are so up to their eyes in work, that to cut prices would be altogether absurd, especially as quick delivery is presumably a feature of the contract. The same committee recommends the placing of a contract for two sets of electric cranes with the Clayton Manufacturing Company, of Manchester. These matters were to come before the Corporation yesterday (Thursday).

Hackney.—The Hackney Vestry at their meeting last week had under consideration the report of their consulting engineer, Mr. Robert Hammond, on the tenders received for the generating plant required for the municipal electricity works. The following is a list of the tenders received, that of Messrs. J. H. Holmes & Co., of Newcastle-on-Tyne, for £22,735, being accepted:—

Name of firm.	Engine.	Dynamo.	Amount of tender.
			£
British Schuckert Elec. Co., Ltd.	Allen	Schuckert	*18,409
Easton, Anderson & Goolden, Ltd.	E. A. & G.	E. A. & G.	*18,735
Yates & Thom	Yates & Thom	None	19,470
British Schuckert Elec. Co., Ltd.	Willans	Schuckert	*19,532
W. H. Allen Son & Co.	Allen	Schuckert	*19,616
British Schuckert Elec. Co., Ltd.	Allen	Schuckert	*20,200
Do. do. do.	Willans	.. .. ..	*21,324
Dick, Kerr & Co., Ltd.	Willans	Elecl. Equipment Synd.	21,408
J. H. Holmes & Co. (*Accepted*)	2 Belliss 2 Willans	Holmes	22,735
D. Bruce Peebles & Co.	Belliss	Peebles	22,870
Do. do.	Willans	Peebles	22,907
Johnson & Phillips	Allen	J. & P.	23,000
Electric Construction Co., Ltd. ..	Belliss	E. C. Co.	24,968
Read, Holliday & Sons, Ltd. ..	Peache	Read-Holliday	24,000
Electric Construction Co., Ltd. ..	Allen	E. C. Co.	24,320
Westinghouse Electric Co., Ltd. ..	Belliss	Westinghouse	24,729
Do. do. do.	Willans	Do.	25,092
Electric Construction Co , Ltd. ..	Willans	E. C. Co.	25,367
P. R. Jackson & Co., Ltd.	.. ..	.. .. ..	26,595
Brush Electrical Eng. Co., Ltd. ..	Universal	Brush	28,259
Thos. Metcalfe, Ltd.	Metcalfe	Schuckert	30,764
Read, Holliday & Sons, Ltd. ..	Victor Coates	Read-Holliday	31,445
British Schuckert Elec. Co., Ltd.	Musgrave	Schuckert	36,272
Westinghouse Electric Co., Ltd. ..	Musgrave	Westinghouse	41,096

* Conditions of specification not accepted by tenderer.

Hull.—The Guardians of Sculcoates Workhouse have accepted the tenders of Reame, Nokes & Co., Hull and Middlesboro, for the electric lighting and telephone work.

Ilfracombe.—We have just received the following list of the tenders submitted to the Council for electricity works:—

SECTION A.

	£ s. d.
Rowland & Co. (Morrin Climax)	1,796 19 0
Babcock & Wilcox	2,243 0 0
Stirling Boiler Company	2,674 0 0
Haythorn	3,290 0 0

SECTION B.

Electric Construction,	Willans engines	£6,948
" "	Belliss "	6,451
Mather & Platt,	Belliss "	6,331
" "	Willans "	5,981
Willans & Robinson	Own "	5,897
Read-Holliday,	Belliss "	5,877
" "	Willans "	5,643
British Schuckert,	.. ..	5,696
Brush Company,	Raworth "	5,449
Thomson-Houston Company,	Belliss "	5,745
" " "	Willans "	5,461
India-Rubber Company,	.. ..	5,414
Alley & Maclellan,	Own "	5,338
Thomas Parker,	Willans "	4,960
" "	Alley-Maclellan engines	4,762
" "	Reavell engines	4,492
Crompton & Co.,	Willans "	4,860
" "	Peache "	4,620
" "	Allen "	4,550
General Electric Company,	Willans "	4,864
" " "	Alley-Maclellan engines	4,652
Parsons,	Turbine engines	4,607
W. H. Allen & Co.,	Own "	4,598

SECTION C.—SWITCHBOARD.

Electric Construction Company	£925
Thomson-Houston Company	818
General Electric Company	779
Jas. White	674
Thos. Parker	671
Edison-Swan	625
B. Thomas	578
R. E. Crompton & Co.	555
Cowans	525
Veritys	501
Middleton	478

SECTION D.—UNDERGROUND MAINS, ARC LAMPS, &C.

British Insulated Wire Company	£3,823
Glover & Co.	3,292
Western Electric Company	3,018
St. Helens Cable Company	3,010
Callender & Co.	2,781

SECTION F.—ACCUMULATORS.

	Battery.	Maintenance.
Ashmore Brown	£999	£45
Tudor Company	986	75
D.P. Company	917	—
Pritchetts & Gold	844	40
Chloride Company	695	85
E.P.S.	668	56
Hart Battery Company	584	28

SECTION G.—CRANE.

Higginbottom	£175
Rogers	147
Spencer	140
Carrick & Ritchie	135

Perth.—A slight slip seems to have occurred in our announcement of the Parth accepted tenders. Messrs. D. Bruce Peebles & Co., have received the complete contract for steam dynamos, motor generators, balancer and booster at £6,110.

FORTHCOMING EVENTS.

Monday, October 23rd.—Yorkshire College Engineering Society, Leeds. President's address and inaugural paper on "Workshop Training with Technical Education," by Wilson Hartnell, M.I.M.E.

Friday, October 27th.—At 5 p.m. Physical Society meeting at the rooms of the Chemical Society, Burlington House. Agenda:—"The Magnetic Properties of the Alloys of Iron and Aluminium," by Dr. S. W. Richardson. Exhibition of a model illustrating a number of the actions in the flow of an electric current, by Mr. G. L. Addenbrooke. Repetition of some experiments with the Wehnelt interrupter devised by Prof. Lecher, by Mr. W. Watson.

Saturday, October 28th.—Manchester Association of Engineers. Mr. J. S. Raworth on "Generation and Electrical Distribution of Motive Power."

NOTES.

The Electro-Harmonic Society.—For the concert of Friday evening next a very good programme has been arranged. The "Anglo-Saxon" singers have been engaged, Mr. George Nelson will play on the "glassophone," Mr Gatehouse will perform on the "wee sinfu feedle," Messrs. George Robins and George Schneider will present humorous sketches, and, as usual, Mr. Izard will preside at the pianoforte.

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Obituary.—P. B. Elwell.—Our special correspondent at Sydney, writing on September 12th, informs us with very great regret of the death of Mr. Paul Bedford Elwell, M.I.C.E., M.I.E.E., &c., electrical engineer to the New South Wales Government Railway Department. "Some three years ago," he writes, "Mr. Elwell had an illness which necessitated amputation of the leg, and after the operation the doctors said that if there was no sign of the disease in the system within three years he might reasonably hope to be entirely free for the remainder of his life. Unfortunately in January last, just when the three years had expired, Mr. Elwell was struck by the motor of a steam tram as he was crossing the line in Phillip Street on his way to his office, and was hurled some distance. The tram was coming out of the yard at a faster pace than usual, and ordinarily there would have been plenty of time for even Mr. Elwell, hampered as he was, to have got out of the way. The blow brought on the old trouble, and though he was able to continue his official work up to within a few days ago, and up to the last couple of months to attend at the office, since then the growth of the disease has been so rapid that he succumbed on Sunday, September 10th, sincerely regretted by all who had come in contact with him. Mr. Elwell's death is a great loss not only to the electrical community but to New South Wales, and especially to Sydney, as it is almost entirely due to his efforts that electric traction is the order of the day in New South Wales. He always took a great interest in the Electrical Association of New South Wales, and was one of the early presidents, and has been for many years an active member of the Council of that body, besides contributing several interesting and valuable papers. His last paper, read on May 5th last, 'On the Utilisation of Electric Energy from Intermittent Sources,' brought forth one of the most interesting discussions in the annals of the Association. Mr. Elwell instituted many important improvements in the working of the signalling system on the railways, the earlier portion of his engagement with the Railway Commissioners being devoted to department of his work; latterly the greater part of his time has been absorbed in dealing with electric traction, and so successfully has he dealt with the question, that though the development has been slow, it has been certain; all new lines constructed here in recent years are worked electrically, and it has culminated in the decision of the Railway Commissioners to convert the whole of the existing tram lines to the electric system, and the inauguration of the fine power house now in course of construction at Ultimo, the design of which Mr. Elwell is, of course, mainly responsible for. Mr. Elwell's death is perhaps the more to be regretted, inasmuch as a few days more will see the completion of the first part of this grand work, and the opening of the long-looked for George Street tramway line as, though it has not yet been opened for traffic, September, 18th has been set down for the commencement of the official running; but there still seems to be some doubt as to whether everything will be completed and tested by that time. The overhead conductors, of fig. 8 section, are in place, feeders drawn into the Callender conduit, switchboard in position, and engines and dynamos erected and steam connected, and one of the engines has been under steam and run up to speed. It is intended to run all the North Sydney lines from the power house at Ultimo, and for this purpose a pair of steel-taped Callender cables, 61/18, have been laid in the harbour from Dawes Point to Milson's Point to act as a feeder in duplicate, though the Callender conduit is not yet completed to Dawes Point. The conversion of the Milson's Point line is practically completed, and will be ready for running as soon as power is available from Ultimo; it is intended to use the harbour water for the return circuit, experiments in this direction having been carried out for some time past by the Railway Department. The permanent way has been practically relaid, new sleepers having been laid between Milson's Point and Ridge Street, the present terminus of the cable tram. A trial run was made recently, and as it was made at night, after the ordinary traffic had been stopped, five incandescent lamps were arranged at the end of the trolley pole, in order that the overhead arrangements might be inspected, especially the behaviour of the trolley when passing curves, &c.; power was obtained from the generators at present running the Mosman and Willoughby tram service."

H. Y. Castner.—The death has just occurred in New York State of Mr. Hamilton Y. Castner, of Castner-Kellner celebrity. It is about 12 years since Mr. Castner came over from his native land to work his patent process for manufacturing alkali—metal sodium. His process for the manufacture of aluminium was the means of reducing the price of that metal to what was then a remarkably low figure. One of his schemes, which proved perfectly successful, was the production of sodium on a large scale, but, as the *Times* remarks, perhaps a more important work accomplished by Mr. Castner was the establishment on a manufacturing scale of a process for the electrolytic production of alkali and bleaching powder from common salt. This discovery of a practical and economic method of applying electricity to the decomposition of common salt is of the highest commercial importance, and Castner's process bids fair to eclipse altogether the purely chemical reactions by which hitherto these two products, so essential to the well-being of modern society, have been obtained. It is interesting to note that these two great improvements in industrial chemistry have been carried out by the genius of an American citizen, working in England and supported by the help of English capital, and by the co-operation and advice of English business men and men of science.

J. Tough.—We regret to announce the death of Mr. J. Tough, A.I.E.E., at the early age of 48. He was not, perhaps, so well known to employers as to the employed, as his energies were mostly expended within the factory walls of quite a number of contractors. Commencing as a working mechanic, he was in those days one of the best specimens of his class, and for hard work, indomitable energy, good nature, and fair dealing between master and man he had few equals. By his own industry he raised himself to very good positions, and we feel that his death leaves a distinct gap in the ranks of the few men who have the interests of their employers as well as their own at heart. In the pioneer days of electric lighting Mr. Tough was engaged with the Maxim-Weston Company; latterly he has been in the employ of Messrs. Gwynne & Co., of Brook Street, Holborn. Mr. Tough was a man of sterling character, and to his widow and children we offer our sincere sympathy in their distress.

Vice-Admiral Colomb.—By the death of Vice-Admiral Colomb, at the age of 68 years, we have lost far too soon one of our greatest naval authorities. His experience in the service dates back to 1846, and in 1886 the age limit compelled his retirement from actual office, although he has subsequently rendered valuable assistance in dealing with important matters connected with naval work and life. He will be remembered by those of our readers whose memory carries them back to the early days of the electrical industry as a partner of the late Colonel Sir Francis Bolton, who was one of the founders of the Institution of Electrical Engineers.

The Safety of Electric Motors.—We quote the following interesting editorial note from the New York *Electrical Review*:—"What a holding up of the hands in horror there would have been 10 years ago if anybody had suggested electric motors as the prime movers of a powder mill! Yet the art of constructing these machines has advanced so far that the induction motor is to-day considered the safest power machine for such uses. The equipment of the new powder factory of the United States Navy Department is of interest in showing the feeling of safety that has been engendered by the perfection of the electrical transmission and distribution of power. The induction motor has been said to be 'as simple as a grindstone.' Likewise it is as sparkless as a water-wheel, and in a dangerous place like a powder factory, as safe as a block of ice."

Lectures.—At the meeting of the Birmingham Sunday Lecture Society on 15th inst., Councillor Lancaster gave an address, illustrated by lantern slides and experiments, entitled "One Hundred Years of Electrical Discovery." Mr. A. C. Osler presided.

Prof. S. P. Thompson commences a course of six lectures on "Polyphase Machinery" on Monday evening, October 30th, at the Finsbury Technical College. For particulars see our "Official Notices."

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A Forty-Mile Aluminium Wire Transmission Line.—A short illustrated paper read by Mr. Perrine before the Pacific Coast Electric Transmission Association, on tests and calculations of the 40-mile aluminium wire two-phase transmission line of the Standard Electric Company, of California, from the Blue Lakes power house to the Stockton sub-station, is printed in the *Journal of Electricity* and abstracted in the *Electrical World* Digest. The line was designed to deliver 1,000 KW. at 8·8 per cent. loss. The wire is 294 mils in diameter, weighs 4,194 lbs. per mile, and the ultimate tensile strength is 1,539 lbs., or 22,700 lbs. per square inch; the stress at 1 per cent. elongation is 800 lbs.; the conductivity by dimensions is 59·9 per cent. of Matthiesen's standard for soft copper. No elastic limit is given, as it is not well defined in aluminium. The wire was strung in warm weather and had been subjected to extreme cold, but the measurement of the whole resistance of the line showed that it had not stretched. The resistance was found to be 92 ohms, which corresponds to 42·8 miles. Tests were made of the insulation and the condition of the wire during extremely bad weather. The insulation of one wire from earth was found to vary from 160,000 ohms on a rainy day to 44 megohms on a clear day. On one day, during a shower, the line varied in a couple of hours from 5 or 6 megohms down to ¼ megohm, but under no conditions fell below 160,000 ohms. An interesting effect of the self-induction and capacity was observed, namely, that it overcompounds the step-up transformers. The step-up ratio is 2,300 to 25,000 and the step-down ratio 23,000 to 2,200 with a possible range of 200 volts in the regulator, but when current was put on the line without any load, the voltage rose completely beyond the range of the regulator, which seemed impossible with 25,000 volts initial; the voltage at the step-down station showed 27,000 on the line. There is a rise of potential at the end of the line due to the capacity, but it is only 200 volts, and a rise of over 2,000 was observed, which was entirely due to the transformers. A calculation from the constants of the transformers accounts for all but 200 volts of the rise, and an error in calculating the angle of lead in the transformer may account for this. This effect is explained by simple diagrams.—In the discussion which followed, Mr. Lee gave some further information as to aluminium and described a very simple joint. It is merely a flattened aluminium tube, the two wires being laid side by side and twisted up in the same way as in the McIntire joint. Mr. Cory gave the results of some mechanical tests made in the laboratories of the University of California. Joints were tested which had been made by the linemen on the Stockton line. It was found in every case that the line itself gave way before the joint, showing that at least with joints made recently, the strength is greater than that of the wire. This wire had not been strung, so that it had not been subjected to any mechanical strain or continued vibration.

Appointments Vacant.—The Stockton-on-Tees Corporation wants a resident electrical engineer for the electricity works at £250 per annum.

The Manchester Tramways Committee wants an electrical engineer to assist in the erection of the overhead electrical equipment of the tramways. See "Official Notices" this week.

The Bury Electric Lighting Committee wants an assistant distributing engineer and a meter inspector. See "Official Notices."

The Manchester Corporation wants a steam assistant, a mechanical assistant, and a mains engineer for the electricity supply department. See "Official Notices."

The Hastings Corporation wants an assistant electrical engineer at £120 a year. See "Official Notices."

The Wakefield Council wants a city electrical engineer at £250 a year.

The Blackpool and Fleetwood Tramroad Company wants an engineer-in-charge. See our "Official Notices."

University College, Liverpool.—The Governors of the University College, Liverpool, have received a cheque from Mrs. George Holt and her daughter, Miss Emma Holt, for £5,000 each, to be devoted to the purposes of the physical laboratory.

Central Station on Wheels.—The Eastern Railway Company, of France, is utilising what *L'Industrie Electrique* calls a central station on wheels for repairing the Torcenay tunnel. It is mounted on a railway truck, says our New York namesake in an abstract, and includes a petroleum engine driving a dynamo, which furnishes current both for propelling the truck by means of a motor and for lighting the works in the tunnel. This little central station suffices for four to six arc lamps, or 20 to 40 incandescent lamps, and it has been found of great service in tunnels and for night work. Our Paris contemporary also states that in Germany trials are being made with an ambulance carriage built on similar lines. It is provided with a 5-H P. petroleum engine, with sufficient fuel to run 15 hours, driving a 63-volt 40-ampere dynamo, and is furnished with a powerful projector.

Magnalium.—This is the name of a new alloy of aluminium and magnesium, discovered by Dr. L. Mach, which is said to possess valuable properties. The addition of magnesium in quantity not exceeding 30, and not less than 10, parts by weight to 100 parts by weight of aluminium, imparts to the latter metal properties which, in the pure condition, it does not possess, without raising its specific gravity (2 64), on the contrary, slightly lowering it, since the specific gravity of magnesium (1·74) is even less than that of aluminium. The addition of magnesium produces an alloy which is harder, and is easier and cleaner to work than pure aluminium. Turning produces a surface as bright as a mirror, and shining like silver, the metal coming off in long spiral turnings. The alloy files clean and regular, without tearing, or choking the file, as aluminium does. Deep and sharp screw threads can be cut on it, and very clean holes can be bored out. The colour of the metal resembles silver more than aluminium, and it takes a high polish. The hardness and strength of the alloy are considerable; the hardness can be varied by varying the proportions of aluminium. An addition of heavy metals is not only unnecessary, but is positively injurious, since this deteriorates its working properties, and increases its specific gravity. Previous attempts to make useful alloys of aluminium and magnesium are said to have failed, owing to the aluminium not being pure. This point is of great importance, and aluminium made by an electrolytic process must be used.

The Dowson Gas Station at Oerlikon.—There is at Oerlikon, for the electrical driving of a tramway, a station in which there is a 200-H.P. gas generator, and two of 100 H P., with three boilers of 200 H P. The generators burn Belgium anthracite from Liege. The gas is washed, and scrubbed through coke and sawdust. Three engines of 125 H P. drive each a four-pole 550-volt generator at 180 revolutions in combination with 280 Tudor cells in parallel with the dynamos, the regulator cells being charged by a motor-generator, and on the switchboard is an automatic cell switch to regulate the pressure. The apparatus comprises two heavy solenoids. The coal per effective horse-power is stated to be 1·4 lb. Each tram runs 100 miles daily, the line being five miles long, with 20 cars, of which only 10, as a rule, are running. The trolley wires are 8 mm. copper, suspended from span wires carried by Mannesmann steel tubes, or fastened to brackets and single poles. The feeders are placed between the rails and connected to the overhead system every 200 metres. Plastic rail bonds are employed. Each car carries two 25-H.P. motors, geared 1·45, and running at 450 revolutions per minute, with series parallel controllers. Speed is limited to 15 miles per hour.

Personal.—Mr. W. D. W. Lyons, who has just retired from the Finance Department of the Board of Trade, will continue to carry on his duties as Board of Trade auditor of the accounts of electric lighting companies.

Mr. J. W. London, for many years manager of the Douglas Southern Electric Railway Company, has left the island to take up the managership of the Norwich Electric Tramway Company.

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Use for Gas Engine Waste Heat.—Mr. O. F. Allan points out in the *Gas Engine* that gas engineers reject from 20 to 50 per cent. of the heat supplied to them by allowing it to pass off with the water of the jacket. This is so far an unavoidable loss as regards the engine, but it need not be all loss. He suggests that by means of a thermometer in the outlet of the jacket, the best temperature for each engine might be found approximately and adhered to. But even at the best there is still much waste heat, and he suggests it might often be used in the shape of hot water for the domestic supply. It may be used in radiators to warm houses, in public buildings for the same purpose, and so on. In manufacturing establishments economy is secured. Thus at the dye works of Mr. Porrit, of, we believe, Cleckheaton, a Thwaite producer plant supplies gas for the motive power engine, and no avoidable waste is permitted. The jacket water goes to the dye vats, and is thus entirely used, and the total fuel consumption has become a negligible quantity, as compared with the previous coal consumption with boiler and steam engine. Yet gas engines driven by producer gas are as yet comparatively scarce, and millions are thrown away annually in waste gas, and waste heat of all descriptions, for lack of the means or spirit to utilise them. We think that many schemes for utilising waste heat might be inaugurated, were it not for the inevitable opposition of the local authority possessing streets to be crossed. A whole London square, for example, with a central garden could easily be supplied with heat, water, and electric light and power from a comparatively small station. Such an installation would be capable of being exploited at a minimum of waste, yet no one attempts to do it, perhaps because the scheme is so palpably sound that the ordinary suspicious landlord company thinks there must be some knavery at the back of what he cannot criticise. It is supposed to be sound practice to locate a supply station out of town. Yet this view is only sound so long as the waste of 90 per cent. of the fuel-heat is looked on as justifiable simply because it is not convertible into power, as though there were no call for hot water. Half the labour of ordinary housekeeping in these days of impossible domestics would be solved by a public supply of hot water and the use of electricity for cooking, or even gas, which cannot as a rule afford a cheap source of heat for heating large quantities of water for baths, &c.

Army Reserve Men.—The Chloride Electrical Storage Syndicate, Limited, in whose service a number of army reserve men are employed, have resolved that for a period of three months half pay should be paid weekly to the wives and families of army reserve men in the syndicate's employ called on to rejoin the forces during the present crisis, and employment assured the men on their return.

Is Brilliant Public Speaking any Criterion of Engineering Ability?—Several members of the Institution party to Switzerland expressed surprise at the brevity of the speech which Mr. C. E. L. Brown read at the luncheon in the Ton Halle, Zürich. In England, and especially in electrical circles, we are, perhaps, too much given to judging a man's abilities by the sort of speech he can make. Mr. Brown's speech simply showed that he was what he professed to be, a *practical* electrical engineer. There are many such in this country amongst the young men who have been quietly doing the work of our electrical engineering companies during the last few years. They only want encouragement and opportunities to raise our profession into the front rank. The sort of language that one is accustomed to use by long contact with the staff and workmen of an engineering factory will hardly pass muster in a public meeting, and this is the reason why a man who can explain a drawing or piece of apparatus to a foreman in a few telling sentences, will have considerable difficulty in expressing himself in a public hall. Will the members of the Institution therefore please remember during the coming session that the man with the provincial accent or halting speech may have useful practical information to impart. Jokes and quibbles on word endings, &c., are all very well, but that sort of thing does not carry us much "forrader."

Proposed Assembly of Scientists at Paris in 1900.—The British Association for the Advancement of Science has followed up the fraternising of English and French scientists at Dover by setting on foot a scheme for an international meeting, or assembly, in connection with the 1900 Paris Exhibition. With this object in view a general and advisory committee, consisting of members of the B.A., the French Association, and of other representatives of pure and allied science, education, art, &c., is to be formed for the purpose of promoting the arrangements. Profs. Mavor and Geddes are the acting secretaries, and Mr. T. R. Marr the assistant secretary. The offices are 5, Old Queen Street, Westminster, S.W., and 95, Boulevard St. Michel, Paris.

Appointment.—The Bootle Town Council has appointed Mr. W. R. Wright, of Burnley, as its borough electrical engineer.

Presentation.—Mr. P. B. Steele, manager of the electrical department of Messrs. Shirras, Laing & Co., Limited, Aberdeen, was, on the occasion of his departure from the firm's service, presented with a handsome silver salver.

NEW COMPANIES REGISTERED.

Hiram S. Maxim Automobile Syndicate, Limited (63,846).—This company was registered on October 13th, with a capital of £25,000 in £1 shares, to adopt an agreement with H. S. Maxim and J. de Meray, to acquire certain inventions by Hiram S. Maxim relating to motor carriages and other vehicles, and to carry on the business of motor car, motor cycle, and bicycle manufacturers, engineers, suppliers of electricity and other motive power, and manufacturers of electrical apparatus and machinery of all kinds. The subscribers are:—J. de Meray, 1, Rutland Gate, Hyde Park, 2,000 shares; M. Lachman, Bickenhall Mansions, W., engineer, 2,000 shares; H. W. Rydon, Winchester House, E.C., solicitor, 1 share; A. Grove, J.P., 11, Hans Road, S.W., 2,000 shares; A. C. M. Innes, 22, Ryder Street, S.W., gentleman, 1,000 shares; M. E. Williams, Winchester House, E.C., solicitor, 1,000 shares; The Maxim Electrical Engineering Company, Limited (W. J. Wheatley, secretary and manager), 1,000 shares; and H. S. Maxim, 18, Queen's Gate Place, S.W., civil engineer, 1,000 shares. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; remuneration, 10 per cent. of the net profits divisible.

West of England Electric Installation Company, Limited (63,813).—This company was registered on October 9th, with a capital of £25,000 in £5 shares, to adopt an agreement with the mayor, aldermen, and burgesses of the City of Bristol, and to carry on the business of electricians, electrical and mechanical engineers, fitters, manufacturers of electrical plant, apparatus and machinery, &c. The first subscribers (each with one share) are:—H. C. Hill, Carlton Chambers, Bristol, accountant; E. Davey, Glenfall Lodge, Redland, iron merchant; G. S. Lysaght, Dorset House, Clifton, iron master; F. W. Ball, 3, Unity Street, Bristol, electrical engineer; H. W. Ball, 3, Unity Street, Bristol, electrical engineer; E. S. Stevens, 22, Southfield Road, Cotham, Bristol, electrical engineer; and F. Holman, 44, Queen Charlotte Street, Bristol, corn broker. Registered without articles of association.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

West London and Provincial Electric Supply Company, Limited (62,097).—This company's statutory return was filed on October 11th, when 39,728 preference and 15,365 ordinary shares were taken up out of a nominal capital of £150,000 in 80,000 preference and 70,000 ordinary shares of £1 each. 12s. 6d. has been called up on each of 32,228 preference and 7,805 ordinary. £23,833 2s. 6d. has been received, and £1,187 10s. remains unpaid. 15,000 shares are considered as fully paid.

Barcelona Tramways Company, Limited.—This company's annual return was filed on September 27th, when 26,000 shares were taken up out of a capital of £300,000 in 30,000 shares of £10 each; £260,000 has been received.

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CITY NOTES.

Chester Corporation Electricity Accounts.
Public lighting and private supply.

The Chester Corporation is one of those municipal bodies which entered upon electricity supply with some hesitancy, and therefore the accounts for the first of the two years summarised below cannot be detailed under the heading of "costs." The revenue account under "to generation of electricity," contains only one engineering item, owing to the station being farmed out to contractors.

"A. 5. To other items (to be specified).
Contractors for supply of electrical energy from Dec. 20th, 1896, to March 25th, 1898, as per contract £3,188 1s. 5d."

It will be noticed that the gross profit has risen from £3,358 in the total under our heading 1897, to £4,658 in 1898, being an increase of no less than £1,300, against a difference in gross revenue of a much smaller sum, namely, £857, and this notwithstanding a drop in the average price per unit sold of nearly ¾d. It is unnecessary to dwell upon this at length, but like all other cases where timidity or natural caution has led to the farming-out principle being adopted (as an example one at once calls Croydon to mind), the Corporation finds that it can do better with the works in its own hands. This is a lesson which may not be without value to those municipalities which are considering how a start should be made.

General Statement.

	1897.	1898.	Increase.
Total capital expenditure ...	£46,790	£54,772	£7,982
Number of units sold	355,957	473,656	117,699
Total maximum demand... ...	266 kw.	350 kw.	84 kw.
Gross revenue	£6,808	£7,665	£857
Gross profit	£3,358	£4,658	£1,300
Average price per unit sold ...	4·50d.	3·77d.	—·73d.

The revenue statement shows that the meter rents per unit sold remained unaltered, but a slight increase is due to a small item appearing in last year's account for "supply of lamps":—

Revenue Statement.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current	£6,680	4·50d.	£7,438	3·77d.	—·73d.
Meter rents	128	·09d.	183	·09d.	...
Supply of lamps	...	...	44	·02d.	+·02d.
Sundry	...	...	...	...	...
Gross revenue ...	£6,808	4·59d.	£7,665	3·88d.	—·71d.

The public lighting at the beginning of the period under review comprises 85 arc lamps. The present number is 116, and 120 incandescents are also in use. The units generated, &c., may be stated thus:—

	Public lamps.	Private supply.	Total sold.	Used on works.	Total generated.
1897 ...	103,311	252,646	355,957	65,522	470,524
1898 ...	147,077	326,579	473,656	71,999	575,131

For the reasons indicated above, the comparison of costs cannot be made on a very definite basis, but attention may be drawn to the low values of the items. Coal at ·3d; oil, waste, &c., at less than ·1d., and wages at less than ¼d., with a total cost of just over 1d. per unit show an extremely creditable state of things.

Costs of Production.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal and other fuel	...	...	£598	·80d.	...
Oil, waste, water and engine room stores.	...	...	163	·09d.	...
Salaries and wages incurred in generation and distribution.	...	...	875	·44d.	...
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	...	...	370	·19d.	...
Works' cost ...	£3,188	2·15d.*	£2,006	1·02d.*	—·80d.*
Rent, rates, and taxes ..	125	·08d.	83	·04d.	—·04d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	...	...	654	·33d.*	...
General establishment charges, stationery and printing, law charges and insurance.	137	·09d.	264	·13d.	+·04d.
Other expenses	...	...	...	...	...
Total costs ...	£3,450	2·32d.	£3,007	1·52d.	—·80d.

* Works' cost, plus management, salaries, taken together in each case in estimating the "increase" (= 2·15d. — 1·35d. = ·80d.).

The profit last year was sufficient to carry over £1,000 to preliminary expenses, while over £800 was put to reserve fund.

Profit Statement.

	1897.	1898.
Interest on loans	£1,612	£1,442
Sinking fund for repayments	732	1,317
Net profit, carried to preliminary expenses	514	1,053
" " reserve fund	500	846
Gross profit	£3,358	£4,658

Brazilian Submarine Telegraph Company.

The directors' report for the half-year ended June 30th, 1899, to be submitted to the general meeting on October 25th at Winchester House at 12 o'clock, reads:—"The directors submit the annexed accounts and balance-sheet for the half-year ended June 30th, 1899. The revenue for this period amounted to £119,360 12s. 2d., and the working expenses to £21,999 3s. 4d. After providing £3,200 5s. for debenture interest and sinking fund, and £1,725 18s. 6d. for income-tax, there remains a balance of £92,435 5s. 4d.; to this is added the sum of £15,801 9s. 4d. brought forward from December 31st last, making a total of £108,236 14s. 8d. Further expenses in connection with closer working union with the Western and Brazilian Telegraph Company, Limited, and the London Platino-Brazilian Telegraph Company, Limited, £635 9s. 5d., and a quarterly interim dividend, amounting to £30,898 19s., have been paid, and £20,000 transferred to the reserve fund. The directors now recommend the declaration of a final dividend of 3s. per share, making, with the interim dividends, a total dividend of 6 per cent. for the year, and also the payment of a bonus of 2s. per share, both free of income-tax, which, together, will amount to £51,639 10s., leaving a balance of £5,062 16s. 3d. to be carried forward. The dividend and bonus will be payable on the 26th inst. Shareholders in the Western and Brazilian Telegraph Company, Limited, have sold to this company about 95 per cent. of the share capital of the former company, steps are being taken to acquire the remaining interest. Notice of an extraordinary general meeting is sent herewith. The auditors, Messrs. Deloitte, Dever, Griffiths & Co., and Messrs. Gane, Jackson, Jeffreys & Wells, offer themselves for re-election."

At the close of this meeting, an extraordinary general meeting will be held to pass certain resolutions approving agreements, issuing certain capital, altering an article of association, and changing the name of the company to the Western Telegraph Company, Limited.

The Western and Brazilian Telegraph Company, Limited.

The directors' report, to be presented at the general meeting to be held at Winchester House on Tuesday, October 24th at 12 o'clock noon, reads:—

"The directors submit their report and the accounts of the company for the half-year ended June 30th, 1899. The total earnings amount to £66,494 8s. 8d., as against £72,692 13s. 10d., showing a decrease of £6,198 5s. 2d. compared with the half-year to June 30th, 1898. The working expenses amount to £45,730 8s., as against £43,179 1s. during the preceding half-year. Including the amount brought forward from December 31st, 1898, and the dividend receivable upon the shares held in the 'Platino' Company, and after providing for income-tax, the balance to the credit of the revenue account is £30,001 3s., from which has been deducted £8,020 2s. 4d. for interest on debentures and debenture stock, and £1,079 10s. has been placed to debenture stock redemption fund, leaving a balance of £20,901 10s. 8d. The directors now recommend the payment of 4s. per share, free of income-tax, for the half-year on the ordinary shares, leaving a balance of £1,421 18s. 8d. to be carried forward. In the case of shares which have been divided into 'preferred' and 'deferred,' the 4s. per share now recommended will be payable, viz., 3s. 9d. per share to the 'preferred' shareholders, and 3d. to the 'deferred' shareholders. The shareholders in this company, representing about 95 per cent. of the capital, having exchanged their shares for shares in the Brazilian Submarine Telegraph Company, Limited, it is now proposed to liquidate the Western and Brazilian Telegraph Company. Notice of an extraordinary general meeting to be held for this purpose is sent herewith. The dividend warrants will be posted on 24th inst."

At the close of the ordinary meeting, an extraordinary general meeting will be held to pass resolutions approving an agreement with the Brazilian Submarine Telegraph Company, winding up voluntarily, and appointing Mr. W. H. Axworthy liquidator.

The Cuba Submarine Telegraph Company, Limited.

The directors' report for the half-year ending June 30th, 1899, to be presented at the general meeting of shareholders on October 25th, at 12 o'clock noon, at 58, Old Broad Street, E.C., reads:—"The directors beg to submit, duly audited, the balance-sheet and accounts for the half-year ended June 30th last. From these it will be seen that the total receipts amount to £25,027 2s. 8d., and the gross expenditure to £7,257 2s. 10d., leaving a sum of £17,769 19s. 10d., which, added to the balance of £4,212 7s. 8d. brought from the last account, leaves £21,982 7s. 6d. at the credit of the revenue account. The traffic receipts show a decrease of £8,738 12s. 10d. as compared with the corresponding period of last year, when they were abnormally large, owing to the Spanish-American war. The

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sum of £8,000 has been added to the reserve fund, which now stands at £128,000. The dividend on the preference shares will absorb £3,000, and leave £10,982 7s. 6d., out of which the directors recommend the payment of a dividend at the rate of 6 per cent. per annum, and a bonus of 2s. per share, on the ordinary shares, both free of income-tax, the balance, £4,582 7s. 6d., being carried forward to the current half-year. The cables continued in good working order until the beginning of the current half-year, when the Cienfuegos-Cape Cruz section became interrupted, the Cape Cruz-Manzanillo section has since also given way, and arrangements are now being made for their repair. The directors are in communication with the Foreign Office as to the company's claim for the cost of repairing the cables damaged during the Spanish-American war. The retiring director is Mr. Robert Kaye Gray, who, being eligible, offers himself for re-election. Messrs. Gane, Jackson, Jeffreys & Wells, C.A., the auditors, also retire, and offer themselves for re-election. Annexed hereto is a comparative statement of traffic."

Prospectus.—Until Monday next, 23rd inst., the Barcelona Tramways Company, Limited, is inviting subscriptions for £48,100 4½ per cent. redeemable debenture stock, and £50,000 5 per cent. cumulative preference capital in £10 shares. Our readers are aware that at the beginning of the year electric traction was inaugurated for a part of the system, and that since then the results of that section have been very satisfactory. The capital now being offered to the public will be applied to paying for and completing the outlay on the conversion of the company's system to electric traction, for providing 40 additional cars, and other purposes. The offices of the company are at Winchester House, E.C., from which forms of application can be obtained.

Montevideo Telephone Company, Limited—The report for the year ended July 31st shows a net profit of £8,227, after providing for working expenses in Montevideo and London and writing off amounts for bad debts, depreciation of stock and materials at Montevideo, and office furniture. To this amount should be added £2,603 brought forward, leaving an available balance of £10,830. The directors proposed to transfer £2,500 to reserve, and recommend a dividend at the rate of 2½ per cent. per annum on the ordinary share capital, £2,258 being carried forward.

Stock Exchange Announcements.—Applications have been made to the Stock Exchange Committee to appoint a special settling day in and to grant a quotation to Metropolitan Electric Supply Company, Limited—£125,000 3½ per cent. mortgage debenture stock; and to allow the following securities to be quoted in the Official List:—United River Plate Telephone Company, Limited—5 per cent. cumulative preference shares of £5 each.

The Indo-European Telegraph Company, Limited.—The board of directors have declared an interim dividend for the half-year ended June 30th last at the rate of 5 per cent. per annum, free of income-tax, payable on and after November 1st next. The transfer books will be closed from October 17th to 31st, both inclusive.

Globe Telegraph and Trust.—The directors announce an interim dividend of 1s. 9d. per share on the ordinary shares.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending October 14th, 1899, were £349 16s. 1d.; receipts for week ending October 14th, 1898, £894 2s. 0d.; aggregate for half-year to date, £18,808 8s. 8d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending October 13th, 1899, were £3,045 2s. 7d.; corresponding period, 1898, £2,664 8s. 7d.; increase, £380 14s. 0d.

The City and South London Railway Company.—The receipts for the week ending October 15th, 1899, were £1,031; week ending October 16th, 1898, £1,002; increase, £29. Total receipts for half-year, 1899, £15,214; total receipts corresponding period, 1898, £15,251, decrease, £37. Miles open, 8½.

The Dover Corporation Electric Tramways.—The receipts for the week ending October 14th, 1899, were £200 2s. 7d.; week ending October 15th, 1898, £182 0s. 10d.; increase, £18 1s. 9d. Total receipts to date, 1899, £8,275 4s. 2d.; corresponding period, 1898, £6,800 9s. 6d.; increase, £1,474 14s. 8d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,788, 1898, 4,296. Number of cars, 1899, 11; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, October 13th, 1899, were as follows:—D. U. T. Co., horse cars, £1,247 11s. 0d.; ditto, electric cars, £2,154 19s. 7d.; D. S. D. Co., electric cars, £851 9s. 3d.; total, £4,258 19s. 10d.; corresponding week last year—D. U. T. Co., horse cars, £2 644 15s. 9d.; ditto, electric cars, £416 1s. 11d.; D. S. D. Co., electric cars, £908 14s. 4d.; total, £3,969 12s. 0d.; increase, £284 7s. 10d. Aggregate to date, £67,099 18s. 1d.; aggregate to date last year, £65,313 13s. 9d.; increase to date, £1,785 19s. 4d. Worked:—The mileage open is 25 miles electrically, 19 miles by horses, as against 12 miles electrically, and 80 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending October 15th, 1899, were £626. Miles of track open, 12. Car miles run, 23,212. Number of cars, 21. The receipts for the week ending October 19th, 1898, were £222. Increase, £404. Miles of track open, 3½. Car miles run, 8,539. Number of cars, 10. Total receipts to date, 1899, from April 1st, 1899, £17,019; total receipts to date, 1898, from June 29th, 1898, £4,446.

The Liverpool Overhead Railway Company.—The receipts for the week ending October 15th, 1899, amounted to £1,524; corresponding week last year £1,388; increase, £136.

The South Staffordshire Tramways Company.—The receipts for week ending October 18th 1899, were £706 14s. 9d.; aggregate receipts for 41 weeks, £27,971 14s. 10d.; week ending October 14th, 1898, £460 2s. 3d.; aggregate receipts for 41 weeks, £25,921 2s. 9d.

STOCKS AND SHARES.

Wednesday Evening.

Once more a better tone throughout the electrical markets has to be chronicled. Fears of dearer money that were induced by the war scare are daily lessening, as the money market displays its regular surplus of cash awaiting weekly investment at 2 per cent. under the Bank of England minimum. The war itself, now that hostilities are actually begun, has acted as a bull point in every direction, anything being considered better than the horrible suspense which hung over the Stock Exchange a fortnight ago. It is generally considered that a short campaign will suffice for the Boers to feel their stupidity in kicking against the pricks, so that to discount peace is now allowable and prudent. Electrical shares, particularly telegraph descriptions, have, of course, fully shared in the better feeling that is abroad, and after the fall the markets stand on a healthier basis than they did prior to the shake-out. While there will be ups-and-downs before the Transvaal matter is settled once and for all, it would seem probable that the trend of investment stocks is likely to be upwards for the next few months, and another factor that has to be borne in mind is the constantly increasing capital which awaits investment in this country.

Coming to details, the principal feature in the electrical supply section is the dealing that is taking place in the new shares and fractions issued by the St. James's and Pall Mall Company. The whole shares fluctuate between 1⅛ and 2¼ premium, but there are many more sellers than buyers, for the simple reason that shareholders have a rooted objection to odd numbers, and to take the little bonus which a sale brings is more tempting than to buy the extra shares required to make an allotment up to a round number. The same remarks apply with even more strength to dealings in the fractions. Each "thirteenth" is worth about 2s. 9d. premium. A glorious muddle, by the way, has occurred with regard to stamping the renunciation letters issued by the company. Whether it is necessary to attach a 6d. or a 1d. stamp to the document is being fiercely debated, but we may here state that the renunciation of *whole* shares requires a 6d. stamp, but in the case of *fractions*, an ordinary 1d. one is all that is needful.

City of Londons weakened upon a sale of 50 shares by a broker, but immediately hardened when he found that he had made a mistake in his order, and attempted to repurchase them. Countys are ¼ off, but the rest of the market shows no quotable change, with the exception of St. James's shares, to which we have already referred, and which are now ex the rights to the new issue.

As indicated in our introductory remarks, the telegraph department has largely recovered from its war-weakness. Easterns have taken the lead and are 6 points up, reckoning the dividend deducted last Friday. It has at last come to be recognised that war will benefit the company immensely, and its business, for the present at any rate, is not likely to be hampered by the somewhat foolish restrictions now imposed upon customers as regards code facilities. Eastern Extensions are also better, the price being now ex dividend, and in the Anglo-American list both Anglo "B" and Ordinary exhibit an advance upon an idea that the stocks looked cheap after being marked ex. Brazilian Submarines have also improved upon the satisfactory report, but Commercial Cable stock has dropped 2½, despite the vigorous defenders that the company has found against those who drew gloomy forecasts of its future when wireless telegraphy shall come into more general use. Western and Brazilians are soon to vanish from the market altogether, as 95 per cent. of its share capital has now been sold to the Brazilian Submarine.

Railway and traction issues call for little comment. Metropolitan Districts have been rushed up by the clique which took them in hand not long ago, and the old reports about what will happen after the line is electrified are again doing service. Buenos Ayres and Belgrano Tramway shares are now quoted 5⅝, fully paid, and Barcelona Trams continue in the neighbourhood of 14, the City having once more been restored to its normal orderliness. The new issue of capital will, it is thought, strengthen the company's position, but the prospectus should have given more figures with regard to the progress that is being made.

Brush Ordinary are a good market, and have found supporters at 2. Electric Construction, contrariwise, incline to dulness, and there are free sellers at the middle price. Elmores have relapsed, and it is stated that the bright hopes entertained not so very long ago as to the company's near future are not being fulfilled.

Telephone shares are inanimate, and in the Trust division Globes have succeeded in retaining their rise of last week.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Oct. 11th.	Closing Quotation, Oct. 18th.	Business done during week ended Oct. 18th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 18s	3 %	£3 9s	61 — 64	61 — 64 xd	62¾	62
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	112½—113½	112 —113 xd	113½	112½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	14½— 14⅝	14¼— 14⅜	14⅝	14½
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	14⅜— 15¼	15 — 15½	15⅜	14⅞
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2½— 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	185 —190	180 —190	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —104	102 —104	103⅛	102½
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½%	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9⅜	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	18½— 19½	...	...
12,981	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½%	3½%	11⅛— 12	11½— 12	11⅞	...
120,000	Direct West India Cable, 4½ % Reg. Deb. ...	100	...	...	...	100 —103	100 —103	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	146 —150	149 —154	152½	148½
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	99 —102	99 —102	100½	99
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	118 —123	118 —123	...	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14 — 14½	14 — 14½xd	14⅜	14⅛
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,040, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	117 —122	117 —122	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	4 %	...	...	102 —106%	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	5½%	10⅜— 11⅛	10⅜— 11⅛	11⅛	10⅞
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15 — 15½	15 — 15½	15⅝	15 1/16
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	30 — 32	30½	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	½— 1	½— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5⅛%	6 %	6 %	5 — 5¼	5 — 5¼	5 7/16	5
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5 1/16	5⅛
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	99 —102	99 —102	101	100
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	½— 1	½— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,889	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8 xd	7⅞	...
3,381	Submarine Cables Trust	Cert.	...	...	...	130 —135	127 —132 xd	128	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5⅛	4⅜— 5⅛	...	...
151,783£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	104 —107	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	99 —102	99 —102	100	...
80,008	West Coast of America, Nos. 1—80,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	102 —105	102 —105	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph	10	1 %	8%	...	1⅛— 1⅜	1⅛— 1⅜	1 7/16	...
94,563	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10⅛— 10⅜	10⅛— 10⅜	10⅜	10 5/16
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8¼— 9⅛	8¼— 9⅛	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	104 —107	104 —107	...	...
156,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7½— 8½	7½— 8½	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	9⅞	...
30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	10 — 11	...	...
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8½	8⅛	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	110 —112	110 —112	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11 — 12	11 — 12	11 1/16	11 1/16
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13½	13 1/16	13 1/16
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10⅜— 11¼	10½— 11	10 15/16	10½
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	13¼	13 1/16
220,000	Do. 4½% Deb. Stock, Prov. Certs (£30% to be paid) Rd.	...	...	...	...	81 — 84	81 — 84	83¼	82½
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5½	5 — 5½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6¼— 6⅜	6¼— 6⅜	6 1/16	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	105 —107	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	15 — 16	15⅝	15½
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14 — 15	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	16 — 17	15 — 16	15⅞	15¼
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 10	9 — 9½	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3⅞— 4⅛	3⅞— 4⅛	4 1/16	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½—15½	14½— 15½	15½	...

* Subject to Founder's Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Oct. 11th.	Closing Quotation Oct. 18th.	Business done during week ended Oct. 18th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2⅜— 8/16	2⅜— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	17 — 18	16½— 17½	17¼	17⅛
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13⅜— 14¼	13⅜— 14¼	14⅛	13⅞
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	125 —128	125 —128	128½	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6¾	6½— 6¾	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅞— 2	1⅞— 2⅛	2	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2 5/16	2½
125,000	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	109 —113	109 —113	111¾	110¾
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13½— 14½	13½— 14½	14⅛	13⅞
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	112 —115	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	10 — 10½	10¼	10⅛
178,308	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	4½— 5	4½— 5	...	..
71,447	Do. do. Def. do.	5	...	...	...	5 — 5½	5 — 5½	...	...
630,000	City and South London Railway	Stock	1 9/16 %	1⅞ %	2⅛ %	63 — 66	63 — 66	...	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6¼— 6⅝	6¼— 6⅝	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3¾— 4	3½— 4	3 13/16	3⅝
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛ %	6 %	6 %	2 — 2⅛	2 — 2⅛	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛ %	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	96½	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3⅛	3 — 3⅛	3⅛	...
140,800	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	106	105½
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	5/8— 6/8	¼ — ½	...	...
9,600	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
8,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	110 —113	110 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 23	21 — 22	21½	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2¾ %	3½ %	3½ %	8½— 8⅝	8½— 8⅝	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13¼— 13⅜	13¼— 13⅜	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	38⅝	37½
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	105	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9⅜	9¼— 9⅜	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6	5½— 6	...	...
540,000	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	100 —103	101 —104	102¼	100

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
British Aluminium, Ordinary, 9—10; 7 % Pref., 9½—10½.
Brompton and Kensington, 4½ % Debentures of £100, 105—108.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 1—3.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7¼—7⅜. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 18¾.

* From Birmingham Share List.

Bank rate of discount 5 per cent. (October 5th, 1899).

MARKET QUOTATIONS, Wednesday, October 18th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	32/-	32/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	35'-	35'-	..
a Ammonia, Muriate (crystal) .. per ton	£25	£25	..
a „ .. .. .. per ton	£23	£23	..
a Bleaching powder .. .. per ton	£6 10	£5 15	15s. inc.
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£26	£25 10	10s. inc.
a Lead, Nitrate .. .. .. per ton	£25	£24	20s. inc.
a „ White Sugar .. .. .. per ton	£31	£31	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3½d.	3½d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£224	£234	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8½d.	..
c „ Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c „ Wire, basis .. .. per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g „ Wire (basis price) .. per lb.	10½d.	10½d.	..
g „ Sheet .. .. .. per ton	£88	£88	..
g „ Rod .. .. .. per ton	£88	£88	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	6/-	6/-	..
h India-rubber, Para fine .. per lb.	4/2½ to 4/5	4/2½ to 4/5	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	68/10	68/11	1d. dec.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£14 5	£14 5	..
g Lead, English Ingot .. .. per ton	£16 15	£16 10	5s. inc.
g „ „ Sheet .. .. per ton	£18 10	£18 10	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£8 17 6	£8 17 6	..
d Mica (in original cases), small per lb.	2d. to 6d.	2d. to 6d.	..
d „ „ „ medium per lb.	1/9 to 2/6	1/9 to 2/6	..
d „ „ „ large per lb.	3/6 to 7/-	3/6 to 7/-	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd str'p & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 11	£3 10	1s. inc.
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15.	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£149	£150 10	30s. dec.
g „ foil .. .. per lb.	1/9	1/9	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/11	1/11	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7¾d.	7¾d.	..
j „ Best Flax, 6 lea. .. per lb.	4½d.	4½d.	..
j „ Hemp, 3 ply 10 lbs. .. per lb.	8½d.	3½d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£13 10	£13	10s. inc.
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£27	£27	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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ELECTRICAL UNDERTAKINGS IN RUSSIA.

In an article in the *Western Electrician*, Chicago, the present position of the electrical industry in Russia is dealt with as follows:—

The electrical industry in Russia in the form of stock companies is chiefly a creation of foreign, especially German, capital, and of a quite recent date. Only 10 years ago Russia had but one electric stock company, the Electric Lighting Company of St. Petersburg and Moscow, formed in 1888. All the others have come into existence during the last five years. At the end of 1898 the number of companies amounted to 20, five of which were purely foreign companies, while the rest of them, in name at least, figured as Russian concerns. In the latter class is the Electric Lighting Company, which was formed with a large share of German capital by the firm of Siemens and Halske, of Berlin. In 1896 the declared stock of the company, valued at 4,100,000 rubles, was exclusively subscribed for in Germany. (A ruble is valued at about 52 cents in American money.)

In 1894 the firm of Sawitzki & Strauss, of Kieff, was converted into a stock company with a capital of £450,000 rubles. The company supplies the cities of Kieff and Poltava with electric light, and furnishes power for industrial purposes. During the first three years of the company's existence dividends of 8 per cent., 1 per cent., and 6 per cent. were paid, while in the last two years no dividend was paid. In the same year, 1894, the Russian Company for the Utilisation of Electric Power (capital 500,000 rubles) was formed. This company did not begin active operations until some years later, and the result of these operations was not a financial success.

Then followed in 1895 the Electric Company M. M. Podobsdow. At first this company seemed to develop favourably; for the first year a dividend of 4 per cent. was realised, and the stock was for a time the object of keen speculation on the St. Petersburg Bourse. Then a perceptible reaction took place, and at present the company is in an embarrassed position. In 1896 the Electricity Company was formed at Warsaw (capital 1,200,000 rubles) by bankers and manufacturers of Warsaw. It has so far been successful, although no dividends have been paid as yet. Then came the Russian Electric Railway and Lighting Company, formerly R. v. Hartmann & Co. (capital 1,000,000 rubles). This company was formed for the purpose of operating the electric railway at Nischni-Novgorod, at the Great Pan-Russian Fair of 1896. Its first year of existence closed with a considerable loss.

Mention should also be made of the following-named companies, which have never been in operation or only during the last year, so that no account of their business can as yet be given: Russian Electro-mechanic Company (capital 4,500,000 rubles), the principal object of which is to build and operate locomotives and electric railways on Jean Jacques Heilmann's system, the stock being chiefly in the hands of Frenchmen; Russian Accumulator Works, Tudor, with a capital of 600,000 rubles; Northern Electric Company (capital 1,200,000 rubles), for the electric lighting of the suburb, Wassili-Ostrow, near St. Petersburg; the Wuoxen Company (capital 5,250,000 rubles), for the utilisation of the waterfalls of the River Wuoxen for electric power, and in which a good deal of foreign capital is represented, a large shareholder being the firm of Brown, Boveri & Co., of Baden, Switzerland; the St. Petersburg Company for the Utilisation of Water-Power for Electric Purposes (capital 6,000,000 rubles), for utilising the power of the waterfalls near Narva and of the Imatra. Then come the Siemens & Halske Russian Electro-technical Works (capital 4,000,000 rubles), and the Russian Electric Company Union (capital 6,000,000 rubles), both of which are chiefly dependent on German capital.

Of the foreign companies operating in Russia three are Belgian, viz., Compagnie Centrale d'Electricité à Moscou Eclairage de St. Petersbourg and Compagnie de Traction et d'Electricité; two are German companies, the Helios Electric Company, of Cologne, and the General Electric Company, of St. Petersburg. Of these companies, the first-named supplies the city of Rostov-on-Don and Jekaterinburg in Southern Russia with electric light; it has been very successful, clearing 82,522 francs in 1896-97, from a capital of 1,500,000 francs, and 109,588 francs in 1897-98. The Compagnie de Traction et d'Electricité has a half interest in the street railways of Tula, Kronstadt, Reval, Vilna, Minsk, Woronesch and Samara. St. Petersburg is the principal field of operation of the other three companies. They supply electric power chiefly for lighting and industrial purposes.

It should also be mentioned that several of the numerous Belgian street railway companies, strictly speaking, belong to this classification, as some of the newer ones not only build electric street railways, but also furnish electric light and electric power.

Thus, it is evident that everything of any importance in the electric industry owes its existence to foreign capital and foreign enterprise. The domestic companies have not succeeded in any respect and are of no importance. The combination formed lately in Berlin for electric enterprises in Russia will probably still more strengthen and increase this state of affairs. Of the above-mentioned firms the following named are members of this newly formed syndicate: Electric Lighting Company, Siemens & Halske and the Union. Taking the influence and financial power of the International Commercial Bank of St. Petersburg into consideration, there is little doubt that the new combination will occupy a prominent position among the electrical industries of Russia. The syndicate has a capital of 20,000,000 rubles. The board of directors consists of seven members. The headquarters are at St. Petersburg, and the banking house of Rothschild Frères, of Paris, is also represented. The Société d'Etudes Russes, of Paris, and the Franco-Russian Electric Company, of Geneva, Switzerland, are also interested in the syndicate.

The imports of all kinds of electrical machinery into Russia are steadily increasing. The latest available statistics on the total importation are those for the year 1897, when the imports of dynamo-electric machinery alone amounted in value to 1,733,000 rubles, as against 1,214,000 in the previous year. About two-thirds of this trade is in the hands of German manufacturers.

ELECTRIC LIGHTING PROVISIONAL ORDERS.

The following is the form of provisional order under the Electric Lighting Acts, 1882 and 1888, to which reference was made in our "Notes" last week:—

PROVISIONAL ORDER

(SESSION .)

PROVISIONAL ORDER

GRANTED BY THE BOARD OF TRADE UNDER THE ELECTRIC LIGHTING ACTS, 1882 AND 1888,* TO (*name of Undertakers*)

IN RESPECT OF (*name of borough or district in which the area of supply is situated*).

1. This Order may be cited as the Electric Lighting Order, 19 .	Short title.
2. The provisions contained in the Schedule to the Electric Lighting (Clauses) Act, 1899 (with the exception of Sections 83 and 84 of that Schedule†), are incorporated with and form part of this Order.	Incorporation of the Electric Lighting (Clauses) Act, 1899.
3. The Undertakers for the purposes of this Order and within the meaning of Section 2 of the Schedule to the Electric Lighting (Clauses) Act, 1899, are the‡	Undertakers.
4. The area of supply for the purposes of this Order and within the meaning of Section 4 of the Schedule to the Electric Lighting (Clauses) Act, 1899, shall be the area which is described in the First Schedule to this Order, and is more particularly delineated on the map deposited together with this Order at the Board of Trade by the Undertakers, and signed by an assistant secretary to the Board of Trade.	Area of supply.
5.§ Subject to the provisions incorporated with this Order, the Undertakers are specially authorised by this Order to break up streets not repairable by the local authority which are mentioned in the Second Schedule to this Order, and the railways and tramways which are also mentioned in that Schedule.	Power to break up streets, &c.
6. The streets and parts of streets throughout which the Undertakers are to lay down suitable and sufficient distributing mains for the purpose of general supply within a period of two years after the commencement of this Order, as mentioned in Section 21 of the Schedule to the Electric Lighting (Clauses) Act, 1899, are those mentioned in the Third Schedule to this Order.	Compulsory works.
7. The maximum prices which may be charged by the Undertakers as mentioned in Section 32 of the Schedule to the Electric Lighting (Clauses) Act, 1899, are those stated in the Fourth Schedule to this Order.	Maximum prices.
8. The sum to be deposited or secured in pursuance of Section 5 of the Schedule to the Electric Lighting (Clauses) Act, 1899, is pounds.	Deposit.
9. This Order shall come into force upon the day when the Act confirming this Order is passed, and that day, for the purposes of the Electric Lighting (Clauses) Act, 1899, shall be the commencement of this Order.	Commencement of Order.

[N.B.—Where an Order is granted to a Company or person having overhead wires already installed, a clause will be inserted providing for their removal, except in special circumstances.]

FIRST SCHEDULE.

¶ Area of supply—

SECOND SCHEDULE.

List of streets not repairable by the local authority, railways, and tramways which may be broken up by the Undertakers in pursuance of the special powers granted by this Order.

(*a*) Streets:

(*b*) ** Railways:

(*c*) Tramways

THIRD SCHEDULE.

List of streets and parts of streets throughout which the Undertakers are to lay down suitable and sufficient distributing mains for the purposes of general supply, within a period of two years after the commencement of this Order—

* In Scotch Orders add "and the Electric Lighting (Scotland) Act, 1890."

† In Scotch Orders Section 84 only, in Irish Orders Section 83 only must be excepted.

‡ A company registered under the Companies Acts should be so described, and the address of the registered office should be added.

§ *See* Section 12 of the Schedule to the Electric Lighting (Clauses) Act, 1899. This provision is not required in the case of an Order granted to a local authority.

¶ Where the area of supply consists wholly of recognised areas of government, such as boroughs, districts, or parishes, it will be described accordingly. In other cases detailed boundaries must be inserted, and a provision added, that in the case of difference between the description in the Schedule and the area as delineated on the deposited map, the latter is to prevail.

** In ordinary cases the level crossings must be specified: In the case of a light railway or other railway running along the highway on the level, the length and position of the railway must be described.

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FOURTH SCHEDULE.

Maximum Prices.

In this schedule—

The expression "unit" shall mean the energy contained in a current of 1,000 amperes flowing under an electromotive force of 1 volt during one hour.

Section 1.

Where the Undertakers charge any consumer by the actual amount of energy supplied to him, they shall be entitled to charge him at the following rates per quarter:—For any amount up to 20 units, 13s. 4d.; for each unit over 20 units, 8d.

Section 2.

Where the Undertakers charge any consumer by the electrical quantity contained in the supply given to him, they shall be entitled to charge him according to the rates set forth in Section 1 of this schedule, the amount of energy supplied to him being taken to be the product of that electrical quantity and the declared pressure at the consumer's terminals, that is to say, such a constant pressure at those terminals as may be declared by the Undertakers under the Board of Trade regulations.

SOME ELECTRIC STREET RAILWAY DATA.*

By HARRIS J. RYAN,
Professor of Electrical Engineering, Cornell University.

During the spring of 1899, copies of a question form for gathering statistical data relating to the construction and operation of electric street railway plants were sent to the managements of some of the plants in our country with the request that they be filled in with the requisite data and returned to the writer. In this request it was stated that average results of the replies would be published. Replies were received from 12 plants that were fairly complete. The data from eight of these plants have been averaged as far as possible. The results form the composite answers to the questions in the form as given below, which was originally sent to the management of each plant.

Whenever percentages appear in an answer they mean that the answer applies to plants aggregating in capacity those percentages of the total average daily kilowatt output for the eight plants.

Buildings.

Size of complete power house, 319 feet × 574 feet; 183,500 square feet. Engine and dynamo room, 240 feet × 440 feet; 105,000 square feet. Boiler room, &c., 188 feet × 440 feet; 82,900 square feet.

Constructive materials:—

Foundations: 37·0 per cent. masonry; 23·2 per cent. concrete; 29·2 per cent. concrete and stone masonry; 6 per cent. brick in cement; 4·6 per cent. not reported.

Walls: 76·8 per cent. brick; 12·2 per cent. pressed brick front; enamelled and pressed brick in engine room; 11·0 per cent. steel structure filled with brick.

Roof: 12·2 per cent. tile with tar and felt; 11 per cent. matched pine on steel structure; 20·5 per cent. composition tar roof; 6 per cent. wood asphalted; 4·6 per cent. wood; 10·5 per cent. slate, steel trusses; 16·5 per cent. slate over engine room, corrugated iron over boiler room; 18·7 per cent. slate on pine sheathing supported on steel trusses and purlins.

Floor: 18·7 per cent. vitrified tile laid on concrete arches and supported on steel I-beams; 16·5 per cent. concrete; 10·5 per cent. wood in engine room, cement in boiler rooms; 23·2 per cent. mill construction, hard wood finish; 24·5 per cent. wood; 6 per cent. wood covered with steel plate.

Car barns: 76·8 per cent., 444,645 square feet; 21 per cent. no report.

Repair shops: 78·9 per cent., 83,722 square feet; 21·1 per cent., no report.

Cost of power house, building only, no reports.

Power House Equipment, Mechanical.

Engines:—Total number of engines, 46.

Types of engines: 1 (125 H P) high speed; 4 (2,100 H P.) Porter and Allen; 16 (12,200 H.P.) American-Wheelock; 1 (1,200 H.P.) Green-Wheelock compound condensing; 12 (9,250 H.P.) "Corliss" or "simple Corliss"; 3 (1,200 H.P.) simple Corliss condensing; 5 (3,650 H.P.) Corliss compound condensing; 4 (2,400 H.P.) Providence-Green tandem compound condensing.

Average rated H.P. of each, 700; aggregate rated H.P., 32,125.

Condensing, 8,450 H.P.; non-condensing, 23,675 H.P.

Cost of engines erected, including foundations: Simple non-condensing, 15,550 H P.; cost $14·88 per H P.

Tandem compound condensing, 2,400 H.P.; cost $29·66 per H P.

Number of spare units, 14; total I.H.P., 9,250.

Boilers: Total number of boilers, 106; steam pressure, 100 to 125 lbs.

Rated power:—

Fire-tube boilers, 19—3,800 H P.	100 lbs.
Fire-tube boilers, 19—3,800	110 „
Fire-tube boilers, 24—7,200 H P.	115 „
Fire-tube boilers, 6—750 H P.	120 „
Water-tube boilers 6—2,250 H P.	100 „
Water-tube boilers 7—2,650 H P	120 „
Water-tube boilers 23—5,950 H.P.	125 „
Total fire-tube boilers 65—14,150 H P. ...	100 lbs. to 120 „
Total water-tube boilers 36—10,850 H P.	100 lbs. to 125 „
Total Cahill vertical boilers 5—1,250 H P.	120 „

Aggregate capacity of boilers, 26,250 H P.

Number of spare units, 24; capacity, 6,725 H.P.

Steam fitting and appliances:—

System of steam piping: 89·5 per cent. single; 10·5 per cent. double.

Natural draught: 100 per cent. use.

Forced draught: 89·5 per cent. do not use; 10·5 per cent. use.

Hand firing: 58·1 per cent. use.

Mechanical stokers: 41·9 per cent. use.

Coal conveyors: 29·7 per cent. use.

Ash conveyors: 46·2 per cent. use.

Economisers: 15·6 per cent. use.

Cost: 11 per cent. fire-tube boilers with natural draught, mechanical stokers, coal and ash conveyors, installed about 1897, cost $19·75 per rated H P.

Summary:—

Cost of steam plant, including engines, boilers, piping, and all auxiliary apparatus, erected and ready for operation: 17,950 H P.; total cost, $316,514, or $45.50 per rated H.P.; varying from $29.10 to $56.90, according to date of installation and nature of equipment.

Power House Equipment, Electrical.

Generators:—

Total number of generators, 54; aggregate capacity. 25,930 KW; 17 generators, direct driven, 11,000 KW.; 21 generators, belt driven, 4,530 KW.; 16 generators, rope driven, 10,400 KW.

Average daily load, 9,608 KW.; maximum, 14,437 KW.; minimum, 5,981 KW.

Number of spare units, 17; capacity, 7,090 KW.

Cost of generators, including foundations, &c.:—

8—4,600 KW.—direct connected, cost $23 per KW.

16—10,400 KW.—belted, cost $13 per KW.

Switchboard:—

Number of generator panels, 59; feeder panels, 131.

Cost of switchboard erected, including necessary apparatus, &c.:—

1. Generator panels: No report.
2. Feeder panels: 16·5 per cent, $1.65.
3. Total: 23·2 per cent., $3,600.
4. Per KW.: 23·2 per cent. 3·46.

Recording instruments, 64·4 per cent. use.

Wattmeters, 84·9 per cent. use.

Summary.—

Cost of electrical equipment, including generators, switchboards, wiring, &c., erected ready for operation: 15,050 KW., cost $18.95 per KW.

Grand summary:—

Cost of completed station and all contents: Excluding land, 15,050 KW., cost $75.25 per KW.

Road and Equipment.

Track:—

Mileage: 58·4 per cent. have 213 miles of road and 335 miles of track; 25·1 per cent. 138 miles of track, single or unspecified; 16·5 per cent. not reported.

Rails: 18·7 per cent. 60 feet, 90 lbs. girder; a few 60 feet, and others 30 feet girder and T, ranging in weight from 35 to 107 lbs.

Track foundation: 23·2 per cent. dirt mostly, ballasted to some extent with crushed stone; 25·5 per cent. macadam; 4·6 per cent. slag; 10·5 per cent. earth, ashes, broken stone, concrete; 18·7 per cent. 90 lbs. 60 feet girder rails with broken limestone ballast 6 inches deep under cross ties.

Bonds: A variety, generally copper rods riveted; vary in size from No. 4 to two No. 000 B. & S. per rail joint.

Supplementary wires: 23·2 per cent. have 35 per cent. in excess of feeder copper.

Ties: 6 × 8 inches × 7 feet average; mostly oak (a few chestnut) spaced 24 inches c. to c. In one instance steel ties 1⅛ × 7 inches × 5 feet 6 inches, spaced 10 feet apart and laid in concrete were used.

Paving: Depends entirely on local conditions.

	Per mile of track. Single.	Double.
Cost of all material used	$6,800	$13,600
Cost of all labour required to instal	3,080	6,160
Cost of paving, labour and material	6,200	12,400
Total cost of road-bed, complete	$16,080	$32,160

This is the average report for 42 per cent. part earth and part broken stone ballast, 7-inch girder rails, cast weld joints, no bonds. Overhead construction:—

Span wire or bracket construction: 67 per cent. span wire; 16·5 per cent. span wire and bracket; 16·5 per cent., no report.

Size of trolley wire: 83·5 per cent. No. 0 B. & S. hard drawn copper, except about 5 per cent. of this where No. 00 is used; 16 per cent., no report.

Poles: 39·2 per cent. iron pipe, spaced 100 feet to 110 feet; 29·2 per cent. steel and wood, spaced 115 feet to 120 feet; 4·6 per cent. cedar, spaced 110 feet; 10·5 per cent. chestnut, spaced 100 feet.

Feeders: 22·5 per cent. have 45 feeders, aggregating 1,066,400 feet; 23·2 per cent. have 125 feeders, aggregating 1,900,000 lbs., including insulation.

	Per mile of track. Single.	Double.
Cost of all material, overhead construction ...	$2,325	$2,826
Cost of all labour for erection	213	427
Total cost of overhead construction ...	$2,538	$3,253

* Paper read at the New York Street Railway Convention.

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The above is for iron poles. For wooden poles, material one-third and labour one-half the above.

Equipment:—

Number of motor cars: Closed, 1,197; open, 1,008; convertible, 75. Total, 2,280. These figures reported for 83·5 per cent.

Average daily number of cars in use: 83·5 per cent, 908.

Average daily mileage per car: 79·9 per cent., 122·4 miles.

Total car-miles per day, 58·4 per cent., 57,862.

Length of car bodies:—

	Closed.	Open.
18·7 per cent.	20 ft.	30 ft.
10·5 ,, ...	16 ft., 18 ft., 28 ft.	27 ft., 30 ft.
4·6 ,, ...	18 ft.	28 ft.
6·0 ,, ...	16 ft., 18 ft.	18 ft., 21 ft.
20·5 ,, ...	28 ft.	22 ft.
23·2 ,, ...	21 ft.	28 ft.

Cost of car bodies: Closed, 20 feet, $900 to $1,200; open, 30 feet to 32 feet, $600 to $800.

Cost of trucks: Single, $175 to $250; double and maximum traction, $315 to $425.

Type of motors: G. E. 800, Walker No. 5, Westinghouse Nos. 3, 12A, 49C.

Number of motors per car: Two, except for a few 28 feet cars on which four motors are used.

Rated power of motors: 25 to 50 H.P. each.

Cost of motors and appliances per car, installed: $700 to $1,000, according to size of motors.

Summary:—

Total cost of motor car, including car body, truck, motors, and all appliances installed ready for operation:—

1. Closed motor car, average, $1,700 to $2,500.
2. Open motor car, average, $1,400 to $2,070.
3. Convertible motor car, average, $2,375.

Roads built between 1892 and 1898, average.

Operating Expenses.

Kind of fuel and cost delivered:—

23·2 per cent. Indiana screening, at $1.07 to $1.25 per ton.

20·5 per cent. soft coal.

6·0 per cent. bituminous, at $3.60 per ton, and slack at $2.35 per ton.

10·5 per cent. anthracite bird's eye and buckwheat at $4.62½.

18·7 per cent. bituminous slack, at $.60 to $.70.

Kilowatt-hours per day: 49·7 per cent., 79,480.

Cost of Power per kw.-hour.

Average report for 42 per cent:—

Operation:	Fuel	$ 0060
	Water	·0001
	Labour	·0027
Repairs	... ...	·00053
Total, without interest or depreciation	... ...	$ 00933

Cost of Operation per Car-mile.

Average report for 42 per cent., cars of medium size:—

Power			$ 01015
Maintenance of equipment:—			
Trucks	$ 00285		
Motors	·00502		
Car bodies	·00669		
		Total ...	·01456
Maintenance of way			·01000
Motormen, conductors, inspection, &c.			05968
General expenses, salaries, &c.			·0386
Taxes, insurance, legal expenses, damage, miscellaneous, &c.			01681
Grand total			$ 11506

AN ATTEMPTED TWO-CYCLE GAS ENGINE.

A new gas engine is suggested by Mr. F. H. Smith and illustrated in *Feilden's Magazine*. The new engine has two pistons in one cylinder. One piston is attached as usual to the rod, the other being free and carrying a spring on its front face. The inlet port is forward in the cylinder and just open when the piston is at full outward position As the main piston travels back it closes this port and compresses the air and gas imprisoned between the two pistons and forces them through a valve in the free piston and into the back of the cylinder. When the main piston moves out the valve automatically closes, and the main piston is of course followed by the free piston by virtue of the vacuum that would otherwise be formed in any intermediate space, and in spite of the opposing force of the now compressed spring. The two pistons thus travel out together until the port is opened again when the spring reacts and draws in the fresh charge of gas and air, the free piston going back to the end of the cylinder under pressure from the spring. Thus there is a charge every revolution, and the only seriously weak feature is the coiled spring. It is essential that this spring should be strong so as to drive the free piston quickly backwards, and whether practical difficulties will prevent ultimate success cannot be said without further experience. But the idea is admirable.

It is claimed that the free piston is an automatic governor, for if the engine ran beyond normal speed the amount of fresh charge drawn in would be reduced because the attached piston would follow up the free piston more quickly than this latter could complete its full back movement. This certainly appears feasible, the action being controlled by movement of the inlet cock, whereby the opening can be made more or less free, and the piston movement can be regulated accordingly. There is something remarkably ingenious about this new engine. We believe it to be perfectly novel, and the combination is very curious, and yet simple. The weak point appears to be the spring between the two pistons. This spring is called on to work through a large range of movement, and will be put to great mechanical stress. But given the endurance of this, or an equivalent in shape of an air cushion, and there is no apparent reason why the engine should not work, and work well.

The free piston in combination with the ordinary piston accomplishes what has been attempted by means of a separate cylinder, as in the Clerk engine. It will be observed that the action of the free piston takes effect after the main piston has passed the inlet port at the forward end of the cylinder, and only then after the exhaust valve is opened so as to remove the pressure from the back of the free piston. This done, the spring begins to act, it pushes back the free piston and draws in the fresh charge between the two pistons, the main piston still moving forward slowly at or near the dead point. The action of the spring must be such as to push the free piston completely back in the space of time occupied by the main piston in travelling from the point where it first opened the edge of the inlet valve to the time of its re-covering same on the return stroke. Clearly any slower action of the free piston will curtail the volume filled by the fresh charge, and the engine will run slower until the full charge is admitted. Hence arises the claim that the speed of the engine is controlled by the free piston, and should the spring become weak the first result would be that the engine would run slower.

The free piston thus forms a sort of inertia governor. A numerical example will assist to give clearer ideas as to the spring. Let the stroke of a 6-inch piston be 6 inches, and the speed of revolution 300 per minute or 5 per second. Then the back movement of the free piston must be performed in a certain fraction of $\frac{1}{5}$th of a second. This fraction of a revolution is represented by an arc of crank movement which we will assume to be 30° on each side of the dead point or a total arc of $\frac{1}{12}$th of the circle. This represents $\frac{1}{60}$th of a second. In this time the free piston must move 6 inches, and as it starts from zero of velocity — we will neglect its inertia or momentum which is negative—it must attain a velocity of 1 foot per second during its movement of 6 inches in order that it may cover 6 inches in the time. Obviously, therefore, the spring must give an acceleration of 1 foot per $\frac{1}{30}$th of a second in $\frac{1}{30}$th of a second. Gravity gives an acceleration of approximately the same rate or 30 feet per second, but requires 1 second to do it in. In other words, assuming gravity = 30, for simplicity, a body moves under its influence in $\frac{1}{30}$th of a second a distance represented by the formula, $s = t^2 \times \frac{g}{2}$; in this case, t being $\frac{1}{30}$th, we have $s = \frac{1}{900} \times 15 = \frac{1}{60}$th of a foot, or $\frac{1}{10}$th of the desired amount of 6 inches. The piston spring must therefore be 30 times the equivalent of gravity. In other words, the spring must have a resilience of 30 lbs. for each pound weight of the free piston. Assume this free piston to average only 1 inch in thickness. Its area is approximately $6^2 \times \cdot7854 = 28$ square inches, so that its weight would be 7 lbs, and the spring must exert an average force of $7 \times 30 = 210$ lbs. The spring pressure is thus 210 ÷ 28 = nearly 8 lbs. per square inch of piston area, which is about 7 lbs. less than vacuum effect, so that with tight fitting pistons capable of producing a good vacuum between themselves there will be a surplus pressure to hold the pistons together on the forward stroke of, say, 5 lbs., in addition to the excess of working pressure behind the piston. These figures, if correct, point to the problem being easy of solution in all respects except the spring, and in the case assumed a 210-lb. spring with a range of 6 inches will be something of a problem to solve, while the substitution of an air cylinder for the spring would rob the cylinder space of something of its charge capacity and unduly reduce the engine power. But in all this let it not be forgotten that the power of the engine is being doubled for equal dimensions, and anything to be subtracted will only mean so much less than doubling. Given a successful spring the idea points to a very substantial increase in the power to be obtained from a given size of engine.

THE UNSPEAKABLE TROLLEY.

Englishmen are prone to consider the French somewhat unpractical, but in doing so we venture to think they are somewhat mistaken. In many ways the French have distinctly distanced not only ourselves, but other nations, in the very lines along which we and others have prided ourselves as being first. We do not here allude simply to scientific matters, though in these the French are well to the front, for what nation has produced a more brilliant array of chemists or physicists than the French? We would refer more immediately to practical affairs. As a city, Paris has no equal; yet the excitable French remain perfectly calm at the sight of trains of half a dozen long tramcars coupled together and running through their streets. Such trains are a common sight in Paris. One may travel on them from the Louvre to Versailles, passing along city streets and suburban roads equally without danger. The motive power is steam. In England the mention of a steam tramway raises a picture of a short puffing ash box, smelling of oil and grease, dirty and unkempt as a London and Chatham locomotive. But in France the steam

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tramway engine is a clean affair. It is difficult to see where the boiler and machinery are placed, so little are they apparent. At various points in the city single large Serpollet tramcars may be seen running of equally clean and sightly description, and, in a word, our neighbours appear to have solved steam traction far better than we have done. On the same lines and of very similar appearance are the accumulator cars. We do not know much of the figures of maintenance, but the cars appear to run well and to be generally satisfactory.

In overhead electrical traction again, the French are not horrified by the presence of the poles or the trolley wires. All over Rouen, a city of large size, and far superior to any of our provincial cities in appearance and cleanliness, the overhead system is extensive and is by no means conspicuous. Now, all these things are within reach of our municipal authorities. Probably they have all been seen by such authorities, though at the expense of long-suffering ratepayers, and there has been no excuse for delay. If the worthy mayors and aldermen who have joined in Continental excursions out of the rates had properly used their eyes they would not so long have stopped the way. Apart, however, from mayors and aldermen, we fear that much harm is done by those who advise them, and who, with an array of facts before them, seem bent, each one, upon some fantastic idea of his own, in place of striving to utilise standard plans and worked-out ideas. We refer to the consulting engineers, many of whom, without an ounce of traction experience, set themselves to advise corporate bodies whom they so confuse by condemning sound proposals in order to foist their own crude ideas on their clients, that practically they stop genuine progress. Overhead work in America is often very rough and crude as compared with recognised standards here. Should we not, therefore, in face of the performances of such rough material there, be satisfied to extend our own better class of work, and trust to the future for improved methods, as these are pointed out by experience?

In the craze for ornament we are very much of opinion that systems of side bracket poles that might be made very little noticeable, are being brought into prominence by an excess of spandrel ornament. Nor do we understand why local authorities are so enamoured of side bracket poles. Span wire construction is far better for both the streets and the public. It is safer and less conspicuous, yet the clumsier bracket appears to have enamoured the local men to an extraordinary degree. A redundancy of pole ornament is meretricious, and does not speak well for the artistic sentiment of the people who countenance it, nor is it very creditable to 25 years of South Kensington operations upon the people. Why, we would also ask, is an electric tramway company compelled to employ eyesweet poles and costly arms and trimmings, when along the same roads the Government and the Telephone Company are permitted, with never a word of expostulation, to erect crooked, black, creosoted, knotty and weather-split poles with a dozen square off-springing cross-arms and irregularly placed and unsymmetrical insulators with 20 wires or more? Not a word is said against the combined ugliness of these systems, and all denunciation is hurled against the two wires of the tramway and the neat poles. The worst feature of a tramway is the miscalled guard wiring, an exploded fallacy that would have been scrapped long ago if our Board of Trade had kept itself up-to-date.

PROF. LUNGE, OF ZURICH, ON THE FUTURE OF WATER-POWER AND ELECTROLYTIC ALKALI PROCESSES.

By JOHN B. C. KERSHAW, F.I.C.

It was the writer's privilege on Wednesday evening, October 4th, to form one of the very large audience assembled in the chemical theatre of University College, Liverpool, to hear a lecture from Prof. Lunge, of the Zürich Polytechnic, on the above subject. The occasion was the delivery of the first of the annual lectures which the Liverpool Section of the Society of Chemical Industry have planned in memory of the late Dr. F. Hurter, for many years one of its most active members. The title chosen by Prof. Lunge for his lecture, "Impending Changes in the Development of Industry," and the fame of the lecturer, who is recognised as the first authority on chemical technology in Europe, combined to attract a very large attendance of members of the Society and their friends, and more than one of Prof. Lunge's hearers had travelled from London in order to be present on the occasion. Some portion of Prof. Lunge's lecture naturally related to his personal and other relations with the late Dr. Hurter, but with these remarks the writer does not intend to deal, since to most readers of the Electrical Review Dr. Hurter was personally unknown.

The references made by the lecturer to the new method of manufacturing sulphuric acid by the direct union of sulphurous acid gas and oxygen in the presence of platinum black—one of the reactions known as "catalytic"—are also outside of the province of this journal.

But the greater portion of Prof. Lunge's lecture was devoted to a consideration of the changes now being brought about by the utilisation of water-power for industrial purposes in various parts of the world, and to the especial use of the power so obtained for chemical manufactures. These are subjects of the highest interest and importance to electricians, and therefore no excuse is needed for bringing the views of such a high authority as Prof. Lunge upon the present and future prospects of these new developments, under the notice of readers of this paper.

With regard to the general aspect of the subject, the lecturer stated his opinion that the gradual change from coal to water, as a source of power in Europe, was inevitable, and that such change would involve some displacement of the centres of industry. The industrial activity of man upon this earth might be divided into three periods. During the first of these, wood had served as his only source of heat or power. That period had lasted some thousand of years, and had only ended with the dawn of the present century. During the second period coal had been used, and was still being used, to provide heat and power for all industrial purposes.

Those nations which had possessed extensive and easily worked coal-fields, and the requisite mental energy to make use of them, had undergone wonderful expansion during this epoch of industrial history, and to their coal-fields such nations were undoubtedly indebted for their present wealth and importance. But this period must inevitably close, for every year was leading to the depletion of the coal beds of Europe at an increasingly rapid rate, and a point must soon be reached when these coal fields would be exhausted. The wasteful and unscientific use of this form of fuel had also tended to hasten the arrival of the day when Europe would have to turn to China or America for supplies of fuel. The coal epoch in Europe, when it had closed, would be seen to have been short compared with the thousands of years which had preceded it; and when the complete industrial history of mankind came to be written at some long distant date, it would probably be described as a mere short intervening link between two lengthy epochs—the one of wood and the other of water—as sources of power.

In countries deficient in natural water-powers, such as England and Germany, manufacturers ought to devote all their attention, at present, to devices and inventions for obtaining more efficient utilisation of the energy stored in their fuel. Gas producers would probably be used on an increasing scale, and the lecturer had recently examined a new form of producer (the Dellwik) which yielded 82 per cent. of the energy of the fuel in the gas. The use of peat and brown coal, on a scientific basis, would probably be greatly extended, and the evil days in front of manufacturers in the two leading industrial countries of Europe, would be postponed in this manner as long as possible. Mental and physical energy, inventive ability, and business knowledge, which were all on the side of the older countries, would undoubtedly count for something in the struggle for survival, and the decline of manufacturing supremacy would therefore be gradual, and might be long postponed.

With regard to the present position of water-power in Switzerland, it had been proved that at the point of generation, power could be produced at a cost of about £1 per H.P.-year. The area over which this power could be transmitted by means of high tension currents was at present limited to about 60 miles radius; beyond this limit the capital expenditure upon conductors, and transmission losses, caused the cost of the H.P.-year to equal, or exceed, that of steam-power, which in the lowlands of Switzerland cost £11 to £12 per H.P.-year.

Prof. Lunge then proceeded to point out that the present limit of successful competition with steam-power might soon be subject to wide extension, and that developments in power transmission without wire or conductors, or in the cheap production of some form of energy carrier, of which calcium carbide was a type, might enable Switzerland to provide all Europe with power from her melting snows.

In this portion of Prof. Lunge's lecture there is little to criticise, with the exception of his reference to the relative cost of water- and steam-power. It may be perfectly true that at the point of generation, the H.P.-year in Switzerland costs only £1, but at the point of utilisation, the cost in many cases is more than four times this amount; and the writer can

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state, as an absolute fact, that the H.P.-year generated by water-power is costing more at Zürich, and more at Rheinfelden, than it would cost if generated from coal under the most favourable conditions in South Lancashire. The figures upon which this statement is based will shortly be published.

Under these relative conditions of cost, it is not quite plain why certain industries should migrate from this country to Switzerland, and the decline of England, as a manufacturing country, when it does occur, will hardly be due to this cause.

The remainder of Prof. Lunge's lecture dealt with the utilisation of water and steam-power for specific electro-chemical and electro-metallurgical industries, and figures were given which represented the prospective production of chemical and other products, when all the factories now building in Europe and America are complete.

The figures presented by Prof. Lunge were based on those recently published by Dr. Borchers (*Zeits. f. Elektrochemie*, July 20th, 1899), and a few of the totals are given below:—

TABLE I.—ESTIMATED PRODUCTION IN 1899.

Product.	Amount in tons.	Largest producing country.	Amount in tons.
Potassium chlorate	10,600	France.	6,300
Caustic potash	17,280	Germany.	17,280
Caustic soda	82,560	France.	45,280
Bleaching powder	225,000	France.	99,050
Calc. carbide	254,000	France.	35,000
		U. States.	60,000
Carborundum	1,025	France.	800

TABLE II.—WATER AND STEAM-POWER AVAILABLE FOR ELECTRO-CHEMICAL MANUFACTURES IN 1899.

Country.	Water-power.	Steam-power.
	H.P.	H.P.
Austria	27,000	...
France	110,000	1,300
Germany	13,800	16,173
United Kingdom	11,500	8,150
Italy	29,400	...
Norway	31,500	...
Russia	6,000	1,500
Spain	7,100	...
Sweden	29,000	...
Switzerland	38,900	...
United States	72,300	11,750
Canada	1,500	...
Belgium	...	1,000
Transvaal	...	454
Total	378,000	...

Prof. Lunge disclaimed responsibility for these figures, and pointed out that some of them, notably those relating to the production of alkali and bleaching powder in France, were certainly inaccurate. The writer has paid considerable attention to the industrial side of electro-chemistry, and he also is convinced that most of these estimates of Dr. Borchers are much in excess of the present production; and he would suggest that they be used with considerable caution. Possibly they are meant to be prophetic, rather than actual, in character, and relate to the year 1901.

At the conclusion of his lecture, Prof. Lunge stated his opinion that the world's consumption of alkali will, in the future, be provided by the ammonic-soda, and by the electrolytic works, that the latter will *alone* provide the world's requirements of bleaching powder and other chlorine products, and that the manufacture of the lower strengths of sulphuric acid will be carried out by the old Le Blanc process. The writer is inclined to agree with Prof. Lunge in this forecast of the future; but he is not so ready as the lecturer to assume that this change in the methods of manufacture *must inevitably* cause the transfer of the chemical industry from South Lancashire to the valleys of France and Switzerland, or to the fiords of Norway. If the Castner-Kellner Electrolytic Alkali Works at Runcorn can manufacture electrolytic bleach and alkali by use of steam-power, and can continue to earn 8 per cent. dividends for its shareholders, the days of the alkali industry are not yet numbered, so far as this country is concerned. But fresh capital will have to be invested in the industry if it is to reap all the advantages offered by these new processes of manufacture; and unfortunately there would seem to be a much greater readiness at the present moment to invest capital in the promotion of chemical undertakings abroad than of those at home. The discussion of the causes of this unsatisfactory condition of affairs would be of interest, but it is outside the scope of the present article, which has for its purpose simply the presentation and discussion of the chief points of Prof. Lunge's most interesting and instructive lecture. The full report of the lecture will appear in the October issue of the *Journal of the Society of Chemical Industry*.

PUMPS FOR CENTRAL STATIONS.

BY E. K. SCOTT.

Steam Pumps.—The ordinary duplex steam pump, until recently the most commonly used in central stations, has been found to be very wasteful of steam because the expansion property is not utilised, and also because the length of stroke is so very uncertain. It may be as much as a couple of inches shorter than full stroke, and as live steam has to be admitted into this clearance there is naturally considerable loss in economy. The Weir vertical single steam pump, of which particulars are given in the table, appears to have overcome many of the objections of the duplex pump, in that it uses the steam expansively, has shorter ports, fewer working parts, and a very much lower number of strokes suffice to pump the same volume of water, thus giving less wear and tear.

COMPARISON OF PUMPS TO DEAL WITH 4,600 GALLONS OF WATER PER HOUR.

Description.	Diameter of water piston.	Length of stroke.	Steam admitted.	Strokes per minute.	Floor space.
Horizontal duplex steam pump.	4	6 in.	Full stroke.	140 each plunger.	5½ ft. × 2 ft.
Vertical Weir single cylinder pump.	8	18 in.	¾ cut-off.	24	2½ ft. square.

Although this is a great improvement, there appears to be a general consensus of opinion in favour of putting down electrically-driven pumps either as a stand-by against the steam pumps, or else to undertake all the pumping of the station.

Electric Pumps for Boiler Feeding.—Broadly speaking, there are two kinds of pumping operations required in a central station:—(1) To supply the boiler feed, and (2) to keep an overhead tank full of water. We will consider each case separately. For boiler feeding the pump is practically always running, the head remains constant, but the delivery is continually varied; therefore, if a ram or piston pump is used, either the number of strokes or the length of stroke must be capable of being varied. The speed of the motor, *i.e.*, the number of strokes, can be adjusted by means of resistances in the field and armature circuits, but the variation thus given is limited, besides being wasteful and reducing the torque of the motor. There are various ways in which the desired object may be attained:—

(*a*) The motor armature may have two separate windings and two commutators arranged with a series parallel controller, so that when the windings are in series the speed is just half what it is when in parallel, the variations being obtained by resistances.

(*b*) By arranging a movable mass of iron in the magnetic circuit, so that the reluctance can be increased or decreased, or by moving the field magnet coils so as to make them more or less effective.

(*c*) By arranging the pump with a bye-pass, as is sometimes done in elevator work.

(*d*) By means of two sets of first motion gear wheels fitted with a clutch, so that the ratio between the motor spindle and the pump crankshaft may be doubled; or by

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using one or other of the various patent speed reduction gears.

(*e*) The pump may be driven through cone pulleys by a shifting belt driving in the ordinary way, or by being compressed between the cones.

(*f*) The pump rods may be fitted with adjustable links, so that whilst the throw of the crank remains constant, the stroke of the ram or piston is variable.

Of these methods the first by means of double commutator motor and series parallel control is being most used, and although the double-wound motor and the switch gear are expensive, taking it all round, it makes the best arrangement.

Centrifugal Pumps.—In the second case, in which a tank has to be kept filled, the pump is generally started and stopped by a float switch, but when running it works at full power. For this kind of work the electrically-driven centrifugal pump should find considerable favour because, being a high-speed machine, it can be direct coupled. The pump itself has a lower efficiency than the piston or the ram type, but as gearing is dispensed with the total efficiency of the combination is very little, if any, lower. It is, of course, much cheaper than the three-throw ram pump and motor, its up-keep is less, and it also occupies less floor space.

It is interesting to note that the application of the induction motor to pumping is rather more awkward than is the application of a continuous current motor. For one thing the speed control is difficult, and when the motor is applied to a centrifugal pump, as often as not the critical speed of the motor (governed by its periodicity) does not agree with the critical speed of the pump (governed by its internal construction). The theory of the centrifugal pump is a complicated problem, on which the writer does not propose to enter, but we know that for reasons of convenience and cheapness of manufacture, &c., the pumps are made in certain standard sizes, and it is found from test that for certain pressures and delivery each size has its critical speed. If the speed is reduced the pump fails to deliver against the necessary head or pressure, whilst if the speed be increased there is a drop in pressure due to internal friction, &c., and the power taken by the motor increases at a rate out of all proportion to the useful work being done.

Where the speeds are a good deal out, and the importance of the job will not run to a specially designed pump, then it is necessary to connect the motor and the pump by gearing or belt.

For high speeds belting must be used, but it should be made endless, as small induction motors work with a very small clearance, and a badly made belt joint may thus spring the shaft and cause the rotor and stator to touch.

REVIEWS.

Leçons sur l'Electricité, professées a l'Institut Electrotechnique Montefiore annexé à l'Université de Liège. Par ERIC GERARD, directeur de cet Institut. Tome premier; sixiéme edition. Paris: Gauthiers-Villars et fils.

The new edition of the first volume of this well-known work is a handsome library octavo of 820 pages. It deals with the elementary theory of electricity and magnetism, the general theory and practice of electrical measurement, and the construction of dynamo-electric machinery. The work is extremely well illustrated and well printed. The treatment is not intended for the use of advanced students, and the ground covered is far too extensive to admit of minute discussion of the important points. But the book is well calculated to attract and interest a technical student, while the statements of exact theory are sufficient for the educational purpose aimed at. French and Belgian students are very fortunate in the style in which their text-books are issued.

Gas and Electric Lighting Works' Directory and Statistics. 1899. London: Hazell, Watson & Viney, Limited.

The title of this directory might more truly be rendered: "A Gas Works' Directory, with a Few Pages Regarding Electricity Works," for that is really what it is. The book cannot be classed among those which it is imperative that the electrical engineer should have upon his shelves, unless for the purpose of learning what a splendid future there lies in store for electricity in the establishment of electricity works in all the towns and villages, &c., which now own or contain gasworks. It may be a useful book from this point of view, as a guide to the electrical promoter where next to centre his attentions. Electricity works, although so well represented in the title, are favoured with 38 pages right at the end of the book, the chapter being headed "Directory and Statistics of Electric Lighting Work," and the compiler is not to be congratulated upon the accuracy of some of the information. We will quote just one or two errors which a casual glance over a few pages has disclosed. The Hammersmith works' capital outlay is given as £42,000, whereas it is somewhere approaching double that sum. The Kingswood electricity system, about which everybody has heard, appears in the list, although the very exciting way in which the works were closed, and came under the hammer early in the year, ought to be well known, as well as the fact that gas lighting is now in vogue there. The Bootle Corporation is stated to be proceeding to carry out its electric lighting powers, but we may inform the compiler that the works actually commenced supplying current in April. At the foot of too many sets of general details are words denoting that "no return has been received." This is a difficulty under which every statistician suffers, and it detracts from any electrical value that the work may otherwise possess. There is a general index of officials, and the arrangement and binding of the book are very good, but as a directory of electricity works it is not so useful as it might be. As a gas works' directory it may be all right. Perhaps we may further add that September was rather a late date for the publication of a directory for the current year.

Cours de Physique de l'Ecole Poletechnique. Par M. J. JAMIN. Deuxiéme Supplément par M. BOUTY. Progrés de l'Electricité (Oscillations Hertziennes—Rayons Cathodiques et Rayons X.). Paris: Gauthiers-Villars.

Jamin's "Cours de Physique" is probably, of foreign scientific manuals, the most widely read in England. The new volume, uniform in size and style with the others, deals with the recent developments in electricity, and this mode of bringing the book up-to-date is certainly very convenient. Of the principal chapters, one treats of new instruments and new measurements of electrical quantities; another of the passage of electricity through electrolytes, another of Hertz waves, another of cathode and X rays. It need not be said that the treatment of the subject by M. Bouty is clear and scholarly. It appears to be fully equal to the rest of the series to which it is appended.

The Construction of Cranes and Lifting Machinery. By E. C. R. MARKS. Manchester: The Technical Publishing Company. 1899. 3s. 6d. net.

This is one of the Technical Publishing Company's little manuals, and gives good dimensioned descriptions of a considerable number and variety of types of lifting tackle, including pulley blocks, crabs, hand cranes, derricks, car lifts, jacks, and capstans, and many others, with a couple of chapters on electric cranes. Lifting tackle is not much understood, as a rule, by most engineers, and this book will be found useful in designing such machinery. As the author truly says, a subject of such magnitude cannot be treated within the narrow limits of a small volume, and only more prominent examples have been selected; but the work has been done well, and we can cordially recommend the book to young engineers.

Problems of Machine Design. By CHAS. H. INNES, M.A. Second edition. Manchester: The Technical Publishing Company. 1899.

With slight exception, this book might have been entitled "Problems in Steam Engine Mechanism," for it deals chiefly with the design of parts of the steam engine—governors, shafts, piston and connecting rods, valve gears, &c., and fly-wheels. The section on valve gears is deduced almost

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entirely from the methods of Zeuner, whose graphic system is employed on both simple valves and the more complicated movements of double valves of the Meyer type.

The illustrations are good and clear, and in view of the recent *Bullfinch* disaster, figs. 57 and 58, illustrative of marine connecting rods, are rather noticeable, though the author makes no comment on the weak form of fork.

The chapter on boiler riveting is excellent, the finding of the percentage strength of a joint being well explained.

The chapter on shafting will be found interesting in connection with the recent arguments anent the Glasgow engines, for a table of examples is given, and shows as much as 10,600 I.H.P. through a 20½-inch shaft at 89 revolutions and 10,350 I.H.P. through a 25-inch shaft at 53 revolutions per minute, the boiler pressures being 150 lbs. and 90 lbs. respectively, and the stroke 69 inches and 78 inches for L.P. cylinders 113 inches and 2—100 inches. The examples are from the mercantile marine, and, of course, for screw engines.

For hollow shafting, it appears that the British navy allows 3,000 I.H.P. to pass through a 16-inch shaft with an 8-inch hole through it at 95 revolutions, and Uncle Sam allows 6,750 I.H.P. in the same shaft with, however, only a 7½-inch hole at 129 revolutions. For 5,000 I.H.P. at 164 revolutions, Uncle Sam bores a 6-inch hole out of a 13½-inch shaft, and at almost the same speed—165·3. Her Majesty cuts out 5¾ inches from a shaft of 11½ inches for 4,000 I.H.P. Obviously, the naval practice of the two nations practically coincides. Our author makes a good point on the question of the bending stress on an overhung shaft. The lever arm of the bending moment is commonly taken from the centre of the neck, but this cannot be correct, for, as the author states, it is obviously absurd to suppose that lengthening the journal will increase this overhang stress. But it is important to maintain a proper contact of the brasses right up to the extremities of a bearing. Indeed, for long bearings it would appear to us to be good practice to use two of half the length each, there being a distinct central gap.

Engine balancing is fully gone into, perhaps with too much elaboration of mathematical formulæ.

We should have liked more on shaft or fly-wheel governors, only two being illustrated, and nothing said of the inertia action which adds so much to the rapidity of action of a governor under sudden variation of load.

A final chapter is given to the drawing of diagrams for compound engines. We are glad to recommend this little book to students and young draughtsmen.

Dissected Model of a Direct Current Dynamo. By Arnold Philip, A.I.E.E., B.Sc. George Philip & Son, 1899.

The essential part of this production is, in the author's words, "a dynamo constructed of paper, which can be opened out and its internal anatomy observed." It must be conceded that this is an accurate description. The model consists of a series of coloured plates, partly profiled, and carefully superposed; the outermost represents a complete four-pole dynamo in elevation (orthographic projection); raising this, the reverse shows the machine bereft of its field magnets, while the next plate shows it with the pulley and commutator bars removed. The back of this plate is a compilation of anatomical details, penetrating as far as the naked shaft; when raised it reveals the armature in position in a sectional view of the frame, while the winding can be lifted off, exposing the armature core in *section*. The plates are full of surprises, and remind us of our childhood's days, when "magical books" were in vogue; every little detail is shown, and its relations with adjacent parts made clear. We are not sure that the type of dynamo chosen is the best for the purpose; it resembles the Lahmeyer designs in some respects, but is quite unlike any modern English machine with which we are acquainted.

The model is prefaced by a lucid explanation, which begins with a sort of family tree tracing various forms of energy back to the sun as the ultimate source; this is followed by a condensed treatment of the theory of magnetism, leading up to its application to the construction of dynamos. Armature winding is more fully dealt with in an appendix. An additional cross-sectional view, at right angles to the shaft, would be an improvement; it is difficult to picture the actual machine from views showing two dimensions only.

The work is intended "for the use of general readers and students," and is essentially of the "popular" description; we believe that the principle upon which it is based is of great value, and that *where actual machines are inaccessible* it will go far to fill the want of them.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

19,710. "Improvements in wireless telegraphy." S. G. Brown. Dated October 2nd.

19,758. "Improvements in electric telephony." A. B. MacGregor. Dated October 2nd.

19,781. "Improvements in or relating to electrical switches." S. A. Hunter. Dated October 2nd.

19,785. "Electro-chemical process for cleaning metal surfaces." The Vereinigte Electricitats-Actiengesellschaft and J. Klaudy. Dated October 3rd.

19,787. "Improvements in means for electrically igniting miners' safety lamps." W. Best. Dated October 3rd.

19,793. "Improvements in or relating to the electro-plating and burnishing of certain articles, and in apparatus to be used therein." B. J. Round and A. Round. Dated October 3rd.

19,818. "Improvements in the construction of wicks for oil lamps which are electrically lighted." R. O. Best. Dated October 3rd.

19,825. "Improvements for rendering moulds conducting in the electrolytic bath." H. J. Sheldon. Dated October 3rd.

19,846. "A new and improved conduit terminal and junction box for electric wires." R. M. Thomas. Dated October 3rd. (Complete.)

19,849. "Means or apparatus for recording the electrical vibrations or undulations known as Hertzian waves." W. Friese-Greene. Dated October 3rd.

19,854. "Improvements in electric railways and tramways on the surface contact system." (Post-dated (April 21st, 1899) and renumbered 19,854, under Sec. 7, Patents, &c., Acts, 1883—1888). P. Pinckney. Dated October 3rd.

19,856. "Improvements in magnetic separators." W. Clark. (C. F. Courtney, New South Wales.) Dated October 3rd.

19,863. "Improvements in or connected with telephonic apparatus." W. Gray. Dated October 3rd. (Complete.)

19,867. "Improvements in or connected with telegraphic apparatus." A. C. Crehore and G. O. Squier. Dated October 3rd.

19,916. "An improved safety connecting bar or hanger for overhead electric wires carrying strong currents." W. P. Thompson. (The firm of Petsch and Gürtler, Austria.) Dated October 4th.

19,939. "An electrolytic method for drilling and slotting metals." S. O. Cowper-Coles. Dated October 5th.

19,941. "Improvements in certain electric tramcars." W. H. Pick. Dated October 5th.

19,943. "Improvements in 'trolleys' for electric tramcars." C. K. Everitt. Dated October 5th.

20,002. "Improvements in electric motors." A. Heyland. Dated October 5th. (Complete.)

20,045. "An improved sliding electric light." W. Hooley. Dated October 6th.

20,068. "An improved ohmmeter or apparatus for directly indicating resistances." C. Beez. Dated October 6th. (Complete.)

20,084. "Improvements in the method of and means for transmitting and receiving electric waves for the production of signals and for imparting motion to machines or apparatus." J. Cervera-Baviera. Dated October 6th. (Complete.)

20,110. "Improvements in electrical accumulators." F. Loppé, H. P. Morin, D. P. Martin, and G. J. A. Griner. Dated October 6th. (Date applied for under Patents, &c., Act, 1883, Section 103, April 1st, 1899, being date of application in France.)

20,114. "Improvements in electrophone apparatus." L. E. Wilson. Dated October 6th.

20,121. "Process and apparatus for the production of insulators for electric wires." F. Kappenberger. Dated October 6th. (Complete.)

20,129. "Improvements in the method of lubricating the bearings of commutators of alternate current dynamos." C. B. Crawshaw and J. W. Longley. Dated October 7th.

20,130. "Improvements in motor-starting and regulating switches." C. B. Crawshaw, H. A. Jones, and J. W. Longley. Dated October 7th.

20,145. "The improved combination electric light fittings." W. Sevenoaks. Dated October 7th.

20,153. "Improvements in electrical resistances." T. E. Gambrell and C. T. Gambrell. Dated October 7th.

20,154. "Improvements in or connected with the controllers of electric tramcars or electrically-driven vehicles, machinery, or the like." G. L. Andrews. Dated October 7th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1899.

525. "Improvements in electric signalling." **S. P. Thompson.** Dated January 7th, 1898. Relates to signalling by means of periodic currents in tuned circuits. The provisional specification refers to signalling on all classes of circuits and lines, but the complete specification only describes methods of signalling in which a magnetic field of predetermined frequency acts inductively on a distant field tuned to the same frequency by means of capacities and self-induction to coils. A generator of predetermined frequency is connected

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through a transmitting key with one coil of a transformer. The second coil of the transformer is connected to a coil through tuning condensers and self-induction coils, and may be provided with a spark-gap. At the receiving station a coil and tuning devices are connected to a similarly-tuned receiver or relay. Various forms of receivers are described, including a coil oscillating in a tuned field, a needle or armature suspended by a tuned torsion wire, &c. One form of receiver, having a three-phase rotating field acting on a suspended coil, is described for use with a two-contact key and double-wound opposing generator. 4 claims.

533. "Improvements in electric arc lamps." A. J. Hills. Dated January 8th, 1898. Relates to arc lamps. In a lamp having two or more arcs in series, the upper carbons are carried by rods which slide in a cast-iron casing and are controlled by clutch-washers in engagement with a single forked link; this is hung from a horizontal regulating lever, supported at one end by an upright, and linked at the other to the armature of a series electro-magnet. The movements of this armature are controlled by a dash-pot. In the lamp shown, a second electro-magnet is in series with the carbons, and normally holds up an armature lever from a contact spring: when the current is sufficiently reduced by the lengthening of the arcs, the lever makes contact with the spring, short-circuiting the main electro-magnet, which then allows the upper carbons to drop. This mechanism may be dispensed with. The length of each arc may be further controlled by a wire connected in parallel with the arc, and arranged so that its thermal expansion or contraction raises or lowers one of the carbon holders. 1 claim.

591. "Improvements in telephone transmitters." A. Graham. Dated January 8th, 1898. Microphones. Microphones are constructed so as to be waterproof and to be capable of resisting shocks when used in exposed positions such as on ships, by divers, &c. The disc is of vulcanite fibre, and carries in a recess a carbon cup with a backing of paper, felt, &c. A carbon and a metal diaphragm closes the front of the carbon cup and has its edges preferably soldered to a metal ring. Carbon dust or granules is enclosed in the carbon cup by a felt, &c., ring. A protective perforated sheet is set in the mouthpiece. The joints are all made good by solder, shellac, or other suitable means. 1 claim.

735. "Improvements in switches for use in electric light installations." H. Taffs and J. Hill. Dated January 11th, 1898. Electric switches. Relates to a quick-break switch particularly adapted for use with lamps. A base having perforations at right angles is fitted with spring plunger contacts and with a grooved sliding block of insulating material on which is a conducting ring. On pushing in the block at one end contact is made; on pushing the other end, contact is quickly broken by the plungers springing into the groove. 2 claims.

831. "A system of conducting electricity for propelling, heating, lighting and telephoning from railway vehicles." H. W. Libbey. Dated January 11th, 1898. Electric railways. Relates to a system of conductors and means of connecting such conductors to the apparatus on railway vehicles for propelling, lighting, and heating such vehicles, and telephoning from such vehicles to any point or station. The main insulated T-shaped conductor is supported in a fork which is surmounted by a plunger attached to a take-off T-shaped conductor arranged in insulated sections. The plunger is supported by a soft rubber cylinder faced above and below with hard rubber washers. The wheel is provided with a groove in its flange and has a conducting ring shrunk on to insulation. A collecting roller is mounted on the bogie truck, and is connected to a switch from which parallel branches go to various circuits with their necessary apparatus. Instead of the two leads being arranged on separate wheels, the flange of one wheel may have two insulated collecting rings acting on two main leads close together. 4 claims.

835. "Improvements in single-phase and multiphase alternate current motors." L. B. Atkinson. Dated January 11th, 1898. Electric motors. Relates to monophase alternating current motors, and is in part an extension of the invention described in Specification No. 15,714, A.D. 1895. Instead of short-circuiting the armature relatively to the inducing axis and producing a cross field for starting purposes by means of auxiliary pole-pieces wound in series with the inducing or field coils, the armature is connected in series with the auxiliary winding, and thus itself provides the necessary cross field. Sparking at the brushes may be prevented by so proportioning the fields that the electromotive force due to the movement of the short-circuited coil in the inducing field is balanced by the induced electromotive force due to the cross field. One device for preventing sparking consists in winding the armature with two independent circuits connected to alternate collector sections, and using divided brushes with separate connecting circuits so as to prevent short-circuiting of the coils under the brush. The motor may be regulated by using an auto-transformer from which any desired fraction of the line pressure can be obtained, or by means of a regulating transformer having a variable coefficient of mutual induction. Or a closed coil inducing winding may be used, and the points of connection of the supply circuit varied so as to vary the direction of the inducing axis relatively to the short-circuiting brushes and to regulate the electromotive force induced in the armature windings. One motor has an inducing or main field produced as before by coils in series with the armature, and a "compensating" field produced by coils supplied like those of the main field from the mains but exerting no inductive effect on the armature and being in phase a quarter period behind the phase of the supply electromotive force. After the motor has been started by one of the above methods, it may be run as an ordinary monophase motor, by short-circuiting the coils in groups through slip rings or otherwise, or it may have an independent winding on the armature adapted for connection to the source of supply, the starting winding being used to excite the field magnets so that the motor runs synchronously. To minimise magnetic leakage, the inducing and induced circuits are made as far as possible geometrically coincident. When the winding of the armature is of the ordinary or diametral type, the inducing winding should be either a two-path distributed winding or a spiral non-crossing distributed winding as described in the specification quoted above. Similarly an inducing winding through one or two holes surrounding the pole face requires a chord winding on the armature. 12 claims.

948. "An improved galvanic battery." J. von der Poppenburg. Dated January 11th, 1898. Galvanic batteries. Relates to both primary and secondary batteries. A primary battery consists of a vessel in the lower part of which is placed a layer of calcium sulphate, to which may be added a chlorate in which may be embedded a metal plate. On the layer is placed a hollow carbon electrode in the interior of which is placed a depolarising substance such as potassium sulphate or bi-sulphate, and this substance is prevented from coming into contact with the layer by an insulating cover of asphalt. A porous ring of felt or the like surrounds the carbon electrode, and on this ring is placed a zinc or like electrode. Around the electrode is placed a quantity of an exciting substance, such as ammonium chloride, and the vessel is closed by a sealed cover in which is a funnel for the admission of water to dissolve the exciting substance. The battery is stated to be regenerative. The same form of battery may be used as a secondary battery, in which case the layer consists of spongy lead, the packing consists of lead oxide or manganic oxide, the cover is dispensed with, and the exciting liquid is dilute sulphuric acid. 3 claims.

933. "Improvements in electrolytical condensers and electric current devices." C. Pollak. Dated January 12th, 1898. Electric condensers, &c. Relates to condensers or current rectifiers consisting of electrolytical cells, such as described in Specifications No. 1,069, A.D. 1896, and No. 23,442, A.D. 1897. The electrodes, one of which should preferably be of aluminium, are immersed in an alkaline solution containing potassium bichromate or like chrome compound. In cases where a quick change is not required, soap solution may be used instead of that above mentioned. 1 claim.

1,002. "Improvements in electricity measuring instruments." A. A. Voysey and R. P. Wilson. Dated January 13th, 1898. Electricity measuring. An electrostatic or other voltmeter is used also for measuring current supplied on alternating-current mains, by connecting it with the secondary of an air-core or other transformer, the primary winding of which carries the current to be measured. Switches for changing the connections, and two pointers and scales are provided for pressure and current measurements.

1,011. "Improvements in holders or sockets for electric incandescent lamps." R. J. Bott. Dated January 13th, 1898. Electric lamps.—Relates to holders for incandescent lamps. A holder for a bayonet-capped lamp consists, in the form shown, of a casing and a flanged insulator connected by a screwed ring, and carrying a detached sleeve provided with diagonal slots, into which the pins on a lamp cap can be inserted in one movement. The sleeve is attached to the casing by a tension spring, held by cross-pins, which engage the insulator and prevent rotation of the sleeve thereon. The lamp terminals bear on contact pieces fixed in the insulator by screws which also hold the conducting wires. The spring allows the sleeve to move away from the body of the holder when a lamp is inserted. In a modification the spring is held compressed in a recess in the insulator by a cross-pin carried by lugs extending from the sleeve within the holder. 3 claims.

1,046. "An improved method and electro-magnetic cut-out for automatically disconnecting charged conductors in the event of breakage or short circuit, applicable to overhead systems of electric traction and the like." R. C. Quin. Dated January 14th, 1898. Relates to means for automatically disconnecting charged conductors, such as overhead wires in traction systems in case of breakage, short-circuit, &c. A series coil is in the conductor and a shunt coil is connected to the extremity of the conductor. These coils control a rocking lever fitted with a support for the weighted switch levers. If the conductor breaks no current flows through the shunt coil, and the lever rocks, opening the switch; similarly the switch is opened with an excess current through the coil. The latter may be replaced by a fuse. A pivoted lever carries an armature at each end, and is fitted with a support for a rod connecting the weighted arms which, when released, operates the switch contact lever, both being pivoted at the same place. A spring tends to pull over the lever. In normal working this is prevented by the shunt coil. 5 claims.

1,140. "Improvements in electro-magnets for electric traction." H. M. Leigh. (The Gesellschaft zur Verwerthung Elektrischer und Magnetischer Stromkraft, Germany.) Dated January 14th, 1898. Relates to electro-magnets for use either in actuating the switches which successively energise sections of the working conductor of an electric railway or tramline, or for use in connection with the rails as a magnetic brake. The magnet consists of a central bolt supporting flanged iron bobbins wound alternately with opposing coils so as to form poles of successively opposite polarity. End blocks having ribs sliding in the grooves of the rails may be provided, and a powerful braking action on the rail is effected by the approach of the pole-pieces when the circuit of the electro-magnet is closed. 2 claims.

1,301. "Electric signalling apparatus." F. B. Herzog. Dated January 17th, 1898. Signalling. Relates to an electric signalling or annunciator apparatus, the indications of which are produced by the electrolysis of a suitable solution, such as iodide of potassium. The solution is placed in a tank which is made of insulating material and closed in front by a removable transparent plate and washer held in place by screws. The tank is enclosed in an outer casing, and the bottom is perforated to receive the rubber plugs through which platinum wires pass from the terminals to the platinum electrodes. The supporting-plates of the terminals may be embedded in an insulating-backing of cement, &c. The terminals are connected to push-buttons, &c., at the different sub-stations, one or more of the terminals serving as a common return for all the circuits. When a signal is transmitted, the solution is electrolysed, and a brown deposit of iodine is formed on the corresponding electrode. Each electrode may be surrounded by a glass cup to catch and retain the deposit, which under ordinary conditions gradually disappears. The deposit may be rendered more permanent by the addition of glycerine, &c., to the solution. Hyposulphite of sodium may also be added to retain the solution in its normal condition. The deposit may be dispersed after each signal by blowing air through the perforated tube, or by reversing the current. A bell may also be included in a common circuit when desired. 21 claims.

1,535. "Improvements in incandescence electric lamps and processes for the production thereof." Dr. C. A. Ritter von Welsbach. Dated January 19th, 1898. Electric lamps. Relates to incandescent lamps. Filaments are made of osmium, or alloys of this with ruthenium, rhodium, or other platinum metals, or these metals alone, and may be coated with oxides, preferably of thorium or zirconium. They are mounted in bulbs which are exhausted or contain reducing gases, and under these circumstances may be heated to extremely high temperatures, so as to emit a large proportion of lighting rays. An osmium filament may be made by coating a wire of platinum, or other metal having a high melting point, by warming it electrically in an atmosphere containing a volatile osmium compound and a suitable reducing gas, such as a mixture of hydrocarbons and water vapour drawn from the middle of a Bunsen flame; the wire is afterwards slowly heated more highly to consolidate the osmium coating, and finally until the platinum has evaporated, leaving a coherent tubular filament of osmium, which may contain a little platinum. The osmium coating may otherwise be deposited by electrolysis, or by repeatedly painting the wire with a solution containing osmium, preferably made into a paste with finely divided metallic osmium or an osmium compound, and a binding material. The filaments are mounted on leading-in wires with such paste, and may be repaired with it; they may be flashed with osmium in the mixture of gases referred to. According to another method, a filament is made by saturating or coating twisted vegetable fibre with an osmium compound, and afterwards burning off the carbonaceous material in gas containing steam and hydrogen or carbon monoxide, but no free oxygen. Or collodion containing an osmium compound may be squirted, denitrated, and decarbonised. Coatings of oxides are produced by applying solutions of nitrate or other salts, and heating; platinum wires so coated may be used at very high temperatures. The provisional specification mentions that the repeated coating operations may be performed by a motor. 17 claims.

1899.

9,829. "Improvements in electric signals or indicators." A. W. Staveley and J. H. Parsons. Dated April 27th, 1899. Relates to drop signals. Consists in the use of a non-magnetic extension-piece clipped or riveted to an iron-plate, and forming holes to receive the poles of an electro-magnet. 4 claims.

8,857. "A new or improved quicksilver electric current interrupter." G. Hirschmann. Dated April 27th, 1899. The mercury vein causing the contact is interrupted at intervals by a rotating disc provided with recesses for the purpose of regulating the number of the current interruptions by the number of these recesses and the speed of rotation of the disc. 3 claims.

9,429. "Improvements in electrical arc lamps." J. Rosemayer. Dated May 4th, 1899. Consists in downwardly extending tubes from the upper chamber having openings at their lower ends or of a downwardly extending casing forming a lower annular opening, so as to allow the gases and air within free outlet, but to restrict the outer air from entering. 2 claims.

9,511. "Method of controlling several rotary phase current motors in an electrical railway train from one point of the train." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated May 5th, 1899. The regulation of the turning moment on starting is effected by providing at the driver's platform a suitable apparatus by which the voltage for working all the motors in the train is varied according to requirement which a resistance that is not subject to variations is included in the induced part of the motor. 1 claim.

9,887. "An improved binding post or device for connecting electrical apparatus." H. H. Lake. (A. R. Shattuck, United States.) Dated May 11th, 1899. Comprises a tubular cylinder of conducting material having one end closed, an enclosing cylinder of non-conducting waterproof material closed at one end and receiving and secured to the other cylinder the conducting wire extending through the non-conducting to the conducting cylinder and the insulating waterproof coating of said wire forming an impervious joint with the non-conducting cylinder. 2 claims.

10,317. "Improved electro-plating process and apparatus therefor." E. L. Dessolle. Dated May 16th, 1899. The process consists of (1) cleaning the article to be plated; (2) touching it up; (3) cleaning it by means of a sand blast; (4) preliminary plating in an alkaline or neutral bath; (5) stopping and filling up surface irregularities; (6) second plating in an alkaline bath; (7) final plating in an acid bath. The anode is double for the purpose of evenly coating the article. 4 claims.

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THE

ELECTRICAL REVIEW.

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THE MUNICIPAL MANAGEMENT OF ELECTRICITY WORKS.

THE mental attitude of many present-day students of social problems is crystallised in the phrase that the municipality can do no wrong. It would be idle to deny the remarkable success that has attended the entry of municipalities into electric lighting; the lowest cost of production and the lowest charges to consumers; these are to be found among municipal undertakings. With the glamour of these results strong upon us, it is held almost treasonable to utter anything against the policy of municipal ownership. But despite the list of successes that have followed municipal effort, the honest doubter may have occasional misgivings as to the real soundness of communal enterprise. We admit that it is a great achievement to be able to show what are, on the face, better results than are usually presented by a private undertaking; but it is important that we should not be entirely led away by them. In the conduct of an electricity works it would be unwise to measure success by the cost of coal per unit, or even the total cost per unit; there are other figures to consider besides the mere production. It is obvious that the relation of capital charges to cost of production provides the real test of the commercial soundness of an undertaking, and we are afraid this is occasionally lost sight of when comparative statements are made concerning the achievements of a company and those of a municipality.

There is no doubt a wide difference between the objects of a municipal electricity works and one owned by a private company. In the latter case the interests are well defined, and they do not pretend to go beyond those of the shareholders. But the rights of the customers and the interests of the shareholders are not so incompatible as municipal advocates would have us believe. On the contrary, we are persuaded that a generous treatment of electricity consumers brings an increased reward to the proprietors. Among municipalities great doubt exists as to what should be done with the surplus; while some strenuously argue in favour of reducing rates, others persistently refuse to aid the general body of ratepayers. Though the credit of the ratepayers may be risked to only an infinitesimal extent in the initiation of electricity works, it ought not to be lost sight of that each and every one has a distinct interest in it, and until a municipality brings the supply within the reach of all its constituents, it ought not to be unmindful of those ratepayers who are at present outside the pale of electricity supply.

We are not anxious to start a time-worn controversy, but it is certainly a somewhat curious fact that, until the advent of electricity supply, municipalisation had not taken very firm root. It is true there were corporation gas and waterworks, but the success in the working of these had not been very striking. The supply of electricity is a much more

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technical and complex undertaking than either gas or water, and that being the case, it is, perhaps, noteworthy that municipalities should have achieved success in it. Probably the very fact of its involving scientific knowledge may partially account for its success, for naturally a body of men who could not grasp the principles underlying the generation and distribution of electricity would be compelled to rely on their engineer, and in consequence he would be permitted to follow his own bent in the development of the supply system. Almost without exception, the most conspicuous examples of success in municipal electrical undertakings have been achieved in those instances where the engineer has been given a free hand. It is unnecessary to quote actual cases, for they must be sufficiently obvious to most engineers. Not for a moment do we suggest that the ignorance of committeemen has been always a stepping stone to the success of an electricity works; on the contrary, we are familiar with some local authorities who, in their inability to appreciate the economics of their electrical undertaking, have actually refused to follow the advice of their engineer to purchase an economiser. Under such circumstances the ignorance of the lay mind must be held responsible for extremely uneconomical methods of working. Again, on the other side, one remembers instances where a municipality, being unable to discriminate between sound and unsound engineering, has permitted its engineer to run riot with his fads. Now, whatever may be the shortcomings of a supply company, and occasionally they are many, we cannot conceive of any directorate of business men embarrassing their engineer in the execution of his multifarious duties. Presuming he carried out his work well, to which he would enjoy their confidence, and would be free from the personal attacks he would be occasionally subjected as an officer of a corporation. Moreover, a board of directors would be able to detect, probably more quickly than an electric lighting committee, whether an engineer was developing the system on sound lines, and we think so because a director stands in a different position to a committeeman. No matter how much interest committeemen may display in their electrical scheme, they are not interested in its success in precisely the same sense as a director is. In these days of company promotion and company failure a director is a more or less discredited person, but though we hold no brief for the company's case, we feel no hesitation in saying that the ornamental director is almost unknown in electrical companies. In the development of the electrical supply business, there has seldom been the necessity to hang out delicate baits to hook the public, and hence the electrical director is generally a hard working, sound man of business.

Whatever may be said against the primary principle of municipal ownership, it has become a very real and vital part of our social life, and it is quite reasonable to presume that there will be a wide extension of the system, both in electrical lighting and tramways. Having regard to this widespread acceptance of the principle, we would, in all earnestness, counsel the members of municipalities to modify some of their views regarding the position and duties of an electrical engineer. We have indicated already that an electrical committee may be, under some circumstances, exceedingly well served; yet in one of the most successful municipal schemes in the country the chief engineer, who has had experience in both municipal and private undertakings, has declared, in the strongest possible manner, that it is infinitely preferable to serve a company than a municipal authority. The position of some municipal electrical engineers is almost grotesque, and perhaps the greatest surprise is that electrical men will occasionally suffer indignities in silence. In some instances the very authority of the engineer in his own works is usurped by members of committee, who, ever willing to discover trouble, readily incline their ear to the complaints of the staff. Such a proceeding is invariably attended with disastrous results, and the engineer must either resign his position or be ever afterwards discredited in the eyes of his subordinates. There are some municipalities which have adopted the most unwise course of making their electrical engineer subordinate to the local surveyor. We have nothing to urge against the ability of municipal surveyors in their own sphere, but it is impossible that they should possess without special training the knowledge to control electricity works. Such a dual arrangement can never be successful; the electrical engineer may be blamed for failures and the surveyor may be credited with the successes. Experience is entirely against such a practice, for almost without exception trouble in some form or another has arisen from making the surveyor the nominal head of the electricity works. There is very little doubt that the labour element in municipal life is strongly antagonistic to electrical interests; it is the labour members of a Vestry or a Town Council who insist upon the insertion of objectionable and foolish clauses in electrical contracts, and, curiously enough, it is the labour member who is most troublesome to the resident electrical engineer. If there should be a complaint from a stoker, it is magnified by the labour member into a dispute, and if the electrical engineer requires an increase of salary, the objections arise mainly from the labour section. Most municipalities at the moment are engaged upon schemes of considerable magnitude, which will involve the expenditure of large sums of money, and though we do not for a moment imagine that any electrical engineer would be anything but unswerving in loyalty to the Corporation which he serves, yet we think his tasks would be materially lightened if members of local authorities were to extend to him a little more generous treatment. There are some municipalities whose attitude towards their engineers and officers is one of courtesy and consideration, and in no instance can that fail to produce excellent results.

Aluminium for Electrical Purposes.

DURING the past few weeks we have given some brief particulars of American electrical transmission schemes, in connection with which aluminium is employed for the purpose of electrical conductors. The Snoqualmie Falls system, in Washington State, employs some 67,000 lbs. of this metal of ·26 inch diameter, and 72,000 lbs. of ·23 inch diameter, for transmitting the current from the power station to transformer stations, and from thence to the point of utilisation. The lines extend for a distance of about 20—30 miles. Another similar undertaking is found in California, where aluminium conductors are employed for transmission between the Blue Lakes power house and the Stockton sub-station. The line is 40 miles long, and consists of aluminium weighing 4,194 lbs. per mile. Details are occasionally coming to hand from other parts of America and the Continent, of the utilisation of aluminium in this way, but so far as

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this country is concerned, the developments have not been so great as might, perhaps, have been expected. The only case we know of is that of the Northallerton Electric Light and Power Company, which has made use of aluminium conductors, for which the wire was supplied from the Foyers works. The latest reports received are to the effect that it is giving satisfaction. But, apart from this, our progress has been rather slow, although sure. As our readers are already aware, the Foyers Company has for some time past employed aluminium wire for both lighting and power purposes, and also for telephones, while certain electrical supplies firms in London and elsewhere are experiencing a demand for such wires for electrical use. The Foyers works have turned out trolley wire for an electric tramway system, but we believe this particular installation has not yet been completed. Among the other interesting developments may be mentioned negotiations with the General Post Office, having in view the adoption of aluminium wires for long distance telephony. As a matter of fact, a length of line has been put up for this purpose for trial. The question of jointing is of great importance, and several forms of joints have been tried, but we are not in a position at the moment to say which form has so far proved the most suitable, although they are all more or less so. It is believed that inquiries for aluminium for electrical work will increase when engineers get to know more about the properties of the metal. Of course, it is not for a moment to be expected that aluminium will be able to replace copper for insulated conductors, because the larger section would involve a very much greater expenditure upon insulation, but for bare conductors of telephone lines, &c., it possesses several distinct advantages over copper. We hear various reports from time to time that the prevailing high prices of copper will not continue long, but it is difficult to indulge in prophecy with much likelihood of accuracy. Whatever may be the developments of the next few months in the price of copper, the cost of aluminium at present is considered to give it a considerable advantage under this heading, although we are given to understand that the British Aluminium Company has always been prepared to deliver aluminium in whatever form it is required, at a cheaper rate than copper can be obtained at. Secondly, the saving in weight ought to be taken into consideration. For the same conductivity, aluminium will only weigh half the weight of copper; this means, for instance, that in the case of telephone lines, a considerable saving can be effected in the number of poles, and in the ease of transport, especially where the conductors have to be carried to places difficult of access, there ought to be a considerable saving in freight.

Municipal Authorities and Electric Supply Competition.

THE Association of Municipal Corporations has again, by formal resolution, pledged itself to do everything that lies in its power to defeat all large electric power schemes under which the promoters may desire to compete with existing municipal electricity works on their own ground. Their efforts are brought to bear in this direction with a view to preventing injurious effect upon installations established in the interests of ratepayers. We believe the members of this Corporation underestimate the benefits that many of the larger ratepayers (factory and works owners, &c.) in the interested localities, would derive from a cheap, plentiful, and efficient supply of electrical energy. We are inclined to think that in many places where municipal electricity works have been established, the question of large power supplies did not receive anything like the merited attention (even if it does now!) until the schemes now assailed were introduced. The installations were started primarily for public and private lighting purposes, and there is plenty of scope for municipalities in that direction. But we maintain that the supply of large quantities of power for such purposes as are now under consideration was not entertained or even considered within the range of possibility, but it is now such a crying necessity that Parliament would be fully justified in allowing a private company to come in to provide what the local authority does not, and cannot, give so cheaply. We believe that the injury to municipal works is more fanciful than real. Doubtless the Association mentioned, has renewed its deliberations and vows, in prospect of the promised reintroduction in the present Parliamentary session of the Bills which were ruled out last year. For ourselves we hope that in the interests of the electrical industry and of power users generally, the measures will meet with more success this time. That they are timely proposals to meet a great want is indisputable; the only point against them seems to be the question of injury to municipal plants. This is one way in which our municipal system, as it exists at present, militates against the prosperity of our national industries. To them, what is more essential than cheap motive power?

Concentration v. Sub-division of Electricity Works.

COMMENTING recently upon the "follow-my-leader" tendency which it observes in the design of electricity works, an esteemed contemporary takes the breakdown which left Manchester in darkness for 10 hours, as a text upon which to base an argument against the general practice of providing single stations for the supply of large areas. In support of this contention, it is alleged that continuity of supply must be the paramount consideration in the design of the system of supply, outweighing even cheapness of production. To a certain extent we are in agreement with this view; there can be no doubt that interruptions of supply have in the past caused great injury to electrical undertakings, especially where these were in direct competition with similar systems, but we join issue with our contemporary when it is said that several generating stations should be scattered about a large town instead of concentrating the plant in one building. The first thing to be considered, in the interests of the proprietors—whether these be shareholders or ratepayers—is how to supply electrical energy most cheaply to the consumers. In our opinion this is best achieved by bringing the whole of the generating plant together under the eye of the chief engineer, and simplifying the system of supply to the last degree possible. To avoid accidents, such as the one cited above, the sub-division of the generating plant into groups, each complete in itself from boiler to dynamo, would constitute a valuable precaution; the sub-division might even be carried as far as the switchboards and feeders, leaving the distributing network to form the only connecting link between the groups, in which case there would be practically as much safety as with separate stations, without the divided responsibility and increased staff required by the latter. "Fashion" is not always to be condemned; it is at present the fashion to equip tramways with electrical plant—long may this endure! Moreover, if every engineer were to follow the bent of his own ideas, what an extraordinary perplexity of designs would be brought forward! At a time when "standardisation" is universally called for, an outcry against fashion seems to us to be singularly inappropriate and thoughtless. The very fact that a certain design becomes generally adopted is in itself presumptive evidence that the design is a good one; we see this process taking place all round us, in every department of life, and while it does not follow that in every case the design adopted is the only good one of its kind, yet it is tolerably certain that it has real and substantial advantages as compared with its predecessors.

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THE MAGNETISATION OF COBALT.

A very complete account of the magnetic properties of cobalt is given in a paper read before the Physical Society in June last by Prof. Fleming, A. W. Ashton, B.Sc., and H. J. Tomlinson.* Cobalt stands next to iron in its susceptibility to magnetism, and although determinations have been made of its magnetic constants, no very complete set of observations on the magnetic hysteresis values of commercial cobalt have hitherto been made. This investigation therefore fills a gap in our knowledge, and we give a short account of the most important results obtained.

The experiments were made on a circular ring of the metal, cast by Messrs. H. Wiggin & Co., of Birmingham, the outside diameter of which, when turned up, was 13·84 centimetres. A chemical analysis showed that the metal contained nearly 1 per cent. of iron, 1 per cent. of nickel, and 1·36 per cent. of carbon, besides small quantities of other substances.

The ring was wound with primary and secondary coils of insulated wire, and the induction was measured by the ballistic galvanometer in the usual manner.

The first set of experiments consisted in taking careful sets of complete magnetic (B.H.) cycles; and from these the hysteresis losses in ergs per cubic centimetre per cycle, corresponding to known maximum flux densities, were calculated by measuring the delineated areas. A Steinmetz curve (fig. 1) was then constructed showing the relation of the hysteresis loss in each cycle to the maximum induction for that cycle.

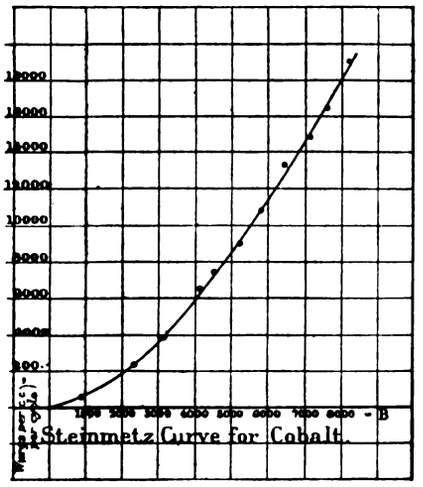

FIG. 1.

This was converted by taking logarithms (ordinary) of both variables, and plotting a logarithm curve (see fig. 2). This last curve proved to be nearly a straight line.

If W = magnetic hysteresis energy loss in ergs per cubic centimetre per cycle, and
B = maximum flux density (induction) during the cycle,
I = maximum magnetisation during the cycle,

then the logarithmic curves show that over a wide range

$$W = 0{\cdot}01\ B^{1{\cdot}6},$$

$$W = 0{\cdot}527\ I^{1{\cdot}62}.$$

These exponential expressions show that the relation found by Steinmetz for iron and steel, and by Kennelly for nickel, holds good also for this sample of cobalt, namely, that the hysteresis loss varies as the 1·6th power of the maximum flux density during the cycle.

It is remarkable that for materials differing so much as the cast cobalt and soft annealed transformer iron, the hysteretic exponent should in both cases be so near 1·6. At low inductions, however, the hysteretic exponent increases in value in all cases. In the case of iron it is well known that magnetic hysteresis becomes zero before the maximum induction becomes zero. There is, in fact, a non-hysteretic range of cyclical magnetisation. Hence it follows that for some small value of the maximum flux density, there must be a range of flux density during which hysteresis increases from zero to a finite value; in other words, its rate of change is then very large. Hence $\log_{\cdot 10} W$ will have a very large negative value corresponding to a certain small value of

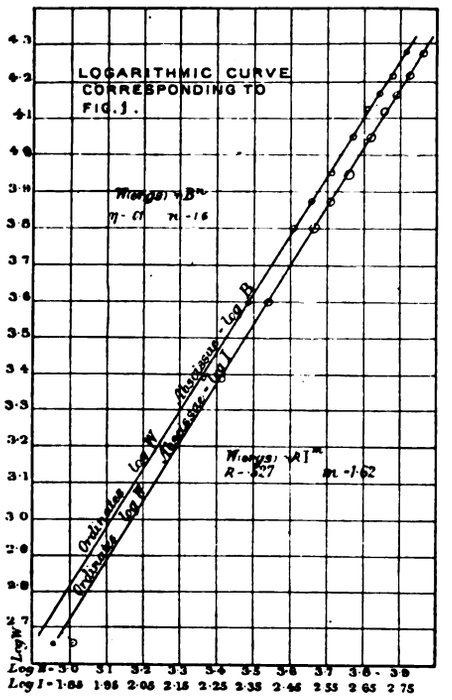

FIG. 2.

$\log_{\cdot 10} B$, and accordingly it follows that the hysteretic constant, n, which is represented by the tangent of the inclination of the line (log. W . log. B), cannot have the value 1·6 throughout all values of B max., but must increase as B max. decreases. That this is also the case for the sample of cobalt is well shown by the lowest observation points on the logarithmic curve (fig. 2).

It is usual to express W in terms of B, but the authors consider that it would be better to express W in terms of I, since of the three magnetic vectors, H B and I, I has reference to the properties of the material itself, B to those of the material and the space it occupies as well, and H may be

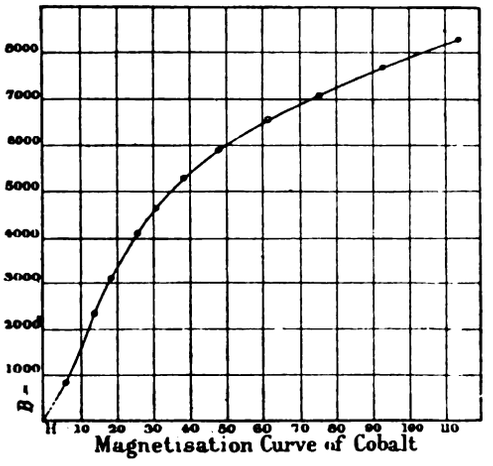

FIG 3.

looked upon as denoting the space qualities only. Hence magnetic material qualities, like W, should be expressed in terms of I rather than B; the logarithmic curve connecting $\log_{\cdot 10} W$ and $\log_{\cdot 10} I$ is given in fig. 2.

The observations furnished a simple magnetisation curve for the metal (fig. 3), and a series of values of the permeability stated in terms of flux density, B, and of the magnetic force, H.

Corresponding experiments were made on a ring of cast-iron of a quality used in dynamos. The results are interest-

* *Phil. Mag.*, Sep., p. 271.

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ing for comparison. The following tables show the values of the induction and permeability for various magnetising forces in case of the specimens of cobalt and cast-iron which were tested.

MAGNETISATION CURVE, PERMEABILITY, AND HYSTERESIS VALUES OF CAST COBALT.

H	B	μ	Hysteresis loss in ergs per cc. per cycle.	Hysteresis loss in watts per lb. per 100 cycles per sec.
6·67	911	137	452	·254
13·23	2,341	177	2,454	1·379
17·91	3,106	173	3,956	2·222
25·76	4,110	160	6,292	3·535
30·53	4,589	150	7,374	4·143
38·56	5,216	135	8,953	5·029
48·54	5,869	121	10,937	6·144
61·08	6,519	107	13,235	7·436
75·46	7·052	93	14,642	8·226
93·18	7,622	82	16,518	9·280
114·03	8,237	72	18,950	10·646

H is the maximum value of the magnetising force during each cycle.
B is the maximum value of the flux-density or induction.
μ is the value of the permeability corresponding to the annexed values of B, and the hysteretic losses also corresponding to the values of H and B are given in ergs and watt-seconds.

OBSERVATIONS ON THE MAGNETIC HYSTERESIS OF CAST-IRON. MAGNETISATION CURVE.

H	B	μ	H	B	μ	H	B	μ
·19	27	139	8·84	4,030	456	44·65	8,071	181
·41	62	150	10·60	4,491	424	56·57	8,548	151
1·11	206	176	12·33	4,884	396	71·98	9,097	126
2·53	768	303	13·95	5,276	378	88·99	9,600	108
3·41	1,251	367	15·61	5,504	353	106·35	10,066	95
4·45	1,898	427	18·21	5,829	320	120·60	10,375	86
5·67	2,599	456	26·37	6,814	258	140·37	10,725	76
7·16	3,350	468	36·54	7,580	207	152·73	10,985	72

BRUSH ROCKER DETAILS AND BEARINGS.

By E. K. SCOTT.

BRUSH-HOLDER spindles which are simply fixed in a round bush as shown in fig. 1 have a very awkward habit of turning round when not expected, and so releasing the pressure on the brushes. Various ways of keying the spindle by means of fibre or hardwood pegs are shown in figs. 2, 3 and 4; in the figs. 2 and 3 they pass through the cast-iron rocker, the insulating bush (shown in section), and the spindle. None of these, however, can be said to be a really good job, and the best way undoubtedly is to hold the rocker spindle in a square bush as in fig. 5.

This last figure shows some features the writer introduced on a line of machines which he designed for the Brush Company. It will be noticed that the nut holding the brush spindle

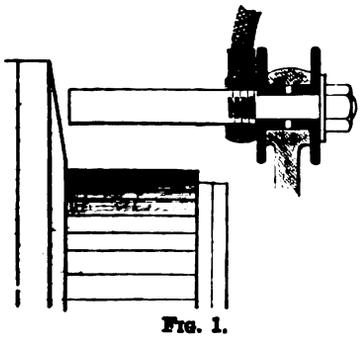

FIG. 1.

in position is on the commutator side of the rocker, instead of being outside as shown in fig. 1. The advantage of this is that the brush-holders may be easily removed by simply slackening off the nut and drawing out the spindle. With the usual arrangement it is generally necessary to dismantle the complete brush rocker to get at the holders, as the spindle

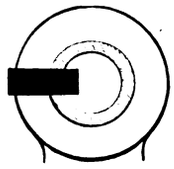

FIG. 2.

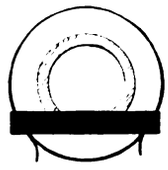

FIG. 3.

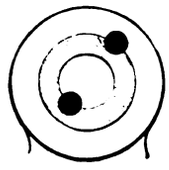

FIG. 4.

comes close up to the upright of the commutator segments and cannot be drawn back.

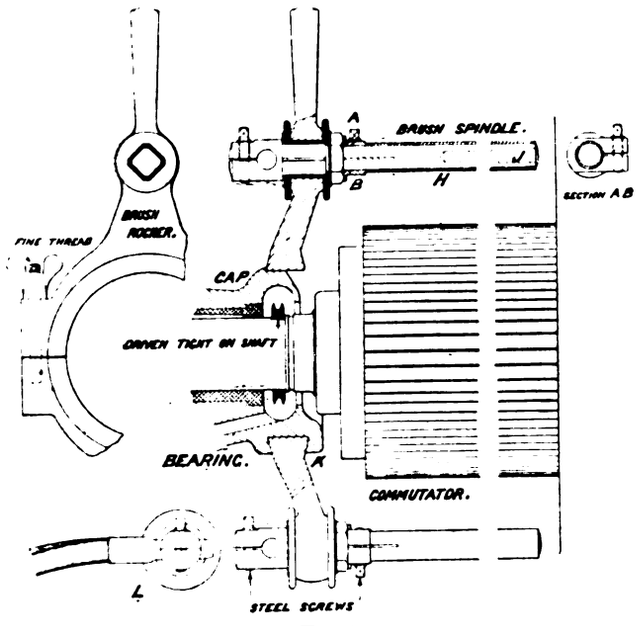

FIG. 5.

Another advantage of this construction is that it enables the connection with the flexible cables to be made direct on to the brush spindle as shown in fig. 5. The joint shown here, and in figs. 6 and 7, is so immensely superior to the ordinary cable eye or taper socket that it has always puzzled the writer why it has not been more generally adopted.

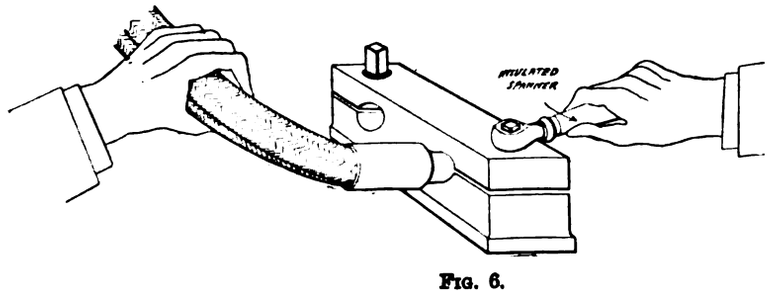

FIG. 6.

The idea came over to this country with the introduction of the Siemens and Halske brush-holder, and the writer employed it on some dynamos as early as 1892. The ad-

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vantage of the arrangement for high tension work will be obvious from fig. 6. As some readers probably know, terminals which are supposed to be dead have a knack of being connected up after all.

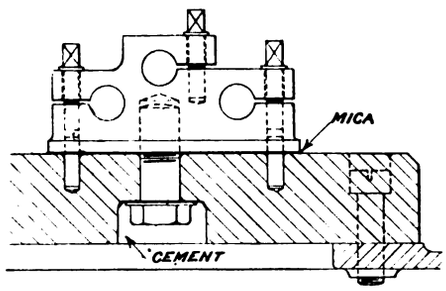

Fig. 7.

Some specifications have asked that all the brushes should be capable of being lifted off the commutator at once, and where there are six or more side by side it is a convenience. One way of carrying this out is to mount a sleeve H (see fig. 5) on the brush spindle. This sleeve carries the holders, and being split at the rocker end, the screw shown in section A, B, can be used to clamp it in any position. In multipolar machines all the brushes on the various spindles may be lifted together by rotating the rocker spindles slightly, the necessary movement being given to them by attaching arms which project inwards to a central ring capable of rotation. The spindles are prevented from moving except when required by anchoring this ring firmly.

A quick and slow adjustment for the brush rocker is sometimes asked for, so that when a large increase of load comes on, or in shutting down, the brushes can be pushed over quickly. Messrs. Holmes have a rather neat method of effecting this, which is shown in fig. 8. The rocker revolves on a fixed ring, A,

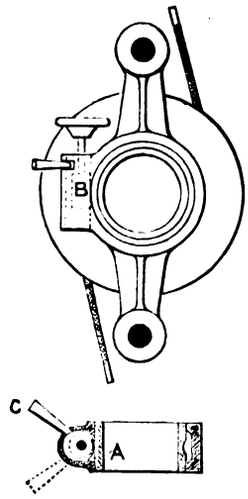

Fig. 8.

having worm-wheel teeth cut into its periphery, and into which the worm, B, gears when the handle, C, is in the position shown in the full lines. If, however, it is turned over to the dotted position, the worm is lifted out of gear on account of its spindle being mounted eccentrically, and the rocker may then be pushed sharply backwards or forwards by hand.

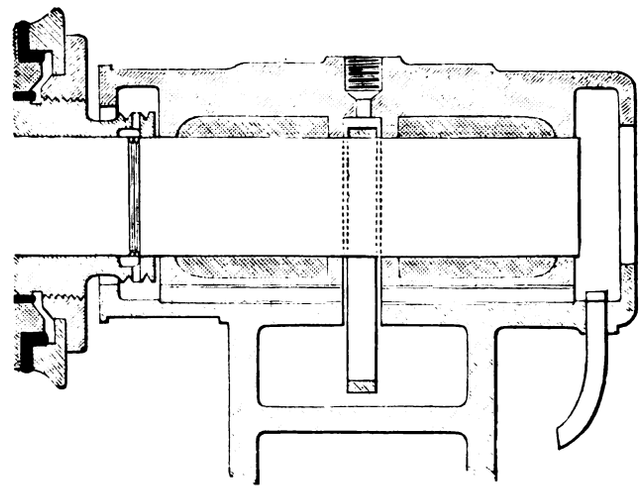

Fig. 10.

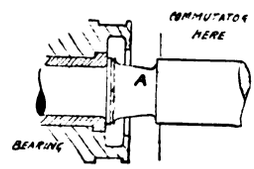

Fig. 11.

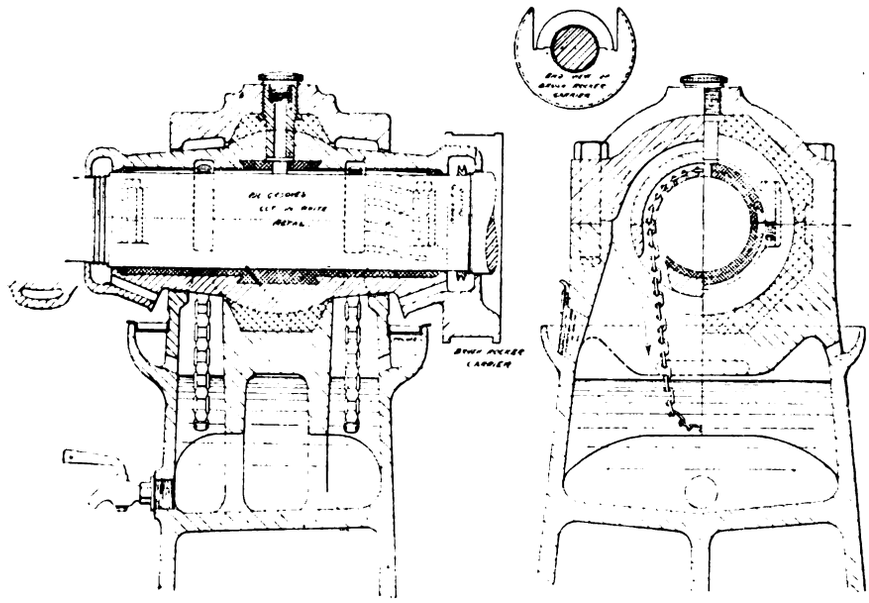

Fig. 12.

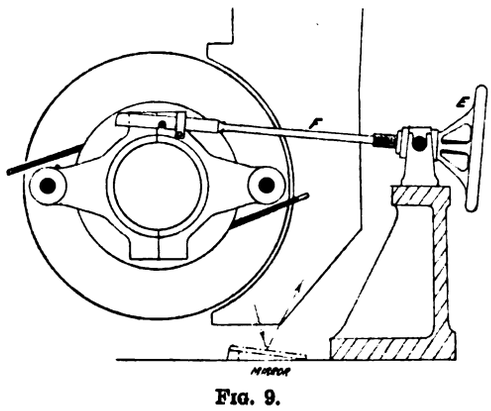

Fig. 9.

Another method somewhat similar to an arrangemen which the writer put on a double commutator machine for a Lancashire central station, is shown in fig. 9. As the fine adjustment had to be effected some distance away from the brushes, the hand-wheel, E, acts as a nut to the connecting link, F. If occasion should arise when the brush rocker requires a quick movement, one has to lift up the link slightly and adjust the rocker by hand. By turning the hand-wheel, the notch in the link can then be allowed to fall into position again.

The condition of the brushes can be observed in an awkward place, such as a commutator next to the fly-wheel of a Belliss or Willans engine, by fixing a small mirror in the position shown dotted.

In assembling a brush rocker and fittings together, it is advisable to thickly shellac varnish the insulating bushes, so

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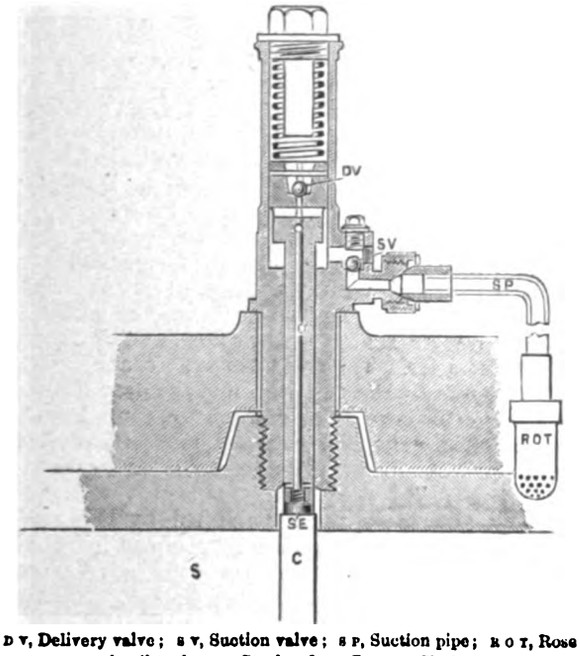
that when they are tightened up the crevices are filled, and there will thus be no opportunity of moisture getting in.

Oil creeping along the shaft and getting on to the brush rocker has often given trouble. The creeping is best prevented by having efficient oil-throwing grooves cut into the shaft, but sometimes the grooves are arranged on a separate ring, which is caulked tight on to the spindle, or else they are cut on a projection of the commutator bush, as shown in fig. 10. If turned in the shaft they should have a very sharp edge to throw the oil efficiently, but care must be taken to have the bottom of the groove well rounded out, otherwise the spindle may be very much weakened. As the centrifugal action tends to cause the oil to run up on to the largest diameter when it escapes from the end of the bush, creeping towards the commutator may be prevented to some extent by turning down the shaft, as shown at A in fig. 11.

In ordinary two-pole and small multipolar machines the rocker is commonly carried on a projection of the end bearing, and as the joint of the bearing cannot be made very tight it sometimes happens that there is a leakage of oil. By adopting the method shown in fig. 12 the rocker need not come near the joint at all, and should it be necessary to remove the top bush, this can be readily effected without interfering with the brush gear. The arrangement is similar to that employed by Messrs. Johnson & Phillips. Of course, in multipolar machines the commutator becomes so large in diameter that it is better to carry all the brush gear by brackets attached to the magnet yoke. In fact, for those machines in which the armature is mounted on the engine shaft this is the only possible construction.

The design of swivel bearing shown in fig. 11 is one which the writer got out some years ago, and there are two features in it which may be worth mentioning. The first is that the seat for the bush is made of white metal which is run in, when the armature has been placed central in the polar



D V, Delivery valve; S V, Suction valve; S P, Suction pipe; R O T, Rose in oil tank; S E, Steel end; C, Cam; S, Shaft.

FIG. 13.

space. In this way machining is dispensed with, and the pedestal may be cast in one piece with the bedplate, giving a cheap and neat-looking construction. The second feature is the use of chains for lifting the oil instead of the usual loose lubricating ring or the original fixed Mohler ring.

This chain method, first introduced on the Brush-Falcon dynamos, proved so successful that it was adopted on the Mordey alternators and other machinery. One advantage of the method is, that as the links dip down much lower into the well the height of the oil need not be gauged to such a nicety. The chain also lifts more oil than a plain ring, and can therefore be used on shafts running at slower speeds. It is specially made of stamped iron links so arranged that the chain may be easily divided at any point by simply turning one of the links at right angles to its usual position.

With the ordinary ring it is necessary to remove the bearing to get it off. Messrs. Thomas Parker, Limited, have, however, got over this difficulty by making the ring in halves, hinging one side and having a snap joint at the other. When the speed of a shaft falls much below about 220 revolutions, both oiling ring and chain methods fail, and the bearings must then be supplied by a small wheel pump working on the same principle as the Roots blower and driven from the dynamo spindle, or else as in the Electric Construction Company's machines by a small plunger pump (see fig. 13), worked by a cam or eccentric cut on the shaft. Messrs. Thomas Parker, Limited, have adopted a similar device, but the pump in this case is on the lower side of the bearing, and oil therefore flows into it by gravity.

THE "SAME CIRCUIT" METHOD OF INCANDESCENT LAMP PHOTOMETRY.*

In the measurement of the candle-power of incandescent lamps, it is customary to use as a working standard of comparison at one end of the photometer some form of standard oil burner, or a previously tested incandescent lamp carefully maintained at its rated voltage. A simple kink of photometric work known as the "same circuit" method, which does away with the bothersome oil burner and eliminates any calculation involving voltage, has come into extended use by lamp manufacturers, but does not as yet seem to be generally appreciated and used as it might be by central station men. It is based on the principle that if two incandescent lamps are supplied from the same circuit, and are burned at about the same brilliancy, their candle-power will increase and decrease in the same proportion with changes of voltage, and their relative candle-power will remain constant.

If, then, a working standard is mounted on one end of the photometer bar and the lamp to be tested at the other end, and both are supplied with current from the same source, even if the voltage fluctuates, the candle-power of both lamps will go up and down together, and the relative candle-power or the position of the photometer screen over the scale will remain constant. Obviously no accurate voltmeter measurement is needed in this method of working.

The connections when working in this way are shown in fig. 1, where S is the standard lamp and T that under test, connected across the same leads supplied from a source of power at the left. If this source of power is of a much higher voltage than that of the lamps—as it is likely to be in central stations having a considerable drop in their

FIG. 1.

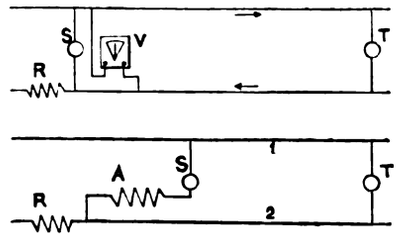


FIG. 2.

feeders—a rheostat should be inserted at R to cut down the pressure and to avoid deterioration of the standard, as well as to bring the two lamps to about their normal voltage. Care should be taken in this case not to turn off the lamp, T, as the reduced drop in R would raise the pressure on the standard, S. Wherever a pressure within 2 or 3 volts of that for which the lamps are rated is available, no resistance is necessary.

A voltmeter may be inserted, as shown, in order to have the lamps at about their rated voltage, since, if the voltage is raised considerably above, or lowered considerably below, normal, the candle-power of the lamp under test might not go up or down exactly the same percentage as that of the standard lamp unless both filaments were of the same physical characteristic, and particularly possessed the same ratio of graphitic to base carbon. Over considerable fluctuations of

* *American Electrician.*

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voltage, however, such as 3 or 5 per cent., the candle-power of all lamps varies in so nearly the same proportion that the adjustment of the voltage, with any care whatever, is not necessary. The adjustment of the lamps to normal candle-power by the eye is quite sufficient, so far as accuracy of the measurement is concerned. The meter may, however, be useful to prevent overburning the standard. Obviously the reading of this voltmeter does not enter into the calculation of the candle-power which is read off immediately from the scale.

When it is desired to test lamps all of one rated voltage, the system is obviously most simple, and when lamps of different voltages must be tested, the only addition necessary is a number of working standards, one for each different voltage. If it is not desired to keep in hand and calibrated so many different working standards, one may be made to serve over a small range of voltage by means of an adjustable photometric scale. For instance, if the working standard gives 16 C.P. at 112 volts, 110-volt lamps may be compared with it by sliding the scale to favour the lamp under test by the difference between the candle-power of a lamp burned at 110 and 112 volts. In the same way the 112-volt standard may be used for testing 114-volt lamps by sliding the scale in the other direction, *i.e.*, to favour the standard, to a point determined by a graduated set of marks on the instruments. The tests may be carried out as explained above, with a pressure on the lamps equal to or somewhat less than that at which the working standard is rated, and either steady or fluctuating.

To reduce the number of standards required for a photometer designed to measure a general line of lamps from 50 to 250 volts, another modification may be made by inserting a resistance in series with the standard lamp alone. The arrangement of the circuit in this case is shown in fig. 2, where the added resistance is represented by the letter A. This resistance should be made adjustable, and may be calibrated so that even in this case no voltmeter measurement is necessary. An explanation of the proper value of this resistance is best given by taking a specific case. Assuming that the lamp, S, gives 16 C.P. at 100 volts, and T is rated at 110 volts, the resistance, A, should be sufficient to absorb just 10 volts and give S 100 when the voltage between wires 1 and 2 is 110. The two lamps will then both receive their normal voltage when the difference of potential between the wires, 1 and 2, is 110 volts, and will rise and fall in candle-power equally when the pressure varies. If the resistance of A is increased sufficiently to give a drop of 12 volts out of 112, it adapts the instrument to measure lamps of the latter pressure. Thus the photometer may be made to measure lamps rated at any pressure above that of the standard, in this case assumed to be 100. The resistance of A may be made adjustable with a contact travelling over a scale direct reading in terms of the voltage to which the resistance adapts the standard lamp, so that when it is desired to measure lamps rated at 114 volts, for instance, the contact is set opposite the 114-volt mark, &c. The resistance should, of course, have a negligible temperature coefficient.

Portable photometers of extreme simplicity and light weight may thus be made and fitted with three standards, one for lamps of 55 volts or thereabouts, another for 110 volts or thereabouts, and a third for 220 volts or thereabouts. The "same circuit" method should prove of the greatest value in central station photometry where the simplicity of its apparatus and circuits, the absence of several simultaneous readings, the total elimination of corrections and calculations, and the ability to work over a considerable range of pressure, steady or fluctuating, should commend it for use in place of any other method.

REVIEWS.

Arithmetic of Electrical Measurements. By W. R. P. Hobbs. Seventh Edition. London: Thomas Murby.

This book is intended to set forth clearly and concisely the application of Ohm's law to electrical measurements *in practice*, and consists of short explanatory notes and worked examples, followed by numerous test problems. In spite of its practical aims, the work has a strong flavour of "science and art school" teaching, as exemplified by the repeated use of such expressions as "multiple arc," joining cells "for quantity," "electromotive force at the terminals" of a battery or dynamo, &c.; while four chapters are given up to academic problems founded on the coupling of cells in parallel and series, and in opposition to one another. The author identifies the "best effect" with the "strongest current," ignoring the inefficiency of this arrangement.

We should not be sorry to see a text-book issued which ignored the existence of primary cells altogether. There is a misprint of + for × on page 52; Minotto is, as usual, wrongly spelt Menotti; a "constant variation" is mentioned on page 94; and "conductivity resistance," whatever that may be, on page 110.

Lezioni di Elettrotechnica dettate nel R. Museo Industriale Italiano in Torino. By Galileo Ferraris. (Published under the auspices of his family and of the Italian Institution of Electrotechnics.) Vol. I. Turin: Roux, Frassati e Co.

Galileo Ferraris was born in 1847 in Livorno-Marcellese, and died in February, 1897. His short life of 50 years was one of incessant literary and scientific activity. His first publication, a paper on "Teledynamic Transmission," was printed in 1869, the year of his graduation at Turin. Of his early work the best known is a book on "Geometrical Optics and Optical Instruments," which has been translated into several languages, and is still used as a text-book in Germany. His future reputation will undoubtedly rest mainly on his discovery of the rotating magnetic field, the principle of action of the modern two and three-phase transmissions of power; he was experimenting on this in 1885, but no account was published till 1888, when he read a paper before the Academy of Sciences at Turin describing his results. "In 1886," we quote from a contemporary journal, "Prof. Ferraris was appointed by the Minister of Public Instruction to deliver a course of lectures on 'Electricity' to graduate engineers at the Industrial Museum of Turin. These lectures, to which the Professor has devoted a great deal of activity, were a marked success from the beginning. The attendance increased from year to year, and at present the lectures furnish the leading course of electrotechnics in Italy. These lectures are models of their kind, and of the highest scientific character. Their conciseness, a charming literary form, and especially their expression of the deep feeling and enthusiasm of the devoted man of science, cause them to be interesting to an unusual degree, and make those who had attended the course proud of the honour of having been pupils of Prof. Ferraris."

These lectures were never published by Ferraris himself, but some of his pupils have collaborated in publishing them, after his death, from their own notes, as an expression of respect and devotion for their late teacher. The passage we have quoted above, and the editorial preface to the volume, are both eloquent of the man's inspiring personality and scientific distinction, while the volume itself cannot fail to impress the reader as being a highly philosophical statement of the existing views of electrical science.

Prof. Ferraris (we quote from the preface) had himself intended to publish a treatise on practical electricity, or else a series of monographs on the subjects taught in the schools. He had actually realised part of his design by writing "A Geometrical Theory of Vectorial Fields," which was intended to form the first chapter of the introduction to his treatise. This essay was presented to the Academy of Sciences in Turin some months after the death of Galileo Ferraris, with a brief preface by Prof. Corrado Segre, and was published in the "Memoirs of the Academy," Vol. xlvii., 1897. From the character of this fragment it is clear that the complete work, matured in his singularly lucid mind, would have been of capital importance both to science and to engineering.

The present volume contains only the theoretical part of the course, and is complete in itself. The treatment is

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essentially geometrical, and the attention is constantly fixed on the vectorial distribution in space. Symbols are employed mainly for statement; there is little mathematical process.

This volume may be followed later by a second on the applications of the theory.

Manual de Télégraphie et de Téléphonie. By J. PIERART. New Edition. Bruxelles: En Vente Chez l'Auteur.

This is a handy and up-to-date little book and really contains an immense amount of information judiciously condensed.

The first four chapters are headed "Electricity," "Batteries," "Magnetism," and "Electro-Magnetism." In "Electricity" the writer does not deal with the usual "sealing wax and pith ball" description, but plunges at once into the subject of how electricity can be produced, and gives brief descriptions of certain of the phenomena and laws of electricity, descriptions quite sufficient for the purpose. "Batteries" are dealt with at a greater length. Descriptions of the various kinds of batteries are given briefly; also the faults to which the cells would be liable in practice are referred to, and the way to pick out a bad cell is stated. It may be questioned if there was really any necessity to have described the Bunsen cell, seeing that it is never employed for either telegraphic or telephonic purposes, and the space occupied in the description might, perhaps, have been more usefully employed. The accumulator being now extensively used in telegraphy, comes in for a suitable amount of attention. "Electro-magnetism" is well dealt with, the descriptions of various kinds of electro-magnets, as used in telegraphy, being satisfactory. Chapters V., VI., and VII., dealing respectively with "Telegraphy," "Telephony," and "Simultaneous Telegraphy and Telephony," form the bulk of the book, and are very practical in their contents. Necessarily they deal with the subjects from a Belgian point of view, though not exclusively so. It is perhaps a little curious that the English standard relay should be simply designated "Standard Relay:" it may be remarked that the resistance of each bobbin is incorrectly stated to be 600 ohms; 200 is the standard value to which these relays are always wound, giving 400 in "series," and 100 in "multiple;" possibly, however, these relays are used in Belgium, wound to 600. The latter country being the home of the Van Rysselberghe system, simultaneous telegraphy and telephony naturally come in for a fair amount of notice.

Altogether, the book is a good one, and is very unpretentious.

Arc Lamps and How to Maintain Them. By H. SMITHSON and E. R. SHARPE. 1899. London: Whittaker & Co.

This little book is addressed to the ordinary consumer, and is intended to show him how to treat an arc lamp, to keep it in good order, and to effect minor repairs. The mechanism of a number of well-known lamps is described, but the total absence of illustrations of the working parts greatly detracts from the value of the descriptions; the style is disconnected and rambling, and the matter does not bear evidence of the 10 years' experience claimed by the authors.

On page 13, dealing with two lamps in series, only one of which lights up, they say that the fault may be due to "no circuit!" The kilowatt is repeatedly called a unit, meaning a Board of Trade unit; a "large leakage" is called a "short circuit"; a method is hinted at by which incandescent lamps are used to indicate leakage from one wire to another, or a short circuit. The normal length of an open arc is given as $\frac{3}{32}$ inch; this is much too short. The enclosed arc is said to burn in a partial vacuum, which is absurd. For 10 and 12 amperes, positive carbons of 18 mm. are recommended, with negatives 11 mm.; 15 and 11 mm. would be more correct. One valuable piece of advice is given—when lamps cannot be got to burn well, *call in an electrician who understands arc lamps!*

OIL ENGINE TESTS.

THE oil engine is gradually achieving for itself a position as a recognised motive power, and the July trials carried out by the Highland and Agricultural Society of Scotland serve as a reminder of this, and the figures obtained will become the new standard of comparison for oil engines for some time to come. We observe an improvement upon previously recognised figures of comparison.

The trials carried out at Edinburgh were made necessarily on such small engines as could be taken to an agricultural show, the largest being of 20 B H P., and the only oils used were Russolene and Royal Daylight, costing 6½d. per gallon at Edinburgh, but any ordinary oil appears suitable within reasonable flashing points. The power was tested by a rope brake.

The full load trial on the first day was 4 hours, the full load being the declared B.H P. On the second day a 2 hours' run was made at half load, and finally every engine was run up to its maximum performance. Engines had to start cold, and time was noted in the getting up to full load. The Trials Committee report that the engines all ran well except in two cases where there were outside reasons for some little difficulties. They were all fairly economical. The largest engine tested was one of 20 B H P. by the Campbell Gas Engine Company, of Halifax, with 12½ × 21 cylinder. It ran at 190 revolutions, weighed 5 tons, and is listed complete at £280. It required 31 minutes to start it from cold, in each case the longer time being generally required by the larger engines, Crossley's 16 B H.P. requiring 18½ minutes, though Tangye's engine of 17½ B.H.P. only required 15 minutes, and, moreover, it developed 18·06 B.H.P., the engines of Crossley and Campbell falling below their declared power, though Campbell's smaller engine of 13 B H P. did 13·87 B H P., and most of the other engines did more than was promised. After all, however, the ratio of I H.P. to B H.P. is perhaps more important than the ratio of performance. Crossley and Campbell were almost equal at ·771 and ·773 mechanical efficiency, while Blackstone and Tangye ran fairly close at ·858 and ·842, other engines had no indicator facilities. The oil consumption differed considerably, Crossley getting off with ·793 lb. per B H P. against Campbell's 1·2 lb. and Blackstone's engine only using ·746 lb. per B H P. From the figures as a whole we may lay down a useful rule for practice, that the mechanical efficiency and the oil per B H P. are at best of the same value ·75 or three-quarters. This is a convenient figure for memory, and those makers who do not approximate to this figure should seek the fault. Russolene gave both the best and the worst results in different engines. Royal Daylight gave the second best and the second worst results, so that the two oils may be rated equal. One engine only did better at half than at full load—Campbell's smaller 13 B.H P. engine—which at 6·73 B H P., reduced its oil per B H P. from 1·2 to 1·180, all other engines showing an increase.

On maximum effect Campbell's large engine added over 27½ per cent. to its rated B H P., whereas Crossley's added only 12½ per cent., and Blackstone's large engine over 40 per cent, while their other engines added over 30 per cent. to their declared power.

The prices for engines appears to be about £14 per B H P., or £11 per minimum H P., though Tangye's, and Pollock, Whyte & Waddel gave 1 B.H P. for £8 and £7.

About ·75d. may be taken as the hourly cost of an oil engine in fuel for first-class work, when at full power, with oil at 7·5d. per gallon. In other words, a first class oil engine will produce 1 B H P. hour for $\frac{1}{10}$th of the cost of a gallon of the oil it consumes.

We think there should be some more uniform and standard method of rating oil engines. The declared B H P. of one engine was 14 for a speed of 200, whereas the same size and stroke were rated by another maker at 13 for 210 revolutions, and yet another, even larger, was rated only at 10 B.H P. for 220 revolutions.

The prices for engines bear a fairly even ratio to their claimed B H.P., but the trials show that some makers are much more liberal in their sizes than others.

PROF. SMITH ON GOVERNORS.

PROF. SMITH, who writes on governors in *Feilden's Magazine*, has done good work and has been looked on as being in touch with practice, but if *Feilden's Magazine* is intended to be practical it must print different matter from the article in question. As an example of fine professorial diction it is first class, but it is so wrapped up in verbiage and abstrusely technical phraseology as to be almost unreadable. Technical details are wanted plain. Now, how is this for comprehension: Prof. Smith wishes to use the pitching of a ship to regulate the steam at the engine, and this is how he tries to convey the idea of doing so:—"The mechanical resistance of the water to the rotation of a marine propeller in rough weather varies violently in accordance with the relative positions of the stern post and of the water surface in passing through the wave crests and troughs, and this change of geometrical relation may be made to operate (telegraphically, and by help of an electric or mechanical relay) a central gear, &c." While writing this it might have been as well to have made a little clearer the medium in which the propeller revolves; apparently it revolves in rough weather rather than in water.

The foregoing sentence represents the general tone of the whole lengthy article in which there is doubtless some valuable matter, but it is so concealed and swathed in the bandages of a mummified terminology as to be deprived of any useful significance. Prof. Smith decries the almost general effort of designers to seek a variation of speed for

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the purpose of effecting a governing operation, thereby utilising the error it is sought to avoid to actuate the controlling mechanism. There are other phenomena than speed that might be so utilised, such as stress, induction, current, &c. The series winding of the fields of a compound wound dynamo is instanced as a type of governor which acts at once by the increased magnetism induced by the increase of current which would otherwise cause a loss in E.M.F. This governing action takes place without alteration of speed. The engine governor, which acts by the change of the speed it is meant to control, acts as though in a dynamo it were endeavoured to keep up the pressure by a control apparatus operated by the fall of pressure.

Among other devices, reference is made to the bellows governor—a corrugated sheet metal vessel—whereby the variation of pressure in a boiler is made to vary the current. A different form, known, we believe, as Smith's, was, and probably still is, much used in the North, and in competent hands is an admirable contrivance for maintaining a steady steam pressure. We have seen the same effect secured by means of a cylinder and piston device.

It is suggested to govern electrical engines by a series electric current control operating upon the engine valves. With modern sensitive and powerful governors of the shaft type, governing appears hardly to require much finer apparatus, at least for high speed engines.

It is also suggested that change of driving effort and resistance might be utilised as a means of control. Stripped of its efflorescence we take it that something which will alter under varying stress might be placed between, say, a fly-wheel and a dynamo that would very quickly vary the mass volume of the elastic fluid flowing from the steam generator through the channels of communication terminating at the container of the distribution mechanism attached, or in propinquity to the cylindrical vessel containing the piece which moves under the elastic force of the actuating fluid of the heat engine, to such distribution mechanism container. We hope this is clear. We have endeavoured to imitate the style of the worthy professor. Clearly he would vary the cut-off by a spring resistance in the driving shaft—a sort of coupling.

Incidentally Prof. Smith is inclined to attribute many fly-wheel accidents to want of arm strength rather than to rim failure, and it is probable if the arms of a fly-wheel did shear off, that the rim would drop and break so quickly that the true cause of failure might be unperceived. Taking account merely of the rim strength, the absorptive power in foot-pounds per pound of weight is $\frac{E}{W}$ = nearly $\cdot 3 \frac{n}{N} \times$ centrifugal stress in pounds per square inch of rim section. Then, if $\frac{n}{N}$ = 1 per cent., and sectional stress is limited to 4,000 lbs. per square inch, the limit of absorptive power for cast-iron is 12 foot-pounds per pound of rim per 1 per cent. of variation. But this may be increased by making the arms radial tie rods with initial tension of considerable amount, and a cast-iron spider with hollow arms is suggested to contain the tie rods. The Professor would turn the arm ends to a circle less than he would bore out the facing seats inside the rim, and he would pull the rim to a seat on the arm ends by tightly screwing up the tension rods. This, he thinks, would enable higher speeds to be run with safety. We need not follow the remainder of the article into the question of ball governors, and when Prof. Smith writes again, we hope he will not endeavour to "write fine." Surely Prof. Smith has written long enough to have written plain English. Certain technical terms are absolutely necessary, but there are times when it is distinctly better to call spades spades, and not digging implements or—any other sounding phrase.

LONDON COUNTY COUNCIL.

At a meeting of the Council on Tuesday the chairman of the Highways Committee stated in reply to questions that the Committee intended at an early date to present a report to the Council in regard to the statements of Mr. Hanbury in relation to the telephone service.

The Council's Power Station.

The Council adjourned for a week the consideration of a report by the Highways Committee, stating that Prof. Kennedy had expressed the opinion that the Council's southern tramways and the proposed additional tramways and light railways could be worked by means of one generating station constructed on the site of the Council's tramway depôt at Camberwell. Part of the depôt is the Council's freehold, while the remainder is held on a lease, of which about 75 years are unexpired, at a rent of £250 per annum. Mr. Kennedy also suggested that, as eventually this generating station would be an extremely important one, it was desirable that compulsory powers should be obtained for the acquisition of the freehold of the portion of the depôt now held on lease, and also of certain houses abutting upon the north-east corner of the depôt, and the property on the east between the depôt and Camberwell New Road. The buildings on the additional property, if acquired, need not be immediately pulled down, but the property would probably be obtained on better terms in the near future than if the purchase were to be deferred until it became obvious that its acquisition was essential for the growth of the generating station. The cost of the acquisition of the freehold and of the interests in the property adjacent referred to above, would be about £90,100; and the Committee was of opinion that the suggestion should be adopted, and the property scheduled as to be acquired under the powers to be sought by the London County Council Tramways (Electric Traction) Bill. The committee recommended accordingly, but the consideration of the question was postponed.

The Proposed Palace Line.

It may be remembered that in July last the Council decided to obtain powers for the construction, among others, of an electric tramway on the underground system between Rushey Green and the Crystal Palace. The Highways Committee then thought that the property, consisting principally of forecourts of houses, and parts of estates not yet built upon, required to widen some portion of the route sufficiently to enable a double line to be laid, could be acquired at considerably less cost by negotiation with the owners than if the Council should obtain compulsory powers for the purpose. The Council's valuer had been in negotiation with the owners for the acquisition of the necessary property, but had not made such progress as would justify the Council in proceeding with the proposal. Having regard to all the circumstances, the Council decided, on the recommendation of the Highways Committee, to abandon this particular electric tramway scheme.

Lighting of Nelson's Column.

The Highways Committee reported that the Charing Cross and Strand Electricity Supply Company recently applied for permission to carry an electric cable overhead from the Union Club, Cockspur Street, to the Nelson Column, Trafalgar Square, for the purpose of lighting the column on Trafalgar Day. As the circumstances were of a special character, and the matter was urgent, the committee had, on behalf of the Council, given consent to the erection, so far as the Council had power, upon the following conditions:—That the work be carried out in accordance with the provisions laid down in the regulations (A 16 to 26) of the Board of Trade with regard to overhead electric lighting wires; that the main used be for supply at a pressure of not more than 200 volts; and that the whole of the work be removed, and any damage that may be done to the public streets in connection therewith be made good, within 10 days from October 20th. The span of the cable, which was carried from the Union Club to the column by means of steel suspending wires, was slightly in excess of that allowed by the Board of Trade regulations, but the Board raised no objection to this deviation from the general rule.

CORRESPONDENCE.

Single-Phase Motors.

In your issue of the 13th inst. I notice a letter from Mr. C. E. L. Brown, referring to an article by Mr. Eborall on the above subject. As this letter might give rise to an error with regard to the meaning of my single-phase motor, Patent No. 29,499, of 1896, I now take this opportunity of replying to it.

According to Mr. Brown's letter, he appears to think that what I have patented is, that with single-phase motors having two circuits of different self-induction, or phase-displacement, one shall be chosen as the working winding, and the other as starting winding. This is, of course, not the case—nor would it give grounds for a patent.

As a matter of fact, my patent does not speak of working or starting windings, but simply claims "that with single-phase motors having circuits of different phase-displacement, the self-induction of the circuit of greater phase-displacement shall be made smaller than the self-induction of the circuit of lesser phase-displacement.

This method of designing single-phase motors is certainly in direct opposition to all other methods, as Mr. Eborall clearly saw. For the purpose of obtaining large differences of phase, such methods always consisted in making the winding of small phase-displacement of small self-induction, and the winding of large phase-displacement of large self-induction.

For instance, consider fig. 1 of Mr. Brown's patent—the example cited by him. Obviously, the ring winding produces the greater phase-displacement, and the drum winding the smaller. But the former has 16 turns, and the latter 4 turns, that is, the winding of *larger phase-displacement* has the *greater self-induction*.

Alexander Heyland.

"Aluminium Conductors."

With reference to the relative advantages of aluminium and copper, the following statement shows briefly how matters stand at present in this country, and is a handy way of ascertaining the more economical metal to employ:—

The conductivity of aluminium is $\frac{6}{10}$ths (60 per cent.), and its weight $\frac{3}{10}$ths, that of copper. Therefore, for the

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same resistance, the weight of aluminium will be $\frac{1}{6} \times \frac{3}{10} = \frac{1}{2}$ that of copper.

The lowest price aluminium wire can be obtained in this country at present is 1s. 7d. per lb. Therefore, with high conductivity copper wire at 9½d. per lb., the two metals cost exactly the same for the same resistance.

Copper wire at present costs rather more than 9½d. per lb., so that the balance is slightly in favour of aluminium for bare conductors.

It must be remembered, too, that its weight would be only half that of copper, so that for overhead work the supports would be cheaper.

The diameter of an aluminium conductor, as compared with copper (being for, say, a current of 250 amperes, 21·5 mm., against 16 5 mm.), quite excludes any chance of its adoption for insulated conductors.

F. E. A.

Measurement of the Internal Resistance of Accumulators.

In the article on "Measurement of the Internal Resistance of Accumulators," appearing in the ELECTRICAL REVIEW, of October 20th, page 623, there are two inaccuracies in the diagrams made by omitting lines in the engraving of my original figures. In fig. 2 there ought to be a connection between the positive pole of the cell under test and the looped line representing the connection between the two coils of the differential galvanometer. In fig. 4 the terminals of the galvanometer should be joined, one to the positive pole of the cell under test, the other to the junction of R_1 and R_2.

E. C. Rimington.

[We regret the unfortunate slips to which our correspondent draws attention; the correct figures are reproduced below.—EDS. ELEC. REV.]

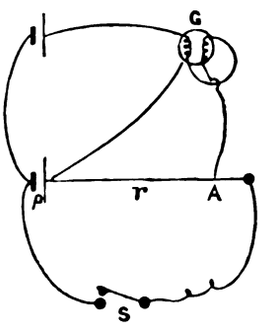

FIG. 2.

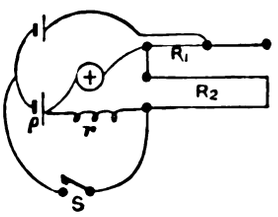

FIG. 4.

WHAT IS A "FACTORY?"

THE definition of this term has become shrouded with considerable importance ever since the Workmen's Compensation Act came into force, and, in a large number of cases arising under that Act which have reached the Court of Appeal, its true interpretation has come either directly or indirectly before their Lordships' notice. Among the many difficulties which have beset the interpreters of this statute—we include in this term arbitrators, County Court judges and the members of the Court of Appeal—none has been forced into a position of greater prominence than the exact delimitation of the scope of the Act. With a view to marking out that portion of our industrial community within which employers have to become universal insurers, the Legislature has endeavoured, by vague references to older statutes, to define the term "factory" so as to include industries which involve the employment of skilled labour in places utterly unlike anything that we have hitherto been accustomed to regard as an orthodox factory. A study of the cases which have been reported in the Law Reports reveals the fact that, so far, this attempt has met with signal failure, and a recent case in the County Court, to which we will presently refer, serves to show the immense importance of the distinction between work in a "legal factory" and employment outside the "walls" of that extraordinary institution.

Before referring to any of the decided cases, it may be as well to direct attention to that part of the Workmen's Compensation Act which is supposed to have correctly defined the scope of the statute. By Section 7 the term factory includes "every dock, wharf, quay, warehouse, machinery, or plant, to which any provision of the Factory Acts is applied by the Factory and Workshop Act, 1895 [and also every laundry worked by steam, water, or other mechanical power]. By Section 23 of the Factory Act, 1895, certain specified provisions of the Factory Acts (*e.g.*, the provisions with respect to accidents and the power to make orders with regard to dangerous machines) shall have effect as if every dock, wharf, quay, and warehouse, and, so far as relates to the process of loading therefrom or thereto, all machinery and plant used in that process were included in the term factory. The term also includes any premises on which machinery worked by steam, water, or other mechanical power, is temporarily used for the purpose of the construction of a building, or any structural work in connection with a building. The Workmen's Compensation Act also makes certain provisions as to who shall be considered the "owner" or "occupier" of such a factory. Such are the statutory declarations with regard to a "factory." Comprehensive as they may appear, their elucidation is in no way rendered less difficult by the fact that compensation is only awarded to a workman who suffers from injury arising "out of and in the course of" his employment, "on, in, or about" the factory.

The case of M'Nicholas *v.* Dawson (1899, 1 Q. B. 772) gives us some idea of the difficulties which are likely to arise. There a workman was employed in a shed to look after a steam engine connected with a mortar pan for mixing mortar for use on a building near at hand. When thus employed he sustained personal injuries through an accident. The question arose whether he was employed "on, in, or about a factory" within the meaning of the Act, as the building in which the engine was working was less than 30 feet in height. It therefore became necessary for the Court to scrutinise the language of the definitive section most carefully. By the Factory and Workshop Act, 1895, Section 23, a number of provisions are applied to a number of things that, for the purpose of the Section, are treated as factories, which would not otherwise be so. Amongst these are the provisions of the Act with respect to the power to make orders as to dangerous machines, and these are to have effect as if any premises on which machinery worked by steam, water, or other mechanical power is temporarily used for the purpose of the construction of a building or any structural work in connection with a building, were a factory within the meaning of the Act. For this reason the premises in question, upon the facts found, were made a factory by the Act of 1895. And as was pointed out by Lord Justice Romer in the course of the argument, the engine, if it came under the heading of "dangerous machinery," was itself a factory within the meaning of the Act, thus giving us a factory within a factory.

The above case is a fair specimen of the class of problem which the Court of Appeal has been asked to solve in connection with the Workmen's Compensation Act, which has been called, by more than one judge, "a veritable Chinese puzzle." As we have pointed out, however, the exact definition of the word factory is not the only difficulty which besets the adventurous mind that endeavours to interpret the Chinese puzzle. The words "arising out of and in the course of his employment" have cropped up in more than one case. Acts done in a sudden emergency have been held to be in the course of the employment—while, as soon as a servant takes his mind off his master's work to embark upon some frolic of his own, he travels beyond the limits prescribed by the Act; and thus, in the case of Smith *v.* the Lancashire and Yorkshire Railway Company, it was held that a porter who met with an accident when stepping on the foot-board of a train, in order to speak to a friend, was not entitled to compensation. Be it observed that we have no special reason to quarrel with these decisions. They are merely cited in order to give some idea of the countless points which might have been foreshadowed had the Bill, which became law in the summer of 1898, been subjected to further and more thorough Parliamentary criticism.

The next question which has forced itself into notice is, What is the meaning of "on, in, or about" a factory? *Tot homines, tot sententiæ* accurately expresses, not only what has

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been the result of a year's administration of the Act, but what, in accordance with the ruling of the chairman of Appeal Court I. (Lord Justice A. L. Smith) must always characterise the interpretation of these words which are to be found in Section 7. "*Tot homines*" includes the numbers of our County Court Bench sitting in accordance with the provisions of the Act—"*tot sententiæ*," represents their findings upon points of fact, as distinguished from points of law, in respect of which they may be overruled in the Court of Appeal.

That the interpretation of these all-important words "on, in, or about," involves the decision of a point of *fact* as to which the opinion of a County Court judge is final and conclusive, may be gathered from the following words of Lord Justice A. L. Smith in Powell *v.* Brown (1899, 1 Q. B., 157):—"The question arises, what meaning is to be attached to the words 'on, in, or about?' It is obvious that the Legislature thought that the first two words were not large enough to cover all that they intended to include, and they, therefore, added the word 'about,' which is clearly an enlarging word. In my view that word means that the employment may be in close propinquity to the factory, and whether that was so in this particular case is a question of fact to be determined by the tribunal before which the claim comes. The judge, in this case, has found that the deceased was employed 'about the factory,' and this brings the case within the statute." It will be seen that this ruling, which we do not suggest is erroneous, casts a heavy burden of responsibility upon the County Court Judge. He, or the arbitrator appointed by him, has to decide every case upon its merits, without any reference to, and entirely independent of, his colleagues in other parts of the country, who may or may not take the same view of the word "about" that he does himself.

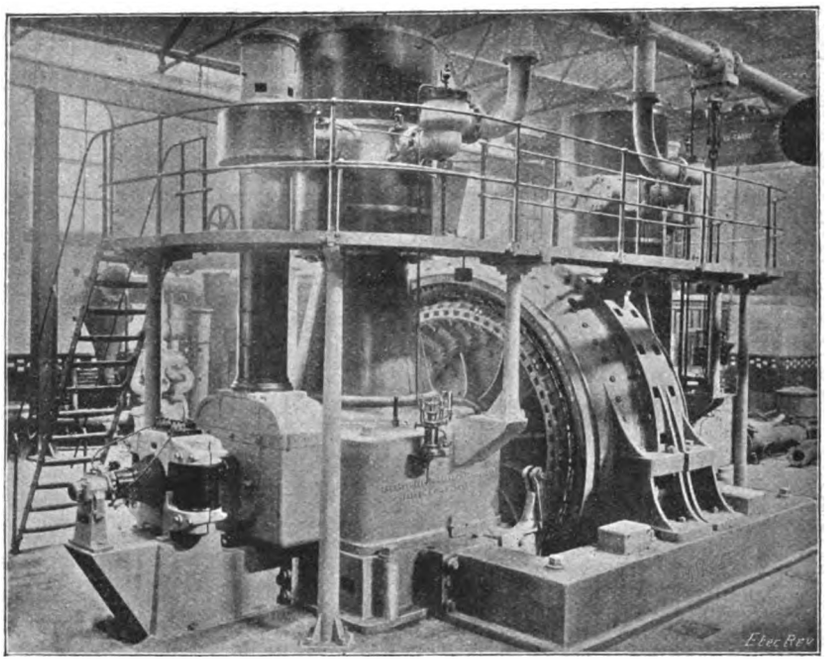
Up till quite recently the only reported cases upon this branch of our subject dealt with the accidents to carters at greater or less distances from the works or other premises of their employers. But a different—and, to electrical engineers—a very much more important case, came before his Honour Judge Addison on October 3rd at the Southwark County Court. There an engineer, named Belsey, sued his employers, Messrs. Sadler & Co., engineers, of Tooley Street, for compensation. It appeared that he had been injured, not upon their works, but at a customer's factory, where an hydraulic crane was in the course of erection. It was argued on behalf of the employers that inasmuch as the accident did not happen "on, in, or about a factory of which they were the occupiers," the claimant was not entitled to compensation. This view was adopted by his Honour Judge Addison, who said: "I come to the conclusion that the factory must be a factory of the undertakers or employers." We should note that, for the purpose of arriving at this decision, his Honour also held that the erection of a hydraulic crane was not an "engineering work." Should this decision be allowed to stand (his Honour having promised to give the claimant every facility for the purpose of lodging an appeal), it cannot fail to be received with lively satisfaction by electrical engineers and contractors, whose employment of outside workmen forms an integral part of their business. If a workman employed in another factory is disentitled to compensation, we may safely assume that those engaged for the purpose of laying wires in private houses may look in vain for relief under the Act of 1897.

Kingswinford.—The *London Gazette* contains the usual notice by the Rural District Council of transference of electric lighting powers (1898) to the Midland Electric Corporation for Power Distribution.

A 600-KW. INDUCTOR ALTERNATOR FOR SHEFFIELD.

After hearing so much of the inductor type of alternator and its widespread use in Switzerland, it will doubtless interest our readers to know what is being done in this country with that type of generator.

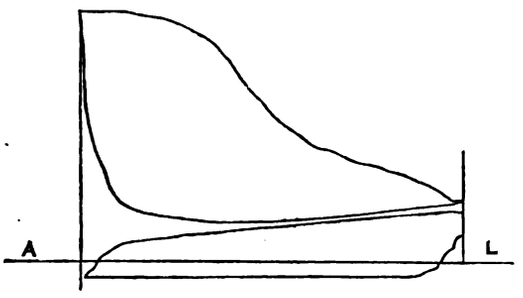
The illustrations herewith represent a 600-kw. combined Raworth Universal engine and Mordey inductor alternator, constructed by the Brush Electrical Engineering Company,



600-kw. Inductor Alternator.—Back View.

Limited, at their Loughborough works, and erected for the Sheffield Corporation in their lighting station.

If we are correctly informed this plant is unique, inasmuch as it is the only inductor alternator known to have been constructed for a frequency so high as 100 periods per second, and the Brush Company showed no little courage in undertaking the experiment with so large a machine in the face of the most pessimistic prophecies.



The plant ran its six hours' official test on August 9th last, and has been in regular service ever since. The results are not only far superior to the guarantees, but superior to the best expectations of the designers. The combined efficiency is, in fact, remarkably good, showing at the test, on non-inductive full load, fully 82¾ per cent., including excitation, when new and comparatively stiff; on one-third load the efficiency was 74 per cent.

Consistently with the high efficiency, the temperature rise is very low, the hottest part only rising 34° F. after six hours' run at more than full load—the maximum output during test being as high as 720 kw.

As will be seen from the illustrations, the rotor—which, as is well known, comprises nothing but a serrated fly-wheel without conductors or windings of any kind—is suspended

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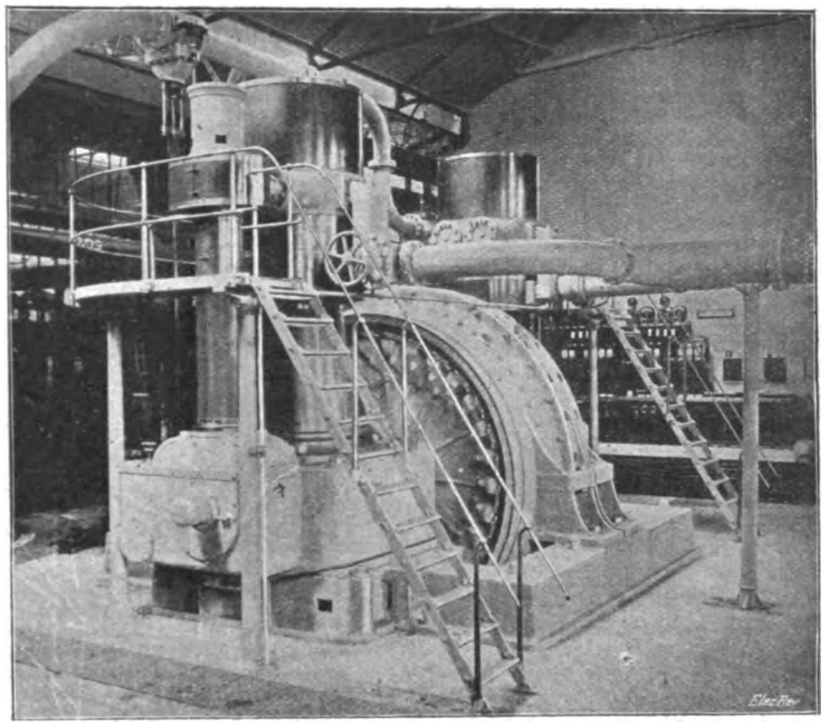
between the engine cranks. The stator conductors are well insulated solid rods of copper, passed through holes in the iron laminæ; the field is excited by a single coil, and the whole construction is so mechanically sound, that it approaches one's conceptions of an ideal dynamo. Now that the one point upon which purchasers were sceptical—namely, "efficiency"—has been effectively disposed of by actual results, and even at 100 ~, we shall be greatly surprised if this type of machine does not make great progress in the immediate future.

It appears to be almost generally admitted that the inductor is not the cheapest form of alternator that can be constructed for a given output at a given speed, but if the same efficiency and regulating qualities are demanded in both cases, the difference becomes unimportant, and in view of its obvious mechanical advantages, it is probable that its higher cost will no more prevent its adoption than the higher cost of direct-coupled dynamos has prevented their adoption in preference to belt and rope driving.

We understand that the Brush Company, who control the patents in this country, have on order a considerable number of these machines of large size, several of which are of polyphase type, and when the doubling of their heavy machine shop is actually completed, they expect to turn out a very large horse-power per annum in alternators.

The engines in this Sheffield set are also worthy of special note, as they are the largest "Universals" so far under steam, though several others will shortly follow. We are glad to hear that they are no less a success than the alternators.

The engine has been so frequently described, that our readers cannot fail to be more or less familiar with it, but we may briefly state that each crank is operated by compound cylinders arranged tandem, each cylinder is single-acting, and the two Corliss valves are between the cylinders, thus obtaining the shortest possible steam ports. The engine in question is of massive proportions. Each crankshaft, for instance, has a bearing next the rotor 13 inches diameter × 34 inches long, and whilst the makers are to be commended for their caution in being well on the safe side, we are not surprised that they now rate this plant at 750 KW. capacity. The speed is 200 revolutions per minute, and the running leaves nothing to be desired.



600-KW. INDUCTOR ALTERNATOR.—FRONT VIEW.

The steam consumption, calculated from the indicator diagrams, was about 27¼ lbs. per KW.-hour at full load (allowing 10 per cent. for clearance), and is well within the specification. It is also particularly good on light loads. The indicator card we illustrate was traced by ourselves from one of the actual cards taken at the official test.

Mr. Wm. Johnson, the engineer to the Sheffield Corporation, is as much to be congratulated upon his perception of the merits of this design of plant and his willingness to take some portion of the risk of trouble with such a new departure as the Brush Company is to be congratulated upon its unqualified success.

BUSINESS NOTICES, &c.

Books Received.—"Fire Tests with Treated Wood." London, 1899, The British Fire Prevention Committee. 2s. 6d.

"The Valuation of Gas, Electricity, and Waterworks for Assessment," by T. & W. Newbigging. Second Edition. London: Walter King. 5s.

Catalogues.—From the Bullock Electric Manufacturing Company, of Cincinnati, Ohio, we have received an illustrated list of their direct current multipolar motors of several types.

A well printed and nicely illustrated list of M.P. type slow and moderate speed motors comes to hand from the British Thomson-Houston Company, Limited. The principal features in the construction of these motors, are shown by small illustrations of the various parts. A classified list showing capacity, weight, dimensions, &c., in table form, is given.

The General Electric Company, Limited, has issued a new price list of plain steel interior conduit with particulars and prices of bends, elbows, junction boxes, and other accessorial parts.

Messrs. O. Berend & Co.'s "E" list, just published, describes the "Prometheus" system of electric cooking and heating, combined with a three-contact and four-way system for the perfect regulation and adjustment of the current. Illustrations and prices are given of various cooking utensils such as kettles, saucepans, plate-warmers and radiators, &c. The Prometheus system of resistances is claimed to be a real step in advance, and a great improvement on the earlier systems of embedded corrugated wire resistances; it is said to be free from all those defects inherent to such systems which are stated to have so far retarded the general adoption of electricity for cooking and heating purposes, viz, cracking of the insulating materials due to unequal expansion and contraction of the embedded metal, short circuiting, and the great difficulty of repairing damaged goods.

The Prism Globe Company, Limited, is circulating a new catalogue of the Prism globes of various patterns and for various purposes. Some brief notes of photometric tests of the globes are given, also illustrations showing the Prism globes in use for street lighting.

Messrs. Gent & Co., of Leicester, send us a new catalogue of bells and telephones which has been made as concise as possible, consistent with the inclusion of all goods for ordinary requirements. Among the various articles shown by illustration, and priced, are pendulum, drop, and other kinds of indicators; iron-cased, water-tight, mining and other electric bells; then follow a large variety of sundry insulators, pushes and pulls of all patterns, fire alarms, electro-medical apparatus, hand, table and intercommunication telephone sets, &c.

A small booklet is to hand from the Synchronome Syndicate, Limited, of Gracechurch Street and Clerkenwell Road, in which some applications of the "Synchronome" system of electric time service are detailed, and a report on the system by Prof. Thompson given, as well as a number of photographs of important buildings where it is in vogue.

Change of Address.—Mr. Sidney à Court, A.M.I.C.E., has removed to 39, Victoria Street, Westminster, S.W., from Artillery Mansions.

The Copper Market in October.—Messrs. H. R. Merton and Co.'s statistical circular for the fortnight ending October 15th, to which brief reference was made last week, shows that the supplies of copper still fail to keep up with the deliveries, the fall in stocks during the fortnight being = 2,164 tons. This fall is, however, more than balanced by the shipments from Liverpool and Swansea to U.S.A. during the fortnight in question, the total shipments from these ports having been = 2,275 tons. Since June 1st, 6,926 tons copper has been transhipped to New York from Liverpool and Swansea, and this unusual feature of the market has helped to keep down European stocks. The full figures for the fortnight ending October 15th are:—Supplies, 8,670 tons; deliveries, 10,834 tons; stocks, October 15th, 26,164 tons. The shipments from outside countries during the fortnight have amounted to 1,434 tons, as against an average of 1,800 tons for the preceding 12 months. The price of G.M.B.'s has only advanced 2s. 6d. per ton, in spite of the fall in stocks, being £75 17s. 6d. on October 15th, as against £75 15s. on September 30th.

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Electrical Wares Exported.

Week ending Oct. 25th, 1898.		Week ending Oct. 24th, 1899.	
Adelaide	Value £12	Albany	Value £277
Albany	121	Alexandria	15
Amsterdam	10	Amsterdam	110
Batoum	50	Boulogne	63
Bombay	105	Brisbane. Teleg. mat.	200
Brisbane. Teleg. wire	13	Buenos Ayres	3,639
Buenos Ayres	56	„ Teleg. mat.	100
Calcutta	657	Calcutta	553
Cape Town	176	Cape Town	236
Colombo	53	Christchurch	75
Copenhagen	400	Copenhagen. Teleg. cable	85
Durban	133	Durban	241
Hamburg	654	„ Teleg. mat.	189
Hong Kong	1,025	Fremantle	52
Limon	12	Gothenburg	12
Madeira	122	Hamburg. Teleg. mat.	200
Madras	19	Hong Kong	714
Malaga	22	Kobe	856
Marseilles	19	Lyttelton	24
Melbourne. Teleg. mat.	296	Melbourne	41
Odessa	70	„ Teleg. mat.	1,032
Ostend	80	Montreal	77
Otago	51	Nagasaki	13
Rotterdam	4,478	Ostend	28
St. Petersburg	175	Otago	76
Santos	120	Perth	137
Shanghai	200	Port Elizabeth. Teleg. wire	317
Singapore	25	Rio Janeiro	64
Stockholm	424	Rosario	858
?„ Teleg. mat.	360	Rotterdam. Teleg. wire	29
„ Teleg. cable	482	Santa Cruz	85
Trinidad	86	Santos	134
Wellington	2,710	„ Teleg. mat.	190
Yokohama. Teleg. mat.	1,645	Stockholm. Teleg. wire	156
		Sydney	1,538
		„ Iron teleg. wire	204
		Trinidad	26
		Wellington	656
		Yokohama. Elec. cable	200
		„ Teleph. cable	780
Total	£14,771	Total	£14,231

Foreign Goods Transhipped.

Durban. Telephones	Value	£43
New York. Elec. goods		450
Total		£493

Fire Prevention.—The British Fire Prevention Committee started its winter session last week, by arranging a private view of its testing station at Regent's Park, and showing a series of experimental tests with a concrete floor, with an iron safe, and with some wooden doors. The very numerous visitors were received by Mr. Sachs, chairman of the executive.

Intended Dividend.—The *London Gazette* contains notice of an intended dividend in the case of J. E. Stott, electrician, Huddersfield. November 3rd is the last day for receiving proofs. Trustee, Mr T. H. Kaye, 8, Princess Street, Huddersfield.

Klein Cooling and Condensing Plant.—The Corporation of Bolton have decided to adopt a Klein's patent fan water cooler at their electricity works for cooling the water requisite for condensing the steam from engines of 3,000 H.P. The fans and also the circulating pump are driven by electric motors, and the cooler is to work in conjunction with engines made by Messrs. John Musgrave and Sons, of Bolton. At the present time a surface condensing and Klein's open type cooling plant is in course of construction for The London & North Western Railway's Works in Crewe for engines of 800 H.P. to work in connection with electric lighting and power plant. The Prestwich County Asylum are now adopting Klein's jet condenser and chimney cooling plant for engines of 450 H.P. in conjunction with their electric lighting plant.

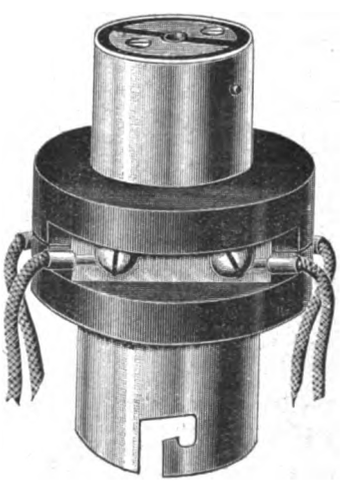
New Electric Car Works.—Rapid progress is being made with the extensive buildings at Hadley, near Wellington, for Messrs. G. F. Milnes & Co., of Birkenhead, for manufacturing electric tramcars and light railway cars. Houses are being erected for the accommodation of 550 workmen who will be employed at the new electric car works, which will cost over £100,000. The company will be able to turn out 700 or 800 cars per annum. Already sufficient orders have been booked to keep the men employed for over two years.

Niagara.—The Niagara Falls Power Company is about to erect several industrial buildings on its lands at Niagara Falls for the special accommodation of firms who desire to rent floor space and power. These buildings will be located near Echota. They will be built of brick and iron, and have slate roofs. Each building will be three stories high. Heretofore the manufacturing plants locating at Niagara have occupied great spaces of land and used a large quantity of power, but have employed comparatively few hands. The proposed structures are to cater to the manufacturing firms who use a small amount of power, but employ many hands. In connection with this announcement, it is stated that beginning about the first of the coming year, the Niagara Development Company, an allied company of the Niagara Falls Power Company, will commence selling houses and lots in the manufacturing district, thus giving operatives an opportunity to own their homes.

Last winter the great steel arch across the Niagara River, close to the Falls, over which the cars of the International Traction Company run, had its safety threatened by the immense ice jam that gathered in the gorge at that point. It will be recalled that the ice jammed high about the bridge abutments on both sides of the river until it was found necessary to blast it away several times. Some of the steel trusses of the structure were also bent by the ice. In order to prevent these alarming conditions in the future, protective walls of concrete rubble are being built about the abutments on both sides of the river. These walls are over 100 feet long, quite thick, and over 20 feet high, well calculated to withstand any pressure of ice that may in the future be brought to bear on them. In addition to this about 30 tons of new steel trusses are being inserted in the bridge to replace parts now deemed too light. The arch rises right from the water's edge, and therefore the danger from the Niagara ice jam, which is of wonderful extent and power, backed as it is by the water and ice that keeps pouring over the precipice.

Liquidations, &c.—A petition for winding up the Milner Portable Electric Battery Syndicate, presented by G. Trenam, 7, New Court, Lincoln's Inn, solicitor, a creditor of the company, will be heard at the High Court before Mr. Justice Wright on November 1st.

The Vetter Current Tap.—We illustrate below the Vetter current tap, which consists of a tapping plug and lamp socket combined, the fitting being attachable in the same way as an ordinary socket plug. The device is exceedingly simple, but it will be found of use wherever electric current is available for private lighting, as it is designed to facilitate the transmission of current to any desired point in the vicinity of the fixture, without the loss of the lamp at the point where the current is taken. As the name indicates, it "taps" the current, and does it in so simple a manner that a novice can use it without the slightest difficulty. The current tap is made in two styles, viz.: Parallel and Series. With the "Parallel" current tap, the procedure is as follows:—To obtain a droplight for the desk, place a Parallel tap in the wall bracket, replace the lamp and carry the conducting cords to the desk lamp. There will then be two lights instead of one. An electric fan can be



operated at the same time from the same tap, thus giving two lights and a fan motor from one outlet. A light can be carried to any part of the lathe, printing press, or wherever desired, by the use of the Parallel tap inserted in the ordinary hanging or fixture socket. The Vetter "Series" current tap provides a ready means to obtain the current for the head lamp, Galvanic or Faradic apparatus from the electric light fixture, using the lamp in the current tap to modify the current. Bicycle lamps operated by storage batteries, can be charged from any electric fixture on the direct electric current, by means of the Series tap, with a lamp placed in same. This speciality and also the "Universal" diagnostic lamp outfit is made by Mr. E. B. Meyrowitz, of New York.

Trade Announcements.—The Phodyne Electrical Company, Limited, has been formed for the purpose of carrying on business as electrical contractors. Mr. J. C. M. Stanton, M.I.E.E., is managing director. The offices are at 66, Victoria Street, Westminster.

Messrs. J. G. Childs & Co., electrical engineers, have removed from 24, Brewer Street North, to 145, Farringdon Road, E.C.

ELECTRIC LIGHTING NOTES.

Battersea.—The Vestry on Wednesday, in connection with the interim injunction obtained by the County of London Company restraining the Vestry from interfering with the mains in Trinity Road, decided to counterclaim for a writ of mandamus to compel the company to remove the mains.

Belfast.—The County Borough has entered into an agreement with the National Electric Wiring Company, Limited, of Faraday House, London, W.C., to instal the light free of initial cost to the consumer where the Corporation's mains are laid. The charge for the hire of the wires and fittings is 1d. per unit for the first hour's use of the consumer's maximum demand per day, and ½d. per unit for all used afterwards.

The Council has had under consideration the question of extensions

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to meet the demand for electricity, and has decided to order additional plant at an early date.

Bonchurch.—The Parish Council has sealed its agreement with the Electric Light Company.

Bridgwater.—The report of Mr. W. H. Trentham, respecting the electric lighting of the borough, has been adopted by the Council, which has also resolved that the necessary steps for carrying out the scheme should be taken. In the report, Mr. Trentham recommended the adoption of the low pressure system, and gave it as his opinion that the Council would save £130 a year.

Cardiff.—The Board of Guardians has under consideration the question of electrically lighting the workhouse.

The Electric Lighting Committee is holding an inquiry into the causes of a recent breakdown of the public lighting, said to be due to water entering a street box.

The contract for lighting the Royal Hotel, which was awarded to Messrs. Edwards & Armstrong, will be carried out under the supervision of Mr. W. Leake, consulting engineer, of Manchester.

Cheltenham.—The Town Council on 23rd inst. agreed to apply for a provisional order to extend the area of electric light supply to the parishes of Charlton, Kings Leckhampton, Prestbury, Swindon, Bishop's Cleeve, Southam, Woodmancote, and Brockhampton.

Clacton.—The Council has decided to make application for a provisional order enabling it to supply the town with electric light.

Cleckheaton.—The General Purposes Committee of the District Council has appointed Mr. Alfred H. Gibbings, of Bradford, as electrical engineer, to prepare a scheme for the electric lighting of the town; the Council intends to apply for a provisional order in the next session of Parliament.

Douglas.—Prof. Fleming has presented a report to the Corporation on the subject of electric lighting. He was asked to report specially as to whether the town should lay down its own installation or take the supply from the Electric Tramway and Power Company, which offered exceptionally favourable terms, and he advised the Corporation to adopt the former course. The Lighting Committee of the Town Council has recommended the adoption of the report. In his report he says the company proposes to supply on the three-wire system, with 460 volts across the mains, the pressure to the consumer being 230 volts. He objects to this high pressure service because it prevents small consumers from using 5 and 8-c.p. lamps, such as would be used with great advantage and economy in boarding houses. It would cost the Corporation £10,000 to lay down mains and erect lamps, and to maintain an efficient independent staff, and for repairs there would be an annual outlay of £1,100 merely to become purveyors of electric energy which they would purchase in bulk at 3d. or 3½d. a unit. They would have to charge more than if they generated it themselves. The great success of the electric lighting industry in some towns, Prof. Fleming points out, has arisen solely from the fact that they have catered for the small consumer. In order that the enterprise might succeed, electric light must become the poor man's light, and not simply the light of the well-to-do. If the Corporation of Douglas bound themselves to purchase in bulk at a fixed price from a limited company, they seriously tied their hands in dealing with the price of supply, and might find in years to come that the financial condition would have been very different had they followed the now usual policy of becoming themselves the manufacturers and undertakers.

Ealing.—A partial interruption of the electricity supply took place on the evening of the 17th inst., lasting for 1¼ hours.

Edinburgh.—An Edinburgh paper says that on 18th inst. the Bruntsfield, Morningside, Newington, Pleasance, Inverleith, Murrayfield, and Portobello districts of Edinburgh were plunged into darkness owing to a fire at the Dewar Place electric lighting station. "About half-past nine the wires at the high tension switchboard in the basement of the building fused, and flames and continuous explosions for a time made the mishap assume a serious character. . . . The fire was soon extinguished, but the destruction of wires and other plant effectually stopped the supply of light to the high tension system for the night. The officials have not been able to discover the cause of the conflagration, although the supposition is that it arose through the fusion of some of the wires." Matters were soon put right, and the supply was turned on again at two o'clock next morning.

The new electricity works at M'Donald Road was formally opened on Monday last. This station will ultimately have a capacity of 30,000 H.P., of which over 1,200 H.P. is already installed. It was remarked that all Prof. Kennedy's original predictions regarding the future of the undertaking had been fulfilled. Bailie Mackenzie, convener of the Electric Light Committee, who had a large share in the successful accomplishment of the work, would only take credit for the fact that he never interfered with the engineers in the details of their work—in our opinion a most praiseworthy distinction.

Elland.—The District Council has resolved that an application be made to the Board of Trade for a provisional order for electric lighting in the district.

Falkirk.—The Edmundson's Electricity Corporation, Limited, has approached the Town Council with a view to making an agreement with the Council for the electric lighting of the town, subject to purchase after 14 years.

Ham.—The District Council is considering a communication from the Kingston Corporation, in which the latter puts forward proposals for the supply of electricity in the Council's district, subject to the approval of the Board of Trade.

Heaton Norris.—The Council has agreed to transfer its electric lighting order to the Manchester Corporation as soon as the approval of the Board of Trade has been obtained. Arrangements have also been made with the same corporation regarding the tramways.

Jarrow.—The Town Council has received a letter from an Electric Syndicate with reference to the supply of electricity to the district, offers for which have already been made by the Walker and Wallsend Gas Company. The committee recommended the engagement of an expert to advise the Council as to the terms offered, to which the Council agreed.

Lanark.—The Burgh Commissioners on Monday last resolved to approve of the electric lighting scheme of Messrs. Hunter & Jack, electrical engineers, Glasgow; to obtain a provisional order, and to raise a loan of £5,000 to carry out the work.

Leek.—The District Council has applied to the Board of Trade for a provisional order authorising the Council to supply electricity within the area of their district, pursuant to the powers and provisions of the Electric Lighting Acts.

Leicester.—The Council on Tuesday had under consideration the recommendation of the Electric Lighting Committee to borrow an additional sum of £100,000 for electric lighting purposes.

London, E.C.—It appears that the question of lighting London Bridge by electricity has been frequently discussed by the Bridge House Estates Committee, but the structure has to be repaved in 18 months' time, and the matter stands deferred until then.

The Local Government Board has sanctioned the loan of £14,680 for the Shoreditch Vestry's electricity works and wharf, for 50 years, at the rate of 3¼ per cent.

Manchester.—At a meeting of the City Council on Wednesday complaint was made of the delay in the delivery of a 2,500-H.P. generator required for the generating station in Dickinson Street. The Electricity Committee's action in ordering generators of such magnitude was objected to, some members expressing their belief that an accident to one of them would be attended with disastrous consequences. The chairman of the Committee, however, Mr. Alderman Higginbottom, said the Corporation had already one 2,500 H.P. generator running with perfectly satisfactory results. It had for a fortnight past taken the whole load of the main generating station, and no accident could by any possibility happen to it. The new generator was expected to be running in another month. The citizens, therefore, need have no fear about the constant supply of the electric current during the winter months. The practice of using such large units, Mr. Higginbottom added, was found, not only in Manchester, but on the Continent and elsewhere, both economical and safe.

Millom.—The District Council has resolved to oppose an application of the Northern Counties Electricity Company for a provisional order for the electric lighting of the town.

Northfleet.—The District Council has rejected the recommendation of the Works Committee, that the Council should apply for a provisional order for electric lighting.

Paddington.—The Vestry has sealed an agreement with the Metropolitan Electric Supply Company embodying the terms arrived at in July last, according to which the company obtains the consent of the Vestry to lay a conduit through the parish of Paddington.

Peterborough.—The Town Council on Friday last accepted the tender of Messrs. Main, Kendall & Main, of Loughborough, for the erection of the buildings for the electricity works at a cost of £2,334 8s. 4d.

Pwllheli.—The Town Council on Tuesday last resolved to apply to the Board of Trade for a provisional order for electric lighting.

Redruth.—At a meeting of the ratepayers last Friday, it was resolved that the Council should not adopt a municipal scheme of electricity supply, but should open negotiations with a company on the best terms obtainable.

At a special meeting of that Council on Monday last, it was accordingly resolved to re-open negotiations with Edmundson's Electricity Corporation.

St. Asaph.—The question of electric lighting has been discussed by the Parish Council, but no step was decided upon.

South Shields.—The new "Readhead" wing of the Ingham Infirmary, which was opened on 14th inst., is lighted throughout by electricity, and the contractor, Mr. James T. Dagleas, has secured the contract for lighting the whole of the old building. The contract for the complete electric light installation at the South Shields Theatre Royal has also been given to Mr. Dagleas.

Swinton and Pendlebury.—The District Council last week had under consideration a report of Mr. C. Hopkinson, of Manchester, on the subject of electric lighting, for which a provisional order has been obtained.

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Tewkesbury.—The District Council has appointed Messrs. Christy Bros. to give expert advice as to the installation of electric light, &c., at a fee of £15 15s.

Twickenham.—Application is being made to the Board of Trade by Edmundson's Electricity Corporation for a provisional order embodying powers to supply electricity in Twickenham and Teddington. If successful, the works will be erected by Edmundson's and transferred to a limited company, from which the District Councils concerned will have the power of purchasing the undertaking after a term of years.

Weybridge.—The District Council is considering the proposal of the Urban Electric Supply Company, Limited, to apply for a provisional order for electricity supply in the district.

Withnell.—The District Council of Withnell, near Chorley, Lancashire, is considering a scheme for the supply of electricity to the district.

Wrexham.—A Local Government Board inquiry was held last Friday by Mr. H. H. Law, M.Inst.C.E., for the purpose of receiving evidence regarding the application of the Town Council for sanction to borrow £20,000 for purposes of electric lighting, with other loans. The town clerk gave particulars as to the way in which it was proposed to expend the money in the construction of the works, &c.—Mr. W. H. Trentham, of London, who prepared the report on the proposed electric lighting station, &c., for the Town Council, gave details as to the way in which the works were to be constructed, and the machinery to be used. Provision would be made for 27 arc lamps for public lighting, and it was believed that there would be sufficient private customers to ensure a profit on the outlay from the very first year.—The inspector said his experience was, that in a general way it took from two to three years before these undertakings began to pay their way.

Yeadon.—The District Council last week received a letter from the Board of Trade pointing out that the Council had taken no steps to carry out their obligations under the electric lighting order granted to them in 1894, and in such circumstances it devolved upon the Board to determine whether the order should be allowed to remain any longer in force. The Council engaged Mr. Enwright, London, to advise as to the best means of carrying out the order, and the clerk was instructed to acquaint the Board of Trade with this fact.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—The Tramway Sub-committee, in view of the narrowness of St. Nicholas Street, has agreed to abandon the proposal to lay a double line of tramways in St. Nicholas Street. It has, however, agreed to recommend a double line from Castle Street, by way of Justice Street and Constitution Street, across the Links to the Bathing Station, the line to be electrically equipped. Another resolution arrived at is to construct a single line in continuation of the Bridge of Don section to join the light railway to be erected by the Seaton Brick and Tile Company.

Adlington to Whittle-le-Woods.—At a meeting of the Chorley Rural District Council last week the clerk said, in reference to the proposed electric tramway from Adlington to Whittle-le-Woods, that they had no legal standing in the matter of the main roads, which were entirely in the hands of the County Council, though the tramway could not be laid through their district without the consent of the Rural District Council. Under such circumstances they could only give their consent to the undertaking.

Birkenhead.—At Wednesday's Council meeting a resolution was submitted for confirmation as follows:—

That tenders be invited for the supply and delivery of 18 single-deck and 31 double-deck electric motor tramway cars, in accordance with the specifications, conditions, and form of tender prepared and submitted by the borough engineer and electrical engineer.

Bolton.—A portion of the Bolton and District Electric Tramway system is now complete, and a formal opening of two sections before the present Mayor's term of office expires is contemplated. The routes to be thrown open to traffic in the first instance are those of Tonge Moor and Great Lever. The lines only await the Board of Trade inspection.

Bradford.—The Tramways Committee is recommending the Council to apply for powers to construct tramways from the junction of Bolton Road and Idle Road, along Idle Road to Thackley, and from Wakefield Road, Tong, through Hunsworth, to the junction of the Leeds and Whitehall Road at the Halfway House, Birkenshaw. It was decided to request the Electricity Committee to proceed with the laying of the cables necessary for the working of the proposed new tramways to Lidget Green and Whetley Hill, the Thornbury extension, and the light railway to Stanningley.

Brighton.—On the advice of the Tramways Committee, the Council has decided that the necessary powers for the purchase of land for the erection of an electrical power station and the laying down of mains, should be included in the Tramways Bill.

Chester.—When the question of tramway municipalisation came up last week, Mr. James Frost wished to have an undertaking that the trams would not be worked by the overhead trolley system of electric haulage before he gave his vote. Mr. Churton said no such undertaking could be given. The motion was simply to give notice of purchase, and the method of haulage would be a question for future consideration. He was of opinion that the overhead system would be the most economical. The motion was carried by 19 to 10 votes, and it was referred to the Local Government Acts Committee to consider whether a provisional order or an Act of Parliament should be applied for to give the Corporation full powers.

Coatbridge.—At the last Town Council meeting a letter was read from the British Electric Traction Company, who applied to Parliament last session under the Light Railways Act for an order to construct a railway from Coatbridge to Airdrie, but which was rejected, owing to it being brought up under the wrong Act, offering to take up the tramway scheme in the burgh. It was decided, however, as the Council is involved in the joint municipal scheme with Airdrie Town Council, to reject the offer.

Dublin.—The Tramway Company have now practically completed the erection of the overhead wires from Parliament Street through Capel Street and Upper and Lower Dorset Street, to Botanic Avenue, alongside the river Tolka. Only the short crossing at Frederick Street remains to have the overhead wires constructed. The existing electric line will bring cars from the Pillar through Frederick Street to Drumcondra. It is expected that the whole of the work will be completed in less than a month's time.

On 18th inst. the new electric tram service was opened on the Northern line of quays between O'Connell Bridge and the Phœnix Park, so that passengers are now carried by electric traction direct from Westland Row to the Park.

East Ham.—The *London Gazette* (October 24th) contains notice of the application of the East Ham District Council to the Board of Trade for a provisional order for the construction of certain specified tramways, and for other incidental powers.

Electric Traction on the Metropolitan Railway.—In the House of Commons on Monday Mr. Ritchie informed Mr. Weir that the necessary plant for introducing electric traction on the metropolitan underground railways between Earl's Court and High Street, Kensington, had been constructed, and he understood that an experimental train would be run during the early part of November. He could not say when electric traction would be introduced generally. That would depend, of course, upon the result of the experiments.

Glasgow.—The Corporation Tramway Department has officially reported upon the collision of two electric cars in Mitchell Street on Tuesday last week. It is stated that in trying to prevent a slight collision with a lorry, the motorman lost his presence of mind, with the result that the car got beyond control and ran down the hill at a rapid pace, eventually colliding with another car. The damages to the car were very slight, and personal injury was also small. The hand and electric brakes were both found to be in excellent order; in fact, the whole car was reported as in perfect condition, both electrically and mechanically. In view of the attention which is now being paid to the subject of car control in several cities where mishaps have been somewhat frequent, we quote the following from the report:—

"In addition to brakes, if the motorman had not lost his head, he could have reversed his handles, and so, by throwing it into power, have caused the car to come to an abrupt stop. The different methods of stopping a car on an incline are:—

1. The hand brakes which operate by placing an iron block against each wheel.
2. The brake connected with the motors which, by a reversion of the controller handles, acts upon the axles of the driving wheels until they are skidding.
3. The dropping of prepared sand upon the track.
4. By reversion of a special handle, the motors can be brought into action to change the direction of the car.

In addition to the ordinary kind of hand brakes, similar to those on the horse cars, and which are powerful enough to control the cars on the steepest hills we have, if the rails are not very greasy, the electric cars are fitted with an electric brake, which consists of an arrangement on the controller, whereby the driver, by moving the handle in the opposite direction to that which puts on the power to drive the car forward, alters the connections of the motors, so that they act as dynamos, and generate current, which is passed through the resistances on the car, and thereby checks the speed by work done in heating these resistances, and the driver can stop the car altogether by altering the position of the handle. The electric brakes are absolutely independent of the trolley current, and it does not matter whether the trolley is on or off, for they can always be applied. In addition to these two means of breaking, so long as the trolley is on the wire, the driver can, by reversing the small handle alongside the big one on his controller, turn the power on and drive the car backwards, being able thereby to stop the car, even on the steepest hills. All that is required is that a driver should never lose his head, and always keep control of the speed of his car."

A local paper says that the Corporation Tramways Committee has agreed to recommend that the offer of the National Conduit and Cable Company, London, for the underground cables required for the extensions of the trolley system, be accepted. The amount of the contract is about £150,000.

Greenock.—The heads of conditions under which offers for leasing the tramways within the burgh of Greenock may be made were further considered at the Police Board last week. The several

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clauses were discussed at considerable length, and numerous alterations were proposed; but the conditions generally were passed without important additions or deletions. Regarding the rates for electricity for the line, the electrical engineer (Mr. Fedden) stated that they would pay the Corporation very well. It was decided to remit the adjusted heads of conditions to the Law and Finance Committee, with power to advertise for and receive offers for the line.

Croydon.—Mr. Monkhouse advised the Tramways Committee that although there is no engineering difficulty in laying down the underground conduit system for a short length in the centre of town, such a dual system would necessitate an increased expenditure, and a service which, in its working, would not be so satisfactory as a continuous service of overhead traction. He recommended that the general principle of one system of overhead electrical traction be adopted. With regard to Mr. Monkhouse's report in favour of the proposal that the line should be leased to the British Electric Traction Company, subject to the contract price with the British Thomson-Houston Company for equipment being satisfactory to the committee, the committee say (according to an exchange) that they are still of the opinion that the best practical way of dealing with the tramways, after acquisition, is to lease them for 30 years, subject to power of determination at recurring periods of five years, upon the terms as contained in their report of May 26th, and they recommended accordingly. The Council has adopted this report.

Halifax.—Mr. A. P. Trotter held a Board of Trade inquiry on 18th inst. with regard to an application by the Corporation for sanction to borrow £49,217 for the purposes of the Corporation electric tramways. The town clerk, Mr. K. Walton, said the site of the new tramway depôt had an area of 4,500 yards. The total cost of the depôt, including the site and manager's house, was estimated to be £10,686 17s. 9d. Then £6,500 was required for the equipment of 13 miles of tram lines in the borough, and £18,000 for car bodies equipped complete, at a cost of £600 each, the remaining £3,800 being for sundries. The Inspector asked what guards had been provided for the new cars. The town clerk replied that the Corporation had got the best known guards. They would be happy to provide the cars with any guard that might be better known and more effective. The town clerk asked that, with regard to the repayment of the loan, 40 years be allowed for buildings, 30 years for permanent way, and 20 years for electrical equipment and cars. The Inspector said he would report to the Board of Trade.

Hastings.—By 23 votes to 9, the Town Council has approved of Mr. Marphy's scheme for laying electric tramways in the borough. The promoter pays £5,000 toward certain street improvements, and £50 per mile for wayleaves for the first five years, and £75 per mile afterwards.

Huddersfield.—The Corporation has just placed contracts for various masonry, painting, carpentry, and other work for the new generating station at Longroyd Bridge.

Lancaster and Morecambe.—The Morecambe District Council has under consideration proposals of the Lancaster Town Council for the acquisition of the joint working of the Lancaster and District Tramway Company's undertaking. A sub committee has been appointed to deal with the matter. The scheme includes the substitution of electricity for horse traction.

Leeds.—Mr. Trotter visited Leeds on behalf of the Board of Trade on 19th inst., and inspected the Chapeltown and Headingley line, on which it is proposed to run electric cars, and the power station. The Board of Trade Inspector expressed his satisfaction with what he had seen, and the line will doubtless be passed for traffic in due course.

Limerick.—Last week a meeting of the Corporation was held to approve or disapprove of the scheme of the Limerick Electric Tramway Company, Limited. After discussion the matter had to be adjourned for a week. The proceedings were followed by hostile demonstrations, which prove that at Limerick to resort to fisticuffs is regarded as the best way to settle the question from the opposition's point of view. The Mayor and certain Councillors had to be escorted home by watchmen with drawn staffs.

Liverpool.—The Council has, by 48 to 31, rejected tramway No. 40 mentioned last week; Nos. 41 and 43 were approved, and, after further matters had been considered, it was resolved that the Tramways Committee be authorised to reconstruct the lines, for electric traction, from the Old Haymarket, along Victoria Street and North John Street, to Lord Street, at an estimated cost of £4,284 for permanent way and paving, and £729 for overhead electrical equipment.

Lowestoft.—The Council last week received a deputation from the Drake & Gorham Electric Power and Traction Company, Limited, who discussed the proposed electric tramway to be constructed from the Royal Plain, Lowestoft, northward, and also the modification of the route of the light railways already approved by the Light Railway Commissioners, to be constructed from Royal Plain southward.

Councillor Jones desired to ask if the promoters would pay a rental for the use of the roads, instead of the share of the dividends arranged to be paid.

The General Purposes Committee recommended that the electric tramway to the North Royal Plain should run along London Road and High Street, and outside the borough boundary, and go to Blundeston and Lound, the line to Blundeston to go by Yarmouth so far as possible. With regard to the route of the light railway authorised south of the Royal Plain, the Committee referred that matter to the Council for their decision.

Alderman Jefferies said that at the Committee meeting it was felt that to go over the old main line would invite possible opposition, so that they recommended that the line should go to Blundeston and Lound. That route would be very helpful to Lowestoft, and if the line could be taken to Lound it would be of further advantage; but the Committee would also be pleased if the company could carry the line to somewhere near Somerleyton Park. If the Great Eastern Railway would give them the line from Corton, Hopton and Gorleston, and the Light Railway a line which would not be in opposition to that route, they would be thankful, and the action taken would not be likely to create opposition on the part of the Great Eastern Railway.

A discussion *re* route followed; 14 voted in favour of London Road, and 6 against.

Mr. Albright then asked the Council not to insist upon the company going to Lound at present. They would go to Blundeston. He suggested that the Corporation should apply for the Bill, the company paying the cost. If the Corporation undertook to do so they would be more likely to get the Bill through, whereas the company might encounter some opposition.

Mr. Drake said they had heard that if the Light Railway Company brought forward another scheme the Great Eastern Railway would oppose it, whereas if the Corporation promoted a scheme the company would not oppose it.

Musselburgh.—The Town Council on 16th inst. agreed to accede to the conditions laid down by Messrs. Drake & Gorham for the construction of an electric tramway between Musselburgh and Portobello. The terms permit of the Corporation buying over the tramway as a going concern at the end of 14 years, with four years' profits added in name of goodwill.

Preston.—The Corporation have decided to follow the expert opinion recently obtained, and to seek Parliamentary powers in the next session to carry out an electric tramway scheme for the borough.

Rawmarsh and Rotherham.—Both the Rotherham Corporation and the Rawmarsh Urban District Council are taking the preliminary steps to obtain powers from Parliament to enable them to lay down electric tramways.

Ryde-Seaview.—Owing to the strenuous opposition of residents the Light Railway Commissioners have refused to grant an order for an electric railway from Ryde to Seaview (I.O.W.).

Southend-on-Sea.—The Council's Light Railways Committee has recommended that the overhead electric trolley system be adopted, and that the surveyor be instructed to prepare the necessary plan.

Surrey.—An important electric tramway scheme for the northern part of Surrey has been elaborated by the Highways Committee of the Surrey County Council. It will be submitted to that body on November 14th, with a recommendation that application be made to the Light Railway Commissioners to obtain the necessary powers. The scheme includes 29 miles 2 furlongs of line, and it is announced that this is only the first part of a scheme for the whole county, which will be hereafter elaborated. The scheme includes lines connecting Hammersmith Bridge with Barnes, Mortlake, and Richmond, and several lines in the latter borough; a line from the London county boundary at Wimbledon Common, passing over Kingston Hill to Kingston; lines connecting Tooting Junction with Mitcham, Carshalton, and Sutton, approaching Croydon Urban boundaries at several places; and an extension from these lines by two routes to Raynes Park, through Wimbledon and through Merton. From Raynes Park the lines will pass across country to New Malden, thence onward to Kingston—where it will throw a branch northward towards Richmond, as far as Ham Common—and so from Kingston through Surbiton, with several subsidiary routes, to Ditton. A daily paper remarks that the local authorities in several of the places affected have proposals of their own already in hand, and there may be a good deal of clashing, though in other cases, notably at Richmond, a desire has already been expressed to work with the County Council.

Swansea.—The British Electric Traction Company, in view of their recent application to extend their tramways in Swansea under the Light Railway Act, and their failure to get the order granted, have written to the Swansea papers explaining their position and intentions with regard to the matter. The letter says that the Mayor of Swansea offered, as his only apparent reason for opposing the company, his belief that they were not sincere in their proposals. The company, in the letter, reply to this by pointing to the £100,000 now being spent in the town to electrically equip the tramways. The letter goes on to say that, should the Corporation intend to carry out the extensions themselves, they could only do so within the borough limits. The fact of their going outside the borough would imply that there would be two authorities owning the lines, seeing that the outlying portions would be under the control of the Glamorganshire County Council. The company state that it is not their intention to pursue the matter, in consequence of the fact that, owing to their failure to secure the extensions under the Light Railway Act, all hope is excluded of the Corporation giving their consent under the Tramways Act.

Warrington.—The Town Council has this week decided to apply to the Board of Trade for a provisional order for the construction of electric tramways within the borough. The main streets are excessively narrow and crowded. Our correspondent says that at present it is impossible for an ordinary omnibus to approach the centre of the town except at a crawling pace.

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Worcester.—The Electricity Committee has decided to recommend the Council to acquire and work the city tramways at the expiration of the company's lease.

TELEGRAPH AND TELEPHONE NOTES.

Cardiff Telephones.—At a meeting of the General Purposes Committee of the Cardiff Corporation on Monday, the Mayor said that there was no prospect of the Corporation being allowed to buy out the local telephone system, because the Government expected to be able in 25 years to acquire the telephonic system throughout the country. In a recent interview granted by the Duke of Norfolk to the Mayor, the member for the borough, and the town clerk, the Postmaster-General had stated that if the Corporation would lease the whole of the local Post Office system for a period not exceeding 25 years, a license would be granted to them. Penarth, Barry, and neighbouring places would be included. The whole matter will come up for consideration at an early meeting of the Corporation, for which the town clerk was instructed to get details of the scheme.

Colombia Cables.—Reuter's New York agent said, on the 23rd inst.:—"A censorship has been established at Panama and Buenaventura on all telegrams for Colombia, the Government of which advises the cable companies to refuse messages for Cartagena, Barranquilla, Cucuta, Ocana, and Bucaramanga, as the lines to these places will probably be down for a long time."

The Iceland Cable.—On page 638 of our last issue we reproduced a paragraph from the *Financial Times* referring to a cable to Iceland, in which it was stated that the cost is estimated at 10,000,000 kroner. We understand that this is evidently an error, and that probably 2,000,000 is meant instead of 10,000,000.

Manchester Telephones.—The City Council was asked at its meeting on Wednesday, on the recommendation of a special committee, to endorse the New Mutual Company's application for a license. This company was started with a guarantee fund, about two years ago, and just when it appeared likely to get its license—having the support at that time of the Corporation—the announcement was made than no more licenses would be granted by the Postmaster-General to private companies. The New Mutual Company's proposed terms are £6 6s. a year for an unlimited service. Shareholders would receive an advantage upon this rate, proportioned to the amount of the investment in the company. For limited user the charge would be £2 17s. 6d., and 1d. per message. It is also considered that a minimum inclusive charge of £4 10s. for 400 messages would suffice, to commence with, for limited user, as an alternative to the preceding offer. The company propose to transfer their business to the Corporation, or the Post Office, if at any future time either of them desires to take over the same, on repayment to the company of capital expended, with 5 per cent. interest, or at a valuation by arbitration. They ask for a license to extend over 21 years. It should be stated that the special committee of the Corporation by whom the lengthy negotiations with the National Company have been conducted were by no means unanimous in their support of the New Mutual. A large section both of the committee and of the City Council would prefer a municipalised telephone service. They were able on Wednesday to persuade the Council, as an alternative to the recommendation to support the New Mutual, to ask the committee to reconsider the subject, to consider the question of a municipal license, and to prepare a full report and recommendations for the Council.

Norfolk Music Festival and Telephones.—During the Norfolk and Norwich Triennial Festival week a connection by telephone was made between the St. Andrew's Hall and the Norfolk and Norwich Hospital and the Institute for the Blind in Magdalen Street, Norwich. The necessary work and the provision of the apparatus was done gratis by the Norwich Mutual Telephone Company. There were at times as many as 16 receivers being used at the hospital, the wires being of such a length that they might be changed from bed to bed.

The Pacific Cables.—In the House of Commons on 19th inst. Mr. Hogan asked the Secretary for the Colonies whether he was in a position to report any effective progress in the negotiations for the construction of the Pacific cable from Canada to Australia, or of the proposed alternative cable from South Africa to Australia. Mr. Chamberlain, in reply, said an arrangement has been arrived at with the colonies interested in the Pacific cable that the elaboration of the scheme, and the management of any line that may be decided on, should be entrusted to a board of eight members sitting in London. Her Majesty's Government are to be represented by three members, including the chairman, Canada by two members, and Australia and New Zealand by three. The Dominion Government have appointed the Earl of Aberdeen and Lord Strathcona to represent them, and the Australian colonies and New Zealand have nominated the Agents-General for New South Wales, Victoria, and New Zealand as their representatives. I am in communication with the Chancellor of the Exchequer and the Postmaster-General as to the nomination of the representatives of Her Majesty's Government, and I hope that the board will be constituted and in a position to meet next month, when the Agents-General for Victoria and New Zealand, who are now in the United States, have returned. I am informed that the Eastern and Eastern Extension Telegraph Companies have proposed to lay a cable from South Africa to Australia; but I have not learned that the colonies have yet come to any decision on this proposal.

The Telegraph in Central Africa.—According to the *Daily Chronicle* Brussels correspondent, the *Mouvement Geographique* says that, owing to the unsettled condition of the country between Tanganyika and Manyema, the telegraph expedition under the charge of Mr. Mohun, an American, has been unable to commence operations in the basin of the lake. The expedition is bearing in a westerly direction, and in June last was about to erect the first telegraph pole at Lungula, so as to continue work in the direction of Kasongo. The same authority says that communication between the Zambesi and Lake Nyassa is slow and difficult.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Bilbao-Falmouth	... Oct. 12, 1899	... Oct. 19, 1899.
Cayenne-Pinheiro	... Oct. 11, 1899	... ...
Corea-Japan	... Aug. 7, 1899	... ...
Gibraltar-Tanger	... Oct. 19, 1899	... ...
Jamaica-Colon	... June 30, 1899	... ...
Latakia-Cyprus	... June 20, 1899	... ...
Para-Maranham	... Oct. 20, 1899	... ...
Trinidad-Demerara (1871 original)	Oct. 20, 1899	... ...
Do. do. (1891 duplicate)	Oct. 6, 1899	... ...
Landlines.		
Lines from Haiti to Gonaives, Gros Morne, Port de Paix, Plaisance, Cape Haitien, Port au Prince to Miribalais and Jacmel ...	... Aug. 18, 1899	... ...
Communication with Mafeking	... Oct. 14, 1899	... ...
Nicaraguan Government line to Bluefields destroyed ...	... Oct. 6, 1899	... ...
Communication with interior of Venezuela	... Sept. 23, 1899	... ...
Landlines of Yucatan (Mexico)	... Oct. 21, 1899	... Oct. 22, 1899
Communication with all offices beyond the Orange River	... Oct. 18, 1899	... ...
Saigon-Bangkok	... Oct. 24, 1899	... ...

Telegraphists' Grievances.—The departmental commission appointed by the Duke of Norfolk to inquire into the complaint of the London telegraphists that a large percentage of the staff is compelled by the authorities to go on holidays in the winter months has, under the presidency of Mr. J. C. Lamb, drawn up a proposal to be submitted for the acceptance of the staff. The scheme, says the *Times*, which there is every reason to believe will be agreed to, secures for the general body holidays in the more favourable months, and in substance is as follows:—(*a*) Annual leave to be allocated in eight months of the year—namely, March to October. (*b*) All periods of annual leave as at present allotted to be curtailed by three days, such curtailment to be restored to each officer some time during the remaining four months. (*c*) *Pro rata* payment for duty performed on Bank holidays during the period of March to October to cease and leave in lieu thereof to be granted each officer, this to be added to the three days mentioned above.

The Telephone Service.—The Whitechapel District Board of Works will not grant an interview with the metropolitan superintendent of the National Telephone Company with reference to the Board's refusal to grant permission to the company to lay down telephone mains in certain streets of the district.

Wireless Telegraphy.—A Press despatch says that it has been decided to adopt the Marconi system in Cuba, and arrangements will shortly be made to establish communication between all the American West Indies by this means.

CONTRACTS OPEN AND CLOSED.

OPEN.

Birkenhead.—November 14th. The Corporation wants tenders for 13 single-deck and 31 double-deck electric motor cars, also for boilers, economisers, mechanical stokers, steam dynamos, booster and battery. See "Official Notices" October 20th.

Birkenhead.—November 14th. The Corporation wants tenders for switchboard and instruments for the South End tramway generating station. See "Official Notices" this week.

Bradford.—November 9th. The Corporation is inviting tenders for 25 electric tramcar bodies, electrical equipments for same, and trucks and trolleys for ditto. See three of our "Official Notices" this week.

Croydon.—November 13th. The Guardians want tenders for electric wiring and fitting at the workhouse, infirmary, and union offices. See "Official Notices" to-day.

Essex.—November 27th. The Governors of Felsted School, Essex, are inviting tenders for boiler, two 27-kw. steam dynamos, condenser, pipework, accumulators, cables, and switchboard for electric lighting. See "Official Notices" this week.

France.—November 14th. Tenders are being invited by the French Post and Telegraph authorities in Paris for the supply of 10,000 metres of pipes 80 mm. diameter for pneumatic despatch tubes. Tenders to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

(*Continued on page* 683.)

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ELECTRO-PNEUMATIC SIGNALLING.

In a recent issue we were able to place before our readers some interesting details with respect to the application of electricity to lighting, and various other purposes, at the new Boston Railway Station. Some idea of the magnitude of this building may, perhaps, be conveyed by the fact that it covers ground to no less an extent than 12 acres, while the total area pertaining to the station proper is 35 acres. The platform arrangements provide for luggage, baggage, &c., being dealt with on one platform, while that on the other side of the train is devoted to the passengers. Thus the officials are enabled to proceed with their work uninterrupted by the passengers, and the passengers, on their part, are able to select their seats without experiencing that inconvenience so characteristic of our large terminal and other stations consequent upon passengers and luggage being huddled together upon one and the same platform. Time and temper are saved; the dispatch of the train is effected more certainly and more smartly than is possible under the system which obtains with us. Greater space is necessarily occupied, for, at least, there must be one platform devoted to luggage to every two appropriated to the passengers; but where this space can be spared, there is reason to believe great convenience, with ultimate economy, will attend its adoption. Although, perhaps, not entirely novel, yet another feature of this station is the employment of subway lines, forming loops with the main lines, for the local service. These subways are lines having their own platforms and connections, by steps and slopes, with the platforms, &c., of the main station.

Fig. 1.—Signal Cabin and Power House.

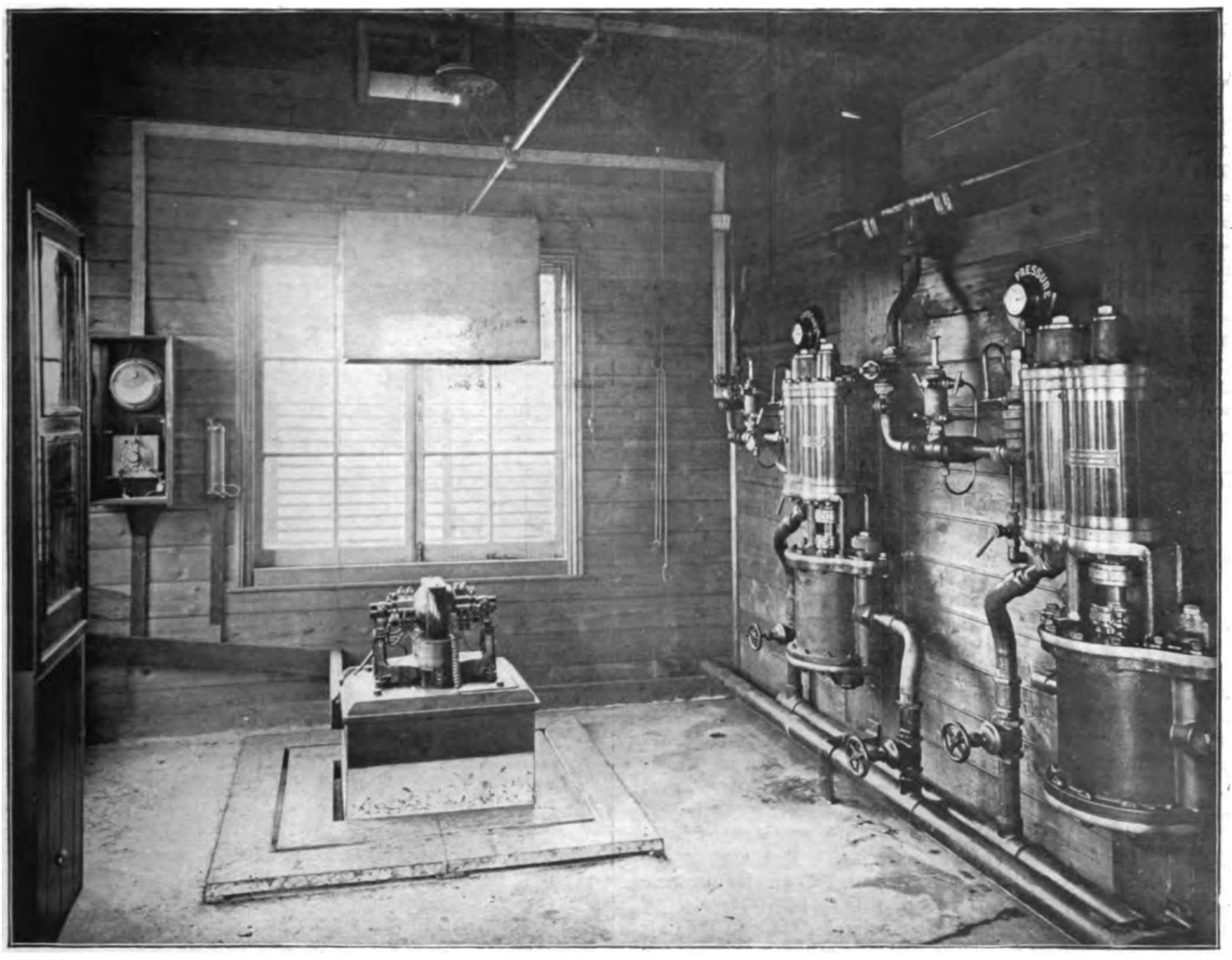

Fig. 2.—Interior of Power House, Spitalfields, G.E.R.

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They are signalled and operated from the signal cabin that deals with the signalling of the upper or main lines. Whether

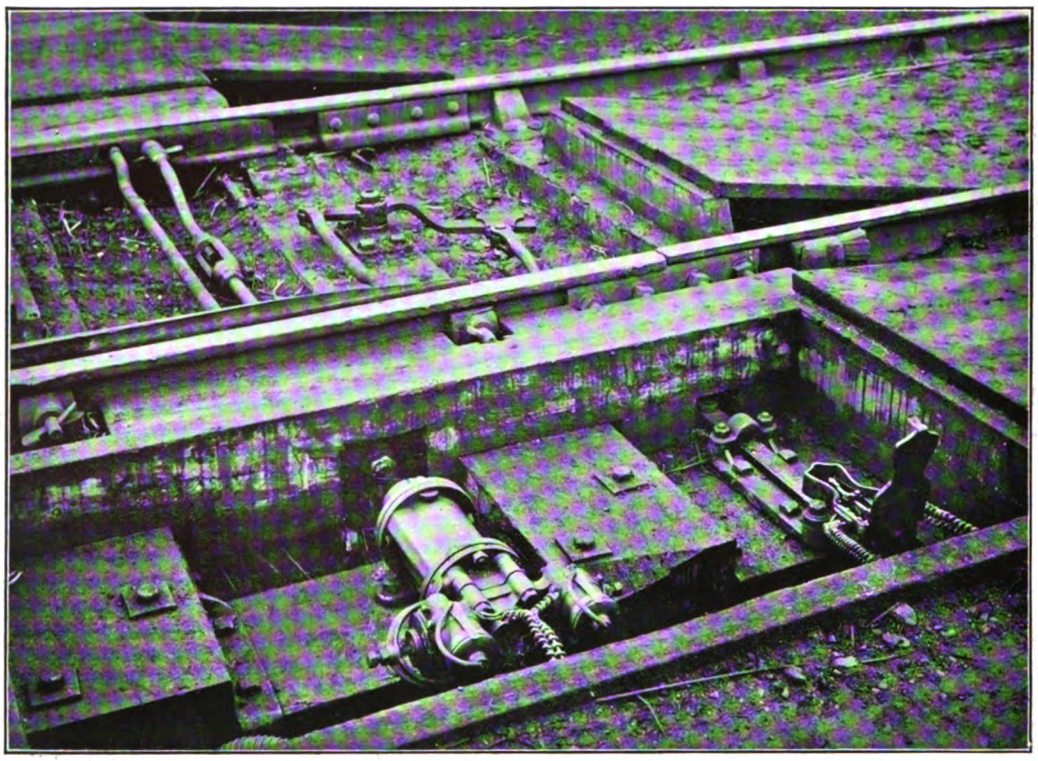

Fig. 3.—Trailing Point Lay-Out.

these subway roads will be worked by electrical power or compressed air has not so far been determined, but there can be little doubt that electricity will form the motive agency.

It is not, however, our forte to discuss the arrangements of the station so much as the mode and manner in which these arrangements are met by, or call for, the aid of electricity. We have already dealt, as fully as the space at our disposal would admit, with its application to lighting, and its use for motor work. It is gratifying to observe how universal has been its application to every purpose. Whether for passenger lifts, goods lifts, traversers, or other kindred purposes, electricity stands as the agent. We wonder how long it will be before our own railways grasp the fact that economy resides in the general application of this form of energy, not merely to lighting, but to all purposes in which power is called for at such points. Why should expensive hydraulic plants be laid down along with machinery for lighting, when the same agency which effects the lighting is quite capable of doing the work for which the hydraulic machinery is provided? Doubtless its advantages will some day be recognised on this, as they have already been on the other side of the Atlantic. In the meanwhile the equipment of the new Boston station may be accepted as an object lesson worth considering.

It is the mode of dealing with the operation of the signals and points to which we are desirous of devoting this article. The switching and signalling system includes a very complete installation of electro-pneumatic interlocking apparatus. Two interlocking machines are required, and these are located in two signal "towers," analogous to our signal boxes. In each of these towers, operating models of the tracks are provided, upon which each movement of the points, or switches, and signals may be duplicated in miniature, so that the operators may have before them the exact arrangement of the roads or signals under their control.

Both the points and the signals are operated by compressed air, controlled by electricity. The signals are arranged, in some cases, on the ground, but chiefly on wide signal bridges, varying in span from 50 to 120 feet.

The power plant is contained in a well-designed building 460 feet long and 40 feet wide. Here provision is made for the lighting, heating, refrigeration, and power required throughout the station. The total horse-power laid down is 2,000, and the building makes provision for an increase of 50 per cent. on this.

In the employment of compressed air controlled by electricity for operating the points and signals there is—in principle—nothing new; but it is doubtful if it has ever been employed, generated from one centre, over so large an area, or for so extensive a system. In England, although

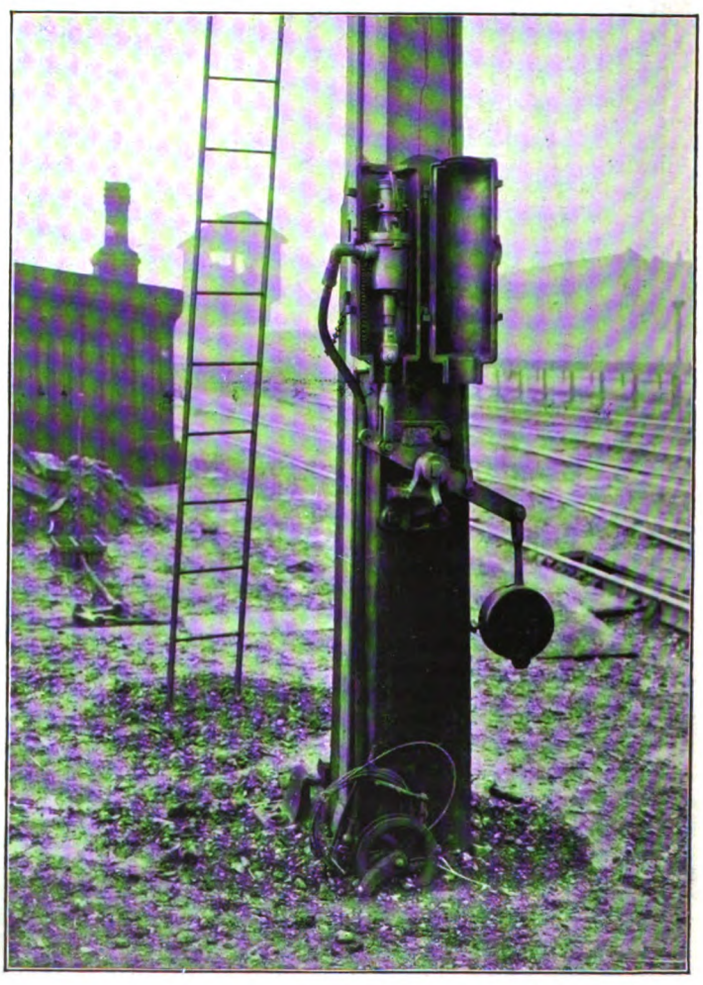

Fig. 4.—Signal Motor.

the subject has for some time been before the railway management, we have but one application of it—that at the

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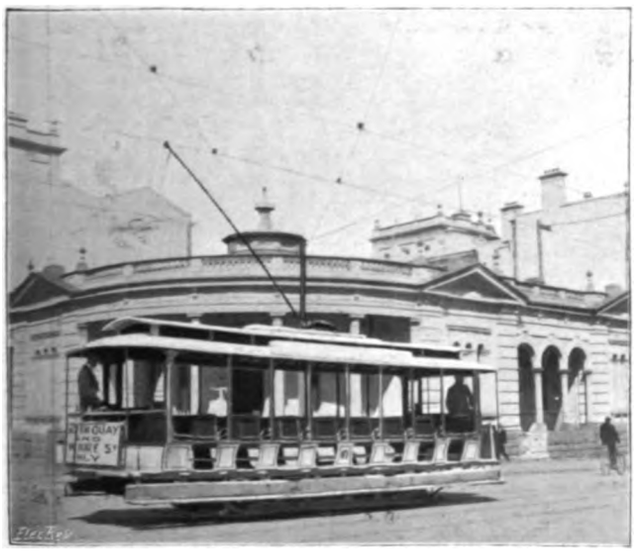
Bishopsgate Goods Yard, on the Great Eastern Railway. This goods yard, as may be imagined, is an extremely busy one, and it, no doubt, is an excellent selection as a test of the

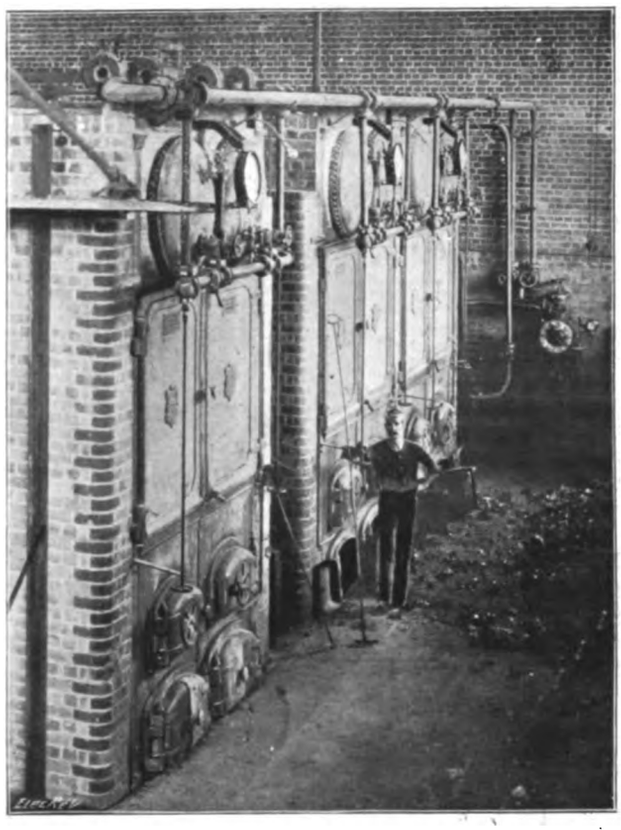
Brisbane Tramways.

Brisbane Tramways.



Brisbane Tramways.

suitability of such a method of working to English railway requirements. As such, some reference to the details involved may be of interest to our readers. In the United States the place from which the points and signals are operated is spoken of as the signalling tower. In England we use the expression signal box. The arrangement and design of the buildings is not by any means identical, but there is this, on that point, to be said—the signal boxes used on British railways are the outcome of experience of our needs. No doubt the same may be said of the system in operation in America. The requirements differ; traditions differ; the conditions, taken as a whole, are totally distinct. In England our commercial centres and towns are within easy reach of one another. Manufactories abound; even along the lines of railway we find siding connections affording access to factories, works, &c. All these need signal protection, the operation of points, &c., and naturally they become signalling centres. In America, outside the large



Brisbane Tramways.—Boilers.

commercial centres, long stretches of country intervene. Under these circumstances automatic signalling has been a necessity, and hence the extent to which this form of signalling has been adopted, and the preference for it, which obtains in the United States, and which marks such a wide difference in the general mode of signalling trains in America as compared with the practice pursued in this country.

Fig. 1 is an illustration of the signal box containing the necessary switching and signalling apparatus for operating the Bishopsgate yard. Adjoining it is seen the power house, air reservoirs, &c. Fig. 2 shows the interior of the power room. The air pumps are in duplicate, and, in this instance, are operated by hydraulic power—that form of power being available for the purpose, it was felt unnecessary to establish independent generating plant. Each pump has an automatic governor, seen to the left of the illustration, which stops the water supply as soon as the air pressure reaches 75 lbs. per square inch. Leaving the pumps the air is passed through the group of bare iron pipes, seen in fig. 1, adjoining the power house, and which form a condenser, and serve to dissipate the heat generated by the compression of the air, and also to condense the moisture. The air is now carried to the reservoirs, if reservoirs are used. It will, however, be evident that these are not in all cases necessary, and that under any circumstances their capacity may be of a very limited character. The amount of air required per minute in this plant is about 10 cubic feet, measured at atmospheric pressure. Where reservoirs were used the consumption would,

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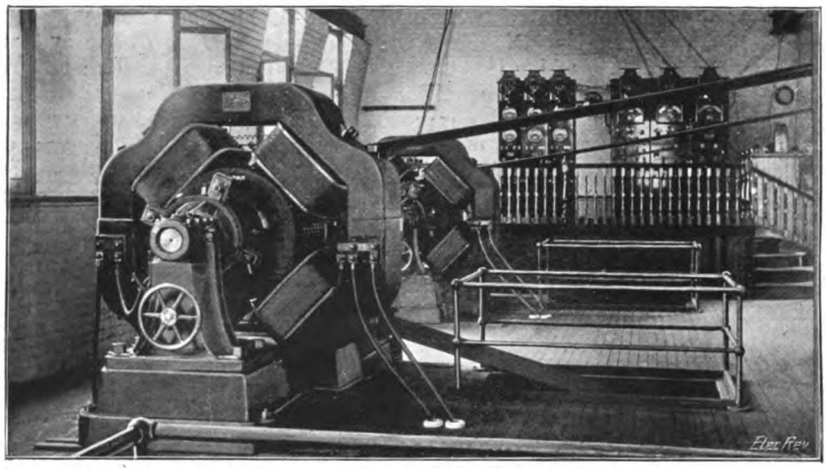
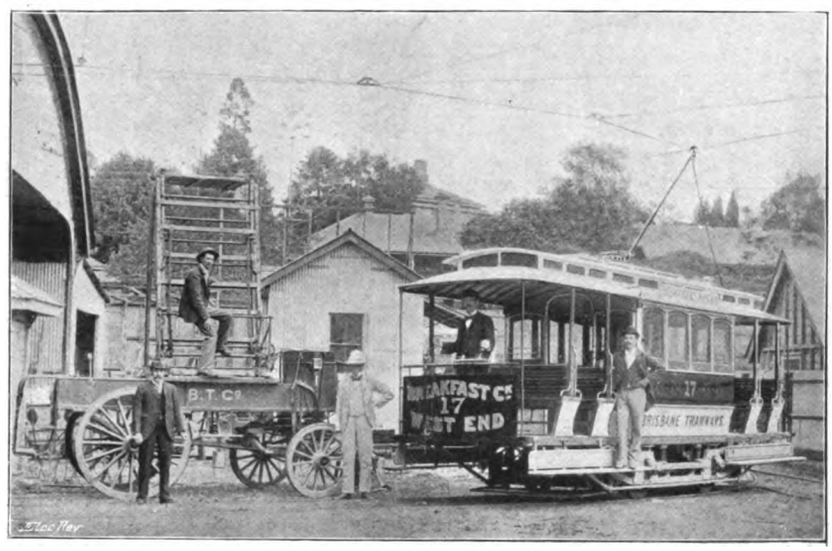
of course, control the size of the reservoirs. From the reservoirs the air is distributed by means of a 2-inch main, with branch pipes of ¾-inch diameter, as required. Auxiliary reservoirs may be used as found necessary; where the system entails a considerable extent of piping, they are desirable, and, under any circumstances, are of advantage in inducing a more prompt action of the parts they control. These branch pipes, as will be understood, terminate at the cylinders and apparatus operating the signal or point connection.



Brisbane Tramways.—Generators.

Fig. 3 shows the parts controlling a point connection. To the left of the engraving is the air cylinder; to the right of it is the locking piece, with its lid raised.



Brisbane Tramways.—Repairing Tower.

Fig. 4 is from a photograph of one of the signals, showing the gear applicable to it. The cover of the cylinder valves and electrical parts is thrown back so as to expose the internal arrangements. The position of the signal arm is that indicating danger. To place it in the "all-clear" position, air has to be compressed into the cylinder, and that end of the lever, to the opposite end of which the weight is attached, has to be pressed down so as to elevate the weight end of the lever to an angle of some 30° from the position shown in the illustration.

(To be continued.)

BRISBANE ELECTRIC TRAMWAYS.

Our Sydney correspondent sends us some photographs of the electric trolley system at Brisbane, Queensland, along with certain particulars of the power house and line equipment.

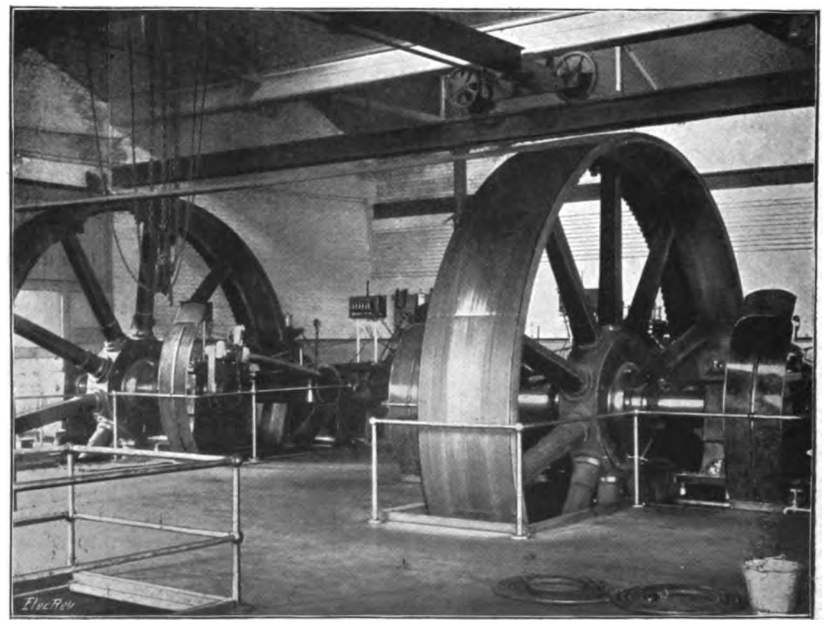
The tramways are in the hands of a company, and they are doing very well. As happens in all towns or districts where electric traction is introduced, the service is unquestionably a great boon to the public. The system covers altogether some 18 miles of streets, or about 30 miles of track. The overhead work is almost entirely span wire construction, with iron tubular poles.

The power house is situated fairly centrally near the Roma Street Railway Station. There are three Babcock and Wilcox boilers, working at 150 lbs. pressure. At present, hand stoking is used, but American mechanical stokers, feeding from underneath, are now being fitted; a water tower is used for condensing purposes. The generating plant consists of three General Electric multipolar generators, belt-driven from Robey horizontal compound engines.

The switchboard is also of General Electric manufacture, with the usual panel arrangements. There are three feeder panels, each carrying two feeders, but only two panels are in use at present. The remaining one will soon be occupied, as two new feeders are now being erected. The standard size of the feeders is 500,000 circular mils.

The feeders are all run overhead, as, curiously enough, though the Brisbane Electric Supply Company are compelled to run their mains underground, it has been ruled that the Tramway Company may not do so.

There are in all some five different types of car running, the majority being of a composite type, with the centre portion enclosed, and at each end a section with open ends and sides, as shown in the adjoining figure. Most of the cars



Brisbane Tramways.—Engines.

of the enclosed type are made up of two of the old horse-car bodies joined together. All cars were built by the company; the trucks, which are of the Peckham type, being imported. A special car has been built for pleasure parties, the intention being to run it over the various lines, going by

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one route, and returning by another, with a fixed charge for the whole trip, or letting it out to private parties for the same purpose. The car is quite open, as shown in the photo, but arrangements are being made for a removable awning; the seats are made removable, so that in the event of private parties taking it, chairs can be substituted. It is anticipated that there will be a great demand for this car on hot summer nights.

Our correspondent also informs us that there is a big scheme on foot for purchasing the whole of the Adelaide tramway system, and converting the present horse lines into an electric system. The Westinghouse Company and their Sydney agents, Messrs. Noyes Bros., are the parties principally concerned in the deal, and negotiations are so far advanced as to only require the necessary Parliamentary sanction to be complete. There are seven tramway companies to settle with, and it is said that the purchase price is somewhere in the vicinity of £300,000.

CONTRACTS OPEN AND CLOSED.

OPEN.

(*Continued from page* 678.)

Glasgow.—November 14th. The Corporation wants tenders for two 800-H.P. compound vertical auxiliary engines for the new tramway power station at Port Dundas. See "Official Notices" October 13th.

Glasgow.—November 20th. The Electricity Department want offers for 10 miles of 2-inch cast-iron pipes. See "Official Notices" October 13th.

Hoylake and West Kirby.—November 15th. The Council is wanting tenders for Lancashire boilers, superheaters, economiser, steam engines, alternators, motor alternator, crane, wiring, steam, &c., piping, switchboards (high and low tension), batteries, transformers, concentric mains, &c., &c. See "Official Notices" October 13th.

Llandudno.—November 6th. The Council wants tenders for three 150-KW. high speed engines and dynamos, also motors and boosters. See "Official Notices" October 20th.

Maidstone.—November 6th. The Corporation wants tenders for steam dynamos, balancers, boosters, boilers, economiser, surface condenser and feed pumps, switchboard, &c., battery, crane, mains, arc lamps and posts, and electricity meters. See "Official Notices," October 20th.

Middlesbrough.—November 22nd. The Electric Lighting Committee wants tenders for condensing plant and pipe-work for the electricity works. See "Official Notices" October 20th.

Morecambe.—The Urban District Council wants tenders for boiler, steam dynamos, switchboard, transformers, mains, pumps and condensers, and storage batteries for electric lighting extensions. See "Official Notices" October 13th.

Newcastle-on-Tyne.—November 30th. The Tramways Committee wants tenders for two 1,000-H.P. steam dynamos for electric tramway works. See "Official Notices" this week.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

St. Pancras.—The Vestry wants offers for the supply of temporary generating plant for the Regent's Park electricity works. See "Official Notices" October 20th.

Spain.—November 7th. The Spanish Ministry of Public Works in Madrid is inviting tenders, until November 7th, for the concession for the construction and operation of an electric tramway in the town of Cadiz. Particulars may be obtained from, and tenders are to be sent to, La Direccion General des Obras Ribleas, Madrid.

Sydney (N.S.W.).—November 3rd. The Municipal Council of Sydney is inviting tenders for the construction and erection of a refuse destructor for treating 60 tons of refuse per day (24 hours).

Warsaw.—The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul-General at Warsaw, stating that tenders are invited by the municipality of that city for the construction of freezing chambers and electric lighting in the covered market halls. The latest date by which the tenders have to be sent in has not yet been fixed. Such particulars as have been received may be examined at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

Wrexham.—November 8th. The Council wants tenders for boiler house plant, engine house plant, dynamos, switchboard, mains, posts, battery, meters, crane, and buildings for electricity works. See "Official Notices" October 13th.

CLOSED.

Colwyn Bay.—The District Council has given the contract for electricity works' buildings to Mr. Thomas Brown, of Chester, at £1,910.

Glasgow.—Messrs. M'Callum & Hope are to supply the iron stairs required for the Port Dundas electric power station at a cost of £142 3s. 8d.; Messrs. Mechan & Son the switchboard galleries for £600; and Messrs. Hayward Brothers & Eckstein, Limited, the floor lights for these galleries for £610 16s. 8d. Messrs. Babcock and Wilcox, Limited, are to provide and erect at the Pollokshaws Road station four water-tube boilers, with galleries and ladders, similar to the five boilers they are now erecting at Port Dundas station, and at the same price for each boiler. The amount of the contract is £5,446. Messrs. D. Stewart & Co., Limited, are to provide and erect for £998 10s. two wagon hoists, with mild steel chains, at Pollokshaws Road station. The contract given to the Clayton Engineering and Electrical Construction Company, Limited, of Clayton, Manchester, to which reference was made last week, is for two 50-ton electric cranes (£4,260) and one 30-ton (£1,350), with a 76-foot span. These are for the Corporation electric tramway station at Port Dundas.

Poplar.—After considering Mr. Warden Stevens's report on the tenders received for Sections F, G, and J of the scheme of engineering works at the workhouse, contracts have been placed as follows:—Section F, high speed (enclosed) engine and dynamo, Thames Ironworks Company, Limited, £827; Section G, electric motor, Fuller-Wenstrom Electrical Company, £419; Section J, economiser, James Carter & Sons, £99 10s.

FORTHCOMING EVENTS.

Friday, October 27th.—At 5 p.m. Physical Society meeting at the rooms of the Chemical Society, Burlington House. Agenda:—"The Magnetic Properties of the Alloys of Iron and Aluminium," by Dr. S. W. Richardson. Exhibition of a model illustrating a number of the actions in the flow of an electric current, by Mr. G. L. Addenbrooke. Repetition of some experiments with the Wehnelt interrupter devised by Prof. Lecher, by Mr. W. Watson.

At 8 p.m.—Institution of Mechanical Engineers. General Meeting, Sir W. H. White presiding.

At 8 p.m.—Electro-Harmonic Society's Smoking Concert at International Hall, Café Monico, Regent Street, W.

Saturday, October 28th.—Manchester Association of Engineers. Mr J. S. Raworth on "Generation and Electrical Distribution of Motive Power."

Thursday, November 2nd.—At 8 p.m. The Civil and Mechanical Engineers' Society opens its 1899—1900 Session at Hôtel Victoria, Northumberland Avenue, S.W. Paper:—"A Short Account of Some Modern Steam Wagons," by Mr. G. A. Burls, Wh. Ex., A.M.I.C.E.

Friday, November 3rd.—At 8 p.m. The Institution of Junior Engineers, at the Westminster Palace Hotel. Presidential address by the Hon. Charles A. Parsons, F.R.S.

Tuesday, November 7th.—At 8 p.m. Institution of Civil Engineers. Address by Sir Douglas Fox, president, and presentation of medals and prizes awarded by the Council. Reception by the President in the library after the meeting.

Tuesday, November 14th.—Institution of Civil Engineers. "The Waterloo and City Railway," by H. H. Dalrymple-Hay, M.Inst.C.E.; "The Electrical Equipment of the Waterloo and City Railway," by B. M. Jenkin, Assoc.M.Inst.C.E.

Thursday, November 16th.—At 8 p.m. Institution of Electrical Engineers' opening meeting. Presentation of premiums and inaugural address, by President S. P. Thompson, F.R.S.

NOTES.

London's Lost Tunnel.—As we go to press Prof. Chas. A. Carus-Wilson writes: "In your criticisms of my letter of the 16th inst., you ridicule Mr. Barlow for taking the speed of the engine as an indication of the rate of working, for the speed, you say, would be kept constant by the governor, and therefore independent of the load. Your remarks would have some weight if, in Mr. Barlow's experiments, the speed had been controlled by a governor, but this was not the case. The admission of steam was regulated by a throttle valve worked by hand, so that the speed of the fan was liable to vary with changes in the load. Mr. Barlow's results are thus not so transparently silly as you would make them appear."

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Volta and Como. — Although this journal is not primarily devoted to the study of ancient history, we need not apologise for the somewhat lengthy extracts we are printing from Prof. Righi's published address on the scientific work of Volta, delivered at the Volta Centenary at Como. Some of these extracts have been selected for their historical, some for their scientific, interest: the Italian originals of others are superb specimens of rhetoric. The work of Volta and his contemporaries is an inspiring subject. It was so sound, and has proved so fruitful. They laid securely the foundations of electrostatics and of electrolytics with no better means of detecting electrical action than the condenser and electroscope, or that "stupendous discovery," the frog's leg. The modern influence machine, and quadrant electrometer, and the mathematical methods of Fourier, Green, and Thomson are greatly in advance of anything known to them, but none of their work has had to be undone. The death of Volta nearly coincided with the discovery of electro-magnetics, the most momentous of all discoveries, and the period of his life may conveniently be taken as the embryonic period of our science.

American Competition.—We are free to admit much that is said of American competition, but at the same time we have not much faith in its reality. It is less American competition than English apathy that makes it appear as though competition were serious. We have had many a fling at the follies of the trades unions, but we might equally well condemn the methods of our manufacturers, who have been so singularly remiss in setting themselves out to meet the demand. Our electrical companies ought to-day to be full of traction work. We could name half-a-dozen engineering works that should be busy on traction work in place of standing aloof, or supplying goods in a perfunctory and half-hearted manner. Col. E. A. Stevens is writing a series in *Engineering* on American competition, which goes over again the old arguments and glorification of the American workman as a divine kind of creature. But we cannot altogether agree that the American manufacturer is so receptive, or inclined to suit customers. Only recently we met with an example of the intense conservatism of the American manufacturer, who declined even to quote for an addition to the article he made—an addition badly needed, and one which implied no alteration to patterns. He simply wrote a wordy letter of excuse and false argument, and this is but one of many instances we have met of the same ultra-conservative spirit, and an inability to accept suggestions from users. We have elsewhere referred to this subject in respect of the American lathe, which, good up to a point, is absolutely devoid of any satisfactory means of using it, having no strong tool-holder. So prejudiced and blind are the makers of American lathes that they will not even bear criticism from their own Prof. Sweet, who has been roundly abused for attacking this very point of weakness. American competition—such as it is—is on the American side very much (we had almost written entirely) a question of shop methods. But it is not the formidable thing that half-asleep people on this side try to make it out, and would be as nothing if capital and labour here could only arrive at an amicable understanding. We believe that English manufacturers are too much inclined to ask longer time for carrying through an order than is necessary for them, and they are not pushing business as they should do. They simply allow thousands of pounds to slip through their fingers because they will not take the trouble to ascertain prices and ask for orders.

Accumulator Traction at Paris.—The Compagnie Générale des Omnibus is making preparations to substitute on its lines vehicles deriving their propelling power from storage batteries. The *Electrical World* says that there will be a central station at Montreuil of 2,000-KW. capacity, though, for the present, only 1,600 KW. will be installed. There will be two charging stations, both situated in Vincennes. The generators will be driven by de Laval steam turbines. Tudor storage batteries will be used in one charging station and Blot batteries in the other.

Loss of the Cable Ship "International."—Having noticed the loss of a vessel of this name, we made inquiries at the offices of the Silvertown Company, and found that, as we had surmised, it was the cable steamer *International* that had found a last resting place in the Birling Gap, under Beachy Head, and on the westward side. We learned that the vessel went ashore during the late heavy gales while being towed from London to Cherbourg to be broken up, and that by some strange fatality she drifted athwart a submarine cable laid from her some 26 years ago. The *International* was one of the first steamers, if not the first, which left the ways of the shipbuilding yard with cable tanks and other cable fittings on board, and was christened the *International* on account of the nature of the work she was destined to carry out. All other vessels employed in the cable service before the *International's* launching, had been converted into mail or cargo steamers. During her 30 years of cable service the *International* has transported and laid many miles of cable in the Mediterranean, in the Persian Gulf, in the North and South Atlantic, and in the Pacific Ocean. She had on several occasions been chartered by the Postmaster-General before the Government Telegraph Department had a telegraph ship of its own, and was also employed by Government as water-condensing transport at Suakin during the Egyptian campaign. The vessel began her career in troublous times, as shortly after laying a cable between Great Britain and the Channel Islands, she was called upon to lay some short cables for the French Government in December, 1870, and her employment in this work gave rise to a lawsuit, under the Foreign Enlistment Act, in which the India-Rubber, Gutta-Percha, and Telegraph Company made a successful defence against Her Majesty's Government. The work undertaken was the laying of a series of cables (1) between Gravelines, in the Pas de Calais Department, and Cherbourg; (2) between Flamanville and St. Brieuc, in Brittany; (3) between Quiberon and Belle Isle, on the Atlantic seaboard of France; and (4) between Belle Isle and Verdun, near Bordeaux. Besides the ordinary dangers of the sea during winter, there existed others which necessitated an escort, and the ironclad *Thétis* and the composite paddle frigate *Ctesiphon*, of the French Navy, accompanied the *International* and her consort, the French Government cable vessel, the *Ampère*. In spite of many troubles, including running ashore in a heavy fog, the *International* successfully completed her work in a very short period of time, and Faidherbe's Army of the North at last found itself in telegraphic communication with Orleans and Bordeaux. The work done by the *International* was that which every cable ship is called upon to perform, and whereas when she was launched vessels in her class of employment numbered nine, there are now about 40, whose sole occupation is the laying and maintaining of telegraph cables. The *International* was a good staunch vessel, and has left behind her a record of excellent work.

Suggested Improvement in Overhead Trolley Construction.—The *Engineer* mentions that in a German electrical journal there recently appeared a description of a magnetic arrangement for doing away with the springs in the trolley pole bases used for overhead electric traction. When the height of the overhead conductor varies, there is a tendency on the part of the trolley to leave the conductor, with the result that the pole strikes and breaks the span-wires before the car comes to rest. In order to avoid this risk, the author proposes to dispense entirely with springs in the trolley base, and to substitute for them a coil-and-plunger mechanism traversed by the main current. If the trolley should be thrown off the conductor, the excitation of the magnet ceases, and the trolley pole falls down out of harm's way.

Electric Canal Traction.—Our New York namesake says that the Erie Canal Electric Traction Company was organised recently to introduce electricity as a motive power, not only upon the Erie Canal, but upon all the canals in the United States, and upon the canals of France and Holland. It possesses patents applying electricity to a motor or tractor which, from the tow-path, so it is said, will propel or tow six ordinary canal boats of 240 tons each five miles an hour. The capital of the company, amounting to $5,000,000, has been underwritten by a Wall Street syndicate.

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Cowper-Coles Sound Locator and Projector.—This instrument, which we illustrate, is for the purpose of readily locating the direction of a sound, and for projecting sound long distances. The instrument consists of a reflector, which is made entirely by electro-deposition, mounted on an arm which can be readily turned on its centre, and depressed or elevated by the operator. When it is desired to ascertain the exact direction from which a sound emanates, the apparatus is turned on its axis, and as soon as the reflector is opposite the source of sound it is heard much intensified in the receiver. When it is desired to carry on a conversation

between two distant ships or points, two instruments are used, so that the beam of sound is thrown from one reflector to the other, and focussed in the receiver of one instrument. One operator speaks into the flexible tube, while the operator working the other instrument places the tube attached to the receiver to his ear. Conversation can thus be carried on at long distances without unduly raising the voice. Some experiments have recently been made at St. Margaret's Bay, near Dover, with this instrument. The ticking of a watch, when placed in the focus, could be distinctly heard about 20 feet away, even with a strong breeze blowing across the direction of sound.

Incandescent Lamps of Small Candle-power.—A New York contemporary says that the French Société d'Encouragement des Industries Nationale some months ago offered a prize for the best lamp of 2 C.P., the voltage to be 100. One of the conditions of the test was that the lamp should have a life of at least 400 hours. Lamps were offered by three manufacturers in competition for the prize, but the committee appointed to undertake the tests did not make an award for the reason that only one lamp had a life outside the minimum period. Each of the competitors, however, was given a silver medal in view of the excellence of the lamp presented in other respects than life. New propositions have been made in which the life is fixed at a minimum of 500 hours as a mean of five lamps tested. The prize will be awarded in 1901.

General Post Office.—Mr. M. Cooper has been appointed Principal Technical Officer of the Postal Telegraph Department.

The Universal Exhibition of 1900.—We have received the following circular letter from the French Ministry of Commerce:—

INTERNATIONAL CONGRESS OF ELECTRICITY

(Paris, August 18th—25th, 1900).

Sir,—The Universal Exhibition of 1900, which will assemble at Paris a number of scientists and engineers from all parts of the world will offer an exceptionally favourable opportunity for the study of those questions of general interest which are now no longer confined within the limits of a single nation, but extend over the whole area of civilisation. French electricians have thought that it would be to the general advantage, under the circumstances, to form and organise in 1900 an International Congress of Electricity. Since the Paris Electrical Exhibition of 1881, congresses of this kind, held in different countries, have marked the progress of electrical science and industry.

Questions of units and terminology formed, at first, the subject of discussion at these conferences, and we appreciate daily the immense benefits of the resolutions passed with international approval. During the last 20 years, a period very short in itself, but one which will hold a glorious place in history, we have witnessed the most unforeseen discoveries, fresh applications of researches that had seemed to be confined to the domain of pure science, and an extraordinary extension of electrical industries. Practice has brought into evidence a number of problems, concerning which it will be both interesting and profitable to gain the views of technical men. It seems, therefore, that, without detracting from the importance rightly attached to questions of theory, the discussions of the Congress will be mainly of an industrial and economic nature. In view of this probability, the accompanying programme indicates provisionally the manner in which the work will be distributed among the various sections of Congress.

The report of the meetings, with the papers accepted by the Committee will appear in a publication distributed gratuitously amongst the members.

We hope that you will give us your valued assistance by associating yourself with the work of the Congress of Electricity of 1900. We send you herewith a form of application, which will merely have to be filled up and returned to the address indicated.

E. MASCART,
President of the Committee of Organisation of the Congress of Electricity.

Vice-Presidents.	*Secretaries.*
E. MOISSAN, H. FONTAINE, C. M. GARIEL.	E. JARRY, E. SARTIAUX

Programme.

I.—Scientific Methods and Instruments of Measurement.
II.—Generation of Electrical Energy—Transformers—Transmission and Distribution—Electric Lighting—Electric Traction.
III.—Electro-Chemistry—Electro-Metallurgy—Accumulators—Electric Furnaces.
IV.—Telegraphy—Telephony and various Applications.
V.—Electro-Physiology.

The very comprehensive nature of the programme gives ample scope for the choice of a subject on which to read a paper, and having in view the importance which this Congress is likely to acquire, we anticipate a very high standard in the quality of the proceedings. The most popular and interesting sections will probably be Nos. II. and III.; but so rapid has been the progress made in all departments during the last few years, that there can be no lack of valuable communications in any section.

The Transvaal War.—Among those who have left for the front is Major W. C. Beevor, of the Royal Army Medical Corps, who takes with him a complete X ray equipment, with which he will be able to render great service to his country and to those fine brave fellows who are now fighting for us, by minimising their sufferings in bullet localisation and extraction. Major Beevor's practical experience with the apparatus in Indian warfare renders him eminently suited for the present service. He takes with him a Pidgeon influence machine, in which he is understood to have made certain alterations to enhance its fitness for the particular conditions under which it will be employed.

A daily paper says that the War Office has contracted with the Wireless Telegraph and Signal Company for the use of the Marconi system in South Africa for a period of six months. Captain Kennedy, R.E., superintendent of railway telegraphs, Natal, is stated to have left Southampton for Durban, taking the six sets of apparatus and a staff of assistants and operators. It is stated that the first installation will be for communication between Durban and the bar off the port. It is outside this bar that the troops from England are disembarked into tenders for landing. By wireless telegraphy these operations may be facilitated.

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The Manchester Society of Junior Electrical Engineers.—A visit was paid on Saturday last to the Longsight printing works of the "Co-op." Wholesale Society by the members of the above society. These works are lighted throughout by electricity, the manager, Mr. G. Brearley, having induced the directors to provide electrical plant for both lighting and power. A description of the installation, prepared by Mr. A. Blackburn, the electrical engineer, and printed at the works, was presented to each visitor. The special points of interest relate to the motors, Lundell enclosed type, from ¾ to 7 B.H.P. and geared with rawhide pinions to cast-iron cogwheels. At the conclusion of the visit the president, Mr. W. Haldane Gee, moved a vote of thanks to the directors. He said that they were all convinced from the visit that electric driving was the best method for a printing works. In seconding the motion, Mr. Payne eulogised the excellent arrangements adopted in the boiler and engine house. Mr. H. Rust is hon. sec. of the society, and his address is 13, Harcourt Street, Gorse Hill, Stretford.

Charges for Electricity in Whitechapel.—A neat little booklet has been issued by the Board of Works, Whitechapel, over the signature of Mr. Arthur Wright, consulting engineer and manager, giving information for the benefit of prospective consumers as to the conditions under which they may obtain supply of electricity. The charges are based on a novel system, and are lower than those of any similar undertaking in this country, not excepting stations which have been running for some years. During the six summer months ending at Michaelmas a uniform rate of 1d. per unit is charged; during the winter the consumer may pay 1d. per unit + a monthly rental of 1s. per 8-C.P. lamp used, or, at his option, 1d. per unit after the lamps have been used 60 hours per month, the electricity consumed during these 60 hours being charged for at 8d. per unit. The charges will be made out on the maximum number of lamps simultaneously used during the month, as shown by the demand indicator. A table is added showing the probable cost of electricity used for various purposes and periods, as compared with the cost of gas, very greatly to the disadvantage of the latter!—and it is stated that lamps used from dusk to 11 p.m. throughout the year will cost on the average 2½d. per unit, while lamps used in dark places 12 hours per day will be supplied at 1½d. per unit, the saving in the latter case being sufficient to pay the entire cost of the installation in 18 months. The new line taken by Mr. Wright evidently affords strong encouragement to a demand in the summer months. Moreover, as the maximum demand is ascertained for each month instead of each quarter, the consumer will benefit from this cause also. We must congratulate both the Board of Works and Mr. Wright for their courage and enterprise in adopting such a low tariff from the commencement, and we shall watch the future progress of the undertaking with great interest.

Lecture.—Prof. Oliver Lodge lectured at the University College (Physics class room), Liverpool, on 18th inst., on "The Scientific Principles of the Electric Telegraph." The lecture was the first of a series. A short historical sketch of the subject was concluded with an account of the new light thrown on the science by the discoveries of Prof. J. J. Thomson, of Cambridge, which went far to revolutionise all our theories of matter, and which were enunciated last month at the meeting of the British Association at Dover. The lecture was illustrated throughout by experiments and lantern slides.

Personal.—On Friday evening at the Tower Grounds, New Brighton, Mr. Bartlett, electrical engineer of the Tower, was the recipient of a very handsome marble clock and ornaments to match, as a token of esteem by the officials and staff of the New Brighton Tower.

We learn that Mr. Wilfrid L. Spence, A.M.I.C.E., M.I.M.E., of the Electric Construction Company, has been appointed managing director of a new company which is being formed in Scotland with the object, *inter alia*, of undertaking the bulk supply of electricity to local authorities. Mr. Spence's headquarters will be in Glasgow.

The Babcock & Wilcox Superheater.—Superheating does not make very rapid progress, but it ought to do if the *American Electrician* is to be believed. In describing the Babcock & Wilcox superheater, an attempt is made to give the reasons for the economy of superheating, in doing which a very serious mistake is made. Steam at 100 lbs. pressure has a temperature of about 337°. If exhausted at 212° the working range will be 125°, and on this depends the work to be got from the steam. If, however, says the *American Electrician*, the steam be superheated to 462° or by 125° additional temperature, the range down to exhaust will now be 250°, or double what it was without superheat, and "the steam consumption per horse-power-hour will be theoretically only half as great. The true theoretical formula for the heat utilisation is $\frac{T_1 - T_2}{T_1}$ when T_1 is the absolute temperature of the initial steam and T_2 is the final pressure. Applying the formula to the two conditions cited, we have first—

$$\frac{(337 + 459) - (212 + 459)}{337 + 459} = \frac{125}{796} = 0{\cdot}157,$$

and in the second case we have

$$\frac{(337 + 125 + 459) - (212 + 459)}{462 + 459} = 0\,271.$$

The theoretical improvement is 72 per cent. not 100 per cent. Even the 72 per cent. will not, we need hardly say, be realised, nor, indeed, is there much to be expected in practice from the theoretical side. The real practical improvement in economy comes in quite outside any mere theory, for it is connected with the vexed question of the action and reaction of the cylinder metal upon the steam. Another error in the same article lies in the assumption that the initial boiler steam in torpedo boats is throttled down to the engines, for the purpose of superheating the steam so throttled. The idea is that as the boilers can stand the pressure, they may as well do so, the steam being throttled to the engines for mechanical reasons, and the superheat generated thereby is, so far as it goes, of value. It may not be generally known that an insufficient engine and boiler at low pressure may be improved by raising the boiler pressure and throttling down to the engine, if the former is strong enough, and the latter is too weak to carry more stress. A case once came under our notice of a boiler worked at 60 lbs., and throttled down to the engine, until the "folly" of thus "overstraining" the boiler was pointed out to the owner, who reduced the boiler pressure down to what the engine would carry. The result was that he could not run the place, for the engine used so much more steam. This proved the benefit of even the small superheat. In the Babcock superheater the superheater pipes are placed in the triangular space above the water tubes, and below the steam drum, and can thus receive fairly high temperature effects. Provision is made to fill the pipes with water during such time as steam is not flowing through them, thus preventing overheating. It appears that this superheater is being introduced in America from this side.

Electricity v. Gas.—An animated correspondence has been going on for the last fortnight in the *Pall Mall Gazette*, founded on the publication of some figures showing the comparative cost of the rival illuminants in the Whitechapel district, to which we refer elsewhere. Mr. L. De Fonblanque, general manager of the Incandescent Gas Light Company, took exception of the comparison as being misleading, and substitutes his own misleading figures. Mr. De Fonblanque claims "an efficiency of 25 candles per cubic foot of gas consumed" for the new Welsbach burner, leaving the time in which the cubic foot is to be consumed, to be guessed—we believe half an hour would not be far from the truth. The "new" Welsbach burner is a very different thing from the "old" one. It is well known that a burner which gives 50 C.P. to begin with, will fall to 30 C.P. in 500 hours at the outside. Neglecting this fact, however, Mr. De Fonblanque makes the cost of lighting by Welsbach burners one-seventh of that of electric lighting, when the average price of the unit is taken to be 2¾d., and regarding renewals as practically equal in both cases. If we take the average efficiency of the Welsbach at 13 candles per cubic

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foot per hour, which is about correct, the ratio becomes nearly ½. But this is for the naked light, whose greenish-yellow glare is insupportable; when the mantle is surrounded with a suitable tinted shade the loss of light is so great that the ratio falls to equality. The opinions expressed by the various correspondents are of all shades. Mr. Fonblanque, when tackled on the score of decrease of candle-power with time, attempts a *tu quoque*—but does not explain why he suppressed the facts in his earlier letter. As a fact, however, although electric glow lamps vary in candle-power with time—not always decreasing—the average efficiency is about 4 watts per candle for the *whole life* of the lamp, so that the variation was implicitly allowed for in the first instance. After all, however, all this is beside the question. Mr. Wright's circular is addressed to the ordinary consumers, the vast majority of whom use bat's-wing burners, and these, beyond dispute, never give more than 2 C.P. per cubic foot per hour, and cannot compete on the score of cheapness, steadiness, healthiness, or any other feature with electricity.

The Heating of Enclosed Motors.—The occasional use of street railway motors for stationary work in exposed locations has proved so satisfactory, that a demand has arisen for enclosed motors which has compelled practically all manufacturers to place on the market a line of such machines. As the *American Electrician* remarks in an editorial, this demand exists in spite of the fact that such a machine costs considerably more than an open motor of the same power. This is due to the fact that the enclosed motor gets no ventilation, and therefore cannot dissipate readily the heat generated on heavy loads, and must be rated at a very low load. The result is that a motor which will, when open, safely carry 15 H.P. will, if enclosed, reach the temperature limit with a load of about 10 H.P., and its rating when enclosed must be correspondingly reduced. Our contemporary adds that the only way in which the heat is dissipated from an enclosed motor is by radiation and convection from its exterior surface, there being no circulation of air through its parts. The surface must therefore be made larger if the motor is to be enclosed in order to carry away the heat, which otherwise would be dissipated by ventilation. In building an enclosed motor the armature, the commutator, the field magnets, &c., are made larger, and correspondingly more expensive, solely to get an increased surface of the yoke ring and covers. As a rule, the increased size gains nothing in the direction of a reduction of the heat generated within the machine, as is shown by the fact that enclosed motors are generally less efficient than open ones. It would seem to be a far preferable plan, says our exchange, to make the exterior of the motor with deep corrugations similar to those used for dissipating heat from enamel rheostats or theatre dimmers, or even more similar to the deeply corrugated rings of the cylinders of small unjacketed gasoline engines, such as are used in automobiles. These corrugations would greatly increase the superficial area of a given machine without increasing the size of its internal parts, and would almost correspondingly increase the heat which could be dissipated at a given temperature. Motors with deeply corrugated yoke rings of this kind are made by one enterprising house in Italy, and American manufacturers who now make their motors with practically a minimum ratio of surface to volume, would do well to consider this plan.

Institution of Electrical Engineers.—The opening meeting of the 1899-1900 session is to be held on Thursday, November 16th, at 8 p.m., when Prof. S. P. Thompson will deliver his inaugural address. The presentation of premiums for last session's papers will also take place on that occasion.

Appointments Vacant.—The Leyton Urban Council wants a shift engineer for the electricity works at £100 a year, and a chief assistant electrical engineer is wanted for Wigan at £120; also a foreman jointer. See "Official Notices."

Change of Address.—The address of the Northern Society of Electrical Engineers will in future be Fernholm, Barrington Road, Altrincham. All communications should be sent to Mr. Samuel Joyce, honorary secretary, at that address.

Surface Contact Traction.—The *Electrical World and Engineer* Paris correspondent reports that a contract has been completed with the owners of the patents of the Diatto electric traction system for the use of that system on all of the lines of the Compagnie Generale de Traction, which include 60 miles of railway track.

THE TELEPHONE SERVICE.

We publish below an order of the Postmaster-General under Section 3, Sub-section (5), of the Telegraph Act, 1899, defining the terms and conditions upon which inter-communication is to be allowed between competing telephone exchanges:—

Order of the Postmaster-General under Section 3, Sub-section (5), of the Telegraph Act, 1899.

Whereas it is enacted by Section 3, Sub-section (5) of the Telegraph Act, 1899, that if the license of an existing company (hereinafter referred to as "the company") is under the provisions of Section 3 of the said Act extended in respect of any exchange area for a period of not less than eight years the company shall, at the request of any other licensee of the Postmaster-General providing public telephonic communication in the whole or any part of that exchange area (which other licensee is hereinafter referred to as "the new licensee") and under such circumstances and on such terms and conditions as within six months from the passing of this Act may be prescribed by an order of the Postmaster-General made with the approval of the Treasury, afford all proper facilities for the transmission of telephonic messages between persons using the system of the company (either in the whole or in part of the exchange area, as the Postmaster-General may prescribe) and persons using the system of such other licensee, provided that the licensee so requiring intercommunication shall in any such case afford similar facilities:

Now, therefore, I, Henry, Duke of Norfolk, Her Majesty's Postmaster-General, by virtue of the powers vested in me for that purpose as aforesaid, and of all other powers vested in me in that behalf, do, with the approval of the Treasury, order as follows:—

1. When the subscribers of the new licensee at the date when inter-communication is requested equal or exceed in number one-fourth of those of the company at that date in the area specified in the new license, or number 500, whichever first happens, but not before, mutual intercommunication shall be afforded by the company, and the new licensee between their respective subscribers and other persons using their respective systems in the area specified in the new license only. Such intercommunication as aforesaid is hereinafter referred to as "restricted intercommunication."

2. In any case in which the company's exchange area, as defined by agreement with the Postmaster-General, exceeds in extent the area specified in the new license, then, when the subscribers of the new licensee at the date when inter-communication is requested equal or exceed in number one-fourth of those of the company throughout the whole exchange area of the company, at that date, but not before, mutual inter-communication shall be afforded by the company and the new licensee between their respective subscribers and other persons using their respective systems throughout the whole exchange area of the company. Such inter-communication as last aforesaid is hereinafter referred to as "unrestricted inter-communication."

3. The fact that restricted inter-communication exists with reference to the system of any new licensee shall not prejudice that licensee in requesting unrestricted inter-communication, and the two kinds of inter-communication may exist side by side on different terms.

4. The company and the new licensee may make terminal charges not exceeding the following:—

	Per call.
In the case of restricted inter-communication—	
(*a*) When the subscribers of the new licensee at the date when inter-communication is requested number 500, but are less than one-fourth in number of the company's subscribers at that date in the area specified in the new license	1½d.
(*b*) When the subscribers of the new licensee equal or exceed in number one-fourth (but do not equal in number one-half) of the company's subscribers for the time being in the area specified in the new license	1d.
(*c*) When the subscribers of the new licensee equal or exceed in number one-half of the company's subscribers for the time being in the area specified in the new license	*Nil.*
In the case of unrestricted intercommunication—	
(*a*) When the subscribers of the new licensee at the date when intercommunication is requested equal or exceed in number one-fourth (but do not equal in number one-half) of those of the company at that date in the whole of the company's exchange area—in respect of intercommunication with the subscribers of the company and other persons using the system of the company in the portion of the company's exchange area which is not included in the area specified in the new license	1d.

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Per call.

(*b*) When the subscribers of the new licensee equal or exceed in number one-half of those of the company for the time being in the whole exchange area—in respect of such intercommunication as last aforesaid ... ... *Nil.*

5. Any new licensee requesting facilities for intercommunication shall satisfy the Postmaster-General that such licensee possesses the required number of *bonâ fide* subscribers actually working.

6. When intercommunication has once been established—

(*a*) It shall be maintained, notwithstanding that the number (actual or relative) of the subscribers to one or other of the inter-communicating systems may subsequently fall below the number which would entitle a new licensee to request intercommunication, and

(*b*) No terminal charge shall be increased because the number (actual or relative) of the subscribers to one or other of the inter-communicating systems may fall below the number which first justified such charge, and

(*c*) if terminal charges have ceased, they shall not under any circumstances be reimposed.

7. The term "subscriber" means any person with whom the company, or the new licensee (as the case may be) has entered into an agreement for at least one year, for the purpose of enabling such person to communicate from time to time with other persons through the medium of an exchange, and does not include persons using call offices or an exchange.

8. This order may be cited as the Telegraph (Telephonic Intercommunication) Order, 1899.

Given under my Seal of Office this twenty-sixth day of September, 1899.

Norfolk,
Her Majesty's Postmaster-General.

Approved by the Lords Commissioners of Her Majesty's Treasury,
H. T. Anstruther.
W. H. Fisher.

Copies of the above order may be purchased either directly or through any bookseller, from Eyre & Spottiswoode, East Harding Street, Fleet Street, E.C.; or John Menzies & Co, 12, Hanover Street, Edinburgh, and 90, West Nile Street, Glasgow; or Hodges, Figgis & Co., Limited, 104, Grafton Street, Dublin.

NEW COMPANIES REGISTERED.

Royce, Limited (63,871).—This company was registered on October 17th, with a capital of £110,000 in £1 shares, to acquire the business of "F. H. Royce & Co., Limited," upon the terms of an agreement already prepared, to carry on the business of manufacturing electricians and mechanical engineers, to manufacture and deal in all machines, articles, and things required or used in the generation or utilisation of electricity, electrical energy, or other similar power, force, or energy, and to produce, accumulate, and supply electricity for the purpose of light, motive power, and otherwise. The first subscribers (each with one share) are:—F. H. Royce, Brae Cottage, Legh Road, Knutsford, Cheshire, electrical engineer; E. A. Claremont, Endsleigh, Legh Road, Knutsford, Cheshire, electrical engineer; A. W. Claremont, 4, Bloomsbury Square, W.C., solicitor; H. V. Whitehead, Redcot, Chorlton-cum-Hardy, engineer; R. D. Hulley, 11, Albert Road, Levenshulme, engineer; John De Looze, Rossall Mount, Hulton Street, Failsworth, Manchester, secretary; and J. H. Watkins, 1, Bradshaw Street, Moss Side, Manchester, electrical engineer. The number of directors is not to be less than two nor more than five; the first are Frederick H. Royce and Ernest A. Claremont (both permanent managing directors, special qualification 5,000 shares) and James P. Whitehead; qualification, £250; remuneration of managing directors £750 each per annum, others £100 per annum. Registered office, Cooke Street, Hulme, Manchester.

Blast Furnace Power Syndicate, Limited (63,875).—This company was registered on October 17th, with a capital of £100,000 in £1 shares, to acquire any inventions, processes, and rights relating directly or indirectly to the production, accumulation, transmission, distribution, or utilisation of power, whether mechanically, chemically, electrically, pneumatically, or otherwise, and to erect, construct, and maintain factories, machinery, furnaces, railways, &c. The first subscribers (each with one share) are:—Arthur C. Turtle, 26, Esmond Road, Brondesbury, N.W., clerk; Miss Edith M. Roberts, 20, Alkham Road, Stoke Newington; Charles H. Sims, 103, Endlesham Road, Balham, S.W., clerk; Alfred E. Tester, 1, Friern Road, East Dulwich, S.E., clerk; Thomas Welch, 30, Solon Road, Brixton, S.W., clerk; George H. Greer, 392, Hackney Road, N.E., clerk; and Henry Clifton, 5, Malvern Villas, West End, Aldershot, clerk. The number of directors is not to be less than three nor more than seven; the first are Frank L. Gardner, John J. Cooper, Charles Critchett, and Benjamin H. Thwaite; qualification, 500 shares; remuneration, £100 each per annum, and £100 extra for the chairman. Registered office, 32, Old Jury, E.C.

Phodyne Electrical Company, Limited (63,879).—This company was registered on October 18th, with a capital of £10,000 in £10 shares, to carry on the business of electrical engineers, electricians, engineers, contractors, suppliers of electrical and other power, and manufacturers of and dealers in electrical plant and machinery. The first subscribers (each with one share) are:—J. C. M. Stanton, 66, Victoria Street, S.W., engineer; H. A. Stevens, 9, Bucharest Road, Wandsworth, S.W., accountant; M. B. Hamilton, 3, St. John Street, Westminster, clerk; A. Barrengen, 143, Wightman Road, Harringay, N., clerk; M. E. Sheerboom, 6, Ferncliffe Road, N.E., clerk; G. J. Tindall, 1, Wellington Chambers, York Street, Westminster, clerk; and J. Renwit, 29, Hillside Row, Stamford Hill, N.E., clerk. Table "A" mainly applies. Registered office, 66, Victoria Street, S.W.

Manchester and Liverpool Electric Railway Syndicate, Limited (63,881).—This company was registered on October 18th, with a capital of £40,000 in £100 shares to construct, equip and maintain railways, on the monorail or other system, between Manchester and Liverpool or elsewhere, to work the same by means of electricity or other power, and to carry on the business of carriers of passengers and goods by land or water. The first subscribers (each with one share) are:—James H. MacMillan, 41, George Street, Manchester, calico printer; Edward Broadhurst, 56, Oxford Street, Manchester, manufacturer; Benjamin Armitage, 48, Moseley Street, Manchester, manufacturer; John B. Brooks, 92, King Street, Manchester, banker; George H. Gaddum, 7, South Street, Manchester, merchant; Alexander Wilson, 14, Cook Street, Liverpool, solicitor; John D. Crosfield, 6, Stanley Street, Liverpool, sugar merchant; William Oulton, Preeson's Row, Liverpool, shipowner; and William H. Vaudrey, 1, St. James Square, Manchester, solicitor. The number of directors is not to be less than seven nor more than nine; the subscribers are to appoint the first; qualification, five shares; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Column Printing Telegraph Syndicate, Limited (29,493).—This company's annual return was filed on August 29th, when 289 shares were taken up out of a capital of £25,000 in 500 £50 shares; £50 has been called upon each of the 189 and £8,940 has been paid, leaving £510 unpaid; 100 shares are considered as fully paid.

CITY NOTES.

Manchester Corporation Electricity Accounts.

The electricity supply undertaking of the Manchester Corporation is one of the largest and most important in Great Britain, and the figures which have to be dealt with in summarising the accounts, are of quite a different order to those which appear under the detailed headings of most undertakings. It may be interesting to compare the figures which indicate the state of the business for the first complete year (ending March, 1895), and those for the year just ended:—

	Units generated.	Units sold.	Number of public lamps.	Total maximum supply.
1894 ...	1,277,507	1,168,382	...	1,187 KW.
1898 ...	5,633,534	4,773,247	26	4,246 KW.

One statement recently made to us gives an idea of the kind of undertaking Mr. Wordingham is responsible for; it is that the number of boilers being put down, or in contemplation, reaches something in three figures, and the maximum load given above will, we suppose, be rapidly increased, as the immense areas surrounding the present supply district are connected up to the mains. In the report, the total length of main conductors laid is given at 130,457 yards equal to 74 miles odd, while 3,380 meters were in use at the end of the last financial year.

General Statement.

	1897.	1898.	Increase.
Total capital expenditure	£357,617	£493,716	£136,099
Number of units sold ...	3,434,850	4,773,247	1,338,397
Total maximum demand	3,776 KW.	4,246 KW.	470 KW.
Gross revenue	£56,148	£71,453	£15,305
Gross profit	£32,983	£40,935	£7,952
Average price per unit sold ...	3·80d.	3·48d.	—·32d.

The number of consumers is 2,570, and of motors 334, representing no less than 1,160 H.P.

Revenue Statement.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current	£54,397	3·80d.	£69,182	3·48d.	—·32d.
Meter rents	1,751	·12d.	2,240	·11d.	—·01d.
Supply of lamps	...	...	...	...	...
Sundry	...	...	31	...	...
Gross revenue ...	£56,148	3·92d.	£71,453	3·59d.	—·33d.

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Since March 31st last the charge for the hire of electricity meters has been abolished, and it is proposed to still further reduce the charges for electricity supply. In May, 1897, a commencement was made in street lighting, the first instalment being 20 arc lamps in Albert Square, St. Ann's Square, and Piccadilly. Six more lamps have been added, but as plant becomes available, we presume the number will rapidly increase.

The costs are interesting, as showing what may be expected on a large scale. Reductions are shown on coal and wages, and slight increases (which balance the reductions) on oil, waste, &c., and repairs; the works' cost per unit remains therefore as before, at 1·11d. The total cost has fallen, however, nearly a tenth of a penny, due to a decrease under each item after works' cost.

COSTS OF PRODUCTION.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal	£6,450	·45d.	£8,251	·41d.	−·04d.
Oil, waste, water and engine room stores.	2,316	·16d.	3,305	·17d.	+·01d.
Salaries and wages incurred in generation and distribution.	3,380	·24d.	4,383	·22d.	−·02d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	3,766	·26d.	6,113	·31d.	+·05d.
Works' cost ...	£15,912	1·11d.	£22,052	1·11d.	·00d.
Rent, rates, and taxes ..	2,474	·17d.	2,383	·12d.	−·05d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	2,652	·19d.	3,653	·18d.	−·01d.
General establishment charges, stationery and printing, law charges and insurance.	2,127	·15d.	2,430	·12d.	−·03d.
Other expenses	...	...	...	...	...
Total costs ...	£23,165	1·62d	£30,518	1·53d.	−·09d.

As regards profit, interest, and sinking fund charges together absorb nearly £5,000 more than in 1897, but the surplus has been such as to allow of £2,000 more being carried to credit of the rates and about £1,000 more to reserve fund, suspense account, &c., in 1898 than in the previous year.

PROFIT STATEMENT.

	1897.	1898.
Interest on loans	£8,039	£10,572
Sinking fund for repayments	7,986	10,377
Net profit, carried to rates	10,000	12,000
„ being surplus, carried to reserve fund, suspense account, &c. ..	6 958	7,986
Gross profit	£32,983	£40,935

Brazilian Submarine Telegraph Company, Limited.

MR. W. S. ANDREWS (chairman) presided over the fifty-second ordinary general meeting of the shareholders of the above company held on Wednesday at Winchester House, and, in moving the adoption of the report, said the income for the half-year, including the dividends from the Western Company and other companies, amounted to £119,260, and for the previous half-year it was £133,371, showing a decrease of £14,941. The falling off in the traffic receipts was far less discouraging than the figures would lead them to conclude. As a fact, the falling off had nearly all taken place in Brazil, where practically there was no competition to their lines. It really represented, he was sorry to say, the stagnation of trade which really existed in Brazil, although he was pleased to say that since the account was closed the report had been far more encouraging, and, therefore, he hoped to see a far more satisfactory account at the next meeting. The traffic to Uruguay had also undergone diminution, which appeared to be owing to the Uruguay merchants now doing their business to a very large extent through Buenos Ayres instead of telegraphing direct to Europe. They were, however, getting more commercial messages from Buenos Ayres, which was a very satisfactory feature, because at that place there was rather severe competition. With regard to Chili, there was not much to say, except that the bad trade there adversely affected their receipts. Turning to the expenditure, that was £21,999, against £22,253 in the previous year, or a decrease of £254. The outcome of this was that after providing £3,200 for debenture interest and sinking fund and £1,725 for income-tax, there remained a balance of £92,435. To this had to be added the sum of £15,801 brought forward from December 31st last, making a total of £108,236. Further expenses in connection with closer working union with the Western and Brazilian Telegraph Company, and the London Platino-Brazilian Telegraph Company, £635, and a quarterly interim dividend, amounting to £30,899 had been paid, and £20,000 transferred to the reserve fund. The directors now recommended the declaration of a final dividend of 3s. per share, making, with the interim dividends, a total dividend of 6 per cent. for the year, and also the payment of a bonus of 2s. per share, both free of income-tax, which, altogether, would amount to £51,630, leaving a balance of £5,062 to be carried forward. That was their usual dividend, and he thought that they might congratulate themselves that, in the face of somewhat adverse circumstances, they had maintained their dividend and their reserve fund, and were going on in the same prosperous way that they had hitherto done. The Lisbon-Madeira cable was faulty, but it continued to work satisfactorily nevertheless, and as they always acted on the principle of letting sleepy dogs lie, they had not interfered with it. The Lisbon-St. Vincent No. 2 cable gave way altogether, and they had to avail themselves of a ship of the Eastern Telegraph Company, which was near the spot, to restore it, and that had been done with very little outlay, and in a most satisfactory manner. The Chairman then proceeded to deal with the working arrangements which had existed between the Western and Brazilian Telegraph Companies, and said the arrangements for closer working had resulted very satisfactorily indeed, and the shareholders of the Western Brazilian Company had exchanged their shares for shares in the Brazilian Submarine Company to the extent of rather more than 95 per cent. When those arrangements were first brought upon the *tapis*, they were particularly careful to do nothing to offend susceptibilities of the Governments affected, and therefore they did not do anything in the shape of a complete consolidation of the two companies. However, their proceedings had met with the hearty approval of all, and they thought the time had now come for a complete arrangement for the consolidation of the companies. Notice had, therefore, been given to wind up the Western Brazilian Telegraph Company, and for the acquisition of the remaining properties of that company by the Brazilian Submarine Company. By that means they would obtain the collecting ground of the Western Brazilian Telegraph Company, and it should add greatly to their strength. The Governments had asked them to do certain things, but singularly enough the company had themselves intended doing those very things, believing that it would encourage trade and strengthen the concern. He had been asked whether wireless telegraphy would interfere with their company, and, he might say, that he did not think it would, although it was very well for short distances.

MR. FREDERICK YOULE seconded the motion, which was adopted.

Subsequently an extraordinary general meeting of the company was held, when various resolutions dealing with the acquisition of the Western Brazilian Telegraph Company were agreed to.

Cuba Submarine Telegraph Company.

THE meeting of this company, held at 58, Old Broad Street, on Wednesday, was presided over by Mr. Parrish, who said the directors were very pleased to present such satisfactory results. The receipts for the half-year ending June 30th amounted, with interest on investments, to £25,027, while for the same period in 1898 they amounted to £33,504; but then, he explained to them, that such an abnormal increase was mainly due to the traffic arising from the continuance of the insurrection followed by the Spanish-American war. If they went back to the first half of 1897, they would find that the receipts amounted to £25,623, or very nearly the same amount as they were now dealing with, although the earnings from traffic were a little larger, and the interest on investments somewhat smaller. On the debit side of the accounts the working expenses were given as £7,257. In 1898 they were £8,091, and in 1897, £7,005. As compared with last year, the chief reduction was under the account of expenses at stations, and especially under the item of salaries and wages, which had been increased by payments to the staff for overtime and war allowances. Part of that reduction had been absorbed by other local expenses. The net result of the half-year was a profit of £17,769, of which they had placed £8,000 to reserve fund. The preference dividend amounted to £3,000, and the balance enabled them to propose a dividend on the ordinary shares at the rate of 6 per cent. per annum, and 1 per cent. bonus for the half-year. Comparing the balance-sheet with last year, they found that the spare cable in stock figured on June 30th 1899, at £2,908, while on June 30th, 1898, it was £4,559. The difference represented the value of the cable used in repairs and depreciation on that still in stock. It was possible they might find it advisable to send out some fresh lengths and increase the stock again. It was always well to have spare cable stocked for small repairs. The amount of investments had been increased to £117,069. In regard to the item "repairs to cables, &c., damaged during the Spanish-American war, £8,084," they were at present keeping this in the form of a suspense account. They were communicating with the Foreign Office as to their claim for compensation for the damage, and the matter was being laid before the United States Government. The question of their concession being formally recognised by the United States was still unsettled. A good deal depended upon the American policy with regard to Cuba. Some reports said that the Americans had no desire to remain in the island any longer than was necessary, but other reports pointed to a much more prolonged occupation. He said last April they were of opinion that the Spanish Government had treated them very fairly, and he had every expectation that they would eventually receive the amount then outstanding, but until it was actually encashed they preferred to leave it out of the receipts, although they had now practically agreed to the amount with the Government. He had the satisfaction of telling them now that his forecast was not misplaced. The amounts extended over several months of the war period, and it was unfortunate that the Spanish authorities had to leave Cuba before they were actually settled, but the company had copies of the account sent over to London, and sent Mr. Keith and Mr. Scott

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to Madrid to explain the whole matter to the Government officials. They were kindly received, and he was glad to say that in a few days the account was settled, and the present half year's receipts will benefit by some £5,000 or £6,000, which they encashed. That was a very satisfactory outcome of the dealings with the Spanish Government. He had warned them that the receipts must be affected seriously by the lower rates which they had been compelled to charge by the competitions subsidised by the English and French Governments, and under the table giving a comparative statement of traffic, they had estimated the May and June receipts, which were generally poor months, at £2,000 each. He hoped that estimate might prove on the safe side, and that the actual traffics would be rather larger; but such figures must bring home very seriously the heavy loss that lower rates must cause them. The receipts for some time past had been swollen by Government accounts, which had now practically ceased. During the half-year the cables worked well, and were free from accident, but in July the Cienfuegos-Cape Cruz cable broke down. The fault had now been localised, and it would soon be in working order again. The Cape Cruz and Manzanilla cable also gave way, and was now being repaired.

The adoption of the report was seconded by Mr. Keith.

After a few questions had been put and answered, the motion was carried, as was also the declaration of dividends and bonuses, moved by the Chairman, and seconded by Mr. R. Kaye Gray.

The re-election of Mr. R. K. Gray as a director, and of the auditors, followed by votes of thanks to the board and staff, concluded the proceedings.

Western and Brazilian Telegraph Company.

The ordinary general meeting of this company was held on Tuesday at Winchester House, Mr. W. S. Andrews presiding.

In moving the adoption of the report and accounts to June 30th, 1899, and the declaration of a 4s. interim dividend on the ordinary shares, the Chairman said that they were met for the purpose of the interment of the Western and Brazilian Telegraph Company in order that it might come to a fresh life and go on again prosperously with the Brazilian Submarine Company, and as one united undertaking. He briefly went through several items in the accounts in the usual way, showing the increases and decreases in expenditure and receipts, as compared with the corresponding period of last year. There was an apparent falling off in the receipts, but things had changed for the better, and this half-year traffic was going on much better. The falling off was due to stagnation of commercial affairs in Brazil, but that was now mending, and the future was satisfactory. The value of cable used for repairs was £5,093, and this had been charged to revenue. In consequence of this expenditure, instead of showing a considerable saving upon the ordinary expenditure, they showed an increase of £2,590. Cable accidents were beyond their control. The resolutions were adopted.

The meeting then became extraordinary, and passed, after a few questions had been answered, the following resolutions:—

1. That the conditional agreement made between this company of the one part, and the Brazilian Submarine Telegraph Company, Limited, of the other part, and dated October 13th, 1899, submitted to this meeting be and the same is hereby approved, and that the liquidator hereinafter mentioned be and he is hereby authorised to adopt the said agreement, and carry the same into effect with such, if any, modification therein as the said liquidator may think expedient.
2. That this company be wound up voluntarily, and that William Henry Axworthy be and he is hereby appointed the liquidator for the purpose of such winding up.

The resolutions will be submitted for confirmation as special resolutions to a second extraordinary general meeting.

Prospectus.—An issue has been announced this week by Chelsea Electric Supply Company, Limited, of £50,000 in 4½ per cent. debenture stock, ranking *pari passu* with £100,000 already issued. The price of issue has been fixed at 107 per cent. The total share capital of the company is £400,500, of which £200,500 is already issued and fully paid up. The object of the present flotation of debentures is to provide for the further development of the company's business.

Oriental Telephone and Electric Company, Limited.—The directors have declared an interim dividend of 4d. per share, free of income-tax, payable to those shareholders whose names are on the register at this date. The warrants will be posted 31st inst.

West India and Panama Telegraph Company, Limited.—The directors recommend a dividend for the six months ended June 30th of 6d. per share on the ordinary shares, tax free, carrying forward £380.

Castner-Kellner Alkali Company, Limited.—The directors have declared an interim dividend on the ordinary shares for the six months ended September 30th at the rate of 8 per cent. per annum, payable on November 1st.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending October 21st, 1899, were £325 2s. 0d.; receipts for week ending October 21st, 1898, £242 14s. 10d.; aggregate for half-year to date, £18,633 5s. 8d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending October 20th, 1899, were £3,060 19s. 9d.; corresponding period, 1898, £2,566 2s. 6d.; increase, £494 17s. 3d.

The City and South London Railway Company.—The receipts for the week ending October 22nd, 1899, were £1,019; week ending October 23rd, 1899, £1,024; decrease, £5. Total receipts for half-year, 1899, £16,283; total receipts corresponding period, 1898, £16,275, decrease, £42. Miles open, 8½.

The Dover Corporation Electric Tramways.—The receipts for the week ending October 21st, 1899, were £187 19s. 11d.; week ending October 22nd, 1898, £184 0s. 2d.; increase, £3 19s. 9d. Total receipts to date, 1899, £8,463 4s. 1d.; corresponding period 1898, £6,984 9s. 8d.; increase, £1,478 14s. 5d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,743, 1898, 4,251. Number of cars, 1899, 11; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, October 20th, 1899, were as follows:—D. U. T. Co., horse cars, £707 13s. 9d.; ditto, electric cars, £2,801 6s. 10d.; D. S. D. Co., electric cars, £726 18s. 3d.; total, £3,785 18s. 10d.; corresponding week last year—D. U. T. Co., horse cars, £2 271 13s. 2d.; ditto, electric cars, £813 9s. 2d.; D. S. D. Co., electric cars, £616 6s. 8d.; total, £3,201 9s. 0d.; increase, £584 9s. 10d. Aggregate to date, £70,835 11s. 11d.; aggregate to date last year, £68,515 2s. 9d.; increase to date, £2,320 9s. 2d. Worked:—The mileage open is 34 miles electrically, 10 miles by horses, as against 18 miles electrically, and 29 miles by horses, for the corresponding period last year.

The Liverpool Overhead Railway Company.—The receipts for the week ending October 22nd, 1899, amounted to £1,571; corresponding week last year £1,376; increase, £195.

The South Staffordshire Tramways Company.—The receipts for week ending October 20th 1899, were £661 14s. 3d.; aggregate receipts for 42 weeks, £28,033 9s. 1d.; week ending October 21st, 1898, £638 10s. 3d.; aggregate receipts for 42 weeks, £26,559 13s. 0d.

STOCKS AND SHARES.

Wednesday Evening.

Reports of battles in South Africa, attended by satisfactory results to the British forces, have sent a thrill of excitement through the stock markets, such as has not been felt for many months past. That successful engagements at the commencement of the war would be the signal of a general advance, had been the opinion of the majority of members, but the boom which has actually occurred has caught many bears napping, and exceeded the most sanguine expectations. Something of this bullish sentiment, prevalent in other departments of the House, has been again noticeable in the electrical section, and particularly amongst the telegraph descriptions, where business has been brisk, and buying persistent. Anglo-American telegraph stocks continue to advance, and exhibit great strength. The Ordinary at 64 buyers, shows an advance of 3 points as compared with our last week's prices, the Preferred are 2 better at 114—115, while the Deferred have put on 1 at 16—16½. Buying of these has been very determined.

Eastern Telegraphs have been conspicuously in demand. Shareholders in this company may be interested to learn that it was mainly owing to the efficiency of their line that the news of the first victory against the Boers was cabled to London in the short period of 4½ hours. Eastern Extensions have attracted some attention, and are the turn of the market better at 14½ buyers. Reuters are unaltered at 7—8. Indo-European Telegraphs have advanced 1, while other telegraphic descriptions are steady at last week's quotations.

The supply market has been rather neglected and there is little to report. Charing Cross & Strands are dull at 9½—10½, while St. James's and Pall Mall continue to show a sagging tendency at 14½—15½ in the absence of support. The new shares are about 30s. premium, and fractions can be sold for 2s. 6d. Next Saturday, by the way, is the latest date for sending in applications. The new shares are the cheapest thing in the electrical market at present, for besides being purchasable at £1 per share below the old issue, the renunciation letters enable a buyer to get the shares into his name free of stamp and fee.

Chelseas are unaffected by the issue of new debenture stock, which is to rank *pari passu* with the existing 4½ per cents. now quoted at 110 upwards. A small premium has been established upon the new stock, which is issued at 107, and the investment is a very fair one, yielding a fraction under 3½ per cent. on the money.

Traction varieties keep very steady, with no particular feature. British Electrics at 17 fail to regain the 10s. which they shed last week, and the Preference are ¼ off. The company is making steady progress, however, and the fact that some of the English municipalities are taking electric traction into their own hands is not likely to militate against the success of the British Electric, which is breaking new ground in British Columbia and the Colonies. Barcelona Trams are unaltered in price, but the market are only buyers. No dealings are reported, as yet, in the new shares just issued.

The manufacturing section is remarkable only for a brace of rises which have taken place in the debentures of two of the leading companies. Henley 4½ per cent. Debentures and Callender's 4½ per cent. Debentures have both been sought after, with the result stated.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Oct. 18th.	Closing Quotation, Oct. 25th.	Business done during week ended Oct. 25th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	61 — 64 xd	64 — 67	65½	64½
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	112 —113 xd	114½—115½	115	113½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	14¼— 14⅜	16 — 16½	16⅜	14⅜
205,151	Brasilian Submarine Telegraph	10	7 %	7 %	...	15 — 15⅛	15 — 15⅛	15⅜	15 1/16
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	180 —190	180 —190	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —104	102 —104	103⅜	102⅜
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	18½— 19½	19 — 20	...	...
12,981	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½%	3½%	11½— 12	11⅝— 12¼	12⅛	11 1/16
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	100 —103	101 —104	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	149 —154	152 —157	155	150½
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	99 —102	99 —102	100	99½
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	118 —123	118 —123	121	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14 — 14¼xd	14½— 15	14⅝	14⅜
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,040, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
830,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	117 —122	117 —122	120	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,348	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
800,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	4 %	...	...	103 —105%	103 —106%	...	...
180,237	Globe Telegraph and Trust	10	4½%	4½%	5½%	10⅝— 11⅛	11 — 11½	11⅛	10 13/16
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15 — 15⅜	15⅛— 15⅝	15⅝	15⅛
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 32	29 — 31	...	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	49 — 53	...	...
100,000£	London Platino-Brasilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	⅛— ¼	⅛— ¼	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¼— 1	¼— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5⅛%	6 %	6 %	5 — 5¼	5 — 5¼	5 3/16	5
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5 3/16	...
1,339,471£	Do. 3½ % Deb. Stock Red.	Stock	3½%	3½%	3½%	99 —102	99 —102	100	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅜— 1	⅜— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8 xd	7 — 8	...	...
3,361	Submarine Cables Trust	Cert.	...	...	...	127 —132 xd	128 —133	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	4⅜— 5¼	...	...
151,738£	Do. do. 5 % Debs.	Stock	...	...	...	104 —107	105 —108	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	5 %	...	99 —102	99 —102	...	...
80,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	103 —106	103 —106	...	...
269,521	Western and Brasilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph	10	1 %	3%	...	1½— 1⅝	1⅝— 1⅝	...	...
94,568	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10⅜— 10⅝	10⅜— 10⅝	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8⅞— 9⅛	8⅞— 9⅛	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	5 %	5 %	...	104 —107	104 —107	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7½— 8½	7½— 8½	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	9½— 10½	10⅛	9½
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	7½— 8½	...	...
100,000	Do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	110 —112	110 —112	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11 — 12	11 — 12	11⅜	11
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13½	13	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10½— 11	10½— 11	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	13	...
220,000	Do. 4½% Deb. Stock, Prov. Certs (£30% to be paid) Rd.	...	...	...	...	81 — 84	81 — 84	82¾	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5½	5 — 5½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	3⅜	3 1/16
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 6⅝	6½— 6⅝	6½	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	105 —107	104 —106	105	104½
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	15 — 16	15½	15⅜
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14 — 15	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15 — 16	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	15 — 16	14⅜— 15½	15⅝	15⅜
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3⅞— 4⅛	3⅝— 4	...	...
79,800	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½— 15½	14½—15½	15½	...

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‖ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Oct. 18th.	Closing Quotation Oct. 25th.	Business done during week ended Oct. 25th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2¾— 3¼	2¾— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	16½— 17½	16½— 17½	...	...
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13¾— 14¼	13½— 14	14 1/16	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	125 —128	125 —128	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6¾	6½— 6¾	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅞— 2⅛	1⅞— 2⅛	1 1/16	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2⅜	2¼
125,000l	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	109 —113	109 —113	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13½— 14½	13½— 14½	14	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	112 —115	113 —116	116	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10 — 10½	10 — 10½	10⅜	10 1/16
178,303	Do. do. do. £8 paid	10	...	...	...	...	..	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	4½— 5	4¾— 5¼	...	..
71,447	Do. do. Def. do.	5	...	...	...	5 — 5⅛	5 — 5⅛	...	...
630,000l	City and South London Railway	Stock	1 1/16 %	1⅞ %	2⅛ %	63 — 66	63 — 66	63¼	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6½— 6¾	6½— 6¾	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	3⅜	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛ %	6 %	6 %	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛ %	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2½— 2⅝	2½— 2⅝	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	3 — 3½	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000 ...	2	...	...	...	¼ — ½	¼— ½	...	...
9,600l	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
8,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	110 —113	110 —113	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21⅝	21 1/16
800,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2⅞ %	3½ %	3½ %	8½— 8¾	8 1/16— 8 1/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13¼— 13¾	13¼— 13¾	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	39	37½
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9½— 9¾	9½— 9¾	9⅝	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6	5½— 6	...	...
540,000l	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	101 —104	101¼	100

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
British Aluminium, Ordinary, 9—10; 7 % Pref., 9½—10½.
Brompton and Kensington, 4½ % Debentures of £100, 104—107.
National Electric Free Wiring, 10s. paid, ¼—½.
Smithfield Market Electric, 1—3.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 105—107. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 18¾.

* From Birmingham Share List.

Bank rate of discount 5 per cent. (October 5th, 1899).

MARKET QUOTATIONS, Wednesday, October 25th.

CHEMICALS, &c.		This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	22/-	22/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	40/-	35/-	5s. inc.
a Ammonia, Muriate (crystal) ..	per ton	£27	£25	40s. inc.
a „ „	per ton	£26	£23	40s. inc.
a Bleaching powder	per ton	£6 10	£6 10	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£16 10	£16 10	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£26	£26	..
a Lead, Nitrate	per ton	£25	£25	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	8¼d.	8¼d.	..
a „ Caustic (75/80 %) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£7 10	£7 10	..
a „ Crystals	per ton	£3	£3	..
a „ Bichromate, casks ..	per lb.	2¾d.	2¾d.	..
METALS, &c.				
Aluminium Wire, in ton lots ..	per ton	£224	£224	..
b „ Sheet, in ton lots..	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 9" to 12") basis	per lb.	8¼d.	8¼d.	..
c „ Tube (brazed)	per lb.	10½d.	10½d.	..
c „ Wire, basis	per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).		This week.	Last week.	Inc. or Dec.
f Ebonite Rod	per lb.	3/-	3/-	..
f „ Sheet	per lb.	5/-	5/-	..
g Copper Bars	per ton	£88	£88	..
g „ Wire (basis price) ..	per lb.	10½d.	10½d.	..
g „ Sheet	per ton	£98	£98	..
g „ Rod	per ton	£88	£88	..
n German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha, fine	per lb.	6/-	6/-	..
h India-rubber, Para fine ..	per lb.	4/2½ to 4/5	4/2½ to 4/5	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants)	per ton	69/-	68/10	2d. inc.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 ..	per ton	£14 5	£14 5	..
g Lead, English Ingot	per ton	£16 15	£16 15	..
g „ „ Sheet	per ton	£18 10	£18 10	..
m Manganin Wire No. 28.. ..	per lb.	8/-	8/-	..
g Mercury	per bottle	£8 17 6	£8 17 6	..
d Mica (in original cases), small	per lb.	2d. to 8d.	2d. to 8d.	inc.
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/6	inc.
d „ „ „ large	per lb.	3/6 to 7/6	3/6 to 7/-	inc.
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd str'p & sheet	per lb.	From 1/2½	From 1/2½	..
o Platinum	per oz.	£3 11	£3 11	..
p Silicium Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton		From £15	to £40	..
i Steel, Magnet, in bars		£58	£58	..
g Tin, block	per ton	£149	£149	..
g „ foil	per lb.	1/9	1/9	..
n „ wire Nos. 1 to 16	per lb.	1/11	1/11	..
p White Anti-friction Metals— "White Ant" brand ..	per ton	£40 to £70	£40 to £70	..
f Yarns, Cotton, Single 10lb. bundles	pr lb.	7¾d.	7¾d.	..
f „ Best Flax, 6 lea. ..	per lb.	4½d.	4½d.	..
f „ Hemp, 8 ply 10 lbs. ..	per lb.	8¾d.	8¾d.	½d. inc.
f „ „ Russian, 10 lbs.	per lb.	4¼d.	4¼d.	½d. inc.
f „ Jute, 180 lbs. rove ..	per ton	£13 10	£13 10	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.		£26 10	£27	10s. dec.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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RAILWAY POWER DISTRIBUTION OVER LARGE AREAS.*

By A. H. ARMSTRONG, of the General Electric Company.

The formation of the International Traction Company brought under one management the various roads operating in Buffalo and the vicinity. Previous to this consolidation, each of the several roads had its own source of power, and the question of the most economical method of operating the entire system was of the greatest importance.

The Buffalo Railway had installed in its Niagara Street power house two rotary converters of the General Electric type in the fall of 1896, power being supplied by the Niagara Falls Power Company. Two additional converters had been added a year later, making a total nominal capacity of 1,600 kw. installed. This converter capacity, together with an engine capacity of 7,500 H.P., supplemented by a storage battery of 1,500-ampere capacity, had operated the lines of the Buffalo Railway Company.

To operate the enlarged system there were three courses open—increasing the capacity of the Niagara Street power house, building a new power house on the other side of the city to work in conjunction with the Niagara Street station, or the adoption of rotary converter sub-stations fed from Niagara Falls. The cars running to Niagara Falls and to Lockport were already partly fed from rotary converter sub-stations, and the enlargement of the Niagara Street power house would not contemplate the shutting down of these sub-stations. The operation of all the lines in Buffalo by a single power house was open to the serious objection that either a considerable increase in feeder copper would be necessary or boosters must be used. The amount of feeder copper installed provided for a number of feeding points into the system, and would have to be largely increased if the entire system were fed from a single point, as would be the case with one large power house. Heavier cars, equipped with electric heaters and operating at a much faster schedule are being installed, which would still further increase the amount of feeder copper required to such an extent that a single generating station was not looked upon as desirable.

The use of boosters as a permanent means of replacing feeder copper in a system where heavy overloads may be of long duration, is very objectionable, owing to the losses entailed. Overloads of short duration, and especially local overloads due to some special local event can very well be taken care of by boosters, but the cost of the energy lost in boosting daily overloads may be sufficient, as in the present case, to more than offset the interest on additional copper investment required.

The second method of operation, the building of another power house on the east side, was also open to serious objections. The capital investment called for in this case would have been still larger than that required for the additional copper with a single generating station, while the cost of operating two separate stations would have been greater than that of operating a single station of the combined capacity of the two. The required feeder copper also, while less than that for a single station, would be considerably greater than in the third method of operation, by rotary converter sub-stations.

The successful operation of a railway system, and especially one with suburban branches, calls for as high a schedule speed as can be maintained with safety.

It is, therefore, of paramount importance that the line voltage shall be kept up, as it not only ensures a good schedule being made, but results in less heating of the motors themselves. The rotary converter sub-station system permits sub-stations to be located wherever there is the greatest demand for power, as the comparatively small transmission line required can be carried underground to any locality, while the sub-station itself, requiring no boilers or engines, can be located in any neighbourhood, on account of its cleanliness and noiseless operation. The sub-station also requires a very small amount of floor space for its output, as compared with a steam-driven generating station, and hence can be located in the business districts where property is high, which, together with the cost of carting coal, would make a generating station in such a locality expensive to operate, especially as it must probably run non-condensing. The largest congestion of cars, and hence the largest demand for power, exists in the business districts, and it is the possibility of locating sub-stations close to the points of greatest demand that makes the converter system especially adapted to the operation of large city railway systems.

As sub-stations can be located where most needed, it is obvious that the amount of direct current feeder copper required for such a system is much less than would be required for the same effective operation with a single direct current generating station, while the high potential transmission line at 10,000 volts would demand but a small amount of copper.

The number of attendants in a sub-station need not exceed two men for a station having a capacity of, say, three 400-kw. converters, so that the labour account would be much less than in the case of a number of small generating stations.

The above advantages apply to the converter system whether the sub-stations are driven from a large steam-driven generating station, located in the outskirts of the city, and enjoying cheap coal and cheap real estate, or as in the Buffalo sub-stations, they are fed from a water-power station.

* Paper read at the New York Street Railway Convention, 1899.

After careful consideration of the several methods of operation open to them, Mr. W. Caryl Ely, president of the International Traction Company, and Mr. B. Van Horn, general manager, decided upon the adoption of the rotary converter sub-station system as offering the greatest advantages in its economy of operation and first cost of installation.

The method of operating the Buffalo City system, as adopted, involves the installation of five rotary converter sub-stations, besides the operation of the four converters and storage battery in the Niagara Street power house.

The steam plant at Niagara Street, however, will be shut down and kept as a reserve, thus permitting the entire lines of the International Traction Company in Buffalo, Niagara Falls, Tonawanda, and Lockport to be driven from rotary converters fed by the Niagara Falls power.

There will be a total of six sub-stations, including Niagara Street No. 6, having the following maximum output during the winter months, when heaters will be used:—

	Maximum output.	Converter installed.	Ultimate capacity.
Sub-station No. 1 ...	760 kw.	800 kw.	1,200 kw.
" " 2 ...	870 "	800 "	1,200 "
" " 3 ...	1,230 "	1,200 "	1,600 "
" " 4 ...	870 "	800 "	1,200 "
" " 5 ...	890 "	800 "	1,200 "
" " 6 ...	1,600 "	1,600 "	1,600 "
Total ...	6,220 kw.	6,000 kw.	8,000 kw.

The peak of the load is somewhat in excess of the rated capacity of the converters to be installed, but the storage battery in the Niagara Street station has been increased to 3,000 amperes capacity, and this will be used to take the peak of the load, the ultimate capacity of the station providing for reserve apparatus and increase of traffic.

These six sub-stations will feed into a common feeder network through automatic circuit breakers, the load being taken on the larger stations during light traffic at night. The composition of the various sub-stations will be similar in all respects, with the exception of sub station No. 6, which is located in the present Niagara Street power house. The other stations differ only in the number of rotary converters of 400 kw. capacity contained in each, the entire apparatus being furnished by the General Electric Company.

Sub-station No. 1 contains two rotary converters of 400 kw. capacity, with an ultimate capacity of three converters, each converter being fed through three step-down transformers of 150 kw. each, reducing the line potential of 10,500 volts to 375 volts, corresponding to 600 volts on the direct current side of the converters. These transformers are of the air blast type, and feed directly into the rotary converters, the controlling switches being placed in the primary circuit.

The converters, being of the three-phase type, enable the step-down transformers to be connected in delta, so that the disabling of one transformer of a set does not throw the converter out of service. In addition to the individual switch controlling each rotary converter with its transformers, there is a main emergency switch opening the high potential bus bar circuit of the sub-station in case of necessity, where it is desired to throw out the entire station at once.

Artificial reactance is introduced between transformers and converters to enable the converters to regulate with varying loads, this reactance also being cooled by artificial air draught, for which purpose direct current blower sets are provided in duplicate, and feed into a common air chamber, from which individual transformers and reactances draw their supply.

In a large railway system of this character it is desirable to provide a ready means of starting the converters that will be effective and require a minimum time. While any one sub-station is in operation, it is, of course, possible to start the converters of a second sub-station from the direct current side, and suitable starting resistances are provided for this purpose. This can only be satisfactorily accomplished, however, when traffic is very light, and the line voltage high.

A possible shut down may occur during a time of maximum load, when it would not be desirable to start several sub-stations from the alternating current end of the converters, owing to the large lagging current affecting the regulation of the system. To provide an efficient method of starting, there has been installed in two sub-stations a starting set, consisting of an induction motor direct coupled to a direct current generator of sufficient capacity to start one converter.

This method permits the starting of the converters in these stations from the direct current end, which will ensure bringing them into synchronism in a minimum time with the right polarity. The converters in adjacent sub stations can then be started from the direct current feeder system.

By sub-dividing the city into several sections, each fed from a separate sub-station, the present amount of direct current feeder copper need not be increased to any considerable amount, especially as the track joints are being welded, thus making the ground circuit exceedingly good. With the completion of the different sub-stations, the International Traction Company will have in operation a model railway system, having sub-stations fed from a single generating station as a source of power, cars using electric brakes operating over tracks with welded joints, and high-speed suburban lines to the several adjacent towns.

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VOLTA AND THE VOLTAIC CELL.*

Prof. Righi, in an elcquent discourse delivered at Como in connection with the Volta centenary, gave an account of the character and scientific work of Volta, which deserves to be widely read. It is too long to be translated *in extenso* in our pages, but some of the more important passages may be read with interest.

The lecture was divided into five sections, with a preface, a conclusion, and an appendix. The sections deal with the condition of electrical science before Volta's time, Volta's work, other than that in connection with the pile, the discovery of the electricity of contact, the discovery of the pile, and the theory of the pile. The appendix, an essay on the theory of the pile, is an important contribution to this apparently interminable controversy.

Born in Como in 1745, Alessandro Volta, when little more than a boy, took for the subject of his poetical compositions the electrical experiments then in vogue, and the observations made by De Saussure on Mt. Blanc. These show that he was already well versed in these subjects, and of them he sought to improve his knowledge, by maintaining an active correspondence with the Abbé Nollet, and other contemporary physicists. He was led, in short, to investigate electrical phenomena for himself, and when scarcely 24 years old, dedicated his first memoir "On the Attractive Force of the Electric Fire," to Beccaria, of Turin. This was followed, two years later, by another addressed to the celebrated Spallanzani.

In reading these papers, and particularly those which led him to the invention of the electrophorus, everyone must be struck with the singular acumen with which he took account of every detail of his experiments, and with his great capacity for concentrating attention upon the favourable circumstances. Volta was led to the electrophorus by his attack on the theory of the so-called "electricita vindice," proposed by Beccaria to explain certain phenomena which had been observed by himself, and by Wilke, Epino, and Cigna.

We know that, according to this theory, an electrified insulating plate placed in contact with a non-insulated conducting plate is deprived of electricity, and that on separating the two plates the first recovers the primitive charge, leaving on the now insulated conducting plate a charge of the opposite sign. Volta showed clearly that, instead of this being the case, the insulated plate retains its charge throughout unchanged, and that this induces an opposite charge on the conducting plate. The adhesion of the plates to one another during the period of contact confirmed Volta's explanation, and it only remained to give suitable forms and dimensions to the two plates, and to put a third conducting plate under the insulator to construct the electrophorus.

To Volta we owe the discovery of the production of the so-called "inflammable air" by the decompcsition of organic bodies. He was the first to explode this gas mixed with air, and free from hydrogen, in a closed vessel by an electric spark, and was thence led to the invention of the gun and pistol still known by his name, of the eudiometer, now universally used in the analysis of gases, of the hydrogen lamp, and of the apparatus which, four years later, enabled Cavendish to effect the synthesis of water.

An observation made by the illustrious Arago in the course of a eulogy of our great physicist delivered before the Academy of Sciences, of Paris, may be aptly quoted here. He observed that "Volta possessed, in the highest degree, two qualities which are rarely united in one man. The genius that creates, and the spirit that applies. He never abandoned a subject until he had considered it under every possible aspect, nor without having described, or at least suggested, instruments which might be employed by science, by industry, or even by mere curiosity." We have a good example of this in a proposal suggested by his own discovery, and made by him in a letter addressed in 1777 to Prof. Barletti. He proposed to fire an electrical pistol at Milan by the discharge of a Leyden Jar at Como, the two being connected by a pair of iron wires, or alternatively by a single wire and a canal of water.

In this project, which, so far as is known, was not carried out, can be recognised the germ of modern electrical telegraphy. So the germ of the idea of gas lighting may be traced in a proposal made by Volta to Father Campi to employ natural inflammable gas in lamps instead of oil. Perhaps, too, the electrical pistol may be looked on as the first of the modern gas engines.

Of Volta's stern adhesion to strict scientific method, and his condemnation of fanciful speculation, or merely sensational experiment, Prof. Righi has much to say. "What possible good," Volta wrote, "can come out of all this, unless the observations are reduced to scale and measure, and especially in physical science? What is the use of ascertaining a cause unless the quantity and intensity of the effect is determined, as well as its character or quality." It was in obedience to this method that he was led to transform Nollet's thread electroscope, and Cavallo's pendulum electroscope, into measuring instruments, by the construction of the straw electroscope, which he took pains to calibrate by ascertaining the relation between the deflections and the corresponding tension, to use the word then in vogue.

The great success of his teaching at the University of Pavia is attested by Arago, who said that "the pride and pleasure of being able to call oneself a pupil of Volta contributed largely for more than 30 years to the great success of the University on the Ticino."

It was after his appointment to the professorship that Volta composed and published his memoir on the condenser. With this he was able to show the existence of electricity in circumstances in which the straw electrometer by itself was useless, such, as for instance, in his experiments on the electricity of contact. We may recall, too, the experiments made by Volta at Paris, in collaboration with Lavoisier and Laplace; and in London with Bennett, Magellan Cavallo, and other members of the Royal Society, designed to show the production of electricity by the evaporation, the combustion, and the expansion of gases, though modern opinion on the causes of this electrification differs from that which was expressed by Volta and others of his contemporaries.

Another good example of the application of the electrometer, combined with a condenser, is an experiment made by Volta on the nights of July 28th and 29th, 1780, when the sky was illuminated by an exceptionally brilliant aurora; and this is an especially good instance, because it illustrates his extreme caution in drawing conclusions from observation. On these nights, by connecting a condenser and electrometer to an aerial wire he obtained certain evidence of electrification, and even small sparks. This appeared to prove the aurora to be certainly an electrical phenomenon. But later on he did not consider himself justified in considering the point rigorously proved, and writing nine years later to Dr. Bondioli, the author of a paper on the aurora, he declared himself certainly inclined to believe in the electrical nature of the phenomenon, and recognised the similarity between its appearance and that of the electric discharge in exhausted gases; but at the same time he uttered a warning in criticism of those who, he said, "are infatuated with electricity, and see electric fire in every spark and every flame in heaven and earth."

To the phenomena of natural electricity Volta gave many years of study, and published the results in his famous letters on meteorological electricity addressed to Prof. Lichtenberg, of Gottingen, and in a long memoir on hail published by the National Italian Institution. These letters show most clearly that, while occupied with such arguments, he had constantly in his view the introduction of accurate measurement into his researches at every possible opportunity. With the desire of making the indications of different electrometers mutually comparable, and of founding a general system of graduation analogous to that used in themometry, Volta proposed, in the first of the letters referred to above, to determine, by means of a balance, the equilibrium between known weights and the electrical force acting on a metallic disc suspended from one of the arms. But one step, though a very important one, was required to bring this arrangement to the modern guard ring electrometer of Lord Kelvin.

The action of flame in the discharge of an electrified body, similar to that of an innumerable number of sharp points, was discovered by Volta in 1787, and was of undoubted service in his study of the electrical phenomena of the atmosphere; and though its employment as a discharger is not usually convenient, yet recourse is still had to the flame, which presents some advantages in cases of rapid electrical variations, or of imperfect insulation. This use of the flame is treated fully in the letters to Prof. Lichtenberg, and some interesting experiments are described, which might lead to other special applications of it. In one of these experiments, which is little known, having dissipated by the use of a flame the charge of a Leyden jar into the air of a room, he afterwards, by the same means, succeeded in collecting part of it into a new jar.

The theory of hail proposed by Volta, which attributes the freezing to the cold produced by rapid evaporation, is, in its general lines, still accepted, and the ingenious hypothesis of the electrical dance of the little hailstones between two oppositely electrified clouds, invented by Volta to explain their gradual formation and prolonged suspension, though now considered insufficient, cannot be treated as absurd.

Volta has left deep footprints in other fields of research. De Lue, Roy, De Saussure, Lambert, Berthollet, Amontons, and other accomplished physicists who were occupied with the important study of the dilatation of gases, had obtained discordant results. Volta's fine intuition divined that the cause of the discrepancy was the presence of water vapour, which was mixed with the air in many of the experiments. Having eliminated this he obtained consistent results, which enabled him to formulate the laws of the proportionality between the increase of pressure of a given volume of air and the rise of temperature which produces it. He recognised, moreover, that air which contains a constant quantity of vapour behaves like dry air, and justly concluded that water vapour itself behaves like air. Finally, the postscript of a letter to Vassalli asserts that the quantity of vapour, formed in a given limited space is the same whatever may have been the space originally occupied, and however much air it may contain. Gay Lussac and Dalton confirmed these results by numerous experiments, and were able to announce anew the laws which to-day bear their names.

So far the extracts from Prof. Righi's address are taken from the part dealing with Volta's work which did not bear on the discovery of the pile. Those now following refer to Galvani's discovery.

Eight years older than Volta, Galvani's labours had already secured for him a wide and ungrudged reputation, though his habitual delay in publishing his observations led in some cases to the harvest of his honours by others. A survey of his existing MSS. shows that before 1780 he was occupied with the researches which led him to his famous experiment, and that before 1791, the year of publication of his masterly work, "De Viribus Electricitatis in Motu Musculari Commentarius," he had already prepared several accounts of his experiments, and had refrained from publishing them.

After it had been made evident that the lively muscular contraction of the frog, prepared in the classical manner which bears Galvani's name, constitutes an electroscope of immense sensibility, capable of detecting not only the feeblest charges of artificial electricity, but even of atmospheric electricity, Galvani occasionally observed the same contraction in special circumstances where the usual provocative cause was wanting. This singular fact could not fail to attract the attention of so acute an observer as Galvani, and, to put it shortly, by taking account of the condition necessary for its occurrence, he recognised that it was nothing more than the existence of a metallic connection between the lumbar nerve of the frog and the muscle of

* A lecture delivered in Como, September 18th, 1899, by Prof. Augusto Righi.

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the thigh. In fact, it was sufficient to touch these two points of the body of an animal with the ends of a wire to provoke lively contractions, similar in all respects to those effected by the high tension of the electrostatic discharge.

Galvani's experiment, repeated everywhere with success as soon as it was made known, occasioned profound sensation. That Volta was among the first to occupy himself with it appears from a letter to Dr. Baronio of April 3rd, 1792. Not satisfied with verifying what he himself termed "the stupendous discovery of Galvani," he varied the conditions of the experiment in many ways, and applied himself to ascertaining the smallest discharge sufficient to cause the contraction, substituting for the simple wire a Leyden jar whose charges were measured by drawing them from another jar of known capacity. A few accurate and methodical experiments established the important fact that contraction was more lively if the lumbar nerve was connected to the positive armature and the muscle to the negative than in the reversed arrangement. Absorbed by interest in the new phenomenon, Volta for many years could not abandon its study, and, indeed, within a few months published a first memoir on animal electricity, followed soon after by another. Reading the limpid description of his innumerable ingenious experiments, one can follow step by step the laborious logic of his thought, and understand how by slow steps that mental evolution was accomplished which converted the admirer and supporter of Galvani's hypothesis into its opponent, and gave birth to the theory of contact.

His first experiments, in fact, seemed to corroborate Galvani's hypothesis, and his first memoir opens with a passage which does not less honour to the writer than to him of whom it was written. "The dissertation published by Dr. Galvani, of the Institute of Bologna, and professor in that university, who is celebrated for other discoveries in anatomy and physiology, on the action of electricity on muscular motion contains a great and luminous discovery which deserves to mark an epoch in the annals of physical and medical science, not only, nor so much, on account of its novelty, as for the fact that it opens a wide field for research, equally interesting and curious, and of the most valuable application. The third part of this work proves, by the evidence of many experiments, well combined and accurately described, that there exists a true and real animal electricity, that is to say, electricity excited by the living organs themselves."

It was in the course of these experiments on Galvani's discovery that Volta found the action of a circuit of two dissimilar metals to be greatly superior to that of a homogeneous circuit in its effect on the muscle.

Galvani's own experiments, described in the second memoir, showed that the muscular contraction was a secondary effect of the excitement of the nerve. Led by this to experiment on the nerves of sense, he discovered the curious effect of taste produced by the contact of two different metals applied to the tongue, an effect which, though unknown to him, had been described 25 years before by the Swiss philosopher, Sulzer, a member of the Academy of Berlin, in his "New Theory of Pleasures."

Gradually his suspicion assumed a more definite shape, and in letters addressed to Tiberio Cavallo, Volta declared himself to be persuaded that the phenomena observed by Galvani and himself were mainly due, not to animal electricity, but to a very weak artificial electricity produced in some way, not understood, by the contact of dissimilar armatures. At the same time, with admirable prudence, he added that certain effects, such as that of the contraction produced by a homogeneous wire, still appeared to be certainly due to animal electricity.

One point is worth special remark. He perceived at this stage that the electrical want of equilibrium was due, not to a momentary electrical flow like the discharge of a condenser, but to a continuous phenomenon, to designate which he began to use the term *current of electricity*. This conception naturally suggested new and varied experiments, which led him at last to exclude all animal electricity, and to formulate more and more clearly his own hypothesis.

What do you think, begins one of his letters to Vassalli, of the supposed animal electricity? I, myself, am continually more convinced that the whole action proceeds originally from the combat of two metals with one wet body, or with water itself, and that in virtue of this combat, the electrical fluid is thrust forward by the metals themselves into the wet body, or into the water, in some cases more, in others less actively (most actively of all in the case of zinc, least of all in the case of silver), and that by this an uninterrupted flow is induced through suitable conductors, and the fluid is drawn in a continuous circuit.

As may be supposed, the supporters of animal electricity descended into the field, and accumulated experiments tending to establish their hypothesis. Among these Aldini and Doctor Eusebio Valli distinguished themselves by their bravery and activity. On his side Volta opposed new experiments and forcible arguments to those of his adversaries, and the famous battle, waged with ardour, but never without courtesy, spread beyond the borders of Italy, and lasted many years. The spectacle was of extreme interest. Victory seemed to belong now to one side, now to the other, as a new fact or an ingenious argument changed the fortune of the combatants; but so great was the admiration excited by the valour of both, so evident was the love of truth by which all were animated, that no partisanship or hope of victory for a particular side was anywhere evolved.

The first and most important objection to Volta's view was the experiment with the conductor composed of one metal, and his reply to this was that the homogeneity was only apparent, and that small variations of temperature and other circumstances were sufficient to produce the effect.

Why have recourse, exclaimed Volta, to the supporters of animal electricity, to a principle, purely hypothetical, of a natural want of balance of the electric fluid in animal organs? This is merely a useless multiplication of the causes of the action by adding others of the same kind as the effects produced. Let us stand by that which has been directly and indisputably proved, and not be carried away by conjectures and hypotheses, which may be elegant and attractive, but are hardly ever successful, and are useless if they do more than express the results of the most simple and clear experiments.

When once it had been established that an electromotive force exists between two wet conductors of the second class (electrolytes) in contact, it became impossible for the supporters of the hypothesis of Galvani to entirely exclude the intervention of contact electricity and the famous controversy began at length to languish.

The section of Prof. Righi's address dealing with the invention of the pile begins thus:—

Alessandro Volta's noble intellect shone nowhere so brightly as in his researches on contact electricity. A lively imagination, controlled at all times by the coolest judgment, a serene spirit in the face of difficulties, which compelled him to modify his ideas; a penetrating sagacity in contriving experiments, and unequalled skill in their execution; sane reasoning power in the interpretation and collation of facts, and in drawing conclusions from them—these were the salient characteristics of his lofty mind.

We all know how the new discovery (of the pile) astonished the world, what an outburst of admiration it produced, what well-merited honours it earned for Volta. And truly the impression produced cannot have been otherwise than it was—prodigious. Since then we have been able, with extremely simple means, thanks to the pile, not only to produce many of the effects of the discharge of electrified bodies, but to obtain entirely new and unexpected results. Moreover, those previously known have a special character when produced by the pile, which renders them more useful or more interesting than before.

The researches which led Volta to the invention of the pile furnished him with the victorious weapon for a final combat with those who persisted in thinking the so-called galvanic fluid to be something different from the electric fluid, the supposed cause of electrical phenomena. In his first memoir on "The Identity of the Electric Fluid and the Galvanic Fluid," Volta most completely summed up the famous controversy and expounded his own theory. A distinguished nephew of the great Comascan has happily said that this is "a stupendous work, rich with new experiments and subtle arguments," and may be looked on as "his literary testament." The adventures of this memorial are curious and instructive. In 1805 a scientific society offered a prize for competition, inviting men of science *To expound clearly, with dignity and without offence to any one, the question of galvanism at issue between our distinguished members Signor Giovanni Aldini and Signor Alessandro Volta.* The prize was not awarded to any one of the three competitors, and the sealed envelopes which contained the author's names were burned. But one of these competitors was Alessandro Volta, and the work presented by him was this ponderous memoir. Nine years afterwards Configliacchi, Volta's successor in the chair of physics at Pavia, published the work in such a way as not to make it understood that he was not the author, and when long afterwards he composed a bombastic eulogy of Volta, he omitted this memoir from the list of his published works. Since then we have obtained evidence, now irrefragable, that the memoir really came from the pen of Volta.

In this victory (the discovery of the pile) luck had no part. It was the result of a long series of sagacious researches and ingenious experiments inspired by consecutive logical deduction. Thanks to the pile, electricity has ceased to be merely an object of scientific interest, and has become a weapon of research, powerful, far reaching, catholic. By its aid science has developed for mankind a multiform mode of energy which seems destined to produce a profound revolution in human affairs only comparable to that produced in remote ages by the use of fire.

Towards the end of 1792, soon after the discovery of Galvani, a distinguished Italian chemist, Giovanni Valentino Fabbroni, had attributed the muscular contraction of the frog to a chemical phenomenon. He had studied the effects produced when two different metals, immersed in a liquid, are placed in contact, and had recognised that these, which consist principally in the oxidation of a metal, do not occur unless the metals are in contact. According to Fabbroni, the moist body of the frog fills the place of the liquid in respect to the two metals of the conducting arc, and the contraction is due to the chemical action caused by their contact. At the same time, Fabbroni showed that he was inclined to admit the production of electricity as a secondary effect. Afterwards Gautherot adopted this last supposition, and asserted that the chemical action was the true cause of the electrical phenomena which Volta had attributed to simple metallic contact. This idea, adopted by Wollaston, Nicholson, and others, was generally elaborated and completed, and gave rise to the modern chemical theory of the Voltaic cell.

The chemical decomposition of electrolytes, which Nicholson, Carlisle, Vassalli and others effected by making the liquid form part of the circuit connecting the poles of the pile, soon showed that an intimate connection exists between the two kinds of phenomenon, and strengthened the chemical hypothesis. And although the theory of Grotthus and the laws of electricity formulated by Faraday and by our own countryman, Matteucci, have established that the electrolysis of the liquid and the passage of the current are inseparable phenomena, an explanation of the action of the pile can, nevertheless, be still based on Volta's contact theory.

And to-day, whether we attribute the starting of the action of electrolysis to chemical affinities existing between the several metals and the electrolyte, or to the electrification of metals by their mutual contact, and whether, in consequence, we formulate a theory of the pile on the chemical or on the contact hypothesis, it will not be possible to establish the truth of the former, as against the latter theory, except by a direct proof, that no electricity is produced by simple contact between heterogeneous substances.

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Generally speaking, a new theory which penetrates the surface of the hidden causes of phenomena may thrust a little farther back the limit between the known and the unknown, but cannot gives us a view of the first cause. At present it seems possible to base an explanation of the phenomena of the pile on the conception of floating atoms, or groups of atoms, integral parts of the molecule, whose electrical charges they bear; and it may seem possible to extend the principle of this explanation to other electrical phenomena. But supposing we succeed in doing all this, shall we have explained everything? Certainly not. We come then face to face with the question: In what does the electrical charge of an ion consist?

Indeed, we have as yet no precise idea of what the electrical charge of a body or atom may be. The intimate nature of that electricity whose masters we are, which we use in a thousand ways, from which this dying century may draw its characteristic designation, is still a mysterious sphinx defying us from afar. But it is not possible to feel discouragement while we are speaking of Volta. The great progress made in electrical science in our age gives us confidence in future victories, perhaps far greater than those already won. That this progress is mainly due to the pile is the chief glory of Volta. But with this honour he possesses another, that of having restored to our system of research the rigorous experimental method which had been taught by Galileo, from which we had wandered. By keeping our attention on the example of these great leaders, as beacons lit to guide our way, we shall certainly succeed in making the longed-for progress, and shall continually approach an intimate knowledge of the nature of electrical phenomena.

ELECTRIC TRACTION IN SOUTH STAFFORDSHIRE.

From the brief notes which have come to hand from time to time from South Staffordshire, it has been clear that the British Electric Traction Company has been pushing forward with a scheme of great importance in that particular part of the country. Of course, everyone is fully acquainted with the enormous amount of pioneering electric traction work that has been done by this company all over the country during recent years, but it seems to us that if municipal enterprise (hindrance to enterprise we should call it in this instance!) is kept within its proper limits, its South Staffordshire undertakings promise to rank as the most extensive and important of all. The industrial importance of the district lying between Birmingham and Wolverhampton, and between Walsall and Stourbridge, otherwise known as the "Black Country," is recognised by everyone.

The density of population is as shown by the following figures (1891 census), and all the towns mentioned are contained within an area of some 60 or 70 square miles:—

Bilston	23,453	Quarry Bank	6,732
Brierley Hill	11,831	Rowley Regis	80,791
Coseley	21,899	Sedgley	14,961
Darlaston	14,122	Smethwick	36,170
Dudley	45,740	Stourbridge	14,901
Halesowen	14,481	Tipton	29,314
Handsworth	32,756	Walsall	71,791
Kingswinsford and Amblecote	20,724	Wednesbury	25,342
Lye and Wollescote	10,165	West Bromwich	59,489
Oldbury	22,607	Willenhall	16,852
		Wolverhampton	82,620

At the present time (1899) the total population of the area considerably exceeds half a million, and the districts are controlled by no less than 22 local authorities.

A complete system of intercommunication admitting of convenient and rapid transit from place to place is of paramount importance to such an aggregation of busy industrial towns.

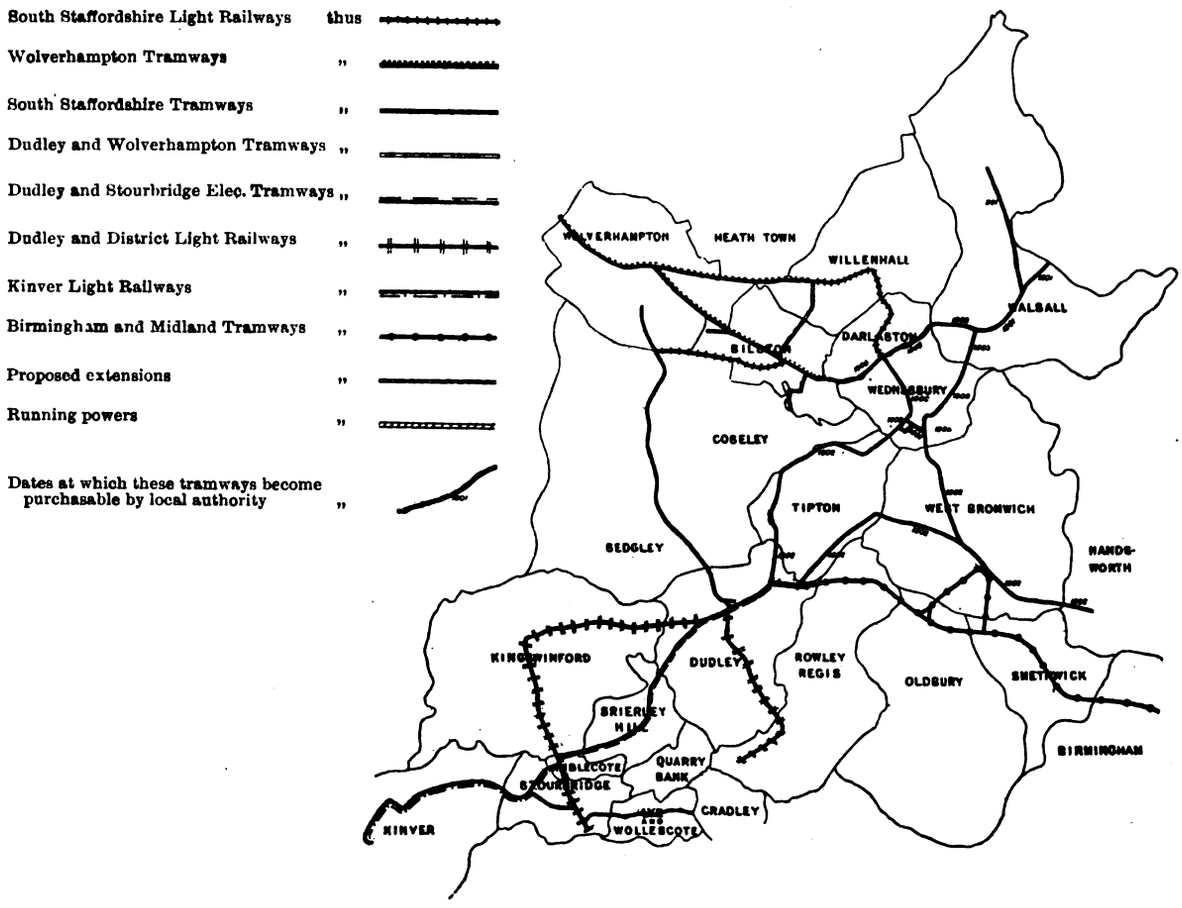
The extent to which this was possible before the British Electric Traction Company appeared upon the scene can be judged from the map given below.

The district is at present served by the following tramway companies:—

Company.	Worked by.	Length of route.	Gauge.
South Staffordshire Tramway Company.	Partly steam, partly electricity	22¾ miles.	3 ft. 6 ins.
Dudley, Stourbridge and District Electric Traction Company.	Electricity.	5¾ „	3 ft. 6 ins.
Birmingham & Midland Tramways Company.	Steam.	11 „	3 ft. 6 ins.
Dudley & Wolverhampton Tramways Company.	Steam.	5¾ „	4 ft. 8½ ins.
Wolverhampton Tramways Company.	Horses.	8¾ „	4 ft. 8½ ins.
		54 miles.	

The lines of these companies are not only quite inadequate in extent for the needs of the travelling public, but are, moreover, entirely separated and disconnected; two of the companies actually having a different gauge to the rest of the tramways in the district, thus making any through communication quite impossible, even if there were joint management.

In such a disjointed system as this, even if the tramways were all that could be desired in regard to comfort, speed, and frequency of service, the inconvenience of changing cars would prevent their being of any great benefit to the community at large; but the inconvenience is aggravated to such an extent by infrequent service and insufficient accommodation that the whole tramway conditions of the district cannot be described as otherwise than thoroughly unsatisfactory.



The public, not unnaturally, only use the cars when forced to do so by the lack of better means of conveyance, and the tramways cannot be made to pay for want of patronage; the financial condition of the companies therefore is not satisfactory. One company has never paid a dividend on its ordinary shares, and only a very small return upon its preference shares; while the shares of all the other companies are at a discount. Consequently, the companies are unable to carry out improvements and to adopt the modern system of working by electricity, which involves a very considerable capital outlay. Matters were gradually going from bad to worse when the British Electric Traction Company some four years ago first entered into negotiations with the companies and the local authorities.

This company's great aim, wherever it brings its influence to bear, is to ensure that tramways shall be made so frequent, rapid and convenient that the public shall be compelled to make use of them and regard them as an unmistakable boon. Its 33-mile system in the Potteries district of North Staffordshire is known to our readers.

In South Staffordshire the company has been heavily handicapped by local authorities who have hampered and delayed progress by imposing terms too onerous for it to accept, such as the purchase of electrical energy from their power stations at too high a price to admit of the tramways paying at all, and the 1896-97 Bill had to be withdrawn. Having thus found it impossible to proceed with the scheme as a whole, the company was forced to adopt the more lengthy process of developing the enterprise piecemeal, by obtaining the control of the tramway undertakings and by making agreements with the local authorities.

Following out this policy of gradual development, the B.E.T. has made arrangements with all the tramway companies in the district, viz.:—

It owns the Dudley and Wolverhampton line.

It is working the electrical section of the South Staffordshire Company's Tramways, and has obtained an Act of Parliament authorising the South Staffordshire Tramways Company to grant a lease of the rest of its lines.

It holds a controlling interest in the Dudley and Stourbridge Tramways, which it has reconstructed and equipped, and these tramways are now working by electricity to the great satisfaction of the people in that district.

It has arranged with the Wolverhampton Company for the purchase of its lines which are outside the Borough of Wolverhampton, viz., the tramways in Bilston and Willenhall, and Parliamentary powers have been obtained for the adoption of a uniform gauge of 3 feet 6 inches throughout.

It is concluding an agreement with the Birmingham and Midland Tramways Company for the eventual purchase of that undertaking.

Several Light Railway Orders have been promoted for the construction of connecting lines and for the extension of the existing tramways.

The British Electric Traction Company has furthermore already made agreements with many of the local authorities, including the Corporation of Dudley, the Urban District Councils of Amblecote, Bilston, Brierley Hill, Coseley, Sedgley, Stourbridge, Willenhall, and the Rural District Council of Kingswinford. The Corporation of Wolverhampton have inserted a clause in their Bill now before Parliament, by which they agree not to acquire or work any lines in the districts of Bilston, Coseley, Darlaston, Sedgley, or Willenhall, without the consent of the British Electric Traction Company.

The tramways system, however, cannot be perfected and completed without the consent of the other local authorities through whose areas the lines pass, and the refusal of their consent is withholding from the district the full benefit of joint control and of through communication over the whole of the tramways. That such a policy is mistaken is obvious to any impartial student of the question: even a cursory examination of the conditions will show the utter impracticability of the local authorities taking over and working independently the short sections within their areas. Travellers do not want to change cars at the municipal boundaries, but want to move from one centre of population to another. Moreover, if the local authorities of Walsall, West Bromwich, and Wednesbury are determined to work the tramways themselves, they can do so only by breaking up the whole tramways system, because they are only entitled to purchase the various sections of the tramways at certain specified dates, and, as will be seen from the map, they cannot purchase the whole of the tramways until 1905. For the next six years, therefore, the tramways in these districts would be in a state of chaos. In separating themselves from the remainder of the system these local authorities will isolate themselves completely; the tramways under their control will be too small to be worked at a profit, and the service and management will necessarily be far less efficient than those of the big system outside.

In the further development of its scheme the British Electric Traction Company will meet with fresh opposition, and new problems will be cropping up at every stage. Further extensions and connecting lines may be made later, but the various existing companies must first be brought into a thorough state of efficiency by the adoption of electric traction under uniform management.

If the company is allowed to complete the work, a passenger will be able to enter a car at the Birmingham boundary or at Walsall and travel to almost any other part of South Staffordshire, and even run out as far as Kinver, a favourite holiday resort.

It goes without saying that so great an undertaking as this is only possible by private enterprise, and we cannot help adding that a great deal of credit is due to the B.E.T. Co. for the untiring way in which its officials proceed with the very difficult negotiations with opposing local authorities.

Electric Railway: Offers Wanted.—The electric railway at the Alexandra Palace, Wood Green, has been acquired by Messrs. Saunders, Todd & Co., of Newcastle-on-Tyne, who are inviting offers for it, and from whom full particulars may be obtained.

SOME FEATURES OF THE ELECTRIC INDUCTION MOTOR.*

By Prof. C. A. CARUS-WILSON, M.A., M.Inst.E.E.

The action of a magnetic field upon a conductor carrying an alternating current might be illustrated in a simple manner by placing an incandescent lamp in the neighbourhood of an electro-magnet and connecting the lamp to an alternating supply circuit. If the magnetic field were uniform, the filament would vibrate in front of the magnet, and if the vibrations could be minutely studied they would be found to increase first of all to a maximum in one direction, then fall to nothing, and then reach a maximum in the other direction, following a harmonic law. The variations of the force on the filament were similar to those which took place in a steam engine, where the turning moment on the crank went through a complete cycle from a positive to a negative maximum, the law of variation being harmonic if the steam pressure were constant and the connecting rod of infinite length.

The conditions under which the conductor vibrated could be shown more perfectly if it were possible to attach a mirror to the conductor and reflect a beam of light therefrom. But in order that the motion of the conductor should give a true indication of the force acting upon it, the moving part must have a very small periodic time and be perfectly dead-beat. These conditions were fulfilled in a remarkable way in the oscillograph recently designed by Mr. W. Duddell, who had kindly lent one of his instruments for the purpose of illustration. In this instrument the conductors were metal strips stretched in a magnetic field; a minute mirror fixed to the strips reflecting a spot of light on to the screen. The delicacy of the arrangement was such that the period of vibration of the mirror was only the two-thousandth part of a second.

When an alternating current was passed through the strip, the magnetic field being constant, the spot of light on the screen assumed an up and down motion in a straight line. It was possible, however, to indicate the true nature of the law of motion by making the beam of light on its way to the screen strike on a mirror which moved to and fro synchronously with the variations of current in the strip. The spot then followed a wave-like course, tracing out an S-shaped figure. If the spot moved quickly enough, the successive impressions would remain on the eye for a sufficient length of time to give the effect of a continuous line of light.

When examined in this way, the force due to a constant magnetic field and a variable current in the strip was seen to vary from nothing to a certain maximum, then to nothing again, then to change sign and increase to an equal negative maximum, and finally to fall to nothing. The strip was thus subjected to a series of equal impulses varying in sign, so that the resultant impulse was zero.

To prevent the impulses from changing sign, it was necessary to make the magnetism change sign at the same time as the current. This could be done by exciting the magnet by an alternating current in step with that in the strip. When this change was made, the spot of light was seen to fluctuate up and down from a fixed line, instead of alternating as before, showing that the strip was now subject to a series of fluctuating impulses. There were, however, dead points at which the strip was not subject to any force. It appeared then possible to combine an alternating field with a conductor or conductors carrying an alternating current in such a way as to obtain a series of unidirectional impulses, and motors had been constructed on this principle. Such motors had the disadvantge of dead points, and uniform motion could be obtained only by making the moving parts of considerable weight, so that part of each impulse was stored up as kinetic energy, and the dead points thus successfully passed over.

The dead points could be avoided in a manner often used in steam engines, where two separate cylinders were set so that when the action of one on the crankshaft was a minimum, the action of the other was a maximum. This principle could be carried out far more completely in an electric motor than in any other form of motor, for the reason that in a steam engine, for instance, the force of each one of the two cylinders varied according to a harmonic law, with uniform steam pressure, and two series of harmonic impulses at right angles did not give a uniform turning moment, with the electric motor, on the other hand, the law of force variation with synchronously varying field and current was not a harmonic law—as might be seen by the shape of the curves on the screen—but a law having the remarkable peculiarity that two such series of impulses at right angles gave a uniform impulse when acting together. It was thus possible to construct an alternating electric motor in which the sum of the turning moments on the shaft was a constant quantity. The induction motor was such a motor.

Taking the fixed coil, A, shown in plan in the figure, to represent the magnetising coil used in former experiments, and the moving coil, B, to represent the conductor or strip, the condition of a unidirectional fluctuating impulse from A to B was, that the magnetism of A should be in step with the current in B. To produce the latter, recourse might be had to the principle of induction, by which currents could be induced in coils through which an alternating magnetic field was allowed to pass.

By way of illustration, coils A and B were placed opposite and parallel to one another, each being connected to a separate strip on the oscillograph, in which the magnetic field was kept constant. When an alternating current was passed through A, a current was induced in B, and the two currents were shown on the screen in the

* Abstract of a lecture before the Royal Institution of Great Britain, Friday, April 28th, 1899.

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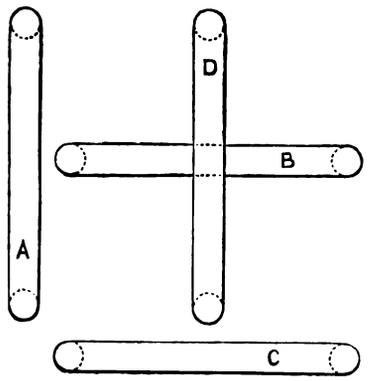
form of two curves overlapping each other. The explanation of the overlapping was that the induced current in B was not in step with the magnetism produced by A, but lagged behind it by an amount of time equal to a quarter of a period.

This lagging of the induced current behind the inducing magnetism had an important bearing on the motor problem, because it showed that it was not possible to make the magnetising coil, A, induce in coil B a current suitable for producing a unidirectional series of fluctuating impulses, since the necessary condition was that the current in B should be in step with the magnetism produced by A.

If a second magnetising coil, C, could be used, in which the current differed from that in A by a quarter of a period, it could be made to induce currents in B which were in step with the magnetism produced by A. The intermediate coil, B, would then be subject to the



influence of two coils, A and C, of which the former produced an alternating magnetic field, and the latter an induced alternating current in step with that field, the two together giving a series of unidirectional fluctuating impulses.

The magnetising coil A exerted the greatest force on the coil B when the planes of the two coils were at right angles to each other, and the coil, C, induced the greatest current in B when their planes were parallel. Hence it followed that the best effect was obtained by placing the planes of the coils A and C at right angles to one another, and B at right angles to A, as in the figure.

If a second intermediate coil, D, were placed across coil B, there would be currents induced in it by A, and a force exerted on it by the field due to C, resulting in a series of impulses similar to those acting on B, but differing from them by a quarter of a period. The sum of the two sets of impulses on the intermediate conducting system was a uniform twisting moment.

If the two coils, B and D, were replaced by a continuous conductor —such, for instance, as a copper drum—this action could go on while the conducting system rotated. In the experiment shown, a copper drum was suspended in front of two coils placed at right angles and excited by currents differing by one quarter of a period. When both coils were excited the drum rotated at a uniform speed.

A striking feature in the induction motor was the rotating magnetic field caused by the variations of magnetism in the different coils. This was illustrated by an experiment in which a small permanent magnet carrying a mirror was centred upon a vibrating rod placed between two pairs of electro-magnets. When two opposite magnets were excited the mirror vibrated between them, and reflected a spot of light on to the screen, tracing out a vertical line. When the second pair of opposite magnets was excited the spot traced out a horizontal line of equal amplitude. Both sets were then excited together by currents in step with each other, with the result that the spot vibrated in a line making an angle 45° with the former lines of vibration. When the exciting currents were made to differ by one quarter of a period, the spot of light reflected from the mirror described a circle, showing that the magnetic field produced by two magnets set at right angles and excited by two currents differing by a quarter of a period is of uniform intensity and rotates at a uniform rate.

The action of the induction motor was based on principles which governed the action of the better known transformer, and for purposes of calculation it was convenient to regard the induction motor as a transformer. One form only of the induction motor had been alluded to; of other possible forms, that in which three magnetising coils were used, with currents differing from one another by one-third of a period was the one most commonly employed in practice.

THE PENALTY CLAUSE.

The non-fulfilment of a contract within a specified time frequently involves the payment of a penalty by the party at fault. While the clause which imposes this liability remains in obscurity when orders are few and far between, it forces itself into a position of unpleasant prominence when orders are many and trade is brisk. Although sometimes inserted in order to act as a deterrent against unreasonable delay in the performance of his contract by the undertaker, it sometimes operates to materially reduce the profits of an adventure. This being so it may be useful to draw attention to some of the legal questions which arise in relation to the penalty clause.

The word "penalty" in this connection indicates that breach of contract may involve a liability altogether out of proportion to the actual damage sustained. The parties, instead of relying upon the remedies provided by law, themselves agree to ensure the fulfilment of contractual obligation by fixing the damages beforehand. But where damages are capable of easy estimation, and where it can be proved to the satisfaction of a court of law that the actual damage sustained is far short of the penalty inflicted, the judges have ever since a famous case in the Chancery Court known as Sloman *v.* Walter been ready to grant relief. Thus at the present day, where the extent of the injury sustained can be clearly estimated in pounds, shillings, and pence, the Court will declare the penalty clause inoperative and proceed to estimate damages according to the scale whereby they are usually calculated. Thus, in a contract to supply goods of known value by a certain day, let us suppose that each of the parties agrees to pay a sum largely in excess of the market value of the goods. The vendor fails to deliver in time, whereupon the buyer claims the penalty. In such a case the Court says: "Nay, the measure of damage is the difference between the contract price of the goods, and the price at which they could have been obtained in the market on the day when the contract was broken." It follows that if by any chance the market price was lower on that day the Court would only grant nominal damages. The above considerations apply, although the parties expressly agree that the fixed sum shall be regarded as liquidated—*i.e.*, fixed—damages, and not as a penalty.

But where the parties, anticipating the likelihood of a breach of contract on one side or the other, have fixed the sum which is to become payable on such breach, if the damages are such as to be wholly incapable of estimation—especially at the hands of the Court—the law is willing to regard the amount as "liquidated damages," and to order payment accordingly. Thus, suppose there was delay in the completion of an electric lighting station, inconvenience to the public might follow, but according to what scale could the damage be assessed? Clearly upon that, and upon that alone which the parties themselves have invented. The whole question may be summed up in the memorable words of Lord Coleridge: "Where the damage is entirely uncertain and the parties agree upon a definite and not unreasonable sum by way of liquidated damages, then that sum will be regarded and will be recoverable."

The greater number of the contracts with which an electrical engineer is acquainted are of such a nature that the damage caused by their breach is "entirely uncertain." The penalty is indeed a "penalty." What, then, are the circumstances under which contractors are relieved either partially or entirely from the payment of these penalties?

The all too-familiar "strike clause" demands but a passing notice. It serves as an excuse for non-performance within the time, although the strike is brought about by the contractor lowering the wages of his men. (King *v.* Parker, 34 L.T. 887.)

Generally speaking, information as to the interpretation of the penalty clause can best be gleaned from cases founded upon building contracts. While time is frequently "of the essence" of such agreements, the consequences of their breach can only be measured by the parties themselves. We may assume that the following rules which have been laid down in cases upon building contracts will apply with equal force to all contracts where delay in performance involves the payment of a penalty.

In the first place it needs no lawyer to remind us that any undue interference on the part of the employer which causes serious delay or hampers the contractor in carrying out his undertaking will release him from paying penalties. This was decided in the case of Russell *v.* Sa. Da. Banderia (Viscount). (13 C.B.N.S. 149.)

There may be an implied waiver of the right to recover penalties. Suppose, for instance, during the performance of a specific piece of work, to be completed within a certain time, the employer and contractor make terms as to additional works or alterations. This subsidiary agreement vitiates a

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claim for penalties, unless it be shown that the time spent upon the whole job was unreasonable (Thornhill *v.* Keats, 8 C.B. N.S. 831), or unless the contractor definitely renews his undertaking to complete the entire work within the limited time.

Where an agreement to complete the work by a certain date contains a clause providing for the execution of any additional works which may from time to time be demanded by the engineer, there is no implied term that the additions shall be such as can be reasonably performed within the time. (Jones *v.* St. John's College, Oxford, L.R. 6 Q.B. 115.)

In addition to other powers which are usually vested in him, an engineer is sometimes permitted to order additional works, and to grant to the contractor a proportionate extension of time within which to perform his contract. In a curious case decided some years ago, it was held that under such circumstances, if the engineer omits to grant an extension, the unfortunate contractor becomes liable to penalties in accordance with the original contract. (Tew *v.* Newbold on Avon District School Board, 1 C. and E. 260.)

The above rules may be summarised thus:—

1. The total destruction of the work in hand, *e.g.*, by fire, releases both parties.

2. Interference by the employer (or contractee) which causes delay, negatives his right to penalties.

3. Additional works or alterations need not be executed within the time limited by the penalty clause, unless there is an express agreement to that effect.

Penalties are easily collected, inasmuch as they can be deducted from the contract price. Acceptance of the completed work after the specified time sometimes operates as a waiver of penalties. (Lucas *v.* Goodwin, 3 Bing. N.C. 737.) Moreover, if it can be shown that the delay was caused by additional works, it is clear that there can be no set off of the amount claimed for penalties against the contract price.

FOG SIGNALLING ON RAILWAYS.

"The season when fogs and snowstorms may be expected is approaching, and the attention . . . ."

Many of us are familiar with circulars addressed to the staffs of our railways, at this season of the year, of which the opening terms are, more or less, as the above quotation; and, already, the daily papers are recording accidents to trains, with consequent loss of life and damage to property, owing to the prevalence of fog.

During the last week or two exemption from fog for the whole of the 24 hours has, in the provinces, been the exception rather than the rule; and the old question, of the sufficiency of the existing means of signalling under such circumstances, comes to the front again with all the force due to the occurrence of accidents of a more or less serious nature.

Without in any way attempting to apportion blame for accidents which will no doubt be the subject of inquiry, it may be said that the subject has sufficient importance of its own to justify reference at this time. The public are quite as much concerned as the railway companies, which, indeed, exist for their convenience.

It may, therefore, be fairly asked whether the time has not now arrived when railway companies should discard so antiquated a system as hand fog signalling; or at least give full and fair trials to other systems, with a view to their early adoption if found satisfactory.

There are, no doubt, some to whom the existing system is all that can be desired, but, in the majority of such instances, their opinions are due to arm-chair consideration, and they lack that intimacy with the conditions obtaining which can only be got at first hand.

The old wheeze which depicted the engine driver ascending a signal ladder with his hand lamp, in order to ascertain whether the signal was "off" or at "danger," is not only an exaggeration, but absolutely misleading. On the contrary, the driver has to run to a schedule which makes no allowance for exceptional circumstances such as are under consideration; the all-right signalling is of a negative character, and he continues to run until stopped by the regular intimation—or otherwise. Under such circumstances the driver must possess at least a portion of the indifference to consequences which dictated the alternative, "Westminster Abbey or a peerage." He, of course, does not anticipate so much honour, whatever the event. One has, however, heard him give expression to the same sentiment as "H-ll or ———," and doubtless he knew best what to anticipate in the event of the worst.

Putting aside such grim pleasantry it is to be hoped that the question of better methods of signalling, under abnormal conditions such as are due to fogs or snowstorms, will not be allowed to drag on in the way that the provision of an efficient means of communication with passengers in trains has done.

A few months ago some remarks on the latter form of signalling appeared in these columns, and very shortly afterwards a meeting, such as had been suggested, was arranged, and a decision come to. It is sincerely to be hoped that similar concerted action will soon be taken to deal with the question of signalling "during fogs or falling snow."

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

20,180. "Improvements in the means of connecting electric tramcars with overhead wires." G. Pinnington. Dated October 9th.

20,189. "Improvements connected with indicating or recording and controlling the speed of electric railway cars or vehicles and other machinery." G. H. Nisbitt. Dated October 9th.

20,207. "Improvements in electric telegraphs." C. Adams-Randall. Dated October 9th.

20,214. "Improvements in or connected with electrolytic bleaching of baled yarns." A. A. Vogelsand. Dated October 9th.

20,216. "Receiving apparatus for high speed telegraphy." Siemens Bros. and Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated October 9th.

20,227. "Improvements in electric tramways and in motor cars therefor." A. M. Taylor. Dated October 9th.

20,237. "Improved manufacture of articles plated with platinum, gold, and silver by electrolysis, and apparatus therefor." L. Bourdillon. Dated October 9th. (Complete.)

20,249. "Improvements in apparatus for detecting and measuring or comparing the strength of electrically produced etheric waves, impulses, or vibrations commonly known as Hertzian waves." A. B. MacGregor. Dated October 9th.

20,261. "The improved electric incandescent lamp." E. S. Ellis. Dated October 9th.

20,277. "An improved electrical selector switch." A. Eckstein and H. J. Coates. Dated October 10th.

20,290. "Appliance for imparting electricity and heat to the body." I. Timar. Dated October 10th. (Complete.)

20,298. "Improvements in and connected with electrical indicating, measuring, and recording instruments." M. Waddell. Dated October 10th. (Complete.)

20,307. "Improvements in guides for trolley or collector pulleys on the overhead system of electrical tramways." F. L. F. Boudry. Dated October 10th.

20,313. "An improved attachment to be applied to the new Scandinavian table telephones." S. Percy. Dated October 10th.

20,316. "Troughs for electric cables." W. Sykes. Dated October 10th.

20,321. "Improvements in the construction and arrangement of electrical resistance coils." W. G. Pye. Dated October 10th.

20,328. "Improvements in or relating to dynamo-electric generators or transformers." J. R. Robison. Dated October 10th. (Complete.)

20,346. "Improvements in the manufacture of incandescing electric lamps." W. L. Voelker. Dated October 10th.

20,360. "Improvements in chimneys for incandescent or other gas, oils, electric, or other lights." J. Marshall. Dated October 11th.

20,388. "An improvement in incandescent electric lamps socket junction bodies." C. A. Swan. Dated October 11th.

20,389. "Improvements in transmitters for Morse alphabet and printing telegraphy." L. Crebotani and C. Moradelli. Dated October 11th. (Complete.)

20,390. "Improvements in apparatus for automatically connecting any two of a number of electric circuits branching from a central station." L. Crebotani. Dated October 11th.

20,403. "An improved electric lamp." L. Coen and C. Cohen. Dated October 11th.

20,412. "Improvements in electric railways working on the surface contact system." R. Lundell. Dated October 11th. (Complete.)

20,438. "Improvements in means for holding shades or globes for electric and other lights." J. Barker. Dated October 12th.

20,480. "Improvements in electric arc lamps." C. Curwen. Dated October 12th.

20,486. "Improvements in electrical distribution switch and fuse boards." A. Jaray. Dated October 12th. (Complete.)

20,493. "Improved electrical signalling system for railroads." G. Berry. Dated October 12th.

20,504. "Improvements in batteries or apparatus for producing ozone." C. A. Sahlstrom. Dated October 12th.

20,507. "Electric igniter for gas." H. von Arnswaldt. Dated October 12th (Complete.)

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20,584. "High voltage electric lighting ceiling rose." T. S. McLaren. Dated October 13th.

20,541. "A waterproof compound action electric bell." R. Bowman. Dated October 13th.

20,549. "A portable electric incandescent coloured lamp or dark lantern for photographic purposes." A. L. Adams. Dated October 13th.

20,605. "An apparatus for preventing sparking and making better contact with the conducting cable and trolley arm in electrically propelled vehicles." J. K. Stanley. Dated October 14th.

20,607. "A system for translating and relaying telegraph cable signals." J. P. Gorton. Dated October 14th.

20,615. "An improved electric safety apparatus for lifts and elevators." J. Bush. Dated October 14th.

20,655. "Apparatus for use in forming joint ends on electrical conduits, drain pipes, and the like." The Albion Clay Co., Ltd., and R. A. Lawton. Dated October 14th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

1,803. "Improvements in and relating to electric arc lamps." L. B. Codd and J. A. Codd. Dated January 22nd, 1898. Relates to arc lamps.—Brake regulating mechanism is constructed as shown. The carbon-holders are hung in guides by pairs of cords which pass over guide-wheels to opposite sides of a double pulley attached to a brake pulley. A chain or cord makes a complete turn round the brake pulley, and is attached at its ends to unequal arms of a lever. This carries cores below series and shunt solenoids, and is weighted so that the longer end, below the series solenoid, descends and slackens the cord when the lamp is not in operation, allowing the carbons to move together. When current is supplied, the series core rises, tightening the cord on the brake pulley, and turning this so as to strike an arc. 2 claims.

1,912. "Improvements in telephones." J. D. F. Andrews. Dated January 24th, 1898. Microphones are formed of carbon or other granules, dust, &c., enclosed in a space or spaces in a flexible or elastic washer placed between two membranes, a membrane and a block, or two discs separated by a membrane and having blocks on their outer surfaces. The elastic material may be formed of carbon dust or granules and a binding substance. Receivers are formed of various patterns in which the magnet may have a diaphragm at either end supported by their edges, or two diaphragms at each end centrally supported. The two diaphragms may also be separated by a coil without a magnet. The magnet may also have a tubular casing acting as an outer pole on a single diaphragm. The microphone and receiver may be combined as one instrument, a double coil being wound on the magnet. This form of apparatus may be employed as a relay. 5 claims.

2,021. "Electrical log recording instrument for the cabin." P. Jensen. Dated January 25th, 1898. The hand is driven over the dial by electric means, that is, by a ratchet wheel advanced by a pawl arm on a bell-crank lever. At certain fractions of a mile the log completes circuit for a magnet and when contact is again broken a spring returns the pawl arm and rotates the wheel. A contact is attached to an annular dial graduated reversely to the dial, and a knob is provided for adjusting this annular dial so that the hand touches it after a given distance has been run and completes circuit for one or more alarm bells in various places on the ship. All these bells, except one, may be cut out when desired. Circuit is completed by the log, say at the completion of every mile, for an electro-magnet which, attracting its armature, pricks a hole in a paper band drawn forward by rollers actuated by the clock. A procker on one of these rollers punctures the strip every hour by the side of the distance record. 4 claims.

2,040. "An electrical fire call." W. Bienheim. Dated January 26th, 1898. Relates to a fire call system in which the firemen are rung up at their houses at the same time that an indicator is dropped at the fire station. A magneto generator sends alternating currents through the line wire to actuate the indicator at the central station. The bells in the firemen's houses are made with high self-induction, so that the alternating currents do not ring them, though they are connected to the single line wire. The alternating current from the magneto generator throws a battery into circuit with the bells, which are then rung by this continuous battery. This arrangement prevents the firemen from being rung up by leakage currents. 1 claim.

2,389. "Improvements in secondary batteries." J. V. Sherrin. Dated January 29th, 1898. Relates to electrodes of the kind described in Specification No. 16,516, A.D. 1896. One form consists of a central, solid, or hollow core, and conducting wires wound helically around it, and around the wires is helically wound a strip of springy conducting material. The active material is packed in until it is flush with the helix, and outer rings of non-conducting material are placed on the ends of the electrode, or the electrode is enclosed in a wrapper of non-conducting material formed by winding a perforated strip of celluloid around it. Another form of electrode consists of a ribbed conducting piece, the ribs being preferably helical covered with a conducting strip, and provided with non-conducting material as described above. Another form consists of a central conducting cord, rings of ebonite, another ring or cushion at each end, but instead of the said cushion the electrode may have a strip of ebonite wound helically around it. Another form consists of a lead conductor arranged as a zig-zag bar with two side pieces and provided with slits. Around this is wound a helix of conducting or non-conducting material, and ebonite rings or their equivalent are fitted on the ends of the electrode. 6 claims.

2,417. "Electric circuit breakers." M. Bouchet. Dated January 29th, 1898. (Date claimed under Section 103 of Act, 1883, July 2nd, 1897, being date of application in France.) A vessel is divided into two compartments and filled with mercury to a certain level. Each compartment is connected to one of the terminals. On lowering a plunger the mercury level is raised and the circuit is completed. The plunger may be controlled by hand or by means of an electro-magnet. The electro-magnet may be in the circuit and act only as a cut-out, or it may be in a separate circuit and be controlled from a distance. In one form the plunger is carried by the movable core of an electro-magnet. The iron part of the electro-magnet preferably consists of three pieces, two forming part of the bobbin and the other a sheath. The core is connected by a rod to a lid or cover hinged on the lid by a spring so arranged as to hold up the cover and with it the core and plunger when the core has once been raised. An arrangement for preventing the core from being crossed down by the resetting handle in places where a consumer is exceeding the maximum current allowed, consists of a cam connected to the handle-spindle by a spring and normally held up by a spring. On turning the handle the spring is put in tension until the cam is freed from the spring. It then flies round momentarily depressing the rod and plunger by forcing down the cover. Two or more of these appliances may be connected to form bi-polar, &c., cut-outs, or switches, and the parts may be so connected that the movement of one affects all the others. 9 claims.

2,420. "Improved means for controlling the working of lifts, motors, and other appliances operated by electric energy." W. A. Key. Dated January 29th, 1898. Relates to means for controlling the flow of an electric current, and is especially applicable for use in connection with motors for working lifts or hoists, the object being to avoid shock or jar and sparking upon applying the current. The controlling device consists of a tank containing water, preferably rendered slightly alkaline, in which are fitted two insulated electrodes, which are closed together at their upper part, but diverge, as shown, at their lower part. These electrodes are connected with the circuit, and are separated from each other by a diaphragm, which is attached to one end of a weighted lever pivoted and connected by a link to the starting switch, so that when the switch is moved, the diaphragm is gradually raised, and allows the current to pass through a layer of liquid which, as the diaphragm rises gradually, decreases in width until the diaphragm rises to such a height that the pivoted piece falls and connects the two plates directly together. A dash-pot connected to a lever is provided to retard its movements to a certain extent. 3 claims.

2,423. "Improvements in the manufacture of filaments for incandescent electric lamps." R. Mullard. Dated January 29th, 1898. Relates to incandescent lamps. Filaments of high resistance are made from carbides of calcium, barium, strontium, iron, zinc, copper, aluminium, magnesium, manganese, boron, or silicon, which may be mixed with coke, graphite, or retort carbon. The materials reduced to impalpable powder are mixed with tar, or cellulose, and zinc chloride solution, or other binding material, and squirted, carbonised and mounted as usual. 3 claims.

2,428. "An improved electrical transformer for currents of high potential and variable frequency." A. Wydts and O. M. Rochefort. Dated January 29th, 1898. Relates to induction coils for currents of high potential and variable frequency. The primary coil is wound on a core and enclosed in a glass or like tube. It is supported on washers so that a space is left for insulating material. The secondary winding is composed of a series of coils built up as follows:—A tube of paraffined paper or the like is formed on a mandrel or core, and a coil of wire wound on, each turn being separated by insulating material. A layer of paper is placed on this coil, and then a second coil is wound, and so on. The coils are then immersed in a hot solution of paraffin in petroleum. The coils are then placed in position in the tube and the whole placed in a vessel containing a similar solution which sets to a jelly on cooling. The secondary wires issue through insulating tubes preferably formed of double tubes separated by insulating material. The interrupter consists of a vibrating arm mounted on a spring. It carries a contact dipping in a mercury cup at one end and an armature at the other. The current is supplied through an adjustable contact and spring. The frequency is varied by sliding the contact on the spring. 4 claims.

2,455. "Improvements in electric contacts, suitable for railway signalling and other purposes." R. Burn and A. C. Brown. Dated January 31st, 1898. Relates to a train-operated electric contact, consisting of wire tufts or brushes which are fixed on suitable supports close to one of the rails. When a train passes, the wheels make contact with the brushes and complete the signalling or other controlling circuit from the brushes through the rail to earth. The invention is stated to be applicable for the following and other similar purposes:—For closing a circuit through an audible or other signalling instrument, and through contact mechanism operated by the ordinary signal lever, the circuit being completed through different signalling instruments according to the position of the lever; for putting outdoor signals to "danger" and locking them, and for unlocking them by a second contact when the train has passed out of the section; for locking and unlocking signals and block instruments in cabins; for actuating audible and visible signals in cabins to indicate whether the section is "blocked" or "clear"; for actuating audible line signals during fogs, &c., and for actuating alarm bells to signal the approach of trains at level crossings, &c. The provisional specification also states that the brushes may make contact with an insulated rim or flange on the train wheels, for actuating a signal on the engine, &c., or for the transmission of power for motor or other purposes. 8 claims.

2,479. "Improvements in terminals for electrical connections, especially adapted to incandescence lampholders." G. Byng and H. Bevis. Dated January 31st, 1898. Couplings applicable to the plunger carriers in holders for incandescent lamps. In one form a screw projects from a flat side of the plunger carrier and is perforated transversely to receive the end of the conducting wire, which is clamped by a screw cap. The face of the cap may be recessed to draw the free end of the wire partly around the screw. In another form a transversely perforated screw enters a hole in the plunger carrier; the wire winds on the screw when this is turned. In other forms, the conductor is passed through a hole in the plunger carrier into a hole in the head of a screw inserted in the carrier, or between the eccentric head of a screw and the body of the plunger carrier. 5 claims.

2,485. "An improvement in electric arc lamps." C. Oliver. Dated January 31st, 1898. Relates to arc lamps. A lamp has a tapered rod connected with the carbons and acted on by a clutch connected by a horizontal lever with the cores of shunt and series solenoids, between which the lever is centrally pivoted on a stationary support. In order to render the action of the solenoids on the arc uniform in all positions of the tapered rod and clutch, a weighted cord or chain is attached to one end of the lever and to one carbon carrier, so that its weight is gradually transferred from the lever to the carbon carrier as the carbons are consumed. In modifications, instead of connecting one end of the weighted cord to a carbon carrier, it may be attached to a pulley which is secured to the supporting pulley; the weighted cord may be replaced by a tension spring. 8 claims.

2,584. "Improvements in the manufacture of electric glow lamps." W. L. Wise. (C. Pieper, Germany.) Dated February 1st, 1898. Relates to incandescent lamps. Filaments are made of metallic thorium or alloys of this with metals of the platinum group, and are heated in the residual air in imperfectly exhausted bulbs to oxidise their surfaces. Other metals, the oxides of which have high light emitting power, may be used instead of thorium. 1 claim.

2,723. "Improvements in electric arc lamps." H. Crudgington. Dated February 2nd, 1898. Relates to arc lamps. In a brake lamp the carbons are hung from a pulley on a brake wheel, the upper holder being the heavier. The brake wheel is partly surrounded by a brake band or chain, the ends of which are attached to the short arm of an armature lever and to a drum provided with a weighted arm, the lever and drum being mounted independently on one axle. The armature lever is acted on by a differentially wound magnet. When its longer end is raised, by the action of the series coils, its shorter end pulls the brake band, turning the drum so as to raise the weight and turning the brake wheel so as to strike an arc. During burning, the weight slowly falls, turning the brake wheel and feeding the carbons together, until an arm of the drum engages and raises a screw on the short arm of the lever, slackening the brake band and allowing the brake wheel to rotate. The drum may be acted on by a spring instead of the weighted arm. 3 claims.

1899.

9,566. "Improvements in and connected with electric safety fuses." J. Gray. Dated May 6th, 1899. A hollow screw is inserted from the underside through the insulating base into a terminal block or bus bar or main conductor block. A vertical hole is formed through the terminal block and a pinching screw entered into this hole. 4 claims.

9,632. "An improved high insulation electric lampholder." F. W. Heaton and H. Smith. Dated May 8th, 1899. Relates to a method of fixing terminals in bayonet or other slotted or screwed lampholders. The cords pass together through the collar grip, and then separate to their respective terminals. The pinching screws are recessed, which prevents the terminals from falling through. 4 claims.

10,215. "Improvements in electrolytic apparatus." M. Haas. Dated May 15th 1899. Relates to improvements in an apparatus for the manufacture of bleaching lye. The liquid is alternately separated into two different streams, and afterwards united again so that whirls are formed and a good mixture of the liquid is attained. 2 claims.

10,815. "Improvements in incandescent electric lamps." C. L. R. E. Mesnge. Dated May 23rd, 1899. (Date applied for under Section 103, Act 1883, October 27th, 1898, being date of application in France.) Consists of an intimate mixture of metal or other conductor with a non-conductor, such as alkaline earth, for the filament of the lamp. 2 claims.

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THE

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ELECTRICAL MANUFACTURERS AND THE LABOUR PROBLEM.

One of the chief problems our English manufacturers of electrical machinery have to face, and which appears to present increasing difficulties, is the supply of workmen. To those behind the scenes, it was somewhat startling to hear that the British Westinghouse Company proposes to put down works and employ 5,000 men in the manufacture of electrical appliances. It is a comparatively easy matter to build the works, and to purchase the tools to fill them, but the building up of an army of workmen is quite another matter. If we go over the works of any of the leading manufacturers in this country, we find employed in them a large number of mechanics, turners, fitters, and machine men of much the same class as are found in ordinary shops where engines or machine tools are manufactured; but in addition to these, we have workmen employed on the duties peculiar to electrical engineering, such as the various winding and insulating operations, the erecting, coupling up, and finishing of dynamos, transformers, lamps, and similar matters, where all must have some knowledge of the peculiar requirements of electrical apparatus, such as the necessity for the careful sub-dividing of the iron cores to prevent waste currents, the careful insulation of the turns of winding from one another, and so on.

As regards the supply of workmen for the first or mechanics class, electrical manufacturers have to take their supply from the great body of fitters, turners, and engine erectors who are to be found all over the country. At the present time there is no supply of trained workmen of this class. It is not an exaggeration to say that every man who is a fair workman, and a good many who are indifferent ones, are in full work, the only men out of work are either bad workmen, or notoriously bad time keepers.

Of late years, in all well-equipped shops, there has been an increased use of automatic machinery; that is to say, of various forms of lathes and small tools which are worked on the "Stop" system, the tools and stops of which can be adjusted by a foreman, and the manipulation of which is left to boys or the younger class of labourers. This has somewhat reduced the difficulties due to the paucity of turners, but even with automatics it takes some considerable time to train a lad to work them to their full rate of output. It is abundantly evident, therefore, that as regards this class of workmen, those who talk so glibly of establishing works on a large scale, will find that they are brought to a dead stop so soon as they attempt to get the men together to work their tools and do the mechanical portion of the erection. There is undoubtedly a paucity even of this class of workmen, so that new works can only be filled up by importing men from abroad, or by bribing them to leave other shops. There is not much probability of the latter course being adopted. For the last two years, in fact, ever since the great strike, very considerable solidarity has existed between employers in engineering shops, and any attempt on the part of a new firm to bribe workmen to leave good places would be so bitterly resented by the general body of existing employers, and probably by the workmen themselves, that it

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is not likely to be carried out to any considerable extent. As regards the other class, *i.e.*, the winders, who do not require such a careful mechanical training, but who must be intelligent, careful, cleanly and neat in their habits, and quick to observe the causes of short circuits or other troubles which follow on careless workmanship, there is undoubtedly a considerable supply of labour from which electrical workmen may be recruited. There are plenty of sharp lads born in London whose prospects of living a useful and comfortable life are much improved by taking up this branch of work. The Londoner is a sharp and intelligent observer, and he does not take long to train for this work. The chief difficulty in dealing with a Londoner is that, if you remove him into the country he feels, especially when young, the dullness of living in a country town as compared with the opportunities which exist in the metropolis for amusement on the Saturday evenings and Sunday.

This brings us up to the second question connected with this highly important matter of the supply of workmen. Employers will be well advised if they realise after all that their workmen are human beings, who require some change from the monotony of their daily toil; those who have already realised this, and who have provided reasonable means of recreation for their men have, we think, already reaped their reward in finding it much easier to obtain a supply of men than those who have done nothing of the kind. A country town possesses considerable advantages for the establishment of electrical works. As a rule, there is not nearly so much fog or darkness as in the great centres such as London, Manchester, Sheffield, or Glasgow. The work can therefore be carried on under better conditions. The air is not nearly so damp, satisfactory insulation tests can be obtained without the necessity of the work having to be previously placed for many hours in the drying oven. No doubt due to these advantages, there is a tendency on the part of electrical manufacturers to move out of large towns, and we think we shall be doing good service to those who have already moved out, and to those who intend to do so, when we point out how important it is that they should, when they establish their new works, thoroughly consider the question, not only of the comfort of their workmen, but of the providing of reasonable means of passing their time, not only in the long winter nights, but also in the summer evenings, where outdoor recreation is possible. The winter evenings can be dealt with by well-arranged classes, by clubs and lending libraries. We may even go so far as to suggest that where the magnitude of the works permits of it, the employers should assist in the establishment of a concert or music hall.

As regards the summer, every help should be given to the men for the establishment of cricket and sports' clubs. The possession of grounds comprising a well laid out cricket field, cycle track, and gymnastic appliances, is a good method of keeping the men in good health, and consequently in the best condition to do their work in the manner most satisfactory to their employers.

Nomenclature of the C. G. S. Units.

We have recently noticed several proposals for changes in the names and dimensions of the practical electrical units, made in both American and French papers; and an article in *l'Industrie Electrique*, of September 10th, carries the discussion a stage further. Of the articles to which we have already called attention, the two principal ones have appeared in the *Electrical World* of New York, and in *l'Industrie Electrique* respectively. The article in the latter journal, to which we are now referring, is signed by M. E. Hospitalier, and contains a long letter from M. Blondel, who informs us incidentally that the article in the *Electrical World* was from the pen of Mr. Kennelly. It appears that these three writers, and, we presume, the editorial authorities of their journals, are agreed upon the desirability of the following three steps:—

1. The adoption of names for the C. G. S. electrical units.
2. The abandonment (by degrees, and in some way calculated to cause as little inconvenience as possible) of the present "practical" system, based on a set of derived units whose values are 10^9 C, 10^{-11} G, S, respectively.
3. The creation of prefixes for a limited number of powers of 10 (multiple of 3 exclusively, and particularly the multiple 10^9).

There is at present no sort of agreement as to what these names are to be, but there is some indication that a serious attempt will be made at the Paris Congress of 1900 to get accepted proposals to be made on this point. There can be no doubt that if all names and all derived units had to be devised for the first time, M. Blondel's terms would be preferable to those which are in use; and that names for the C. G. S. units would be exceedingly convenient. The inconvenience of a change is, however, very serious.

Physical Society Meeting.

It frequently happens that a significant and suggestive experiment, described perhaps in some little-known foreign journal, is lost sight of by the generality of physicists in this country, simply because the original observer is himself too remote to bring it forward. To overcome this difficulty, Fellows of the Physical Society who happen to have the necessary resources are now invited to prepare the experiment and to exhibit it at one of the ordinary meetings at Burlington House. The idea is not altogether a new one, for the Physical Society have always shown their appreciation of exhibits and demonstrations of this kind. The present invitation is given with a view to extend the custom, and, if possible, to make such exhibitions one of the features and pleasures of each meeting. The first piece of apparatus that excited attention last Friday was a lantern with a hissing arc and hygroscopic slides, designed to illustrate absorption and the colours of thin films. By means of a universal carrier the slides were set at different angles; and an ingenious mechanical device, acting for short periods, properly timed, enabled the hygroscopic condition to be intermittently dispelled. Under these conditions, the thickness of film is proportional to the cosine of the angular displacement, and the visibility is a function of the optical intermittence. This lantern was also used for projection purposes, but not with equal success. A paper by Dr. S. W. Richardson on "The Magnetic Properties of the Alloys of Iron and Aluminium," was only read in abstract; this is by far the best method of presenting such papers. The author has obtained **B—H** curves for various alloys through long ranges of temperature, from the solidification point of CO_2 to red heat. Mr. G. L. Addenbrooke's model, described as "Illustrating a number of the actions in the flow of an electric current," led to a discussion on the old problem of the value of mechanical analogies in demonstrating electrical quantities. Since it still leaves us with such phrases as "the flow of an electric current," we are rather inclined to think there is, even now, something adrift. Of course, the model is intended to indicate that there is no "flow" in the wire, *i.e.*, no current, in the fluid sense. And we should have thought that, *a fortiori*, there was no "flow" of the "flow." The repetition by Mr. W. Watson of some experiments by Prof. Lecher was a pleasant climax to a very successful meeting. Nobody, however, seems to have pointed out that the climbing of the discharge up the splayed wires is a comparatively old phenomenon. We have an idea that Ferranti invented a lightning-guard on this principle. Certainly Elihu Thomson did (American Patent No. 434,961, August 26th, 1890), for he explains that "the arc so established will rise to the upper and wider portion on account of the current of air established by the heated flame, and will be bowed and eventually broken at the upper portion of the space." A few years later Siemens & Halske (D. R. P. No. 91,133) made some improvements along the same lines; and in *Dingler's Polytechnisches Journal*, page 215, 1897, will be found a very beautiful photograph of the discharges ascending the deviating conductors.

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ELECTRO-PNEUMATIC SIGNALLING.

(*Concluded from page* 682.)

To each of these parts wires, connected to a solenoid, the core of which forms, or is connected to, the valves con-

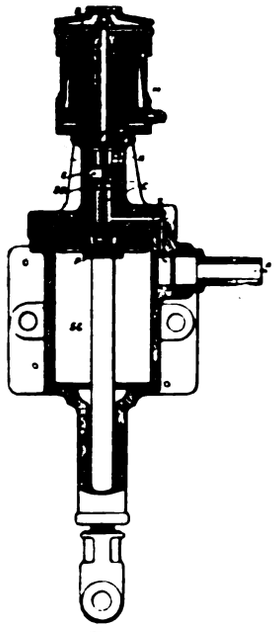

Fig. 5.

trolling the inlet and outlet of the air in the cylinder, are attached. These wires serve to convey electrical energy im-

Air, under pressure, enters from the main pipe, through the connection, A, and passes through the passage, T, to the interior chamber, C. This chamber contains a valve, S P, held closed by a spiral spring, and the spindle of this valve is prolonged upwards and inserted in the spindle, F, of the armature, B, of the solenoid. F has a conical seating, so that it may act as the exhaust valve. On the solenoid, M, becoming energised, the armature, B, is attracted; the spindle, F, then closes the exhaust passage, and, overcoming the influence of the spiral spring, C, pushes the spindle, S P, off its seat, thereby admitting compressed air through the passage E to the space above the piston P. The pressure

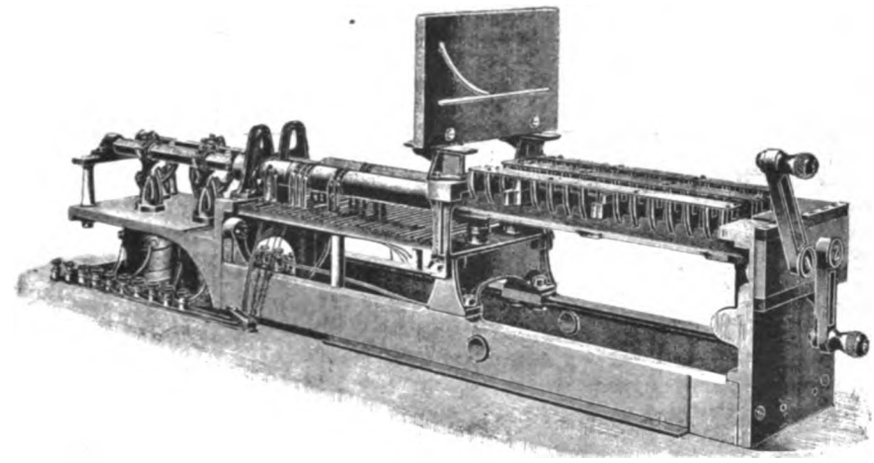

Fig. 7.

exercised by the air thus admitted above P propels the piston forward, and as the rod connected with it is also connected

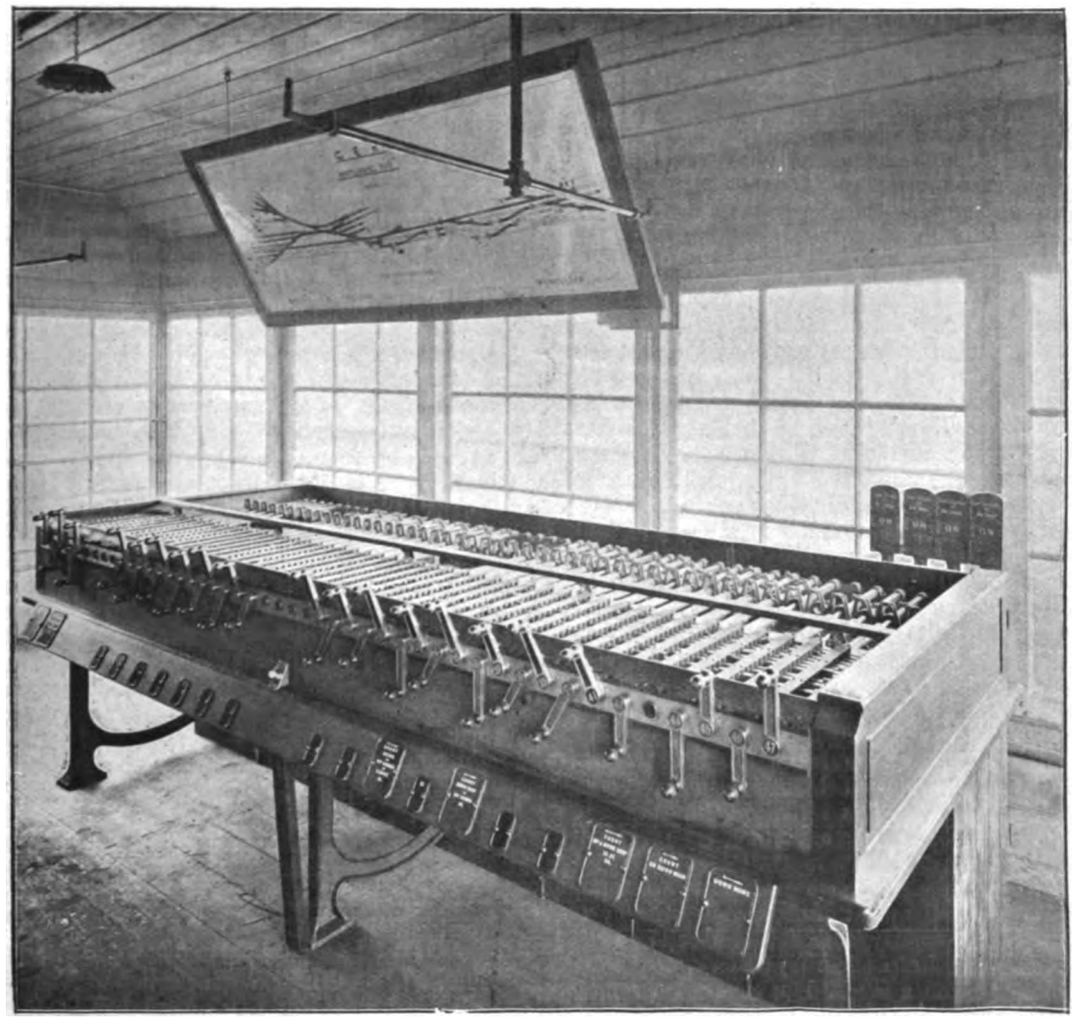

Fig. 6.—Interior of Signal Cabin with Electro-Pneumatic Locking Frame.

parted to them in the signal box. The action in relation to the signal movement will be made clear on reference to fig. 5.

with the lever operating the signal arm, the action results in placing the arm in the "all-clear" position, in which

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it remains so long as the pressure of the air is sufficient to counteract the counterbalance weight of the signal.

On the electric circuit being interrupted, the armature B, under the influence of the spiral spring C, is raised, and the admission of air from the main inlet, A, is cut off. By the same action which secures this, the exhaust passage at E is opened, thus allowing the pressure of the air in the cylinder S C above the piston P to be reduced to the normal, or that at the port H.

The point motor is operated in a somewhat similar manner, with this difference, that the air piston, which moves the points in the same manner as, in the signal motor, P moves the signal, is not returned under the influence of a counterweight, but by air pressure on the opposite side of it. It consists, in fact, of two signal motors, but instead of these operating the points direct, they operate a slide valve, thus admitting compressed air to one side or the other of the piston head. The electric circuits are so arranged, that when one magnet is energised, the other is free. The first portion of the piston travel unbolts the points; with the continuation of the movement, the points are thrown over and locked in that position, and at the final portion of the movement a circuit in the indicator box fixed in the signal box is completed. The completion of this circuit releases an electrical lock on the lever, and thus allows the operator to complete its movement.

We have now to look at the means by which these parts are operated. The action is not effected, as will be readily conceived, by the movement of the ordinary point and signal levers. One of the purposes in view in the establishment of this system is to save labour in manipulation; another is to economise time, and a third is to save space. Fig. 6 shows the point and signal frame, which has been installed at Bishopsgate. It consists of 38 levers, and has space for nine more if required. It is 10 feet 8 inches long, and, of the 38 levers, 12 work 25 semaphores and ground discs, and 26 work 43 points, one facing point lock and bar, and two lock bars. With the ordinary form of signal lever no less than 53 would be required, occupying, it is unnecessary to say, a much larger space. The lever employed is really an electric switch or commutator, having certain electrical and mechanical connections, by means of which the various circuits may be operated and interlocked. Thus, if a particular point lever is moved, the current, on throwing over the signal lever, pervades one group, and thus operates one set of signals, whilst another point lever would in like manner admit of the operation of another group of signals, embracing, possibly, one or more of those operated by the lever previously referred to, but applicable to a different arrangement of route. It will be clear that with such an arrangement various combinations are perfectly feasible and easy.

Fig. 7 represents a section of the frame with two levers only, and which may be seen at the Westinghouse Brake Company's works at King's Cross, or at Messrs. McKenzie and Holland's Signal Works at Gloucester. The lever to the left is a point lever, and that to the right is a signal lever. With the points in one direction one set of signals can be moved, whilst if the points are in the opposite direction another set can be operated. If the points are in a position for a train to move in one direction only, the mechanical interlocking of the two levers is such that the signal lever can only be moved in a corresponding direction.

Each lever is some 5 inches long. It is keyed to a horizontal shaft, of which the portion nearest the lever is employed to work the mechanical locks, which are in all essentials identical with the system of locking generally in use; but, in addition, the Westinghouse system affords a second and electrical means of locking the levers. Each of the horizontal shafts carries an extension, to which are keyed certain locking bars or sectors, which are arranged to work in harmony with the electro-magnets seen immediately below this portion. These magnets are in circuit with wires which come back from the point or signal controlled by that particular lever, and it is only when this current has reached the frame that the action desired by the operator can be completed. Thus, when a signal has been taken off, and again placed at danger, no change can be made in the frame which could conflict with that previously made until the signal has assumed the danger position, and sent a current through the signalling lever magnet, and so released the lock on the sector. Point levers require to be operated under two motions—the pull stroke cannot be made in one. The first portion of the movement interlocks the lever with one of the sectors, and until this is released by the return current, which, as previously explained, is only sent from the "point" itself on the completion of its turnover and the operation of the bolt, the full stroke cannot be completed.

The operation of the frame is thus as follows:—Having ascertained the route of the train, the signalman places all the switches, or combinations of switches, involved, in the necessary positions, by the movement of the various switch levers. This he is unable to do unless all the signal levers which interlock the switches involved in the combination are at the normal position. He then moves the signal lever controlling the signal arm governing the train, thereby locking the switches and admitting air to the signal cylinder. If any circuit is damaged, or a battery out of order, or if the air pressure is insufficient, the signals affected go to danger and remain so until the defect is remedied.

It will be clear from the short description which we have been able to afford of the operation of this system that it possesses certain advantages over the system generally in use in this country. In addition to those previously referred to, we have the abolition of signal wires and point rodding. The wear and tear of the signal is not so great, its action being more graduated and accompanied by less jarring. The position of the signal arm is always the same when pulled off, and is not subject to variation consequent upon the contraction of the wire by fluctuation of the temperature. Where convenient, a large range of roads and signals may be operated by one man from one central point. The system in itself is a valuable one, well thought out, and possessing many advantages. It is, of course, applicable to sections of line as well as to station yards. A central generating station can supply the requisite pressure of air to serve other groups of signals or points than those within its immediate neighbourhood. The drawback, if any, resides in the fact that the requisite pressure of air must be maintained, as must also the electrical pressure. There must be no leakage in either respect. The seating of the valves and the working ability of all parts must be accurate. The absence of this does not entail danger, for in case of failure the signals, as stated, fall to the danger position. But on a busy line stoppage of traffic is impossible. We do not assume that such gear as that we are discussing is more liable to derangement than the apparatus now in use, but when failure does arise, apparently it requires the immediate presence of a mechanic to adjust it. With the signalling gear generally employed on British railways, defects can usually be temporarily adjusted by those who are on the spot. Saving in labour is undoubtedly to be desired. The operation of many of our signal boxes as at present equipped must entail severe physical strain, and if this can be avoided, it ought to be. Whether there would, in the employment of such a system, be a saving in the number of men employed at present, is probably an open question. Wherever the signal box is, there a man must be in order to direct the traffic. It would be easier for him to operate the signals and points by the electro-pneumatic than by the present means, but in point of *cost* there would appear to be little, if any, difference, except in the case of large stations. The system not only insures a satisfactory operation of the signals and points, but by the aid of the return signal on the completion of the movement of the point or signal, prevents the signalman from making a conflicting movement. It may, of course, be argued that this is practically assured under the existing mode of working. Granting this, there are still features attending the electro-pneumatic system which make the experimental test at Bishopsgate worth studying, and it is one which we shall watch with interest.

AN ELECTROLYTIC METHOD OF SHARPENING FILES.

By SHERARD COWPER-COLES.

Those who are accustomed to use files know only too well how quickly they lose their cutting edge, or become clogged when employed for certain classes of metals and alloys.

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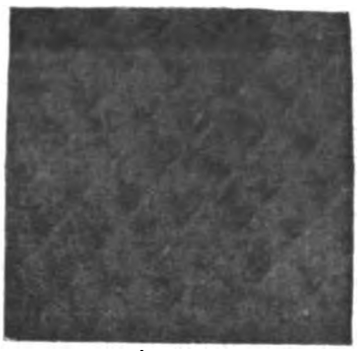
A file card will clean a file in many cases with difficulty, but will not sharpen the cutting edges. The only process that has been successfully applied to the sharpening of files up to the present, is Tilghman's steam sand blast; fine sand is projected on the file with a steam pressure of 150 lbs. through rubber hose fitted with cast-steel nozzles. The harder the surface to be operated on, the greater is the resistance offered, and the more vigorous is the action of the sand.

It occurred to the author that cutting edges might be readily sharpened by dissolving off electrically a thin and even film of the steel. A large number of experiments were made for the purpose of determining the best conditions. The effects of various current densities and electrolytes upon the cutting edges of the files were recorded by

Before.



After.

means of impressions taken on lead foil, and also by taking micro-photographs, some of which are now reproduced. Another method for recording the results obtained was to take gutta-percha moulds from which electrotypes were produced. Current densities were tried varying from 1 to 500 amperes per square foot, and with variations of time from five minutes to 60 hours. A large number of electrolytes were also experimented with, including cyanide of potassium, ferric chloride, ferric sulphate, and solutions of sulphuric acid of different strengths; the best results were obtained with a solution of ferric chloride with high current densities.

The following two micro-photographs show a cross-cut file before and after treatment in a solution of ferric chloride; a current density of about 500 amperes per square foot was used for 15 minutes.

[An electrolytic process of re-sharpening files is described in Kempe's "Engineers' Year Book," page 313 (1899 edition).—Eds. Elec. Rev.]

ELECTRICAL DISTRIBUTION OF MOTIVE POWER.

This subject, which quite recently was briefly treated by us in these columns, has been brought before the Manchester Association of Engineers by Mr. J. S. Raworth, who at once admits the difficulties in the way of obtaining exact data. This scarcity of data is obvious in the Appendix to the paper, in which numerous tables are given of great value, so far as they go, but it is a characteristic commentary on these, that the motors tabulated, and the data given for them, are all of foreign origin. Are British motor makers unprepared to publish the efficiency of their productions?

The author refers principally to supply for motive power from local supply service, and from a general power distribution service. The latter source of supply might have been more fully treated, particularly in view of the possible sanctioning by Parliament of the various large schemes which were unsuccessful last session, for there ought to be a large quantity of available data regarding these schemes.

The subject of the paper is a mixture of several distinct inquiries, all bearing upon each other, but still capable of separate treatment. The cost of electrical energy delivered, the cost of motors and their efficiency, the sub-division of the power, the efficiency of mechanical distribution; all these enter into the question, together with other points apt to be overlooked, such as valuable space occupied by boilers, engines, chimneys, coals, ashes, and all the pipes, pumps, and so on, connected with a steam plant. With all these matters to take into account, when an engineer is called upon to advise upon the adoption of electrical distribution of power, it is no easy matter to present the whole case, for or against, in a convincing and conclusive manner.

We think the best way to put the matter for a general power distribution scheme, is to assume a case. Take a town, for instance, in which there are, say, 50 power users of steam plants, with a total indicated power of, say, 2,500 H.P. In the generation of this power we shall find at least 50 men employed as attendants, and 50 engines, with, say, 60 boilers, and all their appendages. All these separate plants will require, in the aggregate, some acres of space, and run into a large amount for maintenance.

Now, if into this town we introduce a general power supply by electricity, we could run a central power plant of the highest efficiency to supply the whole place with, say, three engines and dynamos, four boilers, and not more than a dozen men. We cannot here go into the figures of such an instance, but those who care to do so, will find that there cannot be a clearer case made out to show that electrical distribution enables power to be delivered within a certain area at a cheaper rate than it can be generated by steam plants scattered over the district.

This example illustrates fairly what is meant by a general power distribution service. It could not offer much inducement to the large power user, who can employ large economical engines, but to the thousands of small users it would offer many advantages and at the minimum cost.

This system might be called the primary distribution. Laying on the power from a centre to many consumers, it is not a question complicated by the efficiencies of motor shafting, and so forth. It is when we come to consider the question of distributing the power inside the works, or what might be called secondary distribution, that complications arise.

The two distributions must be considered apart; the first concerns the generators of the power, the second the users of the power.

There can be no doubt that the time is ripe for the establishment of primary distribution systems, and there need not be much difficulty in the substitution of the electric motor for the engine and boiler. As to the secondary distribution, that is settling down by itself in every day experience.

The main question is one of sub-division. Extreme sub-division means small motors and no shafting, large motors introduce shafting, that is the difficulty. Small motors are less efficient than large ones, hence we have to decide between small inefficient motors with no shafting, and large efficient motors with shafting, which probably wastes much more than is gained in the motor, and Mr. Raworth's reference to the steam engine of high efficiency wasting its power on shafting and belts, applies equally to the large efficient motor driving shafting.

This is proved conclusively by the results of a test recorded in the paper which we quote:—

> The engine, which is a "D Universal," is capable of indicating 45 H.P. It drives 288 feet of 2½-inch shafting, and 46 belts.
>
> The indicated horse-power required to drive the shafting and idle belts is 9·1, equal to 6,788 watts.
>
> The average load (indicated) is 17 H.P., and the maximum load 30 H.P., consequently the average efficiency is only 47 per cent.
>
> Another line of shafting of the same size (2½ inches), and 144 feet long, driven by a motor, takes 2,570 watts; but in this case there were only 16 idle belts. Consequently, to make the comparison fair, we must add seven belts at 67 watts each = 469, making a total of 3,039 watts. If this be doubled, to make the comparison fair with the steam engine driving double the length of shaft, we obtain a total loss of 6,078, as compared with 6,788.
>
> This result is much more favourable to the steam engine than is commonly supposed.

We do not know upon what grounds any other result could be expected.

Sub-division, we believe, will be carried out in most cases, down to 1 or 2 H.P., with possibly certain limitations, as, for example, in the driving of lathes.

For primary distribution it is debatable whether polyphase or continuous current is better. Much can be said on both

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sides, but we are inclined to think the continuous current has the best of the arguments. Much depends on the magnitude of the scheme.

As Mr. Raworth has collected a number of tables of value, we shall refer to these in another article. The paper is admittedly incomplete, but it will have served a good purpose if it raises an interest in this promising line of electrical engineering activity.

The municipal supplies now at work are governed by conditions totally different from those which would apply to a pure power supply, so that it is of no value in the discussion to refer to results of the working of those plants mostly supplying light.

The author's enthusiasm carries him so far as to attempt running cotton and other large mills by motors, but we doubt if the large well-managed engines can be beaten. There might be a saving in distributing the power electrically inside the mill, but to go so far as proposing to compete in these cases seems to us like attempting to drive in the thick end of the wedge first.

THE SULLIVAN SIGNALLING GALVANOMETER.

As the result of Admiral Dewey's cable experiences last year (after the destruction of the Spanish fleet in Manila Harbour), when he failed to communicate through a cable which he had grappled and raised, Mr. Sullivan set to work to design an instrument and a system which would enable a naval commander in war time to readily establish communication through any submarine cable, whenever the exigencies of the case might require it.

As is well known, the Sullivan galvanometer as at present used in the Navy, and by the cable companies generally, is very suitable for mirror speaking purposes when used in

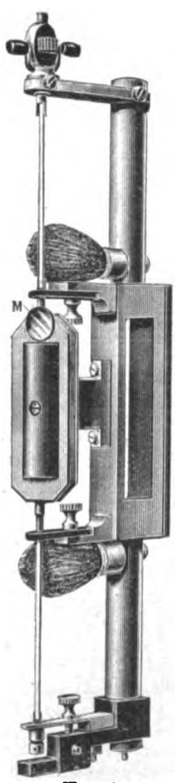


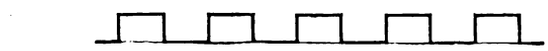
Fig. 3.

conjunction with the ordinary auxiliary apparatus hitherto found necessary, viz., condensers, switches, or short-circuit pieces, and in some cases sending shunts. It has, indeed, been successfully applied on board ship as a syphon recorder, which is the first instance on record of such an instrument being used on the high seas.

Recognising, however, that the ordinary signalling arrangements would hardly suit the requirements of the Naval Service, Mr. Sullivan set to work to so modify his galvanometer as to enable the before-mentioned auxiliary instruments to be dispensed with, and a thoroughly practical and reliable apparatus to be available, which would be equally suitable for receiving messages on *any* length of cable.

Owing to the fundamental difficulties of the case this was not found to be an easy problem. Briefly stated, on short well-insulated and comparatively non-inductive cables, practically the full impulses transmitted reach the distant end *at once*, and the received signals may be represented diagrammatically thus (fig. 1). But on long cables, owing to the retardation due to the electrostatic capacity and absorptive power of the insulating material surrounding

Fig. 1.



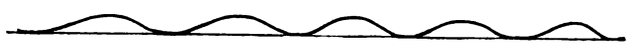


Fig. 2.

the conductor (which retardation increases as the square of the length), the signals tail and lose their individuality, reaching the distant end of the cable more or less weak, sluggish and wave-like in character, as shown by fig. 2. To this retarding effect is super-added the inertia of the suspended coil, and hence it has been necessary hitherto to employ signalling condensers (or some other curbing device) to compensate retardation as much as possible, so as to render the received signals more defined and legible.

It will be noted that the two damping devices which Mr. Sullivan employs, have a very different function and action. The damping of the frame on which the coil is wound is due to the powerful opposing currents set up in the coil system, as it swings in the field of the permanent magnet. The camel's hair brush, on the other hand, gives mechanical or frictional damping, the effect of which is to retard movements of the coil, until the received impulse, or signal, or wave, has attained a potential sufficient to give the coil a more or less rapid swing; thus the effect resembles a smart blow, and not a blow followed by a push, as would be the case without the camel hair brush. In his galvanometer Mr. Sullivan has utilised these two effects and made them in great measure counteract each other; that is to say, the electro-magnetic sluggishness of the coil is atoned for by the mechanical or frictional damping.

By no adjustment of the brush, however, could the sluggishness be so overcome as to get sufficiently sharp and well defined mirror signals on very long cables under the conditions aimed at, but finally success was obtained in the following manner, viz.:—

1. By reducing the electro-magnetic damping of the coil system.
2. By increasing its mechanical damping. (This is done by employing two camel hair brushes.)
3. By increasing its control.

The *flat spring* suspension, by which the desired result was obtained by Mr. Sullivan, is very effective. A round wire suspension has, we believe, been suggested for such a purpose, but, so far as we are aware, a flat spring with its better control has never before been suggested or used for "speaking."

As compared with the ordinary signalling galvanometer, the advantages of the "Sullivan" type are:—

1. It is exceedingly simple, no auxiliary instruments beyond a battery key and a few cells being required for receiving messages through cables of any length.
2. One and the same galvanometer serves for all lengths, as, by means of the camel hair damping, the signals can be made dead-beat on even a mile of cable.
3. It requires no "sending" switch, the inadvertent neglect to turn which from "sending" to "receiving" frequently causes trouble in practical working.
4. The sender can read his outgoing signals, and see that all is right, as owing to the robustness of the suspension the signals can be sent direct through the galvanometer without injuring it.
5. The distant end can interrupt the transmission at any moment if necessary.
6. It is unaffected by moving masses of iron or the numerous vibratory and other disturbances experienced on board ship.
7. The suspension, instead of being a weak point, as in ordinary speaking galvanometers, is as strong, practically,

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as the instrument itself, so that it is never likely to fail at critical moments. The simplicity and thorough practicalness of the instrument are points of paramount importance and cannot be over-estimated.

"*Instruction*" *Galvanometer.*—The object of this instrument is to reproduce, for instructional purposes, signals of the same character as those actually obtained on cables of various lengths, or, in other words, to imitate the retardation of long cables. The fundamental reasons, owing to which signals must necessarily vary in character according to the length of the cable we have already dealt with, and the difficulties encountered in meeting these conditions have also been referred to.

At first it was thought that if long cable signals were to be exactly reproduced or imitated, some sort of inductive resistance, short of an artificial line proper, would be indispensable; such, indeed, has been the common belief, and accordingly, Mr. Sullivan started experimenting in this direction. Eventually, however, and after much experimentation, he found that the end in view could be attained otherwise, viz., by merely increasing the electro-magnetic damping of the coil frame. Inductive resistances are entirely dispensed with and (what is a most noticeable point), *not even a shunt on the galvanometer is used.*

In this case only one camel hair brush is used, and a finer suspension than that employed for the ocean signalling instrument, while the coil frame is not cut through; but in every other respect the two suspension frames are alike and are interchangeable. With the brush removed, the signals resemble those from a long Atlantic cable, and by simply varying the position of the adjustable camel hair brush, the pressure of which on the suspension regulates the period, signals of any desired character or sharpness can be imitated; this is testified to by a number of cable experts. Another advantage of this "Instructional" instrument is that the learner can send through his galvanometer and watch his own signals, and thus see any fault or mistake in his transmission.

The general form of the suspended coil, with the flat spring suspension, is shown by fig. 3, M being the mirror.

In conclusion, we must heartily congratulate Mr. Sullivan on the success which he has attained, by such simple means, in endeavouring to solve what was really a very difficult problem.

TRANSMISSION OF POWER IN FACTORIES.

[COMMUNICATED.]

The leading article in your number of October 13th is so full of interest to everyone engaged in applying motors for power purposes, that the writer would like to add a few remarks on the subject.

The first point is the advisability of grouping machines together, and driving them by a fairly large motor from a line shaft.

Your leading article points out that this is only successful when the machines are very small, and adds that the motor driving the shaft should not exceed 4 B.H.P. The article continues to say that a few large motors put down to run lines of shafting do not effect economy over the whole system of long lengths of shafting and cross belting to connect one length with another.

The writer thinks that, although this statement is correct to a certain extent, there are a great many cases where it would not apply.

The driving of more modern tools, turret lathes for instance, due to the large number of speeds necessary for them, which can most conveniently be obtained by changing the ratio of the sizes of pulley on the line shaft and countershaft, necessitates a certain length of line shafting to each tool. This being the case, there is no doubt that the best way of driving these tools is to group several of them together on to one shaft, and drive this shaft by means of a motor.

Tools of this description must be continually at work, otherwise they are not paying for themselves, and it is almost impossible to show that, by putting a separate motor to each tool with its accompanying line shafting and countershafting, any economy can be introduced. Then, again, take the class of machine tools usually found in an engineering works, and driven from a length of line shafting—tools such as lathes, planing machines, milling machines, &c., requiring, if driven separately, say, from 2 to 6 H.P. each.

It is almost impossible to show, in cases like these, that a motor to each tool will effect economies which will show reasonable returns on the capital outlay. The only way is to group, say, 6 to 12 machines together (depending, of course, upon the size of the machines) on one shaft, and drive this by means of a motor.

The point should not be overlooked that in driving each tool by a separate motor, a certain margin has to be allowed for in the size of motor for dealing with the maximum load, such as the reversal of planing machine, abnormally heavy cut on lathe, &c., and that the margin in the small motor has to be almost as great as the margin in a larger motor for driving the whole number of machines.

As soon as the size of machine to be driven increases, say, to 10 H.P. and upwards, or where the machines are placed in out-of-the-way places, there is no question that a motor to each tool will amply repay the capital outlay; but to put a motor to each of the smaller tools usually driven from a length of line shafting, would not be advisable.

In designing new shops, great economies can undoubtedly be introduced by making provision for the larger and outlying tools to be driven independently, and by grouping the smaller ones together on lengths of shafting.

In this way the sizes of motors could be kept to units such as 5, 10, and 15 H.P., the 5 and 10-H.P. sizes being chiefly for driving the larger and outlying tools by means of separate motors.

It should be borne in mind that the introduction of electric motors for driving purposes is not going to effect the economies often claimed, unless full advantage is taken of the flexibility of the electrical system in the general arrangement of the shop, and this applies very largely to arranging the tools in such positions that the overhead travelling crane can attend to one machine, and that a workman can bring fresh work to his machine, without in any way disturbing the neighbouring tools.

Another point not often appreciated is the possibility after a shop has been mapped out and is working, of adding additional tools and placing them in advantageous positions by driving them separately by a motor, whereas otherwise it would have necessitated placing the tool under a line of shafting, where it would in all probability either be in the way of the other tools or be in a part of the shop not handy.

Taking the case of a machine shop already erected, one finds belts running from the line shaft to the countershaft, and from the countershaft to the tool, as well as a large number of belts transmitting power from one line shaft to a neighbouring one, and from one floor to another.

It would be impossible, as a rule, to conscientiously advise the introduction of a motor to each tool.

On the other hand, however, great savings can be guaranteed by introducing separate motors to the larger and outlying tools, and by judiciously sub-dividing the lengths of shafting into sections to avoid cross belts, and to enable certain lengths to be worked independently of others either for night shift or overtime.

The second point is the question of spur wheel gearing *versus* belt driving, and the remarks in your leading article are undoubtedly important.

In the writer's opinion, the great secret of success with motor driving lies in having a belt somewhere between the armature spindle and the actual tool, to act, as mentioned in your article, as a flexible link. The writer recently had the opportunity of fully discussing this point with an eminent American engineer, who had devoted a good deal of time to motor driving in the States, where the fashion has hitherto been to adopt spur driving wherever possible, and to embody the motor with the tool. The writer was given to understand that this method of driving was being largely given up in the States in favour of belt driving, excepting in those cases when the nature of the work was extremely smooth and unaccompanied by any jerks.

Readings taken of the power required to drive certain punching machines showed that when the motor was connected with spur gearing the maximum readings were higher than when connected to the same machine by a belt, which

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shows undoubtedly that the belt saves the commutator from sudden shocks and jerks.

The third point is the question of using low speed motors instead of the ordinary high speeds. In the writer's opinion, the difference in prime cost between the two is closely represented by the figures given in your leading article, whilst the figures quoted by your correspondent, "Lente," in your edition of October 20th, are too low in the case of the low speed motor, and the difference between the cost of the low speed and high speed installations is not sufficiently marked.

For the sake of argument, however, supposing the additional cost of the low speed installation were only 50 per cent., it is very doubtful whether this extra capital expenditure would be justified, excepting for special cases, where the work was very jerky, or where starting and reversing were constantly necessary. In cases like these lower speeds are often used, but for smooth and continuous running, a large slow running motor seems quite unnecessary.

With the continuous current motors, as made at present by the leading manufacturers in this country, little wear and tear is expected on the commutators with carbon brushes, and as for the lubrication, the present designs of self-oiling bearing would not lead one to expect trouble from them.

From the manufacturer's point of view, low speed motors are undoubtedly desirable, as representing larger machines, and hence increased turn-over to them, but it is difficult to see where the saving is coming in from the user's point of view.

The fourth point refers to the motors themselves. Your leading article states that the enclosed motor is the only one for factory work.

The writer cannot agree with this.

Undoubtedly, in cases where special precautions have to be taken against fire, the enclosed motor is useful, but for shop working, and for use in iron and steel works, shipbuilding yards, &c., where special precautions against fire are not necessary, there is little question that the ordinary open type motor, with every part easily accessible for repairs, inspection and cleaning, is far superior.

Already practical men are beginning to find out that the enclosed motor is not as good for work of this description as the open type, and unless precautions against fire, or damage from materials falling on them, prevents the use of the ordinary open-type machine, it is doubtful whether the enclosed motor will hold its own in works of this description.

The fashion during the past year or so has undoubtedly been towards enclosed motors, and the smaller manufacturers and consulting engineers have considered them the right thing.

The writer's experience, however, differs from the foregoing, and results obtained in several works with open-type motors, extending over a number of years, when compared with the enclosed type, which have been added for extensions, would point to the fact that enclosed motors sacrifice a great many advantages by being shut up, and do not meet with the approval of those who are responsible for their running. In certain cases, however, the enclosed type motor is indispensable.

It should be borne in mind that recently a large number of small manufacturing firms have come into existence, which have laid themselves out for making—if not entirely, at all events largely—enclosed type machines, and the existence of these firms, at all events so far as the electrical department is concerned, depends chiefly upon the enclosed type machine.

Hence one would expect them to advertise and push this design, in preference to the open type two-pole machine.

By watching a few of the leading manufacturers in this country, however—manufacturers who make both open and enclosed type machines—one would come to the conclusion that they certainly prefer the open type to the enclosed, as giving less trouble in working and being easier to look after; and they have drawn this conclusion from practical men, not interested in dynamo manufacture, who have had the two types to deal with.

In the writer's opinion, it is generally a question of adopting either the open type or the totally enclosed type, the ventilated enclosed type being left to those jobs where the fire insurance regulations necessitate them.

In conclusion, this question of motor driving, as to the most suitable type of motor for particular jobs, &c., is one which has to be gone into in each individual case, and one which has to be answered by past experience on the subject.

The experience and actual causes of successes and failures in this particular line have been entirely in the hands of the larger manufacturing firms at present, and provided their advice is taken on the subject there is no question that motor driving in our factories, iron and steel works, collieries, and ship building yards, will go straight ahead. There is, however, a fear that if the average consulting engineer in this country gets hold of the business in the same way that he has got hold of the lighting industry, the application of motors for power purposes may receive a severe rebuff, which will temporarily check progress pending the time that the consulting engineer gains his experience and rectifies his faults. If motors are judiciously applied they introduce great savings, but if, on the other hand, they are applied at random, it is only too easy to spend capital without being able to show an adequate return, and this, more than anything, is likely to harm the industry.

The great difference between an electric lighting plant and a factory plant is, that anyone can find out and learn what has been done in the former, whilst only those actually engaged on the job can know what is going on in the factory, and hence experience has to be gained slowly, and, in some cases, at considerable cost.

LONDON COUNTY COUNCIL.

The Council, at the meeting on Tuesday, resolved to lend £25,000 to the Fulham Vestry for electric lighting purposes, and £14,620 to the Shoreditch Vestry for a site for a new generating station.

The New Generating Station.

The adjourned report of the Highways Committee, to which reference was made in our last issue, was again brought forward. It may be remembered that the Committee recommended the Council to seek powers in the London County Council Tramways (Electrical Traction) Bill for the compulsory acquisition of the freehold of the leasehold portion of the tramway depôt at Camberwell, and of certain adjoining property, for the purpose of a site for the erection of a generating station for the working of the tramways.

Mr. J. W. Benn, chairman of the Committee, asked the Council to postpone the consideration of the question for a week. This was agreed to, although no explanation was given as to the reason for taking that course.

London United Tramways.

It was reported by the Highways Committee that the London United Tramways Company had submitted for approval detailed drawings for the equipment on the overhead trolley system of the tramways in the Uxbridge Road, between the Askew Arms public house and the Uxbridge Road railway station, and between the railway station and Young's Corner, and, by an underground system, of the tramways from Young's Corner to Hammersmith Broadway, and thence along Beadon Road, Glenthorne Road, and Studland Road, and that part of The Grove between Beadon Road and King Street West. The Vestry of Hammersmith had strongly urged that an overhead system should be adopted for the tramways in King Street, Beadon Road, and Glenthorne Road. In support of this suggestion the Vestry pointed out that King Street is narrow, and inconvenience would be caused to shopkeepers and the public during the construction of an underground system; while the District Railway runs under Beadon Road for a distance of 127 yards, and there would be a difficulty in laying a conduit system there, owing to the fact that there is only a space of between 9 and 12 inches between the top of the girders of the railway tunnel and the surface of the road.

The Highways Committee stated, however, that they were advised that having regard to the provisions of the Act and the agreement with the company, the Council had no power to agree to the adoption of the overhead system for the tramways in King Street, Beadon Road and Glenthorne Road, and that as the company were prepared to adopt an underground system, notwithstanding the difficulties to be met with in its construction, the Committee were of opinion that no reason existed for the Council to withhold consent to the plans submitted. The Committee further said:—

The company states that the designs for the electrical conduit are similar to those of the system in operation on the metropolitan tramways in New York, but certain improvements have been made in the details which render the system more suitable for the special conditions under which the tramways are to be operated; and the detailed pains submitted of the proposed system of double-trolley overhead system show that in connection with it there will be no uninsulated return, and thus a great objection to the system, generally used, with a rail return, is removed. The plans show that the wires are to be placed only 22 feet above the level of the rails, although the Council's bye-laws under the London Overhead Wires Act, 1891, require the height to be 35 feet. 22 feet is, however, the usual height for such wires in connection with tramway traction; and the Fire Brigade Committee, whom we have consulted in the matter, has raised no objection to the wires being placed at the height proposed, nor has any objection to the height been raised by the Vestry. We are advised by the engineer, who has been in communication with Dr. Kennedy on the matter, that the plans and details may be approved by the Council subject to certain conditions.

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The Committee accordingly recommended the Council to approve of the plans subject to the following conditions:—

That the trolley wires be not attached to the electric lighting standards of the Vestry of Hammersmith; that the company do furnish to the Vestry detailed drawings of the inspection chambers and boxes proposed to be placed in the carriageways or footways; that the "Bristol" designs for the side and centre traction posts be used; that the cut-out circuits be of such length as shall be approved by the Council's chief engineer; and that the company do submit for the approval of the Council an amended design for the conduit.

The consideration of the recommendation had, however, to be postponed, in view of the opposition being raised at a late hour of the sitting.

Post Office Telephony.

In connection with the scheme for providing a State telephone system in London, the Highways Committee announced that—

Application had been made on behalf of the Postmaster-General for the Council's consent to the erection and maintenance of staging to support lead-covered telegraph wire cables in Queen Victoria Street and Victoria Embankment subways, between the Post Office Savings Bank in Queen Victoria Street, and a point opposite the Temple railway station, and also between Northumberland Avenue and Westminster Bridge, such consent to include all necessary work for connecting the cables with the underground pipes on the Embankment at Middle Temple Lane, the Temple railway station, Northumberland Avenue and Westminster Bridge, and for leading the cables into the Savings Bank.

It appeared that the subways in question are becoming fully occupied, and the Committee stated that modifications of the drawings might be found necessary in order to secure that the greatest possible use was made of the limited space in the subways. Subject to certain conditions specified by the Committee, the Council decided to grant the desired permission.

Prevention of Boiler Explosions.

It was unanimously resolved, on the recommendation of the Public Control Committee, to address a letter to the Board of Trade suggesting the desirability of a Select Committee being appointed to inquire into the causes of boiler explosions and the means to be taken for their prevention. The decision was arrived at as a result of the following report of the Committee:—

Our attention has been directed to the explosion of a boiler which occurred in the early part of the year at Barking, by which a number of persons lost their lives, and others were seriously injured, and we have had under consideration the question of what measures appear to be desirable with a view to preventing similar explosions in future. We find that under the existing law the Board of Trade have power to make inquiry into the causes of boiler explosions, but no public authority has any power to periodically inspect boilers with a view to the prevention of accidents. The question has, however, been frequently before Parliament, and for some years past Bills have, session after session, been introduced (1) for the purpose of regulating and controlling steam boilers; and (2) to provide for the examination and certification of persons in charge of such boilers. We have had before us a return showing that during the 16 years since the passing of the Boiler Explosions Act, 1882, there have been reported 1,121 boiler explosions, by which 466 lives were lost, and 975 persons were injured. We are of opinion that this considerable loss of life and injury to persons can, in a large measure, be prevented by the periodical examination of boilers by competent persons, and of empowering public authorities to condemn such boilers as are reported to be unsafe.

CORRESPONDENCE.

Insulation Resistance.

I have just completed an electric light installation of some size in a technical school that has been in use for a year or two, and I have been surprised to get an extremely high insulation resistance, vouched for by the Corporation electrical engineer, the result is as follows:—

There are over 600 lamps fixed in 522 different positions and controlled by 189 different switches, and the insulation resistance vouched for is 2 megohms, or, as you will see, at the rate of 1,044 megohms divided by the number of lamps.

I have not been sufficiently long in this country since my return from America to ascertain what the highest requirements per lamp are, but I believe that in no supply they exceed 100 megohms per lamp. I therefore believe that in the case referred to above, I have established somewhat of a record for insulation resistance, or, what is sometimes called in architect's specifications, "installation resistance."

I shall be glad to hear from you, or from any of your readers, of any similar high or higher tests that can be vouched for.

D. J. Callow.

October 25th, 1899.

600-kw. Inductor Alternator.

With reference to your article in last week's issue on the 600-kw. steam inductor recently supplied and set to work by the Brush Company, I notice that you mention the steam consumption, 27¼ lbs. per kilowatt-hour. As this is not by any means a record steam consumption for a compound engine, may I point out that the usual arrangement, in which the engines are in one row and the boilers in another, with merely a wall between them, is not adopted; in fact, the shape of the station is such that the plant is arranged in three rows, the steam crossing the first and second rows in order to reach this plant, which stands alone and further from the boilers than any other plant in the station. The bearing that this fact has on the steam consumption needs no comment to steam engineers, and it was so far appreciated by the Brush Company when tendering that they declined to guarantee better results than 30 lbs. per kilowatt-hour. The result obtained must therefore be considered thoroughly satisfactory, particularly as the vacuum from the independent condenser was only 22 inches.

The Brush Electrical Engineering Company, Limited.
R. A. Dawsarn,
Superintending Engineer.

October 27th, 1899.

Babcock & Wilcox Superheater.

Permit me to draw attention to an article in your last issue headed the "Babcock & Wilcox Superheater," written with a view to correcting "a serious mistake" in another paper. The writer assumes that the formula $\frac{T_1 - T_2}{T_1}$ can be applied directly to an engine using superheated steam, T_1 being taken as the temperature of the latter. Now, in the reasoning by which the above formula for the maximum efficiency of a heat engine is arrived at, the whole of the heat is supposed to be received at the higher temperature, T_1, whereas, in the case of a boiler with a superheater attached, the greater part of the heat is received at the temperature of the boiler, and a comparatively small quantity at higher temperatures in the superheater. To take the case quoted in your paper, where steam at 100 lbs. pressure receives a superheat of 125° F., boiler temperature is 337° F., and the temperature of the superheated steam 462° F.

Taking the feed to be at 212° F., the heat taken up in the boiler is over 1,000 thermal units per pound of steam; superheating this pound of steam 125°, the specific heat of steam at constant pressure being 0·48, involves the addition of 60 thermal units.

The increase of the theoretical efficiency, due to some 6 per cent. of the total heat supplied being taken in at temperatures between 337° and 462° instead of at 337°, is obviously quite insignificant, and turns out to be something like 2 per cent. instead of 72 per cent., as stated. Of course, a very substantial increase of efficiency, due to superheating, is obtained in actual practice by the removal of the losses due to initial condensation.

William Tatlow.

Fog Signalling on Railways.

I am much pleased to see your article this morning under this heading, and to find that you are lending your powerful assistance to the purpose for which I also am working, viz., inducing the railway companies to make a combined and thorough investigation of the subject, with a view to determining if it is not now possible to improve upon methods which Sir Douglas Fox says "cry aloud for reform," Sir William Preece calls "barbarous, dangerous, and irregular," Mr. W. M. Acworth considers "primitive," and you now characterise as "antiquated."

At the engineering conference last June I urged that a committee should be appointed to formulate a list of requirements, consider plans submitted, and give a thorough practical trial to any methods that they might consider sufficiently promising. This, I think you will agree with me, is the proper way of proceeding in a matter where it is necessary that all the companies shall use the same system.

Permit me to take this opportunity of thanking you for your full and careful report of my recent paper submitted to the British Association.

I should be much obliged if you would kindly allow me to point out, as a postscript to the paper, that in the case of tender engines it is not necessary that any of my apparatus should be fixed on the engine itself. The armatures, batteries, &c., may all be put on the tender, the indicator being attached to the end of a suitable length of flexible

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cable, so that it may be detachably placed where desired in the cab of the engine.

Whenever it becomes necessary to separate engine and tender for overhauling, the indicator can be lifted down and safely stowed away in a box provided for the purpose on the tender, without necessitating the undoing of a single electric connection, or the attendance of an electrician. When the engine is ready to go out again, it is only a moment's work to take out the indicator and hook it on to its bracket again.

W. S. Boult.

Improved Trolley Pole.

Referring to your note on page 684 on an improved trolley pole, I should like to ask what holds the trolley against the wire when the car is standing or drifting, and there is consequently *no* main current. The arrangement as described seems very good as far as it goes, but apparently it does not go far enough.

W. H. I.

[The note referred to was, as stated, quoted from a contemporary. The difficulty to which our correspondent draws attention might be overcome by using an electromagnet excited in shunt between the trolley wire and earth. —Eds. Elec. Rev.]

Arc Lamps and How to Maintain Them.

In reference to your criticism of our book, "Arc Lamps and How to Maintain Them," we should like to make the following remarks :—

1. It must be remembered that the book is intended for people who have no technical training, but who, nevertheless, re-carbon the lamps and do slight repairs to them. Hence the absence of illustrations, as these people, when in difficulties, have the lamp actually in hand, and it is easier for a man who does not know how to read a drawing, to follow the directions in the book, on the lamp itself. Also, this book is not intended for an advertisement for the arc lamps described in it.

2. On page 13, dealing with two lamps in series, only one of which lights up, "no circuit" is a mistake which will be rectified in the next edition.

3. "The kilowatt is repeatedly called a unit." What is the use of writing about kilowatts for a man who does not understand the term? This book is not an electrical textbook, nor a glossary! On the other hand, all arc lamp trimmers are in the habit of speaking of "electrical units."

4. What is a short circuit? Obviously, not an infinite leakage of current, as no dynamo yet made, gives infinite current.

5. Perhaps our critic has never heard of the very common usage of incandescent lamps to indicate leakages. If so, we know several dynamo attendants (men who are not usually credited with a vast amount of electrical knowledge) who could enlighten him on this point.

6. The length of an open arc cannot be dealt with here without much discussion; but we must take exception to the very emphatic manner in which our critic denies the accuracy of our statement. All practical arc lamp manufacturers know that the length of arc varies with the voltage employed on the lamp and the quality of the carbons. We maintain that for 43 volts, 10 amperes, and good French or Belgian carbons, $\frac{3}{32}$ inch is a very general length of arc.

7. In reference to an enclosed arc burning in a partial vacuum, although more might have been said as to the consumption of the oxygen in the "envelope," we would ask our critic, "Has he satisfied himself that an enclosed arc burns in a plenum?"

8. Has our critic ever seen 15 mm. positive and 11 mm. negative carbons used in 10 or 12-ampere lamps of the different sorts we have described? Messrs. Crompton & Co. use 18 mm. and 12 mm. carbons; Messrs. Royce & Co. use 18 mm. and 11 mm. carbons; and Messrs. Körting and Matthieson use 18 mm. and 12 mm. carbons and 18 mm. and 11 mm. carbons. We will go further, and ask, Has he ever seen 15 mm. and 11 mm. carbons burnt together when both are of the same length in the foregoing types of lamps? If so, we surmise that there would be a busy time for the attendant in replacing burnt carbon holders. Further, we may mention that, in Manchester alone, there are at least 500 arc lamps taking 10 amperes at 43 volts and using 18 mm. and 11 mm. carbons, and that these carbons burn evenly as to length, and last 14 hours.

H. Smithson,
E. R. Sharpe,
Per Smithson, Sharpe & Co.

[Following our correspondents' example, we will deal with the points raised in order:—

1. We still maintain that the usefulness of the book is diminished by the lack of illustrations, which need not be complicated; the possibility of advertising rival manufacturers' lamps ought not to have weight in the matter.

2. This error is admitted by the authors.

3. The authors *themselves* introduced the word "kilowatt," which they now say is too lofty for their readers; *e.g.*, on page 15, "the price of a kilowatt or unit varies in different towns." On the same page they say—" . . . . This equals 1,000 watts or one unit, and if the price of a unit is 5d. . . . . ;" the same error also occurs elsewhere. If arc lamp trimmers are ignorant, must authors pander to their ignorance? Must we drop our h's when we speak to Hooligans?

4. We cannot understand what our correspondents are driving at; we quote the text: "When there is a large leakage of this kind, a short circuit is said to occur." This in a paragraph about *insulation*!

5. We said "leakage from one wire to another, or a short circuit;" the original text we give in full:—" . . . . an earth. To indicate this, *or a short circuit*, incandescent lamps are sometimes fixed on the switchboard, and so wired, that a *leakage from one wire to another*, or from the wires to 'earth,' lights the lamps. The amount of light they give roughly gauges the leakage." (The italics are ours.) The use of glow lamps to indicate leakages *to earth* dates from the earliest days of electric lighting; but how they are employed to show leakage *from one wire to another*, or a short circuit, we do not know. Are they inserted in series with the leakage path? (!) We grant that when a short circuit occurs the lamps usually go out; we suggest, therefore, that for "the amount of light" in the above quotation, our friends should substitute "the depth of darkness."

6. We repeat that $\frac{3}{32}$-inch is too short for an open arc. Of course, an arc will burn at various lengths; but when the arc is too short, there is a great loss of light, and the feed must be very delicately adjusted.

7. An enclosed arc burns under atmospheric pressure, *i.e.*, neither in a plenum nor in a vacuum. This is undeniable.

8. On this point our correspondents marshal an array of facts which we are not prepared to dispute; we may, however, mention that our reviewer was handling and testing arc lamps years before the 10 years' experience of the authors commenced, that he has designed arc lamps, and has superintended the running of numerous types.—Eds. Elec. Rev.]

Consulting Engineer or Tradesman?

Is a "consulting engineer" a tradesman, and as such entitled to trade terms from supply houses such as ourselves?

We conclude that if such a question had been addressed to yourselves in your non-editorial capacity, or for the matter of that, to any of the numerous professional gentlemen who practise as consulting engineers, the answer would be a most distinct negative, if, indeed, you did not feel that the insolence of the inquiry demanded rather more forcible treatment than simple words. But it is to the Editors of the Electrical Review, and through them to their numerous readers, that we administer the interrogatory, the question having been raised in our mind by the increasing use which is being made of the title of consulting engineer by persons who, at the same time, are not at all averse to receiving the profits which rightly belong to the contractor, and more particularly by the correspondence which has lately passed between ourselves and a gentleman who so designates himself.

We ourselves have thought it our duty to protect our *bonâ fide* trade customers from such competition, believing that the consulting engineer should be content with his con-

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sultation fees, and that he was in no way entitled to run with the hare and hunt with the hounds.

In case you may think this matter of sufficient importance to devote the necessary space to the publication of the correspondence, we enclose a copy of it; of course, suppressing all names, particularly those of the two well-known firms who are mentioned as giving trade terms.

The Stewart Electrical Syndicate, Limited,
Per Douglas C. Bate, *Managing Director*.

COPY OF CORRESPONDENCE.

October 27th, 1899.

—— ——, M.I.J.E.,
Consulting Engineer.

The Stewart Electrical Syndicate, Limited,
London.

Dear Sirs,—I shall be obliged if you will let me have your list of *small* and *ordinary* size enclosed lamps for continuous current; and do you make them inverted? Also please let me know best trade terms, and should like list by return.

Yours truly,
(Signed) —— ——.

5, New Compton Street, W.
October 28th, 1899.

—— ——, Esqr.,
—— —— ——.

Dear Sir,—In reply to your esteemed favour of yesterday's date, for which we thank you, we are sending by this post a copy of our price lists of "Stewart" enclosed arc lamps for continuous current, and on receipt of your statement of requirements, shall be pleased to quote you our discounts for quantities.

We regret that we are unable to quote you our trade terms, which, as you are not in the trade, would be unfair to those who are.

We are, dear Sir,
Yours faithfully,
For the Stewart Electrical Syndicate, Limited,
(Signed) Douglas C. Bate, *Managing Director.*

October 28th, 1899.

Messrs. The Stewart Electrical Syndicate.

Dear Sirs,—I was rather surprised to get yours of 28th, saying I was not in the trade, and you could not allow me trade terms. If you refer to —— —— or —— ——, of London, you will find that I have dealt with them for years, and have had the very best terms. Of course, if you are so dense, I can buy elsewhere.

Yours truly,
(Signed) —— ——.

October 30th, 1899.

—— —— Esq.,
—— —— ——

Dear Sir,—We are duly in receipt of your favour of 28th inst., for which we thank you, but can hardly plead guilty to your charge of "density," inasmuch as we have the authority of the printing at the head of your own letter paper for believing you to be a "consulting engineer." However, the mistake is not a vital one, and if you are entitled to trade terms, you can obtain them from —— —— ——, to whom you say you are well known.

We are, Dear Sir,
Yours faithfully,
For the Stewart Electrical Syndicate, Limited,
(Signed) Douglas C. Bate, *Managing Director*

[The question which our correspondents address to us turns, we think, upon definitions; we therefore give our definitions first and our views afterwards:—

Consulting Engineer—One who impartially advises non-technical customers on what and where to buy.

Tradesman—One who buys and sells for profit; strictly speaking, a retail dealer.

Our opinion, then, is that a consulting engineer is *not* a tradesman; he is, however, in the trade, and is accordingly entitled to trade terms when he buys articles *for his own use*. Should he sell any apparatus at a profit, he is no longer a consulting engineer in the ordinary acceptation of the term. We entirely approve of our correspondents' action in refusing trade terms to the self-styled "consulting" engineer, who obviously intended to resell the lamps, and who seems to be, in fact, "consulting" his own interests!—Eds Elec. Rev.]

BUSINESS NOTICES, &c.

Answers to "Situations Vacant" Advertisments.—The man who answers advertisments of "Situations Vacant" is too often blind to his own interests. He can hardly expect his application to meet with success unless he furnishes the information which the advertiser stipulates as necessary. We have reason for believing that failure to state experience, and to give references, has sent many a letter the way of all waste paper. The man at liberty, generally, would have no reason for withholding these particulars, but to the man anxious to better his present position in life there may be feelings that he would like to take his chance without showing his hand too much at first, and trust to providence to make it lead to something. Ninety-nine out of every hundred applications of this class are not replied to. It is in the interests of applicants, that we remind them that all information of the kind referred to is considered "private and confidential" by the recipient. The National Electric Free Wiring Company, which has lately been advertising for men, has received a whole host of letters in which the fatal omission has been made. The matter merely needs mention to lead to its rectification.

Electrical Wares Exported.

Week ending Nov. 1st, 1898.		Week ending Oct. 31st, 1899.	
Adelaide	Value £51	Adelaide	Value £208
Alexandria	40	Alexandria	90
Amsterdam	207	„ Teleph. mat. ..	54
Antwerp	35	Bangkok	49
Bangkok	207	Boca	1,168
Bombay	486	„ Teleg. mat.	409
Boulogne	216	Bombay	147
Buenos Ayres	823	„ Teleg. wire	59
„ „ Teleg. mat. ..	474	Brisbane	16
Calcutta	188	Buenos Ayres	750
Cape Town	271	„ Teleg. wire ..	479
Christiansand	46	Calcutta	276
Colombo	59	Cape Town	410
Constantinople	14	Christiania. Teleg. wire ..	86
Durban	135	Colombo	1,029
East London	10	Copenhagen	263
Gothenburg	46	Durban	16
Hamburg	50	„ Teleg. wire mat. ..	4,168
Malta	47	East London	558
Ostend	45	Gothenburg	90
Otago	63	„ Teleg. wire ..	15
Paris. Elec. batteries	25	Hong Kong	15
„ Elec. fuses	75	Madras	16
Port Elizabeth	18	Monte Video. Teleg. mat. ..	72
„ „ Teleg. mat. ..	180	North Sea. Teleg. cable ..	2,200
Rangoon	49	Port Elizabeth	151
Rio Janeiro	186	Port Said	39
Santander	7	Santos	38
Spezzia	121	„ Teleg. mat.	172
Stockholm	613	Sydney	251
Sydney	446	Valparaiso	112
Tientsin. Teleg. mat.	80	Venice. Elec. launch machy...	500
		Vera Cruz	30
		Wellington	370
		Yokohama	140
		„ Teleg. cable ..	566
Total ..	£4,818	Total ..	£15,161

Foreign Goods Transhipped.

Hong Kong. Elec. plant .	Value	£50
Melbourne. Elec. motors	..	100
Total ..	..	£150

Auction Sale.—From our small advertisements may be gained particulars of an auction sale which will take place on Thursday, November 16th, at Birmingham, of the acetylene works, Corngreaves, Oradley Heath, together with the goodwill and electrical equipment, used in the manufacture of carbide of calcium.

Bankruptcy Proceedings.—At a sitting of the London Bankruptcy Court held last week before Mr. Registrar Hope, John G. M. Hilton, electrician, attended for public examination upon accounts showing liabilities £2,026 13s. 8d., and assets consisting of 4,500 fully paid, and 3,000 half paid £1 shares, which are now regarded as possessing no apparent value. The bankrupt states that in January, 1895, he became one of the managing directors of the Nalder & Harrison Construction Syndicate, in which company he invested £2,250 (money derived principally from his father's estate), but shortly afterwards the syndicate went into voluntary liquidation. He then, in conjunction with another person, purchased the electrical portion of the business, and carried on the same until early in 1897 (the bankrupt putting into the business capital to the amount of £2,000, which he obtained from the trustees of his marriage settlement); at the latter date the business was formed into a limited company, with a nominal capital of £20,000, the partners, as vendors, receiving £9,000 in fully paid shares and £6,000 in partly paid shares, and continuing to manage the business. In March, 1898, however, in consequence of a disagreement, he retired from the company on the terms that he should be entitled to £800 cash (which was to be used to reduce his liabilities in connection with the late firm) and £1,200 in six annual instalments, half of which he capitalised for £300. In January, 1899, he returned to the business and introduced a further sum of £400 (advanced him by his wife's relatives), but in May last the company went into voluntary liquidation. He attributes his insolvency to the failure of the company in the manufacture of electrical apparatus, and to his own want of business experience. The examination was ordered to be concluded.

A receiving order has been made at the London Bankruptcy Court against the estate of E. Max Winter, electrical engineer, Amberley House, Norfolk Street, Strand. The petition was presented by Messrs. H. Clarkson & Son, solicitors, acting on behalf of Mr. Wm. Prebble, surveyor, Bromley, the act of bankruptcy alleged being non-compliance with the requirements of the usual notice. No particulars transpired with regard to assets or liabilities.

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Liquidations, Dissolutions, &c.—Messrs. J. Lovelock, A. J. Seabourne, and A. M. Lee (Lovelock, Seabourne & Lee, engineers and electricians, 8, Jeffrey's Square, St. Mary Axe) have dissolved partnership.

Messrs. G. E. Belliss & Co., Limited, met on September 27th and October 24th, at Birmingham, and passed resolutions approving of the reconstruction scheme and the terms of the agreement for the sale of the company to Belliss & Morcom, Limited. Mr. J. E. Rubery, of 17, Newhall Street, Birmingham, is voluntary liquidator of the company.

Creditors of Elmore's Foreign and Colonial Patent Depositing Company, Elmore's Patent Depositing Company, and Elmore's Wire Manufacturing Company, must send particulars of debts or claims, &c, to the liquidator, Mr. J. Shurmer, Greek Street Chambers, Park Row, Leeds, by December 9th.

For the purposes of reconstruction, Messrs. F. H. Royce & Co., Limited, are winding up voluntarily. Mr. F. H. Royce, of Brae Cottage, Legh Road, Knutsford, and Mr. E. A. Claremont, of Endsleigh, Legh Road, Knutsford, are liquidators. The new company will be known as Royce, Limited. The registration notice appeared under our "New Companies" last week.

A petition for the winding up of Maudslay, Sons & Field, Limited, presented by Major J. H. E. Allen, creditor, will be heard by Mr. Justice Wright, in the Winding-up Court, on Wednesday, November 8th.

A meeting of Nernst Lamp, Limited, is to be held at Dashwood House, E.C. on December 4th to hear an account of the winding up from the liquidator, Mr. Wm. Chaplin.

Books Received.—"Magnetism and Electricity," by J. Paley Yorke. London: Edward Arnold. 3s. 6d.

"Fire Tests with Glass," No. 30, by the British Luxfer Prism Syndicate, Limited, and No. 31 by Messrs. Pilkington Bros, Limited. London: British Fire Prevention Committee. 1899. 2s. 6d. each.

"Fowler's Mechanical Engineers' Pocket-Book," 1900. Manchester: Scientific Publishing Company. 1s. 6d. net.

"Manual of Electrical Undertakings," 1899-1900, by Emile Garcke. London: W. Alderson Smith. 12s. 6d. net.

"The Manufacture of Carbons for Electric Lighting and other Purposes," by Francis Jehl, M.Am.I.E.E. London: The *Electrician* Printing and Publishing Company. 10s. 6d.

Brougham v. Bateman.—Before his Honour Judge Lumley Smith, Q.C., in the Westminster County Court last week, the Hon. Reginald Brougham, electrical engineer, sued Messrs. Bateman, engineers, for the return of a deposit of £10 and damages for the non-completion of an order. The case for the plaintiff was that he went to defendants' premises in Holborn, and there saw Mr. Bateman about some plans and models of some automatic couplings for railway purposes he had designed and provisionally patented. He told him he wanted the working drawing within a week, as a Parliamentary Committee was sitting on the subject, and he wanted to get the matter on as quickly as possible. Mr. Bateman agreed to do it and make models of the couplings. He sent £10 deposit at the request of Mr. Bateman. He wished the thing to be hurried on as there were hundreds of electrical engineers devising schemes for automatic couplings, and the Parliamentary Committee was sitting. A number of frivolous excuses were made for delaying the whole matter, and eventually plaintiff asked for his money back, countermanding the order. He could not get his money back, and he had been put to a great deal of trouble. The defence was that the drawing was supplied in the time specified, but was returned by the plaintiff for alteration, and an employé of the defendants' took it away. A prosecution followed and that delayed the order. Two model trucks were now produced, minus couplings, and their value was said to be £6 10s. The time spent on the order was worth £3 or £4 in addition. The order would have been completed if plaintiff had not stopped them. His Honour said there had been an unfortunate delay owing to a disagreement between Mr. Bateman and his employés, as shown by the correspondence in the case, but that was a risk he took, and customers were entitled to have their work in the ordinary way. To have made the trucks before the couplings was premature, and he thought the plaintiff was entitled to recover on his claim for the return of the deposit, less £1 for the plan, which would be a judgment for the plaintiff for £9 with costs.

Catalogues and Lists.—Mr. Frederic Nell, of Queen Victoria Street, E.C., has published a new catalogue of Smith-Vaile pumping machinery, the Victor turbine, condensing and compressing plant, &c. The 208 pages are divided off into eight different sections as follow:—(1) Duplex steam pumps; (2) single cylinder steam pumps; (3) artesian well and vertical mine pumps; (4) triplex and duplex (single and double acting); (5) jet and surface condensers (air, vacuum, and air circulating pumps); (6) centrifugal pumps; (7) air compressors; (8) turbines. There is a number of illustrations, both photographic and diagrammatic, which give additional interest to the descriptions which accompany them. Section 8, of course, has a good deal of matter, tabulated and otherwise, relating to the "Victor" turbine, tests, table of dimensions, and several pictures show various sizes and styles of these turbines as employed by the Edison Electric Illuminating Company, of Spokane Falls, Wash., and other American works. The Geisler electro-mechanical governor for regulating the speed of water wheels, and the same governor, with motor attached, for operating an automatic waste gate, and some general information relating to water-power, are among the contents of this catalogue.

The Noiseless Gear Company, of Levenshulme, send us a list of their machine cut double helical gear wheels.

Messrs. Gambrell Bros., of Giltspur Street, E.C., have sent us one of their illustrated "B" lists of scientific instruments, including resistance coils and boxes, reflecting galvanometers, direct reading galvanometers, testing sets, switches, &c. Prices and illustrations are given.

From the Electrical Company, Limited, we have received a reference list of various direct, alternating, and three-phase dynamos and motors supplied by them to firms in London and the provinces. There are 467 machines of 3,213 total B.H.P.

Electrical Copper Company v. The Commercial Bank of Scotland.—In the Queen's Bench Division on 27th ult., before Mr. Justice Bigham, sitting without a jury, the case was heard of the Electrical Copper Company, Limited, *v.* The Commercial Bank of Scotland, Limited, both carrying on business in the City. The action was brought to recover £1,696, the proceeds of the sale of 25 tons of copper, against which the Bank of Scotland held warrants as security for certain loans. The point raised was whether such warrants were negotiable instruments, and whether Mr. Robert Mortimer Moir, the managing director of R. M. Moir & Co., Limited, in obtaining a loan as against one of the warrants, acted as a mercantile agent. After the hearing had proceeded for a while, his Lordship stopped the case and said that further evidence was not necessary for the purposes of a legal decision. After consultation, Mr. Joseph Walton, Q.C., announced that his clients had agreed to settle the case without prejudice to their rights against a third party, who had guaranteed the bank against loss. It had, he said, been agreed that the bank should retain £1,000 and the plaintiffs should take the balance of £696, each party to pay their own costs.— Judgment accordingly.

Electrical Engineering in the Celebes (Dutch Indies).—The formal opening of the machinery which was sent out to the North Celebes Mining Company in April, took place at Soemalata on September 9th. Among the company present were Mr. Dane, the mining engineer, Meinherr De Steurs, administrator, Meinherren Van Rlaw, Crickmayer, Heinrichs, Barber, Dr. Vinkhuisen, Mr. Penaluns, Herr Loesche, the erector of the engine, and the two engineers responsible, viz., Mr. Robinson, of London, and Mr. Wilfrid Bowman, of Liscard. In opening the plant Mr. Dane spoke in high terms of the indefatigable manner in which the work had been carried out, and said that considering the great local handicaps, it constituted a record for that part of the world. Since the opening in September the machinery has been working regularly and in a thoroughly satisfactory manner. The plant consists of one engine by Langensiepen, of Magdeburg, one dynamo by Siemens & Halske, one dynamo by the Allgemeine E. G. and six motors, together with the mining machinery by Siemens & Halske. There has also been erected a fitting shop containing a lathe with 15-inch centres and 14 feet bed, drilling machine, &c.

Electrical Engineering in Italy.—The plant of the Società Piemontese per la Fabbricazione del Carburo di Calcio, at St. Marcel, is about to be enlarged by the addition of five 404-kw. tri-phase alternators. The contract for the same has been placed with the Società di Elettricità (Schuckert & Co.), of Milan.

Electrical Works at Tipton.—Our Wolverhampton correspondent says that the Exploration Company, of Cornhill, London, have purchased about 14 acres of land at the foot of the pumping station on the canal side at Ocker Hill, Tipton, as a site for new electrical works. The intention of the company—of which Mr. Thomas Parker, of Wolverhampton, is one of the directors—is to put down a plant of 10,000 H.P. for the purpose of supplying electricity to manufacturers of driving machinery and lighting, and also to local authorities in the district for illuminating the streets. It is stated several well-known London capitalists are identified with this new enterprise. Presumably this is the scheme of the Midland Electric Corporation for power distribution.

Factory Lighting.—Messrs. Ellis & Ward, of Birmingham, have secured the order for the electric lighting of the large bedstead factory of Messrs. Wale & Sons, of Birmingham. The consulting engineers are Messrs. Cerrito, Edwards & Shaw, of Birmingham.

The Madras Electric Tramways Company, Limited.—On Wednesday last (November 1st) Mr. Justice Wright, sitting in the High Court of Justice as an additional judge of the Chancery Division for the transaction of companies' winding up business, had before him the petition of the Electric Construction Company, Limited, for the winding up of the Madras Electric Tramways Company, Limited. The matter had been last mentioned on August 9th, before the long vacation. Mr. Eve, Q.C., who appeared for creditors, claiming altogether £32,000, said that as the defendant company had in the interval done nothing, his clients were entitled to an order for winding up. On the other side, Mr. Herbert Reed, Q.C., appeared, and stated that a question of interest was in dispute, but it was hoped that negotiations would be renewed, and that some result might be arrived at. Petitioners were debenture holders and mortgagees, they were the owners of everything connected with the company, and were collecting its fares, which were largely on the increase. Counsel also mentioned that the shareholders in the Madras Electric Tramways Company included many of the native residents. —Evidence having been heard as to the present position of the company, the matter was ordered to stand over for a fortnight.

The Metropolitan Electric Supply Co.—The *Indicator* says that a circular has been issued by the Metropolitan Electric Supply Company, in which they express regret that they have recently been unable to maintain a satisfactory supply of electricity during all hours of demand. The company's new works at Willesden, fitted up with machinery of unusual magnitude, and of the most modern construction, have just been completed. The directors of

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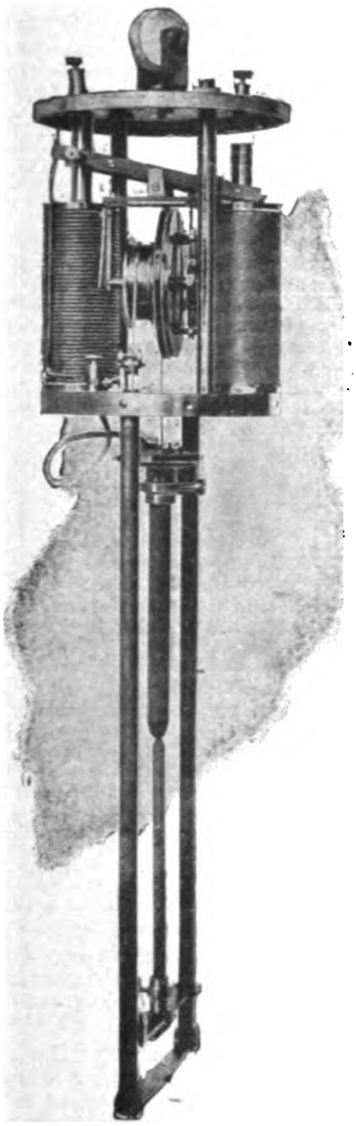
the company in their circular, express the hope that they will shortly be able to fully meet the demands made upon them for electricity.

Mica Manufacturing Company. — Last week Mr. Justice Byrne granted an application on behalf of Mr. Kirkwood that the register of the above company might be rectified by the removal of his name as the holder of 340 shares on the ground that he never applied for them.

New Arc Lamp.—The Electrical Transmission Company, Limited, of Albert Works, Hammersmith, are now putting on the market a new arc lamp, as shown in the accompanying illustration. The lamps can be supplied with cases or globes of any pattern, or in lanterns, to suit requirements. The figure gives a view of the lamp mechanism. This consists of main and shunt solenoids which actuate a rocking lever, which in its turn acts upon a friction clutch by means of which the arc is struck, and the feeding controlled. The friction clutch is of such an effective design that the lamp can be subjected to any amount of shaking or vibration without the arc



being in any way affected. The carbon holders work along the slides on small rollers which prevent sticking and give smoothness of movement. The lower carbon holder is connected to the cross-bar by a simple form of ball joint enabling the carbons to be easily adjusted. We are informed that the Electrical Standardising, Testing and Training Institution, who have examined and tested the lamp, report that the arc strikes quickly and well, and with no objectionable flickering before settling down, and that the lamp runs with great steadiness, the regulating mechanism working with uniform smoothness. The lamps are constructed to work on either continuous or alternating current circuits. Owing to the simple character of the design of the lamp, and the arrangements which the Electrical Transmission Company have made for its manufacture, the price is said to be moderate.

Smoke Nuisance.—At the South Western Police Court, the County of London and Brush Provincial Electric Lighting Company has been summoned at the instance of the Wandsworth District Board of Works, for allowing black smoke to issue from the chimney shaft at their works, the Causeway, Wandsworth.—Mr. W. W. Young, the Board's solicitor, reminded the magistrate that the company had been convicted several times of a similar offence, and appeared to take no trouble to abate the nuisance. During the Welsh coal strike there was some excuse for the defendants, but there was no reason why, with the use of the best coal, and effective supervision over the stoking, the nuisance should not almost entirely have disappeared.—Evidence was given by Sanitary Inspectors Hatton and Weeks, and by an inspector under the Society for the Abatement of the Smoke Nuisance, respecting various occasions on which the smoke was seen to issue in great volume from the chimney.—Mr. Whitlock, the chief engineer of the works, suggested that the smoke was not so black as the witnesses had made it out to be. — The magistrate imposed penalties amounting in all to £45.

"Sparkless Gem" Dynamo Brushes.—Mr. S. Jevons, of the Electrical Engineering Stores, Minories, Birmingham, is the sole licensee for the United Kingdom for the sale of the brushes mentioned in the title of this notice. The brushes are stated to be very popular on the market. They are made under Chaplin's patents, and are the result of constant improvements necessitated and suggested by evolution of the electric generator. Badly constructed current collectors will soon cause the most perfect dynamo to go wrong; yet a poor and worn out machine has been made to nearly double its output by a change of brushes, enabling it to run cool and clean at this point. A true test for the efficiency of a brush is the temperature of the commutator running under it: and the claims in favour of the "Sparkless Gem" brushes are based on the fact that, even if a machine is apparently running well with the usual gauze brushes, the substitution of the later type will bring down the heating at the contact surfaces by several degrees. Owing to the soft and springy nature of the crimpled wire interior, friction is reduced to a minimum: while the casing is constructed to obtain any required degree of firmness without the danger of spreading. Highest conductivity is also attained, as the weight of copper in a brush of this make is at least 25 per cent. more than in a gauze brush of the same dimensions.

Staff Dinner.—The fittings warehouse section of the staff of the Edison & Swan United Electric Light Company, Limited, held the first of a series of social meetings for the winter season on Monday, October 30th, at the Champion Hotel, Aldersgate Street, E.C., where the party sat down to dinner, which was followed by a musical programme. Mr. A. V. Kyrke occupied the chair. Other departments were represented, and a very enjoyable evening was spent.

Trade Announcements. — The Phodyne Electrical Company, Limited, of 66, Victoria Street, S.W., have acquired the electrical contracting business hitherto carried on at that address by Messrs. A. A. C. Swinton & Co., and have taken over the latter firm's staff and offices. Mr. J. C. M. Stanton, M.I.E.E., who of late years has managed Messrs. Swinton & Co.'s contracting business, is managing director of the Phodyne Electrical Co. The firm of A. A. C. Swinton & Co., whose business the Phodyne Co. acquire, was formed some 11 years ago by Mr. A. A. Campbell Swinton. During this period they have carried out numerous and large electric installations, notably in connection with the electric lighting of country houses, among which may be mentioned the country seats of the Marquis of Tweeddale, the Earl of Durham, Lord Rendel, Lord Hamilton of Dalzell, The Mackintosh of Mackintosh, Sir John Stirling Maxwell, M.P., and have in hand at the present time, among others, Bamburgh Castle for Lord Armstrong, and Haggerston Castle. The Phodyne Co. will continue to make a speciality of this class of work, in addition to developing its business in other directions. Mr. A. A. Campbell Swinton has removed to new offices in the same building, 66, Victoria Street, Westminster, where he will continue his consulting practice.

The British Thomson-Houston Company wish us to intimate to their customers that the prices of their electrical apparatus and supplies are being revised. New lists are in course of preparation, and will be ready shortly.

Messrs. Allan & Adamson, Limited, announce their change of address to Clun House, Surrey Street, Strand, W.C. In order to meet the increasing demand for the Allan accumulator it has been found necessary to erect improved works, where the manufacture of these storage batteries can be conducted on a large scale. These works are at Ashstead, Surrey, but communications should be addressed to the London office.

Warren v. St. James's and Pall Mall Electric Light Company.—The High Bailiff of Westminster and a special jury sat on October 28th at the Guildhall, Westminster, to assess the claim made by Mr. Edward Warren against the St. James's and Pall Mall Electric Light Company, in respect of a 16 years' unexpired lease of his premises, known as 40, Marshall Street, Golden Square. Mr. Robson, Q.C., M.P., and Mr. Lawless appeared on behalf of the claimant, and Mr. Balfour Browne, Q.C., and Mr. Davis represented the company. The premises in respect of which the claim arose, have already been taken by the company under their Act of this year for the purpose of erecting on the site thereof a new generating station. On behalf of the claimant expert evidence was given, and the jury, after hearing counsel, assessed the value at £630.

Wire Bound Hose.—Messrs. W. H. Willcox & Co., Limited, have recently introduced with great success a special make of their patent wire bound hose, which they term the "special traction engine quality." They claim to have paid particular attention to the study of the requirements of this class of engine, and to have brought out a specially constructed quality which they are confident meets in every way the demands made upon the water-lifter hoses. A large number of the principal traction engine builders and owners have adopted the use of this hose with general satisfaction. In the construction of the hose there is no rubber to perish in its composition, and it is stated to outlast several ordinary rubber hoses for this reason. It is made with wire on the inside, and also bound externally in such a manner as to effectually prevent kinking. It is prepared in a special way, and is very strong and durable.

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ELECTRIC LIGHTING NOTES.

Bala.—A public meeting was held last week to consider the question of electricity supply for the town. It was decided to obtain expert advice on the subject, and to canvass probable consumers. Out of nine speakers, six bore the name of Jones!

Barking.—An inquiry was held last week by Colonel A. C. Smith, R.E., inspector of the Local Government Board, with reference to an application to borrow £13,280 for purposes of electric lighting. It was stated that sanction for £15,000 was obtained last year for the carrying out of an electric light scheme, which provided sufficient plant to supply electricity to the whole of the street lamps, together with 2,000 8-C.P. lamps for private lighting. The whole of the works provided for in the original scheme had been carried out. At the present time there were applications for 4,500 more private lamps, in addition to an application from Messrs. Lawes, at Creeksmouth, who had guaranteed the Council the sum of £250 for seven years. Messrs. De Pass had also guaranteed £200 for seven years, whilst application for the light had been made by the East London Waterworks Company, Messrs. Warne & Co., and others. The number of lamps actually connected was 650 C.P. in excess of that contemplated when the original loan was sanctioned. The Council had decided to receive no additional applications until the plant was extended. A further sum of £1,800 was included in the application, £1,000 of this being for the extension of the electric light works. This brought the total amount asked for up to £15,080. There was no opposition.

Bath.—At a meeting of the Council last week, the final bill by Mr. R Hammond for professional services as expert adviser, amounting to £280, was received and sent to the auditor. Messrs. Callender wrote pointing out that they had never been allowed to complete their original contract for laying mains, and that they could compel the Corporation to receive 28,000 yards of high tension cable; they were willing that some arrangement should be come to as to the proposed extensions. The letter was sent to the Works Committee.

Bedford.—The Town Council having applied to the Local Government Board for sanction to borrow £41,000 for purposes of electric lighting, Colonel A. J. Hepper on Thursday last week held an inquiry. The town clerk said that the amounts already sanctioned for electric lighting purposes were £63,450. The engineer said that the output had been rapidly increasing, the light had become more popular, and there was a greater demand for it. He estimated the output for the year at 750,000 units. The present application embraced all the streets not previously included. The buildings were for new boilers, condensers, and four new sub-stations. The price of supply was 5d. per unit with 10 per cent. discount. The inspector paid a visit to the electricity works.

Boston.—A special meeting of the Town Council was held last week to consider a resolution of the Finance Committee, recommending the Council to offer £60,000 to the Boston Gas Company for their undertaking. The Council rejected the recommendation, and, instead, decided to apply for a provisional order under the Electric Lighting Act, enabling the Council to supply the town with electric light.

Brighouse.—The Town Council has decided that the price of electricity for lighting purposes be increased from 5d. to 6d. per Board of Trade unit, a previous resolution of the Council that the price be 7d. being rescinded. This alteration in price, the electrical engineer reported, would reduce the deficiency of £205 8s. 2d. in this department for the past year to one of £58 6s. 8d. in the current year. The engineer presented a report recommending the laying down of a new electrical generating plant in order that the department might be made to pay.

Bristol.—The Town Council is about to erect nearly 400 additional arc lamps, to take the place of existing gas lamps.

Ceylon.—The electric lighting of Kandy is being carried out under the management of Mr. J. E. Addyman, the resident electrical engineer of the Colombo Gas and Water Company. A large part of the mains has already been laid on the system of the British Insulated Wire Company, Limited. The generating station is nearly complete, and supply will be commenced in a few months.

Cleethorpes.—Mr. C. S. V. Brown has presented his report on the proposed electric lighting of the town to the District Council, which has decided to obtain a provisional order as soon as possible.

Croydon.—The Board of Guardians has approved the report of a Special Committee in favour of fitting the Workhouse, Infirmary, and offices with electric lighting at an estimated cost of £2,500.

Dartford.—The District Council, after careful consideration of Mr. Hawtayne's report, has decided to adopt his scheme for the electric lighting of the town, and has resolved to apply for permission to raise a loan for the amount estimated by Mr. Hawtayne.

Dolgelly.—The District Council has appointed a committee to consider the question of electric lighting for the town.

Dudley.—Mr. Herbert H. Law, C.E., has held a public inquiry at Dudley relative to the application of the Town Council for permission to borrow, amongst other items, £33,000 for electric lighting purposes. The town clerk stated that the population of the town was 50,000, its ratable value was £113,180, and the outstanding loans amounted to £63,037. In 1897 the Town Council obtained their electric lighting order, and in 1898 the British Electric Traction Company took over the local steam tramways, proposing to electrically equip them. The Town Council opposed that part of the electrical proposals which had reference to the borough, and eventually an arrangement was come to under which the traction company agreed to take what power they required within the borough from the Town Council. It was added that this was the second loan under this head which had been applied for, a generating station sufficient to work the tramways being now in operation. Mr. R. Wilson, electrical engineer, said it was proposed to erect arc lamps on some of the tramway poles. Numerous applications, including two from large works, had already been received for the light. The present generating station consisted of two engines and boilers, with two dynamos, in a corrugated iron shed. The permanent building would be erected round and over the present building. In the new building would be placed two more boilers, fitted with mechanical stokers, and two more dynamos. One of the engines would be 100 H.P., and the other three 200 H.P., the dynamos corresponding. The Commissioner said he believed the loan would be granted for 25 years. The Commissioner, at the conclusion of the inquiry, visited the site of the electrical works.

Exeter.—The Electric Lighting Committee reports to the City Council that upon the accounts of the year ending December 31st last there was a surplus profit of £548 8s. 8d., after payment of all interest and sinking fund.

Glasgow.—Last week the Electricity Committee of the Corporation resolved to recommend that churches be offered supplies of electricity for lighting purposes at 3d. per unit, or half the ordinary rate.

Grays.—Colonel Durnford, R.E., recently held an inquiry on behalf of the Local Government Board into the application of the Urban Council for sanction to borrow £13,000 for electric lighting purposes. Mr. A. H. Preece, electrical engineer, said an arrangement had been entered into for the purchase of land for a lighting station. There were at present 186 public lamps, which would have to be lighted by electricity. These now cost £700 a year, and this amount would have to be credited to the new scheme. The income from private lamps should amount to at least £1,000 par year, giving a total income of £1,700 per annum. Allowing for the cost for interest and sinking fund on the loan, a sum of £1,600, they would have a credit balance of about £100 a year. The repayment of the loan would come to about £700, and the interest on sinking fund and working expenses would be about £900. The Council had received a requisition to adopt electricity by a large number of the ratepayers. There was no opposition.

Henley.—The Town Council has resolved to obtain a provisional order for electric lighting, and has under consideration a report and estimate by Messrs. Shone & Ault on the subject.

Heston and Isleworth.—In the *London Gazette* last Friday there appeared the usual notice of intention to apply to the Board of Trade for a provisional order for the District Council.

Hythe.—The Town Council has resolved to obtain a provisional order for electric lighting, with a view to forestalling the Folkestone Electricity Supply Company.

Ilford.—The Local Government Board has sanctioned loans of £4,400 for the purchase of land for the electric light and tramway stations.

Italy.—The Società Tramvie e Ferrovie Elettricite Varesine has received official permission to put down plant to utilise the water-power of the Giona and Cannera (Como) streams.

King's Norton.—The Urban District Council is considering the question of an electricity supply, for which the late Rural District Council obtained an order in 1898. The duration of the order will shortly expire.

Kingston-on-Thames.—The Local Government Board has sanctioned the raising of a loan of £15,000 by the Town Council on the understanding that no part of the money borrowed would be expended in payments to salaried officers of the Council, or in buying incandescent lamps. The Council has raised the salary of the electrical engineer, Mr. Edgcombe, from £300 to £350 per annum.

Leicester.—The Town Council has approved of the recommendation of the Electric Lighting Committee to borrow £100,000 for necessary extensions. At a recent meeting Alderman Lennard pointed out the steady increase in the demand for electric light in Leicester. The revenue from the department had increased from £963 in 1895 to £5,040 in 1899. It was now proposed to put in additional alternators and engines to increase the capacity from 1,600 KW. to 4,000 KW., and it was estimated that this would meet the demand for the next five or six years. The price at present charged for the light was 4d. per Board of Trade unit, and 2d. per unit for power.

Liversedge.—On Monday the District Council decided to apply to the Board of Trade for a provisional order, authorising the Council to supply electricity for public and private purposes within their district.

London, E.C.—The Limehouse District Board has decided to apply for a provisional order to light the district by electricity. An influential deputation from the East End districts of Mile End, Limehouse, and St. George's, waited upon Sir Courtenay Boyle, in the unavoidable absence of Mr. Ritchie, at the Board of Trade this week. The deputation asked the Board of

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Trade either to allow them to jointly commence their own electric lighting scheme or to revoke the order which had been granted to the County of London and Brush Provincial Company over two years ago, and which work had not been commenced. Sir C. Boyle promised to go fully into the matter with Mr. Ritchie.

Malton.—A special meeting of the District Council was held last week to receive Mr. C. W. Fairley, representing the Northern Counties Electrical Supply Company, who explained the company's scheme for establishing electricity works in Malton. The subject is to be further considered.

Mexico.—A Berlin correspondent of the *Financial Times* states that the Mexican Electric Works, Limited, in which the Dresden Bank and the Swiss Company for Electrical Industry of Basle are interested, and which partially commenced work in Mexico at the beginning of 1898, was enabled to set the works in full operation in October of the same year. The development of the company during the first working year has not quite equalled the original expectations. Nevertheless the available surplus will allow of the payment for the first financial year ended on October 1st of a dividend of 6 per cent, and in order to meet this the Siemens & Halske Company, which guaranteed a 6 per cent. dividend for the first three years, will only be required to provide a small amount of money to make up the deficiency. It is expected that improved results will be obtained next year, especially as the number of consumers and lamp connections is increasing.

Mexborough.—Colonel A. J. Hepper, D.S.O., R.E., inspector of the Local Government Board, last week held an inquiry into the application of the District Council for sanction to borrow £1,428 for the purchasing of land for the erection of an electric lighting station and other purposes.

Newark.—At a special meeting last week the Town Council authorised application being made for a provisional order for electric lighting purposes.

North Riding.—The County Council has resolved that application be made to the Local Government Board for leave to borrow a sum of £4,500 for the purpose of carrying out a scheme of electric lighting at the North Riding Pauper Lunatic Asylum, such sum to be repaid by 10 equal annual instalments of principal and interest combined.

Northampton.—The electric light has been installed in St. Katherine's Church, by Mr. Geo. Basham for the National Electric Wiring Company, Limited. The company have also secured the contract for Messrs. Crick & Co.'s boot factory. The N.E.W. Co. have connected over 70 consumers here in less than seven months.

Pontefract.—At a meeting of the Board of Guardians on October 28th the report of Mr. G. R. Peers, electrical engineer, was read with regard to the lighting of Pontefract Workhouse by means of electricity. He estimated for 470 lamps, mostly of 16-c.p., at a total cost of £1,900, and at a working expense per annum of £208. The Board decided to obtain tenders for the carrying out of the work.

Prestwich.—The Urban Council gives the usual notice in the *London Gazette* of its intention to apply to the Board of Trade during the 1900 session for an electric lighting provisional order.

Rhyl.—The Council is considering the question of providing plant for supplying the whole of the town with electric light.

St. Pancras.—The Vestry on Wednesday resolved to purchase for £7,500 the freehold interest of property adjoining the King's Road generating station for the extension of the works.

Salford.—At the meeting of the Council on Monday, the resolution of the Tramways Committee, recommending that the Council make application to the Board of Trade for sanction to borrow the sum of £53,450, to cover the cost of the purchase of 100 electric tramcars, was considered. There was also on the agenda a resolution of the Electric Light Committee accepting the tender of Messrs. Galloways, Limited, for boilers and fittings, required for the Strawberry Road station, for the sum of £15,200, and another recommending the Council to apply to the Local Government Board for sanction to borrow the sum of £72,000 for the construction of eight sets of steam dynamos, required for the new low pressure generating station in Strawberry Road. In addition there were resolutions to borrow £750 for offices and battery sub-stations, and £879 for the erection of a retaining wall. The Council approved of the recommendations.

Saltburn.—The supply of electricity has now been begun; there are about 1,200 lamps connected, and a large number about to be wired. The sea front is also to be lighted with arc lamps.

Shipley.—A report on the question of electricity supply in the district has been presented to the District Council by Mr. R. C. Quin, outlining a system of supply capable of dealing with tramways, street lighting, pumping and sewage. Mr. Quin strongly recommended that wherever distributing mains were laid the streets should be electrically lighted. He thought it would be well to fix the cost of energy for street lighting at 2d. per unit. This would leave a slight margin of profit to the electricity department, and would be equal, light for light, with gas (Welsbach incandescent) at approximately 2s. per 1,000 cubic feet. The charge to the public he recommended should be 7d. for the first hour's use, on a six months' basis, and 2d. per unit for any further units consumed in the same period. Mr. Quin's estimate of costs amounted to £14,476, made up of the following items:—Generating station, £1,700; mains, £9,100; street lighting, £264; 100 services to consumers at £10 each, £1,000; contingencies, 10 per cent., £1,196; engineering and other expenses, 10 per cent., £1,316.

Southwick.—The Southwick District Council has appointed three members to meet three members from the Shoreham Council and three members of the Portslade Council, in order to discuss the advisability of obtaining powers for the electric lighting of the districts within the jurisdiction of these authorities.

Stoke-on-Trent.—The Board of Guardians last week adopted the report of a committee to the effect that Mr. G. R. Peers's scheme for the electric lighting of the workhouse, cottage homes, &c., at a cost of £4,250, be approved, as well as his estimate for subsequent extensions, costing £2,300. The Board will apply to the Local Government Board for sanction to the necessary loans, to be repaid within 30 years.

Swinton and Pendlebury.—In the report which Mr. C. Hopkinson has presented to the District Council on the subject of its electric lighting scheme, he estimates that the revenue from lighting and traction at the end of the second year would, within a few pounds, balance the expenditure on interest and sinking fund and generating costs, including repairs and maintenance. Mr. Hopkinson believes the Council would find either Manchester or Salford willing to supply the occupiers of property in Swinton on terms which they could not themselves hope to attain to, unless by a large development of the traction load.

Thirsk.—The Thirsk Rural District Council has agreed to the Northern Counties Electricity Supply Company's electric lighting scheme, contingent on the approval of the Thirsk, Sowerby, and Carlton Miniott Parish Councils.

Walker.—At a meeting of the District Council on Tuesday last, it was stated that the money required for buildings, plant, engineers' fees, destructor, purchase of land, Parliamentary and legal expenses, would amount to £29,943, and it was recommended that the Council apply to the Local Government Board for sanction to borrow this money for 30 years. It was also stated that the Newcastle Electric Supply Company had written offering to supply electrical energy in Walker district on advantageous terms, and a committee was appointed to meet the company and report. The report was adopted.

Wallasley.—The Local Government Board has sanctioned the District Council's application for leave to borrow £10,000 for electric lighting purposes, the loan to be repaid in 24 years.

Windsor.—In consequence of the increasing demands made upon the electricity works, and the delay in delivery of the new 400-H.P. engine, a large portable plant of 70 B.H.P. has been temporarily installed at the Peascod Street station. The Lighting Company has just had a 220-H.P. engine and dynamo placed in position, as well as a new boiler.

Wolverhampton.—At a meeting of the Town Council on Monday last the Lighting Committee presented a report with regard to a proposed extension of their plant. They stated that, having regard to the extreme difficulty in obtaining electrical machinery, except upon very long notice, owing to the fact that the leading manufacturers are exceedingly busy, they desired the authority of the Council to obtain and accept tenders immediately for two 700-H.P. steam dynamos, at an estimated cost of £11,000. The constantly increasing demand for electrical energy, for lighting and power purposes, renders it extremely probable that the whole of the plant in respect of which the expenditure of £29,000 was sanctioned by the Council in October last, will be taken up in the course of the next few months. The committee accordingly recommended that the Finance Committee be authorised to apply to the Local Government Board for their sanction to a loan for the purchase of the plant, to borrow the requisite moneys, and, if necessary, to raise Wolverhampton Corporation stock for such purpose.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Accrington.—At a recent Town Council committee meeting a deputation from the Tramway Company attended, and Mr. Garcke, of the British Electric Traction Company, made a long statement in general terms of the policy of that company in buying up such concerns as the Accrington Tramway Company. The chairman requested him to put any proposals in writing, and submit them for the consideration of the committee.

Belfast.—The tenders for rails, &c., for tramways extensions have been referred to a sub-committee of the Council Joint Improvement and Electric Committee.

Birmingham.—The Birmingham and District Tramway Company having intimated their intention of substituting electric traction for the present system of steam between Birmingham, Smethwick, Tividale, and Dudley, the Rowley Regis District Council have decided to waive their statutory rights of purchase for two years.

Blackheath and Woolwich.—We are glad to note that the local opposition to the London County Council scheme for the establishment of electrical tramways between Blackheath and Woolwich is not meeting with much support. Obviously some means of communication are required, the towns are only about a mile and a half apart, and are already connected by rail, but it is sufficient to state that the railway is in the hands of the notorious

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South-Eastern Company to understand the position of affairs; but even that company, as regards service between Blackheath and Woolwich, can surely claim a record for this part of their system, since three trains only are run east between the hours of 9.2 a.m. and 12.40 p.m., and no attempt appears to be made to run on time. To cap all, one of these trains is taken off on Saturdays. Surely this is a case where electrical tramways are demanded, the traffic should be great, the public will be greatly convenienced, and as regards profits, these tramways will be run in competition with a railway company who charge 10d. for a first-class return, where the distance, going and coming, is not over three miles.

Blackpool.—The Town Council has resolved to apply for sanction to a loan of £42,515 for extensions of the Corporation electricity works in connection with the supply of electricity for tramway purposes.

Bolton.—The new cars for the Bolton and district new tramway system were subjected to tests on Monday and Tuesday, and as these were perfectly satisfactory, the lines to Tonge Moor will be opened for traffic immediately the Board of Trade certificate has been received.

The Council has appointed Mr. H. England to the position of general traffic manager for the electric tramways.

Bootle.—Last week the Council held the necessary statutory meeting to pass a recommendation submitted by the General Purposes Committee, to the effect that an application be made to the Board of Trade authorising the construction of the following tramways to be worked by electric traction in the district:—

Tramway No. 1: An additional tramway in Stanley Road, commencing at Marsh Lane and terminating at the Litherland boundary. Tramway No. 2: A double tramway in Knowsley Road, from Stanley Road to the western extremity of the tramway sanctioned by the Bootle-cum-Linacre Tramways Order of 1884. Tramway No. 3: A double tramway to connect the existing tramways in Rimrose Road with the proposed new tramways in Knowsley Road and with the Seaforth tramway. Tramway No. 4: A double tramway commencing at the terminus of the existing tramway in Strand Road, at the junction with Derby Road, passing along Strand Road westward, Regent Road northward to Lyster Road, and Lyster Road, terminating by a junction with the existing tramway in Rimrose Road.

Bowness.—On October 26th, on the invitation of Mr. Frederick Fowkes, managing director of the Windermere and District Electricity Supply Company, several members and officials of the Ambleside and Bowness District Councils and of the County Council left Windermere on a two-days' visit to Dudley and Kidderminster, for the purpose of inspecting the electric tramways.

Burnley.—The Town Council last week passed recommendations by the Tramways Committee, whose Sub-Committee had submitted plans prepared by the borough surveyor for the reconstruction of the tramway between Padiham and Nelson as a double line (except where impracticable owing to the narrowness of the roadway) on a gauge of 4 feet, and also plans of proposed tramways along the following routes, namely: (1) Yorkshire Street and Brunshaw Road; (2) Todmorden Road from Yorkshire Street to Causeway End; (3) Manchester Road to a point about 100 yards above Roberts Row; and (4) Accrington Road from Mitre Bridge to the junction of Rosegrove Lane, thence over the railway bridge to a point on the north side of the railway. Alderman Armistead gave a lengthy report with respect to the proposed new tramways, and said that after serious consideration, the Committee had decided to proceed by Bill instead of provisional order, and the public would benefit very considerably thereby. He referred to the decision of the Committee to have a 4-foot gauge instead of a 3 feet 6 inches gauge, remarking that Lord Jersey, at a light railway inquiry at Colne, recommended that the larger gauge would be better. The new tramway would be double nearly all the way from Padiham to Nelson. The lines from Padiham to Nelson would involve an expenditure of £67,000, the accessories, such as cars, of which there would be 25, would cost £24,000, and the line extensions up Manchester Road, &c., would mean an outlay of £41,800. It would be optional for the authorities of Padiham, Brierfield, and Nelson to reconstruct their own lengths, or they could arrange for the Corporation to do it. Of course, these figures did not include the purchase of the existing lines, which would be settled by arbitration.

Dartford.—The Urban District Council has resolved to interview Mr. Walter Beer, of Victoria Street, Westminster, on the question of constructing a tramway from the terminus of the Woolwich and South-Eastern Tramways at Plumstead through Erith to Dartford.

Derby—Ashbourne.—On 24th ult. Sir Courtenay Boyle heard the promoters and opponents to the light electric railway order for a line 11 miles in length between Derby and Ashbourne, and four smaller railways necessary to complete such connection. When this order was last before the Board of Trade Sir Courtenay Boyle pointed out that there were several gradients and curves and other points gravely affecting the safety of the public which the Board of Trade officers considered should go back to the Light Railway Commissioners for further consideration, and the matters now to be settled were the engineering points then raised. The objectors were the Derby Corporation, represented by Mr. Etherington Smith and Mr. Gadsby, town clerk, and the Derbyshire County Council, for whom Mr. Hughes Hallett, clerk of the peace, appeared. The promoters were represented by Mr. C. R. Eddowes, solicitor, and Messrs. Cooper & Sons, Parliamentary agents. The first objection raised by the Board of Trade was to the promoters having power to reduce the radius of a curve to 1 chain at the Ashbourne end of the line on the ground of its being a danger to the public. Mr. Eddowes, solicitor for the promoters, said the pace would be slow on the incline going into Ashbourne.—Sir C. Boyle: But the clause, as it stood, would allow them to alter any of the curves on the light railway to 1 chain.—Sir Francis Marindin: One chain is very objectionable.—Mr. R. E. Crompton: We only want it for the line going into the private grounds off the street of Ashbourne, and it will be at a walking pace.—Sir C. Boyle: I have no objection to its being altered to 1½ chains, and that must be done.—Mr. Etherington Smith, for the Derby Corporation, who opposed, wanted to know what facilities the promoters would give at the Uttoxeter Road to the Corporation of Derby to prevent interference with their electric tramways. Among other points dealt with was the objection of the inspecting officers of the Board of Trade to the mode of construction, which they considered unsatisfactory and dangerous. To meet this the promoters offered not to lay guard rails, and to make the roadway level with the rails, in the country by ballast, in the town by means of tarred macadam, the wheels cutting their own groove. Mr. Etherington Smith said the Corporation considered this method was dangerous and unsatisfactory.—Sir Courtenay Boyle said the inspecting officers adhered to their objections, and he could not pass the clause on the present occasion. He would not reject it, however, because he understood the Light Railway Commissioners wished to confer with the Board of Trade upon the subject. He therefore postponed the consideration of the clause.

Dublin.—On 24th ult. electric cars commenced running on the Palmerston Park route, on which they will run right through to Dollymount. The Drumcondra line is also electrically equipped, and will be in full working order in the course of a few weeks. This section will be joined to the Haroldscross system, and cars will then run between Drumcondra and Terenure, *viâ* Nelson's Pillar and South Great George's Street, while the Glasnevin cars will run through Dorset Street and Capel Street to College Green. The only horse lines now running are to and from Drumcondra, Glasnevin, Hatch Street, and between Haddington Road and Sandymount Tower, but all these lines will shortly be run electrically. As soon as the Hatch Street line is completed, the electric cars now running from Parkgate Street to Westland Row will go on to Hatch Street. A new line is in course of formation in Lower and Upper Leeson Street, and is already far advanced.

Dundee.—The proposal to extend the electric tramway line between Dundee and Monifieth, to accomplish which steps have been taken, and further east to Carnoustie, is also engaging attention. In August Mr. Addyman, solicitor, Leeds, the agent for the promoters of the line, was in the district, and the Carnoustie Commissioners appointed a committee to interview him on the point of having the tramway extended to the burgh. Mr. Addyman met the committee, and at his request the views of the Commissioners were submitted in writing. During the intervening period the matter has been receiving the attention both of the promoters and the Carnoustie Commissioners, and in the beginning of October Mr. Addyman again visited the district and indicated to the committee that, subject to a report by the engineer, he was favourable to the tramway being extended to the eastern boundary of Carnoustie. The promoters have now made a communication to the Carnoustie Commissioners, saying that if the district provides the promoters with a roadway which will enable an economical mode of construction to be adopted, the promoters are willing to accede to the Commissioners' request. Mr. Hopkins and Mr. Richie, engineers on behalf of the promoters, visited the district last week, examined the road, and had interviews with committees from both Broughty Ferry and Carnoustie Commissions.

Eccles.—The Town Council on Monday passed a resolution in favour of the promotion by the United Kingdom Tramway Syndicate of a provisional order for the construction of tramways to connect the borough with Urmston, on the one hand, and Whitefield on the other. The line will pass through several urban districts, and each local authority reserves the option of supplying the electric current for traction purposes within its area, at a price to be agreed upon, and also the power to elect, within a reasonable period after the confirmation of the provisional order, to undertake the construction of the tramways, and also, at their option, to provide electrical equipment. The lines are all to be worked on the overhead trolley system, and the cars are "double-deckers." There are at present 31 miles of track, covering some 28 miles of streets.

Exeter.—The City Council is carrying on negotiations for the acquisition, from the Tramways Purchase Syndicate, of the horse tramways now in operation in that city, and it is proposed, when they are under municipal control, to use electric traction for the system, which will be about doubled in length when the outlying suburbs are annexed by the city authorities. The Council has, under the tramway order, compulsory purchasing powers in 1902, but in view of the immediate extension of the city boundaries, it is proposed to acquire the undertaking before that time; and at a meeting of the Council on Wednesday (25th) it was decided to offer the syndicate a 10 per cent. premium on a valuation of the undertaking, to be carried out on the Board of Trade basis. The syndicate's present valuation is £9,300, and they asked for a 40 per cent. premium.

Halifax.—The Elland District Council will not accept the proposals of the Halifax Corporation to extend their system of electric tramways to Elland. The barrier to agreement is as to who shall supply the current. It is probable that Elland will oppose the application of the Halifax Corporation to construct lines through a portion of their district to Brighouse.

Lancaster and Morecambe.—Last week at the Lancaster Town Council meeting the Mayor reported upon the negotiations for the purchase of the tramways from Lancaster to Morecambe, and the proposals for a system of electric tramways by the overhead trolley system.

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Leeds.—The Tramways Committee has decided to accept the tenders of Messrs. Dick, Kerr & Co., for 50 fully equipped electric cars at a cost of £550 per car, making a total of £27,500. The order has been placed in anticipation of the requirements of next summer and autumn, when it is hoped that the Dewsbury Road, Hunslet, Beeston Hill, and Elland Road sections will be ready for working. The first delivery is to take place in the latter part of June, and the contract is to be completed by the end of August. The electric cars for the Chapeltown and Headingley route are, of course, in hand, and it is expected that that section may be at work in less than a fortnight's time.

Limerick.—The Corporation last week passed a resolution in favour of the electric tram scheme. Before and after the meeting the opposing carmen and others of the great Irish public made themselves a little troublesome both outside and inside the building, but a strong force of police succeeded in preventing a too hostile demonstration. The length of the proposed lines is six miles, and it is expected that the construction work may be commenced by January next.

Liverpool.—The Council has resolved to apply for a provisional order for the construction of a tramway (500 yards) which the Bootle Corporation has requested, in order to connect County Road and Bedford Road with the docks. The Council also approved various recommendations for road widening for the electric tramways in the city.

Margate.—A daily paper says that the construction of the electric railway, which was stopped at the commencement of the season, has been resumed, the course taken being along the Marine Terrace to the westward.

Merthyr.—A commencement is about to be made with the construction of the light electric railway here.

Middlesex.—Mr. Gaisby, electrical engineer, has prepared a lengthy report upon the proposed light railways in Middlesex for the County Council. The amount involved in their construction is about £240,000. The Council is going on with the scheme for the provision of light railways in the county.

Motor Dust Carts.—The St. George's (Hanover Square) Vestry has decided to purchase or hire, as an experiment, at a cost not exceeding £500, a motor dust van.

Portsmouth.—The Tramways Committee are completing arrangements for taking over the local tramways from the company at the close of the present year. At an employés' dinner just held, Mr. A. W. White, J.P., the company's manager, was the recipient of a massive silver salad bowl and service. The employés on the Gosport lines presented Mr. White with a silver inkstand. At a meeting of the Tramways Committee, the superintendent (Mr. Roller) reported that he had completed the surveys for the five new sections proposed by the committee. It was decided to have double lines wherever practicable. The arrangements for the introduction of electric traction are now under consideration.

Preston.—The electric tramways, referred to last week, will be 4 feet gauge and equipped on the overhead trolley system.

Salford.—The Town Council on Monday considered a series of resolutions of the Tramways Committee. One resolution was to accept the tender of the Westinghouse Electric Company for the supply of 100 tramcars at the rate of £534 10s. per car, subject to the bodies being manufactured by Messrs. Milnes & Co., of Birkenhead, and the trucks being those known as the Brill trucks. A further resolution was to make application to the Board of Trade for its sanction to the borrowing of £53,450 to cover the cost of the cars. The committee recommended the appointment, as tramway engineer, of Mr. E. Hatton, Birkenhead, at a salary of £240 a year. The several resolutions and recommendations were confirmed. The cars, it was explained, are to be "double-deckers," designed to carry 45 passengers, or more in emergency.

Sheffield.—On 26th ult. a trolley wheel ran off the overhead conductor, the arm struck against a cross standard and was bent. It afterwards became entangled in the guard wires. There was consequently a stoppage of the traffic for a short time.

South Staffordshire.—At a meeting of the Urban District Council of Bilston last week, a communication was received from the Light Railway Commissioners relative to the construction of the South Staffordshire Light Railways. In this it was stated that the Commissioners had settled the order authorising the railway to be made, and that it had been submitted to the Board of Trade for confirmation. It was also stated that the period during which the local authorities of Bilston and Willenhall might take over the portion of the railway in their districts, had been increased from 25 to 28 years.

Stalybridge.—A joint conference was held last week of representatives of the Corporations of Stalybridge, Mossley, and Hyde, and the Urban District Council of Dukinfield, to consider the suggested scheme for providing electric traction and lighting for the four towns named. The suggestion was made some time ago by the Mayor of Stalybridge, and the Corporation decided to invite representatives of the local authorities to discuss the question, and, if possible, to formulate a scheme. After full discussion, a resolution was passed unanimously in favour of the undertaking, and the representatives promised to bring the matter before their respective Councils, and to recommend that each should pay its share *pro rata* towards the expenses of engaging an engineer and defraying the formation expenses.

Tynemouth.—At last week's Council meeting Alderman Armstrong stated that arrangements for the supply of electricity for illuminating and traction purposes were proceeding satisfactorily, and it was anticipated that by Easter they would be able to supply the tramway company with power to work the trams. It would be necessary to appoint an electrical engineer to take charge of the works. The Committee has decided to offer the Market to the tramway company as a tram shed for £4,000.

TELEGRAPH AND TELEPHONE NOTES.

Cable Interruption.—The Eastern Telegraph Company announced on Tuesday that the cable between Delagoa Bay and Mozambique on the east coast of Africa became interrupted on Monday. Telegraphic communication with South Africa is maintained by the cables on the west coast of Africa, which are working well. The cable ship *Great Northern* is due at Delagoa Bay to-day, and the company is endeavouring to send her instructions to stop at the position of the break in the cable.

Glasgow Telephones.—We print the following abstracted remarks from the *North British Weekly Mail* as reflecting the present feeling and situation regarding the municipal telephone question at Glasgow:—"After their long and successful fight for the municipalisation of the telephone, the Glasgow Corporation had the right to expect that on the passing of the Telephone Act of last session they would receive a telephone license from the Postmaster-General without the slightest delay. It was certainly not the intention of Mr. Hanbury, who acted for the Government in carrying the measure through the House of Commons, that there should be any delay in the granting of licenses to municipalities. And it was not the intention of Parliament. The desire was to set up public competition with the National Telephone Company as quickly as possible. But the Post Office is slow to move in this important matter. Immediately after the passing of the Act, in August last, the Corporation renewed their repeated application for a telephone license. It has taken more than two months to obtain a satisfactory answer. The Corporation continued to press upon the Postmaster-General, by means of frequent letters, the desirability of at once letting them have the draft license: but not till last week did he send them the printed form of license which he proposes to grant. Such delay is not creditable to the Post Office. It gives ground for the suspicion that the officials of that Department have not yet quite freed themselves from the influence of the company. While it has taken them so much time to draft the form of license for municipalities, they have found time to prepare and issue an order as to telephonic intercommunication which is very much in the company's interest. No time has been lost by the Telephone Committee of the Glasgow Corporation in considering the terms of the draft license which they have at length received. They have had the choice of two periods of license—one of them extending to December 31st, 1913, and the other extending to December 31st, 1925. The longer period would doubtless have been considered the preferable one, as giving the Corporation more time to make good their expenditure, if the conditions had been the same as for the shorter period. But if the Corporation had asked for a license up till the end of 1925, the Postmaster-General would almost certainly have exercised his power to extend the company's license in Glasgow to the same date. It is most undesirable that the license of the company should be extended a day beyond its original term. The Telephone Committee of the Glasgow Corporation have therefore recommended that the Corporation's telephone license should be for the shorter period—that is, up to December 31st, 1913. At the same time the Committee have applied to the various suburban burghs within the Glasgow Telephone Exchange area for their consent to the Corporation's license for that area. It is of the utmost importance that competition should be established as soon as possible. It is not the Corporation who will be responsible for any delay that there may be in establishing the desired municipal competition. Only the slowness of the Post Office stands in the way. And the Corporation will have to keep on hammering at the Post Office until it does all that Parliament has ordered in connection with the granting of a license."

The G.P.O. and Battersea Vestry.—The Battersea Vestry last week declined to withdraw the condition, attached to consents given to the laying of Post Office pipes, that the pipes are only to be used for telegraph wires. This decision was arrived at notwithstanding the threat of the Postmaster-General to take proceedings in the matter failing compliance within 15 days from October 9th, and that one consent related to the laying of telephone pipes in connection with the Government telephone system for London.

Local Authorities and the London Telephone Service.—At the meeting of the members of the Holborn Board of Works on Monday, Mr. G. Phillips, J.P. (chairman), in the chair, a letter was received from the Vestry of Kensington, stating that an application had been received from the Postmaster-General for their consent to lay conduits for underground telephone cables in the district. They considered that the same course should be followed by all local authorities in the matter, and they thought it desirable that a conference should be called to discuss the subject.—Mr. Dinham moved that they approve of the proposal of the Kensington Vestry. The continual taking up of the streets by public companies for the laying of pipes, &c., was a very serious matter, both to the residents of the particular locality in which the work was being carried on, and to the

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public generally. It would appear that they had no jurisdiction over the companies.—Mr. J. Trenner seconded the proposition. He favoured the convening of the conference in the hope that the collective wisdom of the local authorities would devolve something that would be beneficial to the public.—The proposition was carried unanimously.

At the last meeting of the Clerkenwell Vestry, Mr. T. B. Clay, Metropolitan superintendent of the National Telephone Company, attended this meeting with reference to the refusal of the Vestry to allow the company to lay sections of conduit in certain streets. He stated that having regard to the altered circumstances since the Post Office had obtained the consent of Parliament to set up a competing scheme, the company asked the Vestry to extend the same privilege to them as to the Post Office. Mr. G. Beard, vice-chairman, said that the Vestry refused the application of the company because they did not think the rental offered by them was sufficient. The committee, however, would reconsider the matter, when the Post Office authorities were opening up the roads for the laying down of their system. He moved that the Board adhere to its former resolution, and refuse the application. The proposition was adopted.

Pacific under Survey.—Honolulu papers received at Vancouver on October 10th, contain the news of the arrival there of the survey ship *Egeria* from her trip south to survey the route of the Pacific cable. The *Bulletin* says:—"The British cable survey cruiser *Egeria*, now lying in Naval Row, arrived Sunday evening from a southerly cruise. She will leave at the end of this week for Esquimalt. The line of the proposed British-Canadian-Australian cable has been surveyed, and the *Egeria* has completed her labours in that respect. It is stated aboard the vessel that the deep-sea soundings made between the proposed cable line and these islands are purely for scientific purposes. As the whole of the Pacific Ocean has to be sounded anyhow, no particular significance is attached to the survey between the Hawaiian Islands and the main line. It is not at all improbable, however, that a branch cable extending to Honolulu, and so connecting this point with the American coast and Australia, will be established. The British cable will very likely be the first telegraphic connection between Hawaii and the rest of the world. A Honolulu branch would greatly increase the value of the British cable. The officers aboard the *Egeria* are at present very busily engaged making up their reports. On September 2nd the *Egeria* was in Kealakakua Bay, Hawaii. On her recent southerly cruise the survey ship went about 700 miles toward Fanning's Island, taking soundings every 20 minutes, and on her return soundings each day. The *Egeria* was to have left Honolulu on the morning of September 28th.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Cayenne-Pinheiro	... Oct. 11, 1899 ...	...
Corea-Japan	... Aug. 7, 1899 ...	...
Gibraltar-Tanger	... Oct. 19, 1899 ...	...
Havre-Waterville	... Oct. 25, 1899 ...	...
Jamaica-Colon	... June 30, 1899 ...	...
Latakia-Cyprus	... June 20, 1899 ...	...
Para-Maranham	... Oct. 20, 1899 ...	Oct. 28, 1899 .
Trinidad-Demerara (1871 original)	Oct. 20, 1899 ...	...
Do. do. (1891 duplicate)	Oct. 6, 1899 ...	...
Zanzibar-Mombasa	... Oct. 27, 1899 ...	...
Lourenco Marques-Mozambique	... Oct. 31, 1899 ...	...
Landlines.		
Colombian Government lines to Bogota	... Oct. 31, 1899 ...	...
Communication with Mafeking	... Oct. 13, 1899 ...	...
Communication with interior of Venezuela	... Sept. 23, 1899 ...	Oct. 27, 1899
Communication with all offices beyond the Orange River	... Oct. 18, 1899 ...	...
Cuban Government lines ...	... Oct. 30, 1899 ...	...
Lines from Haiti to Gonaives, Plaisance, Cape Haitien, Port au Prince to Miribalais and Jacmel	... Aug. 18, 1899	... Oct. 25, 1899
Lines from Haiti to Gros Morne and Port de Paix... ...	... Aug. 18, 1899 ...	...
Saigon-Bangkok	... Oct. 24, 1899	... Oct. 25, 1899

Wireless Telegraphy.—The United States Navy Department has received information that the battleship *Massachusetts* and the cruiser *New York* have succeeded in keeping up communication with each other at sea, whilst as far apart as 36 miles, by means of wireless telegraphy.

CONTRACTS OPEN AND CLOSED.

OPEN.

Accrington.—November 18th. The Corporation wants tenders for cables, wires, street boxes, and connections for electric lighting. See "Official Notices" this week.

Birkenhead.—November 14th. The Corporation wants tenders for 13 single-deck and 31 double-deck electric motor cars, also for boilers, economisers, mechanical stokers, steam dynamos, booster and battery. See "Official Notices" October 20th.

Birkenhead.—November 14th. The Corporation wants tenders for switchboard and instruments for the South End tramway generating station. See "Official Notices" October 27th.

Bradford.—November 9th. The Corporation is inviting tenders for 25 electric tramcar bodies, electrical equipments for same, and trucks and trolleys for ditto. See three of our "Official Notices" October 27th.

Bray.—November 20th. The Council wants tenders for jet condensing plant for electricity works. See "Official Notices" this week.

Croydon.—November 13th. The Guardians want tenders for electric wiring and fitting at the workhouse, infirmary, and union offices. See "Official Notices" October 27th.

Denmark.—December 28th. The Corporation of Aarhus is inviting tenders for the water-tube boiler plant, steam dynamos and switchboard, accumulators for electricity works. From our "Official Notices" this week further particulars may be obtained.

Essex.—November 27th. The Governors of Felsted School, Essex, are inviting tenders for boiler, two 27-kw. steam dynamos, condenser, pipework, accumulators, cables, and switchboard for electric lighting. See "Official Notices" October 27th.

France.—November 14th. Tenders are being invited by the French Post and Telegraph authorities in Paris for the supply of 10,000 metres of pipes 80 mm. diameter for pneumatic despatch tubes. Tenders to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Glasgow.—November 14th. The Corporation wants tenders for two 800-h.p. compound vertical auxiliary engines for the new tramway power station at Port Dundas. See "Official Notices" October 13th.

Glasgow.—November 20th. The Electricity Department wants offers for 10 miles of 2-inch cast-iron pipes. See "Official Notices" October 13th.

Hoylake and West Kirby.—November 15th. The Council is wanting tenders for Lancashire boilers, superheaters, economiser, steam engines, alternators, motor alternator, crane, wiring, steam, &c., piping, switchboards (high and low tension), batteries, transformers, concentric mains, &c., &c. See "Official Notices" October 13th.

Islington.—November 22nd. The Vestry wants tenders for condensing plant for the electricity works. See "Official Notices" this week.

Leeds.—November 13th. The Corporation wants tenders for wiring, electric lamps, switches and fittings, for the Union Street Baths. See "Official Notices" this week.

Llandudno.—November 6th. The Council wants tenders for three 150-kw. high speed engines and dynamos, also motors and boosters. See "Official Notices" October 20th.

Maidstone.—November 6th. The Corporation wants tenders for steam dynamos, balancers, boosters, boilers, economiser, surface condenser and feed pumps, switchboard, &c., battery, crane, mains, arc lamps and posts, and electricity meters. See "Official Notices," October 20th.

Middlesbrough.—November 22nd. The Electric Lighting Committee wants tenders for condensing plant and pipe-work for the electricity works. See "Official Notices" October 20th.

Newcastle-on-Tyne.—November 30th. The Tramways Committee wants tenders for two 1,000-h.p. steam dynamos for electric tramway works. See "Official Notices" October 27th.

Newington.—November 13th. The Vestry wants tenders for a 400-kw. steam dynamo and continuous current transformer for the electricity works. See "Official Notices" this week.

Pontefract.—The Guardians are to invite tenders for the lighting of the workhouse premises by electricity.

Poplar.—November 16th. The Board of Works wants tenders for laying mains upon the solid system for three-wire continous current, viz., about 17 miles of five-core network, six miles of six-core feeders, also service cables and accessories. See "Official Notices" this week.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

Portsmouth.—November 17th. The Council invites tenders for the supply of 40, 60, or 80 electric tramcars. See our "Official Notices."

Spain.—November 7th. The Spanish Ministry of Public Works in Madrid is inviting tenders, until November 7th, for the concession for the construction and operation of an electric tramway in the town of Cadiz. Particulars may be obtained from, and tenders are to be sent to, La Direccion General des Obras Ribleas, Madrid.

Spain.—November 23rd. Tenders are being invited until November 23rd by the municipal authorities of Chiclana de la Frontera (Cadiz province) for the concession for the electric lighting of the town during a period of five years. Tenders are to be sent to Le Secretariat del Ayuntamienti de Chiclana de la Frontera (Cadiz), whence particulars may be obtained.

(*Continued on page 724.*)

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SOUTH SHIELDS CORPORATION ELECTRICITY WORKS.

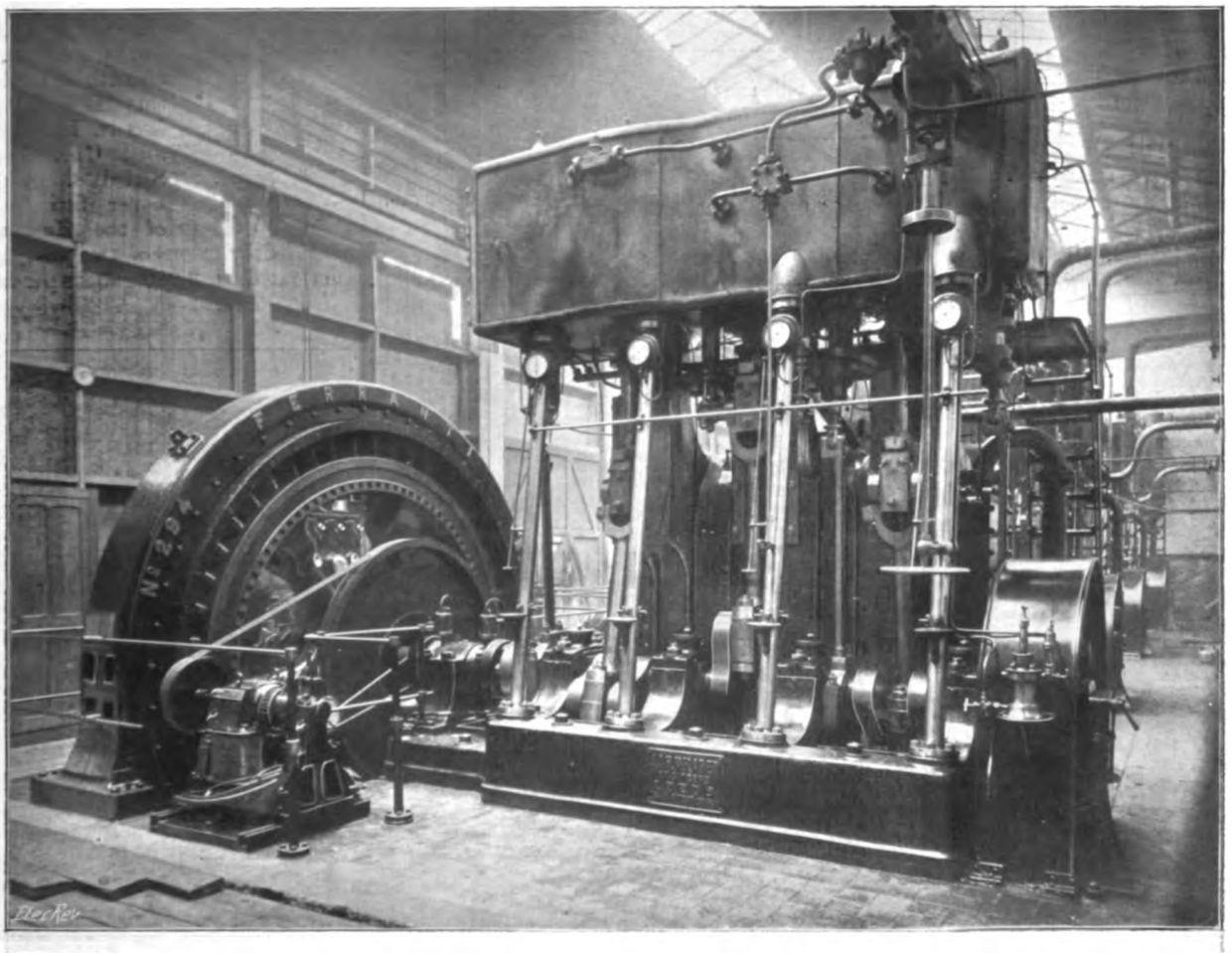
The ancient Tyneside borough of South Shields, although well known to those who go down to the sea in ships, lies in a corner of Durham not often visited by the ordinary business man; yet it is by no means lagging behind the times, and can even give points to its big neighbour, Newcastle-on-Tyne, where alternating current arc lamps are used for street lighting, and the alternators are *not* run in parallel. No one who is familiar with the latter city can have failed to note the occasional momentary blink, often amounting to total extinction, of the glow lamps when the circuits are transferred from one machine to another, or can uphold the street lighting by arc lamps as anything but feeble.

Since 1896, South Shields has been supplied with a 24-hours service of electricity, generated in a station at the riverside at High Shields. The station possesses its own quay, where coal is delivered in barges at the low rate, to Southern ideas, of 8s. 9d. per ton.

The buildings are at present in a transitional stage, large extensions being in progress, while still larger additions have been provided for. The original scheme included engine room, boiler house, and pump room, as well as store rooms and a range of offices; the engine room is being more than doubled in size, and the offices are to be removed entirely to a part of the site facing on an important thoroughfare.

It often happens that a municipality, when first adventuring on the unknown perils of an electricity supply, displays its caution by expending the smallest possible capital upon the undertaking; it is no small testimony to the intrinsic merits of electric lighting, that in spite of this initial handicapping tendency, the vast majority of such undertakings have attained success, and have ultimately absorbed a capital outlay, the bare mention of which, in the preliminary estimates, would have ensured the summary rejection of the scheme! The undertaking here described was no exception to this rule; combining the cautious qualities of Yorkshiremen and Scotsmen, the hard-headed Tynesiders would hear of nothing but a moderate beginning —with the result that the demand has always been ahead of the supply.

The first installation was designed and carried out by Mr. J. A. Jeckell, the borough electrical engineer, who acted as consulting engineer to the Corporation, and the station commenced supply in September, 1896, with but 750 lamps connected. The subsequent progress of the undertaking, under Mr. Jeckell's energetic supervision, is strikingly shown by the following data :—



200-kw. Steam Alternator.

Quarter ending September 30th.	Lamps connected.	Works' cost.
1897	5,969	4·0d.
1898	11,319	2·4d.
1899	22,576	1·4d.

The rate of increase of the lamp connection is evidently almost 100 per cent.; while the handicap due to starting in a small way is well shown in the decreasing works' cost. We

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may add that from March, 1897, to March, 1898, the lamp connection was practically at a standstill, because the generating plant was loaded to its maximum safe limit, and the new plant, which was on order, was delayed by the engineers' strike; in spite of this, however, the undertaking has paid over 6 per cent. per annum on the total capital expended since September 30th, 1898, *i.e.*, two years from the commencement of supply. The original scheme was estimated to cost £28,000; up to the present the capital expenditure has amounted to £75,000, and when all the contracts for extensions are completed the sum total will be £110,000.

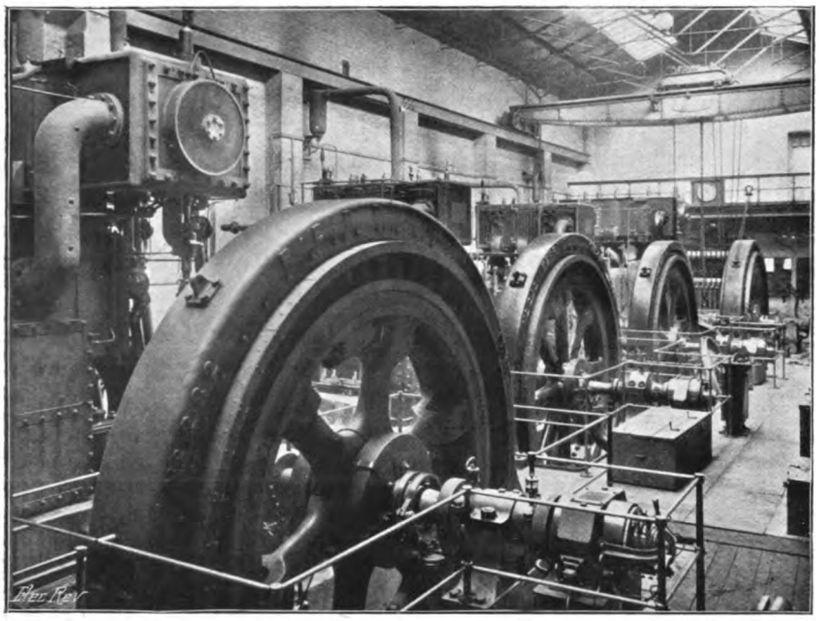
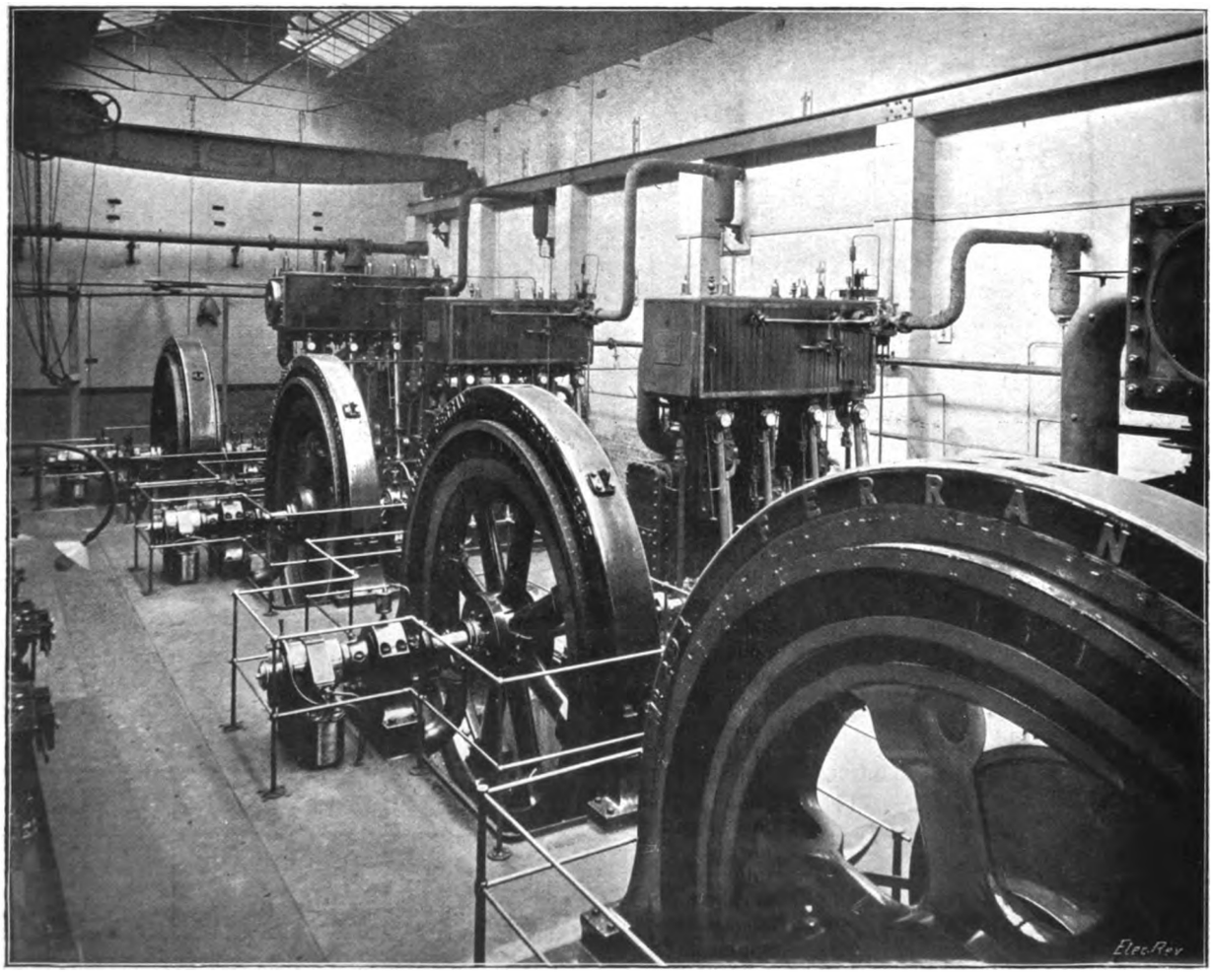


Photo by] [PARRY.

ENGINE ROOM, LOOKING TOWARDS SWITCHBOARD.

The first thing noticeable about the plant is its compactness, if it is not, indeed, crowded. This, no doubt, results from the strong marine engineering bias of the Tynesiders.



GENERAL VIEW OF ENGINE ROOM.

The boiler house adjoins the quay, and contains three marine boilers, each 11 feet diameter × 10 feet 6 inches long, and capable of evaporating 5,000 lbs. water per hour at a pressure of 160 lbs. per square inch. The curved part of each boiler is made of a single plate, there being no circumferential seam in the centre; there is no brickwork about the boilers, but each is provided with a steel chimney 40 feet high, which affords an excellent draught. Two of these boilers are by Messrs. Black, Hawthorne and Co., the third by Messrs. Robert Stevenson & Co. An additional boiler, 14 feet 6 inches diameter × 10 feet 6 inches long, capable of evaporating 10,000 lbs. per hour, is about to be installed; this is made by Messrs. Eltringham and Co., South Shields. All the boiler fittings are of the Hopkinson type. Feed water is provided by means of two compound Worthington pumps, each rated at 2,000 gallons per hour, but capable of 50 per cent. larger output. For surface condensing, similar pumps, of the vertical type, lift water

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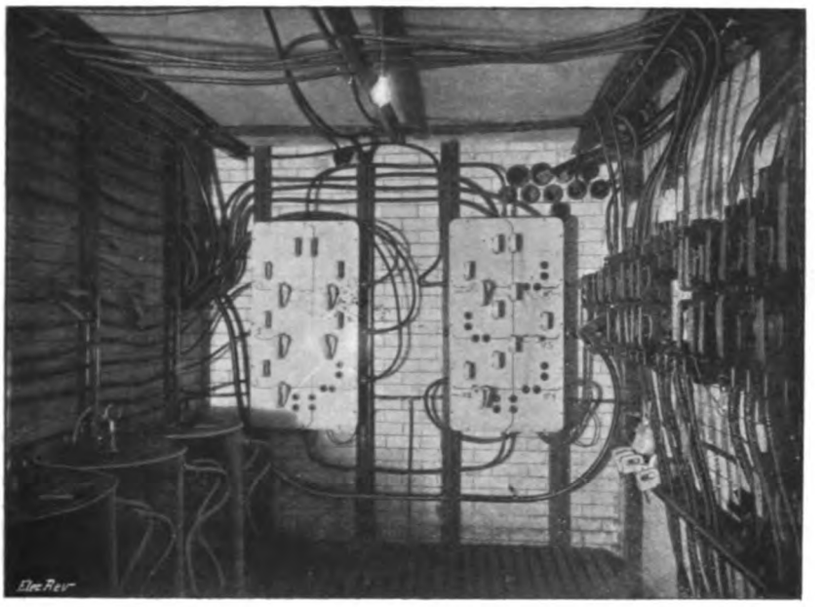
18 feet from the river, and deliver 25 feet to a tank overhead, whence the water flows by gravity through the condensers. Each of these pumps can raise 30,000 gallons per hour; they are situated at the east end of the boiler house in a special pump room. A new pump, of the fly-wheel type, capable of raising 80,000 gallons per hour, is to be put down in the same room, while the feed pumps are to be removed and installed with a new Weir pump in the same end of the boiler house; a Weir evaporator is already in operation, supplying the make-up water for the boilers, as the water supply is too bad for direct use. A grease separator is also to be installed. There are two separate hot-wells, and the feed piping is completely duplicated. A separate condenser is used for the auxiliary plant.

The steam piping, of steel, with copper bends, is arranged as a ring main, though this is not regarded as a desirable arrangement, simple duplicate supply being recommended; it is found that, unless the *whole* of the ring main is kept hot, the unequal expansion of the hot and cold legs causes the joints to start, precipitating the very troubles which it was sought to avoid.

Very large steam separators of simple design are connected with the steam range on both legs, and a similar one is applied to each engine.

The generating sets at present installed are four in number, each consisting of a Ferranti alternator coupled to a McLaren engine. Two of the sets are rated at 100 KW., and two at 200 KW. each; the alternators have magnet fly-wheels and stationary ironclad armatures, working at 2,000 volts, 50 periods per second, 125 revolutions per minute. The construction of the magnet wheels is striking; each fly-wheel was made in halves, the arms being separate at the hub to prevent internal stresses; the shaft was erected in position, the fly-wheel mounted thereon, and steel rings shrunk on projections from the arms next the shaft, binding the whole together. There is no feather or key, the wheel being driven by friction only; although the parts had never been assembled before, they fitted perfectly in every case.



SUB-STATION.

RECTIFIERS AND ARC SWITCHBOARD.

The alternators are driven by triple expansion three-crank vertical marine engines of the open type, made by Messrs. McLaren, of Leeds; they all run at 125 revolutions per minute, with a piston speed of 500 feet per minute, and these standards will be adhered to in carrying out extensions. Each engine is combined with its own surface condenser and air pump, a system which possesses obvious advantages; a vacuum of 26 inches of mercury is easily maintained or even exceeded. There is a duplicate service of condensing water.

The speed of the engines is controlled by McLaren's patent shaft governor, which can be adjusted while the engine is running. Forced lubrication is adopted in the main alternator bearings, which are separate from the engine bearings, by means of small pumps driven by eccentrics on the shaft. So free is the running that we were told one day a 200-KW. set ran for ¾ hour after steam had been shut off, both at the engine stop-valve and at the steam range. A new engine room has been erected adjacent to the old one, large enough to accommodate four 500-KW. sets of similar type; foundations have been put in for two of these, the alternators being supplied by Messrs. Siemens Bros. & Co., and Messrs. T. Richardson and Sons, Hartlepool, respectively, with McLaren engines. Still larger extensions are contemplated, and Mr. Jeckell has prepared the plans for four 1,000-KW. sets in

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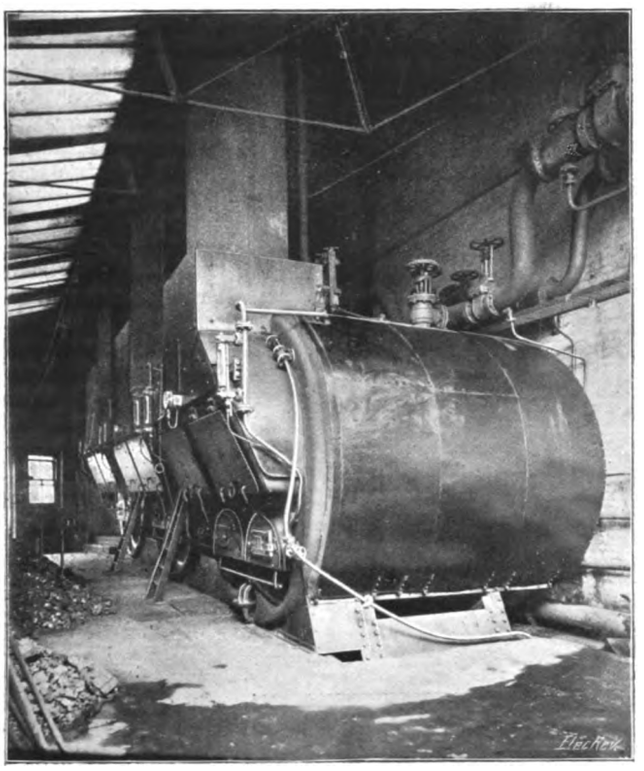
addition to those mentioned; a row of 12 boilers is to be laid down on the outer side of the extended station.

A 10-ton travelling crane, by Messrs. Marshall, Fleming and Jack, of Motherwell, spans the present engine room; a 15-ton crane is being erected in the new engine room by the Dumfries Iron Company.



Boilers.

Along one side of the station are arranged three Ferranti rectifiers, with the arc lighting switchboard; one rectifier is a stand-by, but another will shortly be added, and a third arc lamp circuit connected up. The performance of these machines has given complete satisfaction; we were informed that this can only be ensured by devoting great attention to them and keeping them in first-rate order.

The main switchboard consists of 30 panels of the Ferranti standard type; these are divided in the middle so that the board may be worked as a whole, or either half independently of the other. The board has recently been doubled in size, the new portion being, in fact, as yet unfinished. Duplicate oil fuses are used, so arranged that one can be substituted for another, or a new one inserted without interrupting the circuit or short-circuiting the contacts, and with perfect safety to the operator. Each alternator and feeder is in series with an edge-wise ammeter of Messrs. Ferranti's manufacture. The rheostats for controlling the excitation of the alternators are below the switchboard, and the regulating hand-wheels are so arranged that they rotate in the same direction as the pointers of the voltmeters over the switchboard, thus ensuring the collaboration of hand and eye in paralleling.

There is nothing combustible near the switchboard; the floor is of concrete, and the ceiling above is protected by slate slabs. The importance of avoiding the use of wood near switchboards, and even upon them, we have emphasised before. In this case exceptionally low terms were obtained from the insurance offices, on account of the fireproof nature and absolute safety of the construction.

Each alternator has its own exciter. There was an additional exciter for stand-by, with a two-way switchboard, to enable any alternator to be excited, either from the spare machine or from its own, but this was never required, and has been put out of gear.

A Thomson-Houston watt-hour meter is in series with each machine; no other watt-hour meters are used in the station. Mr. Jeckell finds that the average total loss in circuits during the year practically does not exceed 2½ per cent. of the capacity of the transformers installed.

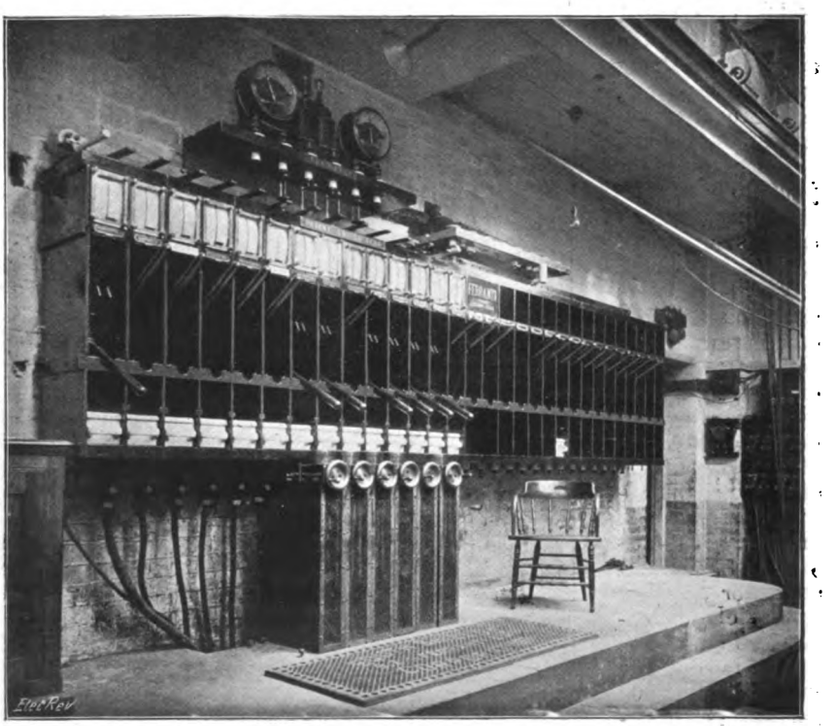
Great care has been taken to ensure safety to the switchboard operators. The main board is mounted on a platform raised above the general floor level, from which all unauthorised persons are excluded, and a teak dais runs along in front of the rectifiers, on which the attendants stand.

The test room opens from the dynamo room, and is equipped with a set of Kelvin ampere gauges reading to 2·5, 20, and 100 amperes respectively, as well as Kelvin multi-cellular voltmeters reading to 100 and 250 volts.

The public lighting is done with 70 12-ampere Brockie-Pell arc lamps, 60 of which are divided between the two rectifier circuits, and 10 are supplied from transformers; 20 more public lamps are to be added with rectified supply. The arc lamp-posts are of graceful design, and were supplied by Messrs. Allen, of Glasgow. The arcs are cut off at 11.30, before which hour the police turn on glow lamps, two of which are carried on each arc lamp-post; a great advantage of this system lies in the fact that, in case of mishap to an arc lamp, the police switch on the glow lamps and report the trouble.

The distribution to private consumers is carried out by means of sub-stations, of which two are at work and five in course of construction. In the early days, transformers in street boxes were used; these have now been removed to outlying districts where the demand is more scattered.

Mr. Jeckell was formerly opposed to sub-stations, which he described as "damp dirty holes"; when, however, the exigencies of the demand rendered them practically inevitable, he determined that his own sub-stations should not be of the above description! They are all of standard size, 17 feet long × 9 feet wide × 9 feet deep, with an entrance shaft 3 feet square at one end—this was found necessary to prevent the entry of rain when the station was opened in



Main Switchboard.

wet weather. The walls are double, of 9-inch brick outside, 9 inches inside, with a 3-inch space between, and lined with white glazed bricks. The inner wall is made waterproof with compound in the middle of its thickness, and the cavity between the walls is drained. A 4-foot square copper

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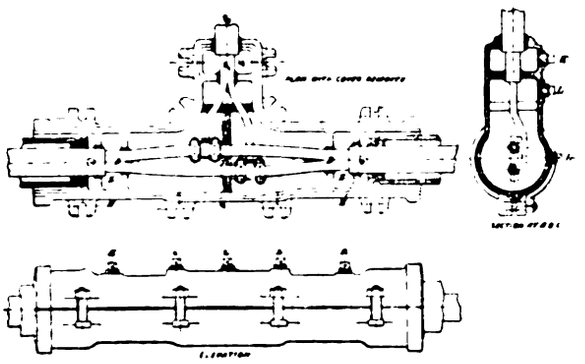
plate is buried in coke and damp earth under the station, to which a 1 inch × ⅛ inch copper tape is riveted and soldered; the ends of the tape are brought into opposite sides of the chamber and riveted to a similar conductor running round the latter, which is used as the earth connection for all purposes, and ensures a doubly reliable path to earth.



D D, cables; E E, stuffing boxes; K, L, plug holes.

Jeckell Junction Box.

Each sub-station is supplied by a separate feeder from the works; two other feeders are tapped also, for a stand-by; the secondary network from each station is independent of the others, but can, if required, be joined up at once by means of street switches. There are six 30-KW. transformers in each chamber, one of these being spare; this is a larger capacity than is usually permitted for a single station, but Major Cardew passed the designs on account of the precautions which had been taken to ensure the safety of the operators. There are two high pressure boards, one connected with the feeders, the other with the transformer primaries; all feeders come in on the right-hand of the feeder board, and those going on to other stations leave on the left-hand. There are 10 low pressure circuits from every sub-station, each provided with a disconnecting fuse, and one ammeter, which can be put in any circuit.

Messrs. Ferranti supplied the high pressure, and Messrs. Fowler, of Leeds, the low pressure switch gear for the new sub-stations.

All the sub-stations are exactly alike in accordance with Mr. Jeckell's maxims, "simplicity and standardisation," which are in evidence in every department of the system; in this connection we may mention that we ourselves insisted on these two points in a leaderette last week.

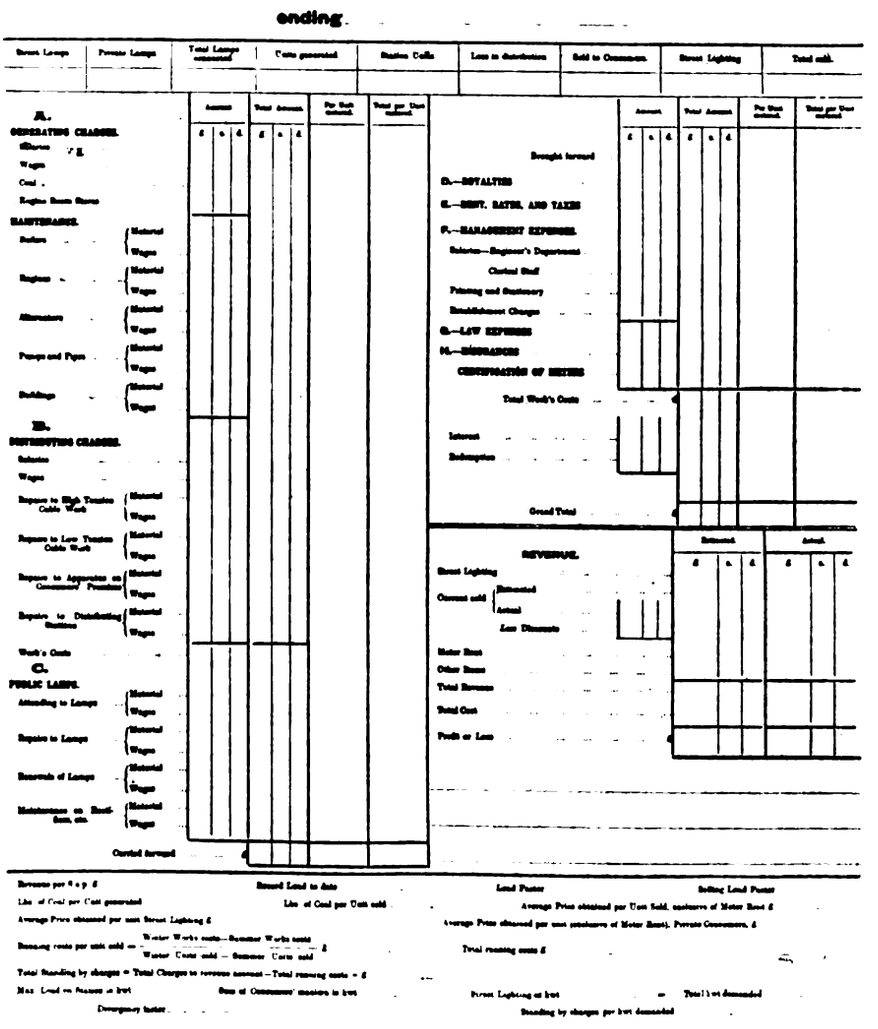
The mains are chiefly of the British Insulated Wire Company's manufacture, concentric and lead covered. Formerly vulcanised rubber insulated cables were employed, but these have been dropped, solely on account of their greater cost. The cables are drawn into cast-iron pipes, one in each, these being found cheaper than earthenware ducts for use in Shields, except where there are more than three ducts together. The pipes have the advantages over armour, that they can be laid without opening great lengths of roadway to see if the cable must pass under any obstruction; they afford facilities for removing faults; and they are not damaged by picks. A special junction box, designed and patented by Mr. Jeckell, and made by Messrs. Smith, Patterson and Co., of Blaydon-on-Tyne, is used for house services; our figure shows the details of the box, as used for twin cables. The pipes are cut where a service connection is required, the joints made, and the lower half of the box adjusted in place with wood brackets to separate the conductors. The cover is then bolted on and the box filled up with compound. These joints are only intended for low pressure work, but have been tested up to 2,500 volts successfully. The holes, H H, are left open to relieve the joint of water-pressure in the event of water gaining access to the pipes on a slope.

All the high pressure mains are eventually to have a cross-section of 0·15 square inch; the low-pressure distributors are to be of 0·15 square inch for 220 volts, and 0·25 for 110 volts, both pressures being in use. About 10,000 yards of mains have been laid this year, and large extensions are in progress; all mains are being laid by Corporation workmen. The system now in hand provides, in fact, for an output of 2,500 KW.

Disconnecting fuse-boxes are put in consumers' houses, but no double-pole switch is stipulated for. Teak meter boards on insulators are used, with either Thomson-Houston watt-hour, or Chamberlain & Hookham ampere-hour meters.

The Wright method of charging is in use throughout the system, at the rate of 7d. for the first hour and 2d. afterwards.

The system of keeping the log-sheets devised by Mr. Jeckell is specially interesting; to make it clear we reproduce a page of the log-book. This volume contains 52 pages headed "Week ending," &c.; 12 headed "Month ending"; 4 headed "Quarter ending"; 2 for the half years, and 1 for the whole year. Every week the particulars in the body of the page are entered; these are summarised every month, then again every quarter, and so on;



Typical Page from Station Log-Book.

the last page, practically without further treatment, constitutes the Board of Trade returns. The system appears to be almost automatic, and it is obvious that the chief engineer can by its means at any time ascertain the exact condition of affairs to date, and the progress of the undertaking as compared with previous years, with perfect ease. The particulars contained in the lower portion of the

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page are not required except at the half years, &c., but are retained throughout for the sake of uniformity. Loose sheets, identical with those in the log-book, are handy for furnishing periodical reports, &c.

In conclusion, we have to express our obligations to Mr. Jeckell, the borough electrical engineer, who spared no pains to impart to us full information on all points, as well as to Mr. Robertson, assistant engineer, and to Mr. W. Parry, for permission to make use of a photograph of the works.

CONTRACTS OPEN AND CLOSED.

OPEN.

(*Continued from page* 718.)

St. Pancras.—The Vestry wants offers for the supply of temporary generating plant for the Regent's Park electricity works. See "Official Notices" October 20th.

Swansea.—November 20th. The Corporation wants tenders for five Lancashire boilers with jet condensing plant, feed pumps, economiser, piping, &c., for electricity works. See "Official Notices" this week.

Warsaw.—The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul-General at Warsaw, stating that tenders are invited by the municipality of that city for the construction of freezing chambers and electric lighting in the covered market halls. The latest date by which the tenders have to be sent in has not yet been fixed. Such particulars as have been received may be examined at the Commercial Department of the Foreign Office between 11 a.m. and 5 p.m.

Wolverhampton.—November 13th. The Lighting Committee wants tenders for two 500-KW. direct coupled generating sets for the electricity works. See "Official Notices" this week.

Wrexham.—November 8th. The Council wants tenders for boiler house plant, engine house plant, dynamos, switchboard, mains, posts, battery, meters, crane, and buildings for electricity works. See "Official Notices" October 13th.

CLOSED.

Blackburn.—The Blackburn Corporation has placed orders for 40 60-passenger cars with the British Thomson-Houston Company, and 20 60-passenger cars with Dick, Kerr & Co., to the specification of Messrs. Lacey, Clirehugh & Sillar.

France.—The French Post and Telegraph authorities in Paris have just given out contracts for 200 tons of copper wire, 4 mm. in diameter, as follows:—La Compagnie Francaise des Metaux, Paris, 50 tons at 2,215 francs per ton; Messrs. Lazare, Weiller & Co., Paris, 50 tons at 2,220 francs; and La Société d'Electro-Metallurgie, Paris, 50 tons at 2,149 francs, and 50 tons at 2,097½ francs. Messrs. Lazare, Weiller & Co, are also to supply 250 tons of copper wire 5 mm. in diameter at from 2,210 francs to 2,240 francs per ton. La Société Francaise d'Electro-Metallurgie, 100 tons ditto. at from 2,049 francs to 2,097½ francs, and La Compagnie Francaise des Metaux, 50 tons ditto. at 2,190 francs.

Germany.—The municipal authorities of Dortmund lately called for tenders for the supply of a 1,000-H P. engine and dynamo required for the extension of the central station. The lowest tenders submitted were: for the engine, £3,162, Messrs. Borsig; and for the dynamo, £2,200, the Allgemeine Electricität's Gesellschaft, both of Berlin.

London.—The Battersea Vestry on Wednesday accepted the tender of Messrs. J. G. Jones & Co., amounting to £860, for the stanchions, columns, and cantilevers required for the electric light station, and that of Messrs. H. Young & Co., at £3,797, for the steel girders, joists, and bolts.

Salford.—At the meeting of the Town Council on Monday the tender of the Westinghouse Electric Company for the supply of 100 tramcars at £534 10s. per car was unanimously accepted. Alderman Linsley thought the car selected was the best in the country. The tender of Galloways, Limited, for boilers and fittings required for the Strawberry Road electric station, amounting to £15,200, was also confirmed.

The committee is arranging to set lines in Cross Lanes and Trafford Road, which it is thought will be a capital training ground for car-drivers.

Shoreditch.—The Vestry of St. Leonard, Shoreditch, has accepted the estimate of Messrs. Buck & Hickman for supplying the necessary engineering tools, including a lathe, the amount being £152.

Waterloo-with-Seaforth.—*Tenders and Contracts* says that the following tenders have been accepted by the District Council for the supply of steel rails, construction of about 1 mile 5 furlongs of tramway track, and laying of about 2,806 superficial yards of wood paving and 26,147 superficial yards of granite sett paving. Points and crossings: Askham Brothers & Wilson, Sheffield. Rails, fish plates, joints, and tie-bars: P. and W. Maclellan, Irongate, Glasgow. Paving road and laying tramway track: Nuttall, Old Trafford, Manchester.

Wigan.—The Council has resolved that the tender of Messrs. Pickaley, Sims & Co., Leigh, for £586 4s. 2d., for iron and brass castings, be accepted.

FORTHCOMING EVENTS.

Friday, November 3rd.—At 8 p.m. The Institution of Junior Engineers, at the Westminster Palace Hotel. Presidential address by the Hon. Charles A. Parsons, F.R.S.

At 7.30. At Newcastle-on-Tyne, first meeting of the session of the North-East Coast Institution of Engineers and Shipbuilders.

Monday, November 6th.—At 7.30 p.m. Society of Engineers at the Royal United Service Institution, Whitehall. Paper on "The Electrolytic Treatment of Complex Sulphide Ores," by Mr. Sherard Cowper-Coles. Synopsis:—

Introduction—Cost of distillation process—Characteristics of sulphide ores—Watt's process—Diffenbach's process—Ashcroft's process—The Siemens-Halske process—Hoepfner's process—Mohr's process—Swinburne's process—Cowper-Coles's process—Crushing, Roasting, and Screening the ore—Zinc leaching—Treatment of fines—Epuration tanks—Electrolysing cells—Best form of cathode—Best material for anodes—Zinc deposition—Effect of copper in the electrolyte—Zinc sponge—Cost of depositing zinc—Weight of zinc deposited—Manufacture of zinc white and zinc sulphate—Manufacture of white lead—Diagram of the Cowper-Coles Cyclical process.

Tuesday, November 7th.—At 8 p.m. Institution of Civil Engineers. Address by Sir Douglas Fox, president, and presentation of medals and prizes awarded by the Council. Reception by the President in the library after the meeting.

Friday, November 10th.—At 5 p.m. Physical Society meeting in the Physical Laboratory of the Central Technical College, Exhibition Road, South Kensington (by kind invitation of Prof. Ayrton, F.R.S.) Agenda.—1. "Contact Electricity." By Mr. F. S. Spiers. 2. "On the Heat of Formation of Alloys." By Mr. J. B. Tayler.

Tuesday, November 14th.—Institution of Civil Engineers. "The Waterloo and City Railway," by H. H. Dalrymple-Hay, M.Inst.C.E.; "The Electrical Equipment of the Waterloo and City Railway," by B. M. Jenkin, Assoc.M.Inst.C.E.

Wednesday, November 15th.—Society of Arts opening meeting. Address by Sir J. Wolfe Barry.

Thursday, November 16th.—At 8 p.m. Institution of Electrical Engineers' opening meeting. Presentation of premiums and inaugural address, by President S. P. Thompson, F.R.S.

Tuesday, November 28th.—Manchester Society of Junior Electrical Engineers. Meeting at Deansgate Hotel, Manchester. Paper by Mr. J. H. Henderson on "Aluminium, Its Treatment and Use, as Applied to Electrical Engineering."

Wednesday, December 6th.—Institution of Electrical Engineers' annual dinner, Grand Hall, Hotel Cecil.

NOTES.

Science Gossip.—The writer of "Science Gossip" in the *Athenæum* for the present week begins his polite chatter by calling attention to the ways of the librarians at the Patent Office Library. He has this against them, that the Royal Society publications bearing the date of January are not put upon the library table until late in October. This, of course, is a horrible crime, but, unfortunately, the writer of "Science Gossip" has jumped upon the wrong criminal. No doubt the *Athenæum* receives the Royal Society publications on the date of publication, and the editor is probably aware of the "lag" between the date printed on the cover, and the date of arrival at his office. It is one of the idiosyncrasies of those responsible for Royal Society publications. The fact that the publication in question, dated January 23rd, was only in our own hands this week, enables us to vindicate the librarians of the Patent Office Library. For our own part, we have nothing but praise for them; notwithstanding the heavy work entailed by the change of premises, they are always able to find you the book you want, and to help you to a reference.

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Thawing Out Pipes by Electricity.—The *Canadian Engineer* gives some particulars as to the current needed to thaw out water pipes by electricity by the system of Wood and Jackson, who report that to thaw out a 1½ service pipe of iron or of lead requires 200 to 250 amperes. With 125 amperes it will require four times as long to effect the same result, and with over 250 amperes there is liable to be excessive heating of brass connections. Iron pipe must be carefully watched to avoid overheating at joints. A transformer has ordinarily been used, but in some cases dynamos have been employed direct. The source of current should have not less than 50 volts pressure. To thaw out 500 feet of 6-inch main in half an hour demands 800 amperes. This will also serve for 500 feet of 12-inch main if applied for one hour and so on, and for mains the source of current should have at least 200 volts pressure. In thawing mains connection is made to two hose nozzles, screwing the wire hard up by means of the cap. After thawing water must be run for half an hour. Three-quarters of 1 H.P. per foot of pipe for half an hour is the power necessary for a 6-inch main; $\frac{1}{16}$ H.P. will serve a 1-inch pipe, and ¼ H.P. will thaw out a ¾ service pipe on the same basis. In thawing out a house service connection is made to the service in the house and to the street main, and the lead in the house is in series with iron plates in a bucketful of salt water as a variable resistance to adjust the current. Thus if the transformer primary has 2,000 volts, the secondary 50 volts, the current should be, say, 15 amperes. Water usually begins to flow in from 10 to 60 minutes. The operation will not damage the pipes, though it will frequently reveal splits. The value of the system is stated to be considerable, for the loss in 1898 to insurance companies was £300,000, caused by primitive methods of thawing out pipes. We suppose it would be too much to expect a London water company to use such a modern method. As a rule, our London companies confine their energies principally to making up high bills, but the supply of water is hardly considered worthy of notice.

Obituary.—The *Times* says that last Friday information reached the School of Military Engineering, Chatham, by cable from Teneriffe, of the death by drowning of Major (local Lieutenant-Colonel) A. E. Wrottesley, Royal Engineers, in command of the telegraph battalion now on its way to South Africa. Colonel Wrottesley embarked at Southampton the previous Saturday with his men and equipment. He had just been gazetted Director of Telegraphs with the Army Corps under Sir Redvers Buller, and was accorded local rank of lieutenant-colonel while so employed. Previously he commanded the Second Division Telegraph Battalion Royal Engineers. Colonel Wrottesley entered the Royal Engineers, at the age of 19, in 1874. He had no war service.

The Automobile Situation.—Mr. H. P. Maxim's statement in *Cassier's Magazine* as to the electric cabs in London, does not come very *apropos* when the whole 40 appear to have been withdrawn—not, it is to be hoped, permanently. There are, he says, 100 cabs in New York, and a few in Paris, and numerous privately-owned automobiles also. In Paris 95 per cent. of private motor vehicles are propelled by "moteurs à pétrole." The same is true of the light delivery wagons. The remainder are propelled by steam or electrically. It is possible to buy in America an electric carriage for two or four persons of a capacity of 30 miles on ordinary grades at an average speed of 11 miles per hour. The load of an electric delivery wagon must be under 1,000 lbs., and the mileage must not exceed 30 if electric power is to be the best possible. Above 30 miles, gasoline or steam must be employed, and it is claimed by Mr. Maxim that American vehicles are the best. We are doubtful of this claim. Gasoline averages 7½d. per gallon in America (we suppose the gallon meant is the American gallon of about 8 lbs. of water). Lubricating oil, to the amount of a pint for each 50 to 100 miles, is required at a cost of 20d. per "gallon;" above 1,500 lbs. of load, steam appears still to hold the palm. Numerous illustrations serve to point the present status of automobile construction, but but very little technical information is forthcoming. It would be of interest if a clear and technical description of a modern gasoline car could be written to inform engineers generally of the present condition of the art of automobile construction in respect of the use of heaters and coolers and the many details of construction that have failed and succeeded and the reasons for such failure. Very few understand the automobile, and we fear that many who do know much about them are too little used in general engineering knowledge and practice to be capable of correctly judging their own pet vehicles. The motor car is progressing, but it has not yet emerged thoroughly from that stage which may be compared with the sealing wax stage through which the dynamo passed.

Personal.—Mr. J. Clifton Robinson, the very popular tramway magnate who has been so prominent a figure in the electric tramway world ever since this country entered the van of progress, is the subject of an interesting article on "Modern Advance in Public Conveyance" in the *British Journal of Commerce*. Mr. Robinson, who is a most interesting personality to those who know him, may claim for himself the honour of being the first to shake the strongholds of our conservatism in regard to street traction, and to arouse us from our drowsiness. Those who have watched the progress of his schemes at Dublin, London and elsewhere, know well that only a man with dogged perseverance and an aggressive disposition, such as he possesses, would have continued in the face of the disheartening difficulties against which he has had to contend. Perhaps we have uttered forth our diatribes against municipal ignorance in regard to electric traction somewhat frequently, but we think never without cause or justification, and we suppose Mr. Robinson has had more experience than anyone else of the unreasonableness, we had almost said pigheadedness, of municipal opposition. From the article before us, we observe that Mr. Robinson has been connected with horse, cable, or electric traction for close upon 40 years. We suppose this is not far off being a record. It is significant to remark that he has discarded cable working, and now pins his faith exclusively to electricity.

Mr. Eugène Aimé Barbarat, Government inspecting engineer of the electric service in the Paris district, has been appointed engineer-in-charge of the Submarine Telegraph Service of France, and of the Repairing Works at La Seyne, near Toulon. Mr. Barbarat succeeds Mr. Morris, who has for a long period been at the head of the Submarine Service, and now retires on pension.

Mr. A. H. Gibbings has resigned the post of city electrical engineer at Bradford. The Cleckheaton District Council has engaged him to act as its consulting engineer, and he is still negotiating with the Southend Corporation for their provisional order.

Gas Explosion at Manchester.—Manchester has been somewhat alarmed lately because of the recent mishap at the Corporation electricity works. On that occasion the public suffered some amount of inconvenience, but the personal injuries to the staff were practically *nil*. As fortune would have it, the rival lighting department of the Corporation, namely, the gasworks (Rochdale Road branch) has now followed suit and done its level worst. Were it not that the injuries to the staff have proved fatal in one case, and extremely serious in others, there might be some humour in the situation. The effects certainly appear to be more disastrous than those of any electricity works accident that has ever occurred in this country. An explosion in a 24-inch gas main set fire to the meter house and the tower; the manager of the branch lost his life, the deputy manager was severely burned, and 11 assistants were also injured.

Marriage.—On October 26th, Mr. Charles Bright, F.R.S.E., was married at St. Mary's, Farnham, Essex, to Isabella Charlotte, daughter of the late Mr. Robert Gosling, of Hassobury, Essex.

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Incrustation of Iron Pipes at Torquay Waterworks.—Mr. Ingham's paper before the Institution of Mechanical Engineers will be chiefly useful to electrical engineers for its useful information on the rusting of pipes, which may be applied in respect of the many pipes and tanks necessary at some stations. The curious manner in which rust manifests itself is well known. The most familiar form is that of the nodule, little mushroom growths of red rust, which on being cut open reveal an oxidised pit beneath. The growth of nodules only $\frac{1}{8}$ or $\frac{3}{16}$ high soon reduces a 10-inch pipe to the capacity of one of 9 inches owing to the increased skin friction. Pipes are scraped by means of "go devils," a rotary system of scrapers actuated by the flowing water itself, and the first scraping of a pipe usually brings to light all kinds of rubbish—lead from joints, stones, bits of broken pipe, an occasional shovel or piece of wood, and generally such articles as children are so fond of throwing into pipes as they lie along the roadside. Nodules of rust contain 49 per cent. of metallic iron, and a 12 months' rust may amount to 21 tons of iron lost from about 14 miles of pipe. The author states that a pipe originally coated with Angus Smith's composition was scraped in 1896, and whereas it had been delivering 516 gallons per minute it afterwards delivered 663 gallons, a difference of 28½ per cent. From this 10-inch pipe in a course of eight miles the scraper collected 35 lbs. of joint lead, some yarn, and a bucketful of stones. Eight miles were scraped in three hours, and six miles in another three hours, an average of 2⅓ miles per hour. At the 14 scouring valves, in the course of the 14 miles, each valve is left open after the scraper has passed, until the water runs clean. This requires sometimes 20 minutes. It is found that high water velocity is favourable to corrosion and incrustation. Cast-iron being taken to rust at the rate of 100, wrought-iron may be taken as 129, and steel at 133. Some waters, as chalk-well waters, treated by Clark's process, will simply cause a clean layer of carbonate of lime inside a pipe. Upland waters, especially if containing peat acid, cause rust. Old red sandstone water neither rusts nor causes deposit. Greensand water causes rust. Filtered water is better than unfiltered. Angus Smith composition is not a permanent protector. At Torquay six years is the outside limit of protection. We agree with the author that founders do not exercise proper care in dipping pipes. Our own opinion is that pipes ought to be well brushed out, by passing through them a revolving steel brush *from both ends*, so as to get the brushing effect each way, and they should be then at once heated and dipped. Dipping should be vertical, and the pipes ought to again be brushed by the revolving steel brush when immersed in the dip, without which treatment perfect contact may be difficult to secure between the iron and the composition. It is undoubtedly at the pinholes, caused by minute air bubbles, that the first encroachments of corrosion are made upon the pipe.

To Central Station Engineers.—In view of the importance of fuel economy in central stations, and the fact that such economy can always be secured where it is possible to purchase bituminous coal at considerably less prices than Welsh smokeless, it appears probable that many central station engineers may wish to put on record in our columns some of their experiences on this question, especially in respect of the means taken to burn bituminous coal with a minimum of smoke and the arrangement and type of boilers most suitable for the purpose, together with particulars as to rates of combustion and evaporative effects obtained. Such information cannot fail to be useful and valuable for the profession generally.

Death from Electric Shock.—We read in provincial papers that an inquest has been held at Eston Junction with reference to the death on 27th ult. of D. J. Evans, from an electric shock at the Cleveland Steel Works. Deceased was employed in the mill department, and had fallen asleep. On awaking, he yawned and stretched out his arms, and one of his hands came in contact with the wires connected with the electric lamps for lighting the works. He instantly dropped, and was picked up quite dead. The inquest was adjourned for the attendance of the factory inspector.

Mr. Barnes on American Competition.—Mr. Geo. N. Barnes is progressing. He has been allowed to air himself in the pages of *Engineering*, and has described himself as a representative British workman! He is asking what we have asked repeatedly—that our workshops shall be equipped to the height of excellence in the way of tools, methods, and machinery generally. This is excellent. He did not seem to see things thus in 1897. No one is so much to blame as Mr. Geo. N. Barnes for the use of out-of-date plant. His own followers were never allowed to do so much work in a day as any old tool would easily do. Why, then, should better tools have been bought? Then he grumbles—sensibly, too—about the early morning's start. We can assure Mr. Barnes that we know of one shop which was working 50 hours weekly before the A.S.E. broke in on it and demoralised every man in it. The men in this very shop refused the offer of a start after breakfast. True, they had an excellent reason in the lack of facilities offered by the railroads. Men like Mr. Barnes have had a great deal to do with the London County Council, and it is this same Council, so solicitous for the working man, that has deprived London working men for years to come of the only effective competition with the sluggard steam railroads. Need we say that had the County Council willed it, every main road leading out of London would, and might to-day, have had its trolley road, and the early morning start might have been abolished? Mr. Barnes's fellow agitator is on the County Council. Why does he not agitate for electric tramways in place of needless experiments and the delays incidental to the conduit system? Finally, let us make a note—it may be useful to refer to when Mr. Barnes again stirs up a strike against machinery—he states that machinery and workshops of the latest type are absolutely necessary, and should be honestly used. Note the honesty! Does Mr. Barnes mean at last that machinery should be allowed to do what it will do? Does he discountenance the running of a lathe with the tool not cutting, and such tricks of trades unions? When a friend of ours was waited on by a deputation from Mr. Barnes, he offered to run his shop six hours a day at the same day's wages as paid for eight hours if Mr. Barnes would guarantee one hour's honest work per day. We may not be just to Mr. Barnes, he may mean all he now says; but we have made contact with his methods and his organisation; we have seen the brutality his society exercised on weaker labouring brethren, and were we to live a century we could never forget it all. Much of what he now writes, may be, is true. He is late in writing it. With much we absolutely agree. We regret that he did not hold the same opinions three years ago, and we think few who knew of his works in 1897 will accept his article with different feelings.

"Special!"—Our 'cross-the-way contemporary *Electricity* is always happy on its birthday, and it shares its mirth with its readers by dealing out to them a special issue with special articles by special men. Mr. Robert Hammond writes a few notes regarding the quarter-million electricity scheme at Hackney, for which he is consultant; Mr. A. P. Haslam continues his articles on the 1898 electrical energy costs, and gives many pages of tables, &c., showing the comparative outputs and costs for municipal plants; Mr. Charles R. Gibson has something to say about the relation of magnetism to electricity; Mr. W. H. Booth contributes some very brief comments on "superheated steam essential to economy in the generation of electrical energy"; Mr. Bathurst indulges in a reverie on the topic upon which we think he has written before, viz, "Electric Wiring"; the Cairo electric tramways are illustrated and described; Mr. Howard Little also has some suggestions regarding wiring; and last, but not least, we find some remarks from the pen of Mr. H. Scholey on the importance of the electric motor to the proper development of the electricity supply business. From "Ourselves" there is an outstretched hand for the entire electrical profession, followed by a special curtsey to the electrical press and others who have contributed to our thriving contemporary's prosperity. There is a dash of repentance in an otherwise well-filled cup of confidence, in the promise of doing better in the future than in the past. The editors of *Electricity* are to be congratulated upon the choice of subjects of current interest, and the publishers upon the high-class quality of the printing and illustrating work.

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Lillie Evaporator.—Economy of fuel has been so studied in sugar manufacturing, that in the best works all the heat and power on a cane estate are obtained from the megass, which is by no means a fuel to be despised. One of the principal economies is the system of triple effects, which are simply low pressure evaporators. In the Lillie apparatus of McOnie, Harvey & Co., of Glasgow, the exhaust steam from the engines in the factory is the heating agent in the first evaporator, which is a vessel containing copper tubes laid horizontally. The sugar juice drops from tube to tube, steam passing through the tubes. The hot water of condensation, and the steam or vapour driven off the syrup, pass into the tubes of the second vessel, and evaporate the syrup in that vessel, while the third vessel, at the lowest temperature of all, is similarly supplied with heat from the second vessel, and its syrup is under vacuum, so that the final low temperature heat is thereby enabled to effect an evaporation otherwise impossible. To make 1 ton of sugar by the old system of direct firing called for 1 ton of coal, besides all the megass. With these triple effects concentrating in vacuo no coal is needed, there is less waste made, and the product is better. The same principle might with advantage be applied to make up the inevitable losses of water which occur with surface condensing steam engines. There is always some water required to make up loss of steam at glands and gauge cocks and safety valves. This water may be, and is, made good by evaporation. But it is not necessary to evaporate at atmospheric pressure. By placing the evaporator in connection with the surface condenser a constant supply of fresh water might be produced by allowing the exhaust steam from the engines to traverse the evaporator on its way to the condenser. The evaporator would assist the condenser, and the unavoidable accumulation of scale could be easily dealt with. By adding suitable materials the scale would be prevented from crystallising as a hard mass and the evaporator could be readily cleaned. The temperature of a surface condenser may be 120°. If connected near to the air pump the evaporator will be able to extract considerable heat from the engine exhaust, which will have a temperature higher than the water and the evaporator. Or the evaporator may be placed in the flues—even between the economiser and the chimney—and will utilise heat now sent to waste. It can be of light construction, and fed simply by a ball valve. It should certainly be possible to obtain the make-up water supply without expense of live steam or fresh coal. Waste heat will do it when vaporising in a vacuum.

Lectures.—Mr. G. S. Ram, electrical engineer to the Coventry Corporation, lectured on "Engineering Calculations and Measurements" to the members of the Coventry Technical Institute Engineering Society at their last meeting. Mr. Ram urged the importance of the adoption of the metric system, pointing out that it had already been adopted in electrical measurements. The lecture was illustrated with diagrams.

At the City of London College Science Society on Wednesday last week, Mr. W. Cozens-Cooke, A.M.I.E.E., read a paper on "Wireless Telegraphy." The President, Prof. Henry Adams, M.Inst.C.E., occupied the chair. The lecture was illustrated by experiments.

The Pimbley Economiser.—A novel form of economiser, known as the Pimbley, has been brought to our notice. The claims made for this economiser are that, owing to the more rapid movement of the water within it, the heat absorption capacity is very largely increased, and the recent experiments of Mr. Halliday are adduced in support of this contention. The next claim is that the high velocity of flow of the water prevents the adherence of scale, which must obviously travel foward to the boiler. To effect these ends the new economiser is made of pipes hung from top boxes, and free at their closed lower ends. Each pipe is really two pipes of segmental cross-section, the two pipes being joined at the bottom, but elsewhere separated by a flat space exposed to the flue gases. The pipes are short, and are scraped externally by scrapers worked by rods, not by chains. Being so short, the economiser can be placed in situations where longer pipes are inadmissible. There is no reason, however, why ordinary economisers should not have quite as rapid a flow in their pipes as this new economiser, if such rapid flow is desired. The claim for non-incrustation, even with a very impure water, is one which time alone can prove or disprove. We must confess to a strong feeling of doubt in respect to non-circular pipes, as we feel that in time some boring out must be inevitable, and we doubt the desirableness of pipes other than circular for other reasons. Testimonials are produced, however, which declare that scale refuses to form inside a Pimbley pipe. But what if scale did form? How can the pipes be bored out—an operation so easy with circular pipes? We have placed the facts before our readers, and further information is to be had from the makers of the new economiser, Messrs. Jas. Carter & Sons, of Stalybridge, Cheshire. It would be interesting if a longer experience should prove that incrustation did not occur where flow was rapid. If there is any truth in this, why do the internal pipes of steam boilers—we mean the feed distribution pipes—become so choked?

The Army Reserves.—The staff of the Sunderland Electricity Works held a meeting last week, and resolved to contribute weekly to the Mayor's fund on a scale proportionate to the respective salaries of the members. We heartily commend their example to the notice of our readers.

The Electrical Engineers' Swiss Tour.—An exhibition of photographs, taken by members during the recent visit to Switzerland, is to be held in the library of the Institution from December 5th to 12th. It is intended to reproduce a selection of the photographs for presentation to the library, the president, and the secretary of the Institution, and to enable members to obtain copies of these albums and of such photographs as they prefer. Full particulars may be obtained from the secretary of the Photographic Committee, Mr. R. S. Erskine, 22, Stamford Road, Kensington, W. We look forward to an interesting collection of photographs, for those who were not armed with cameras formed but a very small proportion of the party.

The Manchester Society of Junior Electrical Engineers.—A general meeting of this Society was held at the Deansgate Hotel, Manchester, on Tuesday evening last. Mr. W. W. Haldane Gee presided. A paper was read by Mr. S. Payne on "Condensers and Condensing as Applied to Electric Light Stations," which proved to be very interesting, the subject being afterwards freely discussed. The next meeting of the Society will be held on Tuesday, November 28th, when a paper will be read by Mr. J. H. Henderson on "Aluminium: its Treatment and Use as Applied to Electrical Engineering."

Appointments Vacant—The Devonport and District Tramway Company is in want of a tramways clerk of works.

The Watford Council wants an assistant engineer and other members of staff for the electricity works. For particulars of these appointments see our "Official Notices" this week.

The St. John Del Rey Mining Company, Limited, want a second electrical engineer for their mines in Brazil, for a four years' engagement, at £300. See "Official Notices" this week.

Institution of Electrical Engineers' Annual Dinner.—We learn from the secretary that the annual dinner of the Institution of Electrical Engineers will be held in the Grand Hall of the Hotel Cecil on Wednesday, December 6th.

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A Double Conduit for Street Railways.—A difficult piece of track conversion is being carried on in New York, where, according to the *Scientific American*, both the Metropolitan Street Railway Company and the Third Avenue Railway Company possess the right of way through the same street. To operate the latter company's line by independent power system required a separate pair of power rails in separate conduits. The Metropolitan conduit had already been installed for a year and a half, so the Third Avenue Company is pushing the present conduit over to one side to give room for the other conduit beside it, between the two rails of the track. The difficulties are numerous in view of the fact that the track is kept constantly in service for the Amsterdam Avenue Cars, so that the men have to work alongside rails which are constantly charged. The pavement is first removed and the concrete foundation and conduit wall are broken up and removed from around the yokes and conductor rail. The track is shored up to carry the cars which are constantly running over it. Temporary wooden yokes are inserted to maintain the gauge of the track, and the old yokes are loosened and pushed to one side, carrying with them the old slot rails, insulators and conductor rails. The conductor rails are then removed in single lengths and the free ends are fitted with slippers to prevent the shoes on the ploughs from being carried away. The old yokes are promptly removed and replaced by new ones fitted for the two conduits, which are symmetrically placed between the track rails. While each company will have its own source of power, both will use the same rails.

Fire Tests on Wood.—A recent report of the British Fire Prevention Committee gives particulars of a fire test made upon "non-flammable" wood by the British Non-Flammable Wood Company, Limited, of London. The object of test was to record the effect of fire upon "non-flammable" wood (yellow pine), particularly to ascertain if boards of non-flammable wood sustain or spread flame *when in contact with fire*. The procedure of the test was to be as follows:—(*First stage*)—The application of flame for 5 minutes from one side at a temperature of about 500° F. (*Second stage*)—The application of flame for 10 minutes from the same side, and at approximately the same spot, at a temperature of about 750° F. (*Third stage*)—The application of flame for 15 minutes from the same side, at a second spot, and at a temperature of about 900° F. The three stages of the test were to follow at the shortest possible intervals. One-inch yellow pine boards were to be used in the form of a partition. The result of the tests was as follows:—No incandescence or spread of flame was observed, nor did the material, as far as could be seen, contribute in any way to the spread of flame. The surface of the boards was charred. Flame was applied at materially higher temperatures than those specified in the "object of the test." The temperature rose in the first stage to about 1,000° F.; in the second stage to about 1,150° F.; and in the third stage to about 1,300° F.

NEW COMPANIES REGISTERED.

Fladbury Electric Light and Power Company, Limited (63,942.)—This company was registered on October 25th, with a capital of £2,000 in £1 shares, to carry on at Fladbury or elsewhere in England the business of electric lighting, and to produce and supply electricity or electrical current and force, light, heat, or motive power, and telegraphic, telephonic, or other means of communication or locomotion. The first subscribers (each with one share) are:—L. Harold Elkington, Manor House, Fladbury, gentleman; Stephen H. Deakin, White House, Fladbury, merchant; George T. Stephens, Fladbury, miller; James W. Wagstaff, Fladbury, gentleman; A. L. Stephens, Charlton, near Pershore, miller; Lewis H. Helley, 3, Percival Road, Edgbaston, Birmingham; chartered accountant; and Edward R. P. Vradley, Elmdon, Sandford Road, Moseley, Birmingham, accountant's cashier. The number of directors is not to be more than five; the first are Stephen H. Deakin (chairman), Leigh H. Elkington, George T. Stephens, and William Wagstaff; remuneration as fixed by the company.

United States and Canadian Rhea, Rubber and Insulite Syndicate, Limited (63,957).—This company was registered on October 26th, with a capital of £30,000 in £1 shares, to acquire from W. J. Cordner certain inventions relating to the manufacture of a composition from rhea fibre, applicable for electric insulation and other purposes, and to carry on the business of manufacturers, spinners, dyers, and merchants of rhea fibre, cotton, flax, hemp, jute, and other fibrous substances. The first subscribers (each with one share) are:—W. Brinder, 43, Appach Road, Brixton Hill, S.W., clerk; B. Blewitt, 22, Grove Road, Wanstead, clerk; O. H. Oliver, 2, Beresford Villas, Park Terrace, Southend, cashier; J. Fell, 21, Hayter Road, Brixton Hill, S.W., secretary; S. C. Whittle, 40, Carlingford Road, N., accountant; A. Lowey, 248, Thorold Road, Ilford, secretary; and F. E. Mardon, 24, Arlingford Road, Brixton, S.W., clerk. The number of directors is not to be less than two nor more than seven; the first are H. B. Burnell, W. J. Cordner, and J. Keefe; qualification, £100; remuneration, £100 each per annum (£150 for the chairman), and a share in the profits.

F. J. Jones & Co. (Chester), Limited (63,988).—This company was registered on October 28th, with a capital of £3,000 in £1 shares, to acquire and take over as a going concern the business of an electrical engineer and electrician now carried on by Frederick J. Jones at the Princess Street Electrical Works, in the City of Chester, to adopt an agreement with the said vendor, and to carry on the business of electricians, electrical and mechanical engineers, and suppliers of electricity, cycle, bicycle, tricycle, velocipede, motor, motor carriage and vehicle manufacturers and dealers, &c. The first subscribers (each with one share) are:—Robert J. Knowles, 61, Brief Street, Chester, grocer; Thomas C. Burrell, 115, Foregate Street, Chester, draper; Frederick J. Jones, 5, City Road, Chester, electrician; Mrs. Mary H. Jones, 5, City Road, Chester; Samuel Smith, 16, Nicholas Street, Chester, solicitor; Edward N. Humphreys, Old Bank Buildings, Chester, chartered accountant; Rhoades B. Humphreys, 5, Hamilton Street, Hoole, Chester, accountant; and William D. Shepherd, 115, Foregate Street, Chester, outfitter. The number of directors is not to be less than three nor more than seven: the first are F. J. Jones, Thomas Gase, and Robert Knowles; qualification, £100.

Glacier Anti-Friction Metal Company, Limited (63,989.)—This company was registered on October 28th, with a capital of £2,500 in £1 shares, to carry on the business of iron-founders, electrical, consulting, and general engineers, metal workers, boiler makers, machinists, iron and steel converters, &c. The first subscribers (each with one share) are:—C. W. Findlay, 4, Upper Bedford Place, W.C., metal merchant; A. J. Baute, jun., 4, Upper Bedford Place, W.C., metal merchant; T. W. Davies, 4, Upper Bedford Place, W.C., slate dealer; W. A. Clegg, Sunnyside, Knight's Park, Kingston-on-Thames, merchant; E. Siluvary, 45, Woburn Place, W.C., merchant; L. Avon, 45, Woburn Place, W.C., bank clerk; and W. J. Gresham, 40, East India Dock Road, E., engineer. Table "A" mainly applies. Registered office, 91, Queen Victoria Street, E.C.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Miners' Lamp Electric Lighting Company, Limited (28,010).—This company's annual return was filed on September 27th, when 301 shares were taken up out of a capital of £3,000 in 600 shares of £5 each; 190 shares are considered as fully paid, and the full amount has been called upon each of the remaining 111. £550 has been received, leaving £5 unpaid.

Exchange Telegraph Company, Limited (6,152 C).—This company's annual return was filed on August 23rd, when 8,125 "A" and 16,200 "B" shares were taken up out of a capital of £246,250 in 8,125 "A" and 16,500 "B" shares of £10 each. £8 is considered as paid on each of 2,125 "A" and £1 on each of 16,200 "B" shares (total, £279,000). £9 per share has been called up on £6,000 "A," and £1 per share on 2,125 "A" shares, resulting in the receipt of £56,023. £102 remains unpaid, and £816 has been paid on 102 forfeited shares.

CITY NOTES.

Yarmouth Corporation Electricity Accounts.
Public lighting and private supply.

The works at Yarmouth are but small, and, to some extent, suffer from the common complaint of all electricity undertakings at seaside resorts, that the load curve is not exactly what the engineer would choose had he a say in plotting it. Blackpool is probably the most marked case of the kind, but naturally, all "season" resorts are affected in the same way, although not to the same degree. Although there is still a loss shown after meeting all charges, this has fallen from several hundred to only a little over £50. This shows that the financial position is rapidly being improved, and a feature is that half the increase in gross revenue is gross profit. The average price received per unit sold remains about the same, just under 5d., and this, we suppose, will not be altered until the turning point between profit-making and losing has been reached and passed.

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GENERAL STATEMENT.

	1897.	1898.	Increase.
Total capital expenditure ...	£33,622	£35,723	£2,101
Number of units sold	190,000	243,669	53,669
Maximum load in KW.	213 KW.	267 KW.	54 KW.
Gross revenue	£4,015	£5,165	£1,150
Gross profit	£1,365	£1,959	£594
Average price per unit sold ...	4·91d.	4·93d.	·02d.

For the units turned out the capital is certainly moderate. The public lamps have been increased from 72 to 75, and the units taken are as follows :—

	Units generated.	Units public lamps.	Units private.	Total sold.	Units not accounted for.
1897 ...	271,420	69,240	120,760	190,000	7,660
1898 ...	333,731	78 500	165,169	243,669	9,622

REVENUE STATEMENT.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current ..	£3 885	4 91d.	£5,002	4 93d.	·02d.
Meter rents	130	·16d.	163	·16d.	·00d.
Supply of lamps ..	...	...	...	...	...
Sundry	...	...	...	...	...
Gross revenue	£4,015	5 07d.	£5,165	5·09d.	·02d.

The works' costs have fallen about an eighth of a penny, and the total costs nearly the fifth of a penny; the only items in which an increase is shown being "repairs" and "rent, rates, &c." Even at the enhanced figure of about ¼d. per unit, repairs are extremely moderate, and although the latter item has a great deal more than doubled, it is a matter over which the engineer is, as a rule, powerless.

COST OF PRODUCTION.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal	£1,080	1 36d.	£1,311	1 29d.	− ·07d.
Oil, waste, water, and engine room stores.	271	·34d.	318	·31d.	− 03d.
Salaries and wages incurred in generation and distribution.	576	·73d.	598	·59d.	−·14d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	105	·13d.	245	·24d.	+·11d.
Works' cost	£2,032	2 56d.	£2,472	2·48d.	−·13d.
Rents, rates and taxes ..	66	·08d.	169	·17d.	+ 09d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	451	·57d.	435	·43d.	−·14d.
General establishment charges, stationery and printing, law charges and insurance	101	·13d.	130	·13d.	·00d.
Other expenses	...	...	...	...	...
Total costs ...	£2,650	3 34d.	£3,206	3·16d.	−·18d.

The gross profit being less than the sum required to meet interest and sinking fund payments was aided by £57 being charged to the rates. Interest absorbed about £80 and sinking fund about £130 more than the previous year, the exact figures being :—

PROFIT STATEMENT.

	1897.	1898.
Interest on loans	£950	£1,029
Sinking fund for repayments	852	987
Net profit (being deficit charged to rates) ..	−437	−57
Gross profit	£1,365	£1,959

Monte Video Telephone Company.

MR. F. W. JONES presided over the annual general meeting of the above company, held at Winchester House, E.C., on Thursday last week, and said that last year the chairman pointed out a steady improvement in the company's business, and now he had the pleasure of saying that the prosperity had continued. The returns from the manager in Monte Video showed that there was a continual increase in the number of subscribers, the total of such increase being 160 for the year, or 50 per cent. more than last year. The result of that was shown in the item "subscription sales, rentals, transfer fees, &c., £18,308 10s. 8d.," which was nearly £2,000, or 12 per cent., more than last year. While that result was satisfactory in itself, it was a still further satisfaction to find that the working expenses were only heavier by £240, in which fact was reflected the efforts of their manager in Monte Video to keep down working expenses. The chairman proceeded to deal with the various figures in the balance-sheet, and said that with the amount written off stock of materials, that item was now closely approximating its actual value, the obsolete material in stock being now carried as without value. The capital issued was rather more than last year, the further issue being the preference and ordinary shares given in exchange for the company's promissory notes, as provided for under the scheme for reduction of capital. It would be remembered that at the date of the last annual meeting, none of those notes had been sent in for exchange, but they had now been cancelled and disappeared from the balance-sheet, all of them having been sent in for exchange for shares, with the exception of two for small amounts which were included in the item of sundry creditors. These shares, they were advised, would rank for dividend from the respective dates of allotment. The capital outlay for the year had amounted to £2,248, or £600 more than last year, but a less amount than might have been expected considering the greater increase in the number of subscribers. He thought the figures showed that the undertaking was in a sound condition and that the business was progressive, but a telephone business like theirs entailed considerable capital expenditure. With that before them the board considered it only judicious to place to reserve a sum fully covering the monies expended out of revenue and charged to capital, and they accordingly decided to carry £2,500 to reserve. They recommended also the payment of a dividend of 5 per cent. on the preference shares and 2½ on the ordinary shares, leaving £2,258 to be carried forward. The chairman proceeded to explain the changes which had taken place on the board owing to the fact that large blocks of shares had changed hands. During the past winter he had visited the River Plate, and took the opportunity to spend some time in Monte Video in order to look into the affairs of the company there. He found the conduct of the business under the administration of Mr. A. B. Powers was highly to be commended. His report to the board on his return was that the business was well managed, and only needed reasonable provision for capital expenditure to insure its position and increase its value. He also confirmed opinions previously expressed as to the advisability of keeping in mind certain extensions and improvements which the circumstances of their business would not admit of being indefinitely postponed. They were (1) the ownership of the control of the camp lines which connected Monte Video with important towns within 100 miles; (2) metallic circuits for the Monte Video subscribers; and (3) improvement of the central office building to obtain more accommodation for themselves and additional revenue by letting off. These improvements made it necessary to have more capital, and the board were considering the practicability of making use of their powers to raise the necessary funds, and it was hoped that they would be able to make satisfactory arrangements.

MR. LOCH seconded the motion, and it was carried.

City and South London Railway Company.

ON Tuesday Mr. C. G. Mott presided at a special general meeting of this company, held at 46, King William Street, E.C. He said he was sorry to trouble them to go to a meeting merely for a formal purpose, but unfortunately at the last half-yearly meeting they could not carry out the proposed conversion because the stock was not fully paid up at that time. It having now been paid up he moved:—"That the existing 22,500 ordinary shares, numbered 1 to 22,500, be converted into consolidated stock."

MR. TATE seconded the motion, and it was carried unanimously.

MR. MOTT said it might interest them if he stated that the extension through to Moorgate Street was in a very forward state, and they hoped to be able to open it to the public very early in December—say, about five or six weeks time. They could not say exactly, but everything was very nearly completed. As to the extension to Clapham Common, the underground works were nearly finished; there were surface stations to be built, and it was hoped they would be ready for opening probably about March. The construction of the Islington extension was also proceeding rapidly.

A vote of thanks to the chairman closed the meeting.

Thames Ironworks, Shipbuilding, and Engineering Company, Limited.

THE first ordinary general meeting of this company was held on Monday at the offices, Orchard Yard, Blackwall.

MR. ARNOLD F. HILLS, who presided, said that since the reconstruction in July the engineering works of Messrs. John Penn & Sons, at Greenwich, had been finally taken over, and the new boiler shops, machinery, and plant were now practically in working order. A complete system of electrical driving and lighting had been introduced, with the result that the new shops for engine and Belleville boiler work were probably the best of their kind in the United Kingdom. After giving the meeting some particulars of contracts which had been received from the Admiralty and other sources, Mr. Hills said that, taking a broad view of the whole situation, he could but congratulate the shareholders upon the steady development of the company's business during the past three months, and he hoped that the present prosperity might be continuously maintained and enlarged.

At a subsequent meeting a resolution was passed making formal alterations in some of the articles of association.

Eastern Extension, Australasia and China Telegraph Company, Limited.

THE report for the half-year ended June 30th, states that the gross receipts amounted to £324,361, against £277,282. The working expenses, including £28,177 for maintenance of cables, absorb £107,266, against £102,873 for the corresponding period of 1898, leaving a balance of £217,095. From this is deducted income-tax, interest on debentures, debenture stock, and contribution to sinking fund, and £5,000 for the creation of a reserve fund in connection with the proposed removal of the head offices, leaving £175,799 as

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the net profit for the half-year. Two quarterly interim dividends of 1½ per cent. each, amounting to £62,500, have been paid for the half-year, leaving £113,299, from which £100,000 had been transferred to the general reserve fund, and the balance of £13,299 is carried forward. Further cable renewals and extensions have been carried out during the half-year, and the cost, amounting to £68,901, has been charged against the reserve fund. With a view to providing an efficient alternative service between Australia and this country, the directors, in conjunction with the Eastern Telegraph Company, have submitted to the Governments of Australasia a proposal for extending the new Cape cable to Perth and Adelaide without any subsidy or guarantee, and at once reducing the tariff between Great Britain and Australia to 4s. per word, to be followed by further reductions on a sliding scale down to 2s. 6d. per word as the traffic responds to the reductions.

Prospectus.

Yesterday, Thursday, the list opened and closed for London, and to-day it closes for the country, for the issue of £70,000 5 per cent. cumulative preference shares in the Alliance Electrical Company, Limited. The share capital of this company (formerly Veritys' installation department) is £120,000, in 7,000 £10 preference shares and 5,000 £10 ordinary shares. The company was formed to take over the business of electric light wiring and installing, and also retailing electric light fittings, formerly carried on by Veritys, Limited, at 137, Regent Street, London, and at Birmingham and Manchester. This branch of Messrs. Veritys' business has been for some time carried on quite independently of the electrical manufacturing and wholesale supply of electrical apparatus to the trade conducted from 31, King Street, Covent Garden, London, and its separate branches. It was considered advisable to form a separate company to develop the business, and for trade reasons. The prospectus gives names of a few of the many eminent personages for whom the firm has executed installation work. The auditors certify that the profits on the business taken over have averaged £8,790 per annum for the past three years. The purchase price of the business and properties was £106,150, for which £56,150 in 5 per cent. preference capital, and the whole £50,000 ordinary capital, have been allotted, these terms reckoning from February 1st, 1899; but Messrs. Verity have agreed to take cash, with interest, at 5 per cent. per annum from that date, in lieu of their preference capital, in order to enable them to further extend their factories at Aston for the manufacture of larger electrical machinery. The chairman of the Alliance Company is Mr. George Verity; Mr. J. Elwin-Coles is the London manager; Mr. T. Ions the Birmingham manager; Mr. C. S. Northcote is the Manchester manager; while Mr. W. R. N. Grimley is the managing engineer. Mr. W. Nicholson, of 137, Regent Street, W., is the secretary.

Stock Exchange Notices.—The Stock Exchange Committee have appointed Tuesday, November 14th, a special settling day in United River Plate Telephone Company, Limited, 16,639 5 per cent. cumulative preference shares of £5 each, £3 10s. paid, Nos. 1 to 16,639, and ordered same to be quoted in the Official List.

Callender's Cable and Construction Company, Limited.—The directors have decided to pay an interim dividend on the original ordinary shares of 5s. per share, equal to 10 per cent. per annum.

Electrical Undertakings, Limited.—A meeting of this company was held at Winchester House on Friday last, for the purpose of passing certain resolutions, but our representative was refused admission.

Chelsea Electricity Supply Company.—Letters of allotment and regret for the issue of £50,000 4½ per cent. debenture stock have been posted.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending October 28th, 1899, were £238 10s. 1d.; October 28th, 1898, £262 3s. 10d.; aggregate for half-year to date, £18,871 15s. 9d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending October 27th, 1899, were £2,905 13s. 5d.; corresponding period, 1898, £2,819 2s. 3d.; increase, £86 11s. 2d.

The City and South London Railway Company.—The receipts for the week ending October 30th, 1899, were £1,045; October 31st, 1898, £1,000; increase, £45. Total receipts for half-year, 1899, £17,278; total receipts corresponding period, 1898, £17,275; increase, £3. Miles open, 8½.

The Dublin United Tramways Company.—The receipts for the week ending Friday, October 27th, 1899, were as follows:—D. U. T. Co., horse cars, £880 19s. 9d.; ditto, electric cars, £2,611 2s. 0d.; D. S. D. Co., electric cars, £759 17s. 2d.; total, £3,767 18s. 11d.; corresponding week last year—D. U. T. Co., horse cars, £880 9s. 10d.; ditto, electric cars, £2,364 15s. 8d.; D. S. D. Co., electric cars, £849 19s. 4d.; total, £3,595 4s. 10d.; increase, £172 14s. 1d. Aggregate to date, £74,603 10s. 10d.; aggregate to date last year, £72,110 7s. 7d.; increase to date, £2,498 3s. 8d. Worked:—The mileage open is 37 miles electrically, 7 miles by horses, as against 13 miles electrically, and 29 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending October 22nd, 1899, were £609 October 26th, 1898, £248; Car miles run, 11,598; 1898, 3,601. Number of cars, 21; 1898, 10. Total receipts to date, from April 1st, 1899, £17,628; 1898, from June 29th, 1898, £4,694. The receipts for the week ending October 29th, 1899, were £664; November 2nd, 1898, £248; increase, £416. Car miles run, 12,010; 1898, 3,665. Number of cars, 28; 1898, 10. Total receipts to date, from April 1st, 1899, £18,292; 1898, from June 29th, 1898, £4,942. Miles of track open, 13; 1898, 9½.

The Liverpool Overhead Railway Company.—The receipts for the week ending October 29th, 1899, amounted to £1,630; corresponding week last year £1,407; increase, £223.

The South Staffordshire Tramways Company.—The receipts for week ending October 27th 1899, were £624 18s. 11d.; October 28th, 1898, £664 10s. 6d.; aggregate receipts for 43 weeks, £28,658 8s.; 1898, £27,224 3s. 6d.

STOCKS AND SHARES.

Wednesday Evening.

The buoyant tendency, previously the feature of almost every market in the House, received a decided check on the alarming report of British reverses at Ladysmith. The gravity of the situation was quickly realised by operators, and the more speculative quotations rapidly shrank in the hands of nervous bulls and under the influence of bears all too ready to grasp the opportunity of netting a profit on the fall.

Electric specialities, however, remained remarkably firm and merely shed small fractions.

In the telegraph department Eastern Telegraphs Ordinary, with a stride of 4 points, have been a feature, purchases being numerous on the strength of the increased revenue that will accrue to the company's coffers as a result of the war. Anglo-Americans have received support from a good quarter, and again mark an advance. Current quotations for this stock are still well below the highest points touched this year, a fact worth the investor's attention. Reports are afloat that the company's receipts have been considerably larger than last year's takings, and optimists are looking for a dividend for the current year of anything between 20s. and 30s. per cent. on the "A" stock, as compared with 18s. per cent. for 1898. Should only 25s. per cent. be realised, a yield of 7 per cent. on present price basis will be forthcoming to holders of the Deferred stock. Eastern Extensions have lost the improvement gleaned during the previous week. Reuters have failed to register any improvement. Other telegraph descriptions are unaltered.

National Telephone issues have received a fillip, and show a small rise. Supply shares have fluttered, Notting Hill Electric Lighting, St. James's and Pall Mall Electric Ordinary, and Chelsea Electricity Supply securing rises of 10s. each. The recent issue of debenture stock by the last-named company was largely over applied for. St. James's New are 10s. better, and it will be remembered that it was pointed out in this column last week that these shares were a cheap purchase.

It is somewhat singular that, in a good market, Electric Constructions should be so much out of favour. It may be that the price is weak upon the fact that two or three hundred shares in a deceased account are hanging over the market, but these would be a mere bagatelle in ordinary times. The quotation, however, has again receded ⅛. Callender's Cable Construction shed ¼, but Henley's Debenture have recovered a point.

In the traction list, Central London Ordinary, fully paid, have been in moderate request, and the price has improved a trifle. The date of the completion of the works is said in the Stock Exchange to be drawing near, and as that time approaches there is likely to be a little life infused into the shares. City and South London were not affected by the statements made by the chairman at Tuesday's meeting. The line ought to be paying handsomely in another 12 months' time if the company's extensions attract the traffic which it is hoped that they will. Waterloo and City remains stolidly a point or two above par. Metropolitan Districts have lost most of their late spring, and at 32 show a trifling decline on the week.

Anglo-Argentine Trams continue dull, and there are sellers at 4. Other foreign and provincial tramway shares exhibit strength, and Calcutta can be disposed of at 9, the medium price. Tramways Union at 1½ are quoted ex £7 return of capital and bonus, this, of course, making the price equal to 8½ before the distribution.

A Leeds reader asks us for the quotations of Hampstead Electric Ordinary and Preference. We have to inform him that the market will not make any price at all. At the time of the company's *début* there was a very nominal price quoted, but the prospectus met with no favour, and subsequent attempts on the part of outside brokers to sell the shares at an absurdly high price have not tended to encourage a buying spirit. Should any inquiries come into the market they will be duly noted in this column. We are afraid that it is not only our Leeds correspondent who wants a bid for these unsaleable shares.

Wireless Telegraphy shares are likely to make a move shortly, several operators of the company's instruments having been despatched to the theatre of war in the Transvaal. Globe Telegraph and Trust Preference are better; the official quotation of 15¼—⅜ would be more correct if it were marked 15⅝—⅞, which is the market price.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Oct. 25th.	Closing Quotation, Oct. 31st.	Business done during week ended Oct. 31st, 1899. Highest.	Lowest.
124,400	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,550	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	64 — 67	65 — 68	67	65½
3,047,220	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	114½—115½	116½—117½	117½	115½
3,047,220	Do. do. Deferred...	Stock	...	...	18s. %	16 — 16½	16½— 17	16 15/16	16 5/16
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	15⅝	15
75,000	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2 — 3	2½— 3	...	...
20,000,000	Commercial Cable	$100	8 %	8 %	8 %	180 —190	180 —190	...	...
1,262,520	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	102 —104	103 —105	105½	103½
224,860	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9⅛	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20 xd	...	...
12,981	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
20,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710	Direct United States Cable	20	3 %	3¼%	3½%	11¾— 12¼	11¾— 12¼	...	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101 —104	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½ %	7 %	7 %	153 —157	156 —161	159½	153½
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	99 —102	99 —102	101	99½
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,462,260	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	118 —123	117 —122 xd	119	118
280,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	14½— 15	15 — 15½	15⅝	14¾
16,200	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,040, 3,976—4,826	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400	Do. do. Bearer, 1,050—3,975, 4,827—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
289,000	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	117 —122	118 —123	...	...
25,100	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
45,800	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
200,000	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	102 —106%	102 —105%	...	...
180,227	Globe Telegraph and Trust	10	4½%	4½%	5½%	11 — 11½	11 — 11½xd	11⅝	...
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15½— 15¾	15½— 16 xd	15¾	15½
180,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	29 — 31	30 — 31	29¾	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	49 — 53	48 — 52 xd	...	...
100,000	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ½	¼— ½xd	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1 xd	...	...
490,000	National Telephone, 1 to 490,000	5	5⅛ %	6 %	6 %	5 — 5¼	5⅛ — 5⅜	5⅜	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13 — 14	13½ — 14½	14½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13 — 14	13½ — 14½	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5⅜	5¼— 5⅜	5⅜	...
1,239,471	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	99 —102	100 —102	100¼	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅜— 1	⅜— 1 xd	...	...
100,000	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,889	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,281	Submarine Cables Trust	Cert.	...	...	...	128 —133	128 —133	...	...
88,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5¼	4¾— 5¼	...	...
151,788	Do. do. 5 % Debs.	Stock	...	..	...	105 —108	105 —108	...	...
200,000	West African Telegraph, 5 % Debs.	100	5 %	%	...	99 —102	99 —102	...	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	¾— 1	¾— 1	...	...
180,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	102 —105	102 —105	...	...
269,531	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
88,331	West India and Panama Telegraph	10	1 %	⅝%	...	1⅝— 1⅞	1¾— 1¾	1 7/16	...
34,568	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10¼— 10⅜	10¼— 10⅜	10⅜	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	8½— 9½	...	...
80,000	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	5 %	5 %	...	104 —107	104 —107	...	...
155,100	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7½— 8½	7½— 8½	8⅝	8⅜
13,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	9½— 10½	9½ — 10½	9⅞	9¾
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	6 13/16	...
24,000	Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	7½— 8½	8 — 9	...	...
200,000	Do. do. do. % Deb. Stock Red....	Stock	4½%	4½%	...	110 —112	110 —112	111½	110⅝
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11 — 12	11 — 12	11⅝	11½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	12½— 13½	13¼	...
200,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10½— 11	10 — 11	10⅝	10⅜
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	13	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	81 — 84	111 — 114	...	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5½	5 — 5½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3¾— 4	3¾— 4	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6¼— 6⅜	6¼— 6⅜	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	15 — 16	15 5/16	...
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14 — 15	...	...
200,000	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	...	...
6,428	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15 — 16	15½ — 16½	...	...
21,980	St. James's and Pall Mall Electric Light, Ord.	5	10½%	14½%	14½%	14½— 15½	15 — 16	15⅝	15
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
25,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3¾— 4	3¾— 4	3 13/16	3¾
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½—15½	14½— 15½	14⅝	...

* Subject to Founder's Shares.
Unless otherwise stated all shares are fully paid.
Dividend is marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Oct. 25th.	Closing Quotation Oct. 31st.	Business done during week ended Oct 31st, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2⅜— 3½	2⅜— 3½	3⅝	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
80,000	British Electric Traction	10	...	...	6 %	16½— 17½	16½— 17½	17⅝	...
30,000	Do. do. 6 % Cum. Pref. 80,001—60,000	10	...	...	...	13½— 14	13½— 14½	14	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	125 —128	126 —129	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6⅝	6½— 6⅝	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅝— 2⅛	1⅞— 2⅛	1 15/16	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛— 2⅜	2¼— 2⅜	2 7/16	2⅜
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	109 —113	109 —113	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	105	104½
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13½— 14½	13 — 14 xd	13⅝	13
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	113 —116	113 —116	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10 — 10⅛	10¼— 10⅜	10⅝	10⅛
178,308	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5¼	4⅜— 5¼	5 1/16	5
71,447	Do. do. Def. do.	5	...	...	...	5 — 5⅛	5 — 5⅛	...	...
680,000£	City and South London Railway	Stock	1 9/16 %	1⅞ %	2⅛ %	63 — 66	63 — 66	63½	63
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6¼— 6⅜	6¼— 6⅜	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3¾— 4	3¾— 4	3 13/16	3 9/16
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £8 pd. 1 to 99,261	5	5⅛ %	6 %	6 %	2 — 2⅛	2 — 2⅛	2⅛	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛ %	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2⅛— 2⅜	2 — 2¼	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3⅛	3 — 3⅛	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	103 —106	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	¼— ½	¼ — ½	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	110 —113	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21⅛	21⅛
800,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3½ %	3½ %	8 1/16— 8 1/16	8⅞— 9	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½— 13⅝	13½— 13⅝	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	37¾	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9¾	9¼— 9¾	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	101 —104	101	...

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
British Aluminium, Ordinary, 9—10; 7 % Pref., 9½—10½.
Brompton and Kensington, 4½ % Debentures of £100, 104—107.
National Electric Free Wiring, 10s. paid, ¼—½.
Smithfield Market Electric, 1—3.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 105—107. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 18¾.

* From Birmingham Share List.

Bank rate of discount 5 per cent. (October 5th, 1899).

MARKET QUOTATIONS, Wednesday, November 1st.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a " Nitric .. .. .. per cwt.	22/-	22/-	..
a " Oxalic .. .. .. per cwt.	32/-	32/-	..
a " Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) .. per ton	£29	£27	40s. inc.
a " " .. .. per ton	£27	£25	40s. inc.
a Bleaching powder .. .. per ton	£6 10	£6 10	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 °/₀) .. .. .. per gal.	7/-	7/-	..
a " (50/90 °/₀) .. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£26	£26	..
a Lead, Nitrate .. .. .. per ton	£25	£25	..
a " White Sugar .. .. per ton	£31	£31	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 °/₀ at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	8½d.	8½d.	..
a " Caustic (75/80 °/₀) .. per ton	£24	£24	..
a " Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a " Recovered .. .. per ton	£5 10	£5 10	..
a " Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 °/₀) .. per ton	£7 10	£7 10	..
a " Crystals .. .. .. per ton	£3	£3	..
a " Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£224	£224	..
b " Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8½d.	..
c " Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c " Wire, basis .. .. per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f " Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£88	£88	..
g " Wire (basis price) .. per lb.	10½d.	10½d.	..
g " Sheet .. .. .. per ton	£88	£88	..
g " Rod .. .. .. per ton	£88	£88	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	7/-	6/-	1s. inc.
h India-rubber, Para fine .. per lb.	4/2½ to 4/5	4/2½ to 4/5	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i " Pig (Cleveland warrants) per ton	69/6	69/-	6d. inc.
i " Forgings, according to size per ton	From £11	From £11	..
i " Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8 .. per ton	£14 5	£14 5	..
g Lead, English Ingot .. .. per ton	£17 12 6	£16 15	17/6 inc.
g " " Sheet .. .. per ton	£18 16	£18 10	6s. inc.
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£9 5	£8 17 6	7/6 inc.
d Mica (in original cases), small per lb.	2d. to 8d.	2d. to 8d.	..
d " " " medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d " " " large per lb.	3/6 to 7/6	3/6 to 7/6	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p " rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd str'p & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 11	£3 11	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£146	£149	£3 dec.
g " foil .. .. per lb.	1 6	1,9	3d. dec.
n " wire Nos. 1 to 16 .. .. per lb.	1/11	1/11	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7¾d.	7¾d.	..
j " Best Flax, 6 lea. .. per lb.	4¾d.	4¾d.	..
j " Hemp, 8 ply 10 lbs. .. per lb.	5¾d.	5¾d.	..
j " " Russian, 10 lbs. per lb.	4¾d.	4¾d.	..
j " Jute, 180 lbs. rove .. per ton	£13 10	£13 10	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£26 5	£26 10	5s. dec.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
Messrs. Henry C. Yeo & Co.

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k Messrs. Morris Ashby, Limited.
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n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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PHYSICAL SOCIETY.

(Ordinary Meeting held October 27th.

Prof. W. E. Ayrton, F.R.S., Vice-President, in the chair.)

Dr. S. W. Richardson read a paper "On the Magnetic Properties of the Alloys of Iron and Aluminium."

Observations were made upon four alloys containing respectively 3·64, 5·44, 9·89, and 18·47 per cent. of aluminium. The alloys were used in the form of anchor rings, and were wound with primary and secondary coils separated by asbestos paper. The temperatures used ranged from −83° C. to 900° C. The low temperatures were produced by the rapid evaporation of ether surrounded either by ice and salt, or by carbon-dioxide snow. The high temperatures were obtained either electrically or by gas muffles. In both cases the actual temperatures were deduced from the resistance of the secondary, which was made of platinum wire, and wound next the metal. The author employed Maxwell's null method of measuring mutual induction, increasing the sensitiveness by the introduction of a secohmmeter, making about three revolutions per second. In order to test the accuracy of the method, some of the experiments were repeated with a ballistic galvanometer in the ordinary way, and the agreement obtained between the results in the two cases was well within the limits of experimental error. The chief conclusions to be drawn from the experiments may be summed up as follows:—(1) The alloys behave magnetically, as though they consisted of two distinct media superposed. (2) The general roundness of the curves, and their lack of abruptness near the critical point, seem to indicate that the alloys are heterogeneous in structure. (3) The permeability decreases with rise of temperature near the critical point, until a minimum value is reached, when further rise of temperature produces very slight diminution, if any, in the permeability. (4) The experiments suggest that the maximum value of the permeability for an alloy containing 10 per cent. of aluminium is reached at about 90° C. (5) An alloy containing 18·47 per cent. of aluminium has a critical point at about 25° C., and gives no indication of temperature hysteresis. This alloy probably has a maximum permeability much below −90° C. The author has found that at high temperatures there is a second maximum in the induction curve. This maximum becomes less and less noticeable as the field is increased.

The Secretary read a note from Prof. Barrett on the electric and magnetic properties of aluminium and other steels. The first part of the note dealt with the electrical conductivity of various alloys, and discussed the effect of composition and annealing upon the value of the conductivity. The second part of the note referred to magnetic effects. The most remarkable effect produced by aluminium on iron is the reduction of the hysteresis loss. The permeability of nickel steels is shown to be very much influenced by annealing. It is found that the addition of a small quantity of tungsten to iron hardly affects the maximum induction, yet increases the retentivity and coercive force. The experiments show that the best steel for making permanent magnets is one containing 7½ per cent. of tungsten. The magnetometric method was employed throughout.

Prof. S. P. Thompson drew attention to the wide range of temperature over which the author had conducted his experiments, and also to the small number of alloys used. He said a very much finer connection between the properties could be obtained from the examination of more alloys, and expressed his interest in the existence of the second maximum on the induction curve. He would like to know how the percentage composition of the alloys had been determined. Turning to Prof. Barrett's note, Prof. Thompson referred to the difference in the breadths of the hysteresis curves for aluminium and chromium alloys.

Mr. Appleyard asked for information upon the permanence of the curves.

Dr. Richardson, in replying, said the compositions were determined by analyses made after the experiments had been performed. It was proposed to carry on the research upon a series of aluminium alloys which he had obtained.

The Chairman expressed his special interest in the agreement which the author had obtained between the ballistic method and the null method of Maxwell, increased in sensitiveness by the secohmmeter.

Mr. Addenbrooke exhibited "A Model illustrating a number of the Actions of the Flow of an Electric Current."

The model consisted of a spiral of steel wire in the form of a closed circuit. Inside the spiral was placed a wire, which was supposed to be carrying the current, and which directed the motion of the spiral. A rotational movement given to one part of the spiral was transmitted by the wire and produced a rotational movement at another part of the spiral. The resiliency of the spring represents capacity and the torque electromotive force. Self-induction can be represented by weighting the spring.

Prof. Everett expressed his interest in the way that the correspondence between the propagation and the rotation agreed with that between the direction of a current and the direction of the magnetic force.

Prof. S. P. Thompson agreed that many analogies could be worked out by the model, but gave one or two examples to show that erroneous conclusions might be drawn by pushing the analogy too far.

Mr. W. Watson repeated some experiments with the Wehnelt interrupter devised by Prof. Decher.

The experiments showed in a clear and striking manner the fact that subsequent sparks tend to pass through the portion of air heated by the first one. In the first experiments motion of the heated air was caused by differences in density, and in the latter experiments by allowing the sparks to take place in a strong electro-magnetic field. The continuous rotation of the spark in a given field proves the unidirectional nature of the discharge.

In reply to Mr. Blakesley, Mr. Watson said he used the word "ionized" in his explanations to express simply the fact that the air had been rendered a conductor by the passage of the spark.

The Chairman referred to one of the first experiments performed. In this experiment the electrodes consisted of two copper wires in a vertical plane, slightly inclined to one another, and nearest together at their lowest points. On switching on the current the spark passed between the lowest points, but as the ionized air ascended, so did the most conducting path, and consequently the spark worked its way to the top of the electrodes. Here the heated air passed away, and the spark returned to the lowest point to rise again. The chairman thought that these effects might be due to the magnetic forces produced by the circuit itself. That similar effects in the arc light were due to this cause had been proved many years ago.

Mr. Watson repeated some of the experiments under new conditions, and proved that the explanation of the phenomena was not to be found in the tendency of the circuit to enlarge itself owing to magnetic forces.

Mr. Boys pointed out that the relation of the heating effect to the current, which was small in the arc light, was very large in the case of the spark discharges used, and therefore the movement of the spark in the latter case was practically determined by the heating effect in consequence of the relatively small importance of the electro-magnetic effect.

Prof. S. P. Thompson remarked that similar effects could be produced by an alternating current working an ordinary induction coil.

The Society then adjourned until November 10th, when the meeting will be held in the Central Technical College.

TRANSMISSION OF POWER BY GAS.

We referred some time ago to the question of the transmission of gas for the purpose of actuating gas engines at sub-stations in place of the transmission of high pressure current and the use of step-down transformation. At the time we gave some figures relative to the size of pipes necessary to carry gas for 1,000-H.P. engines, and pointed out that with producer gas—*gaz pauvre*—there was an enormous bulk of gas to be carried for very little energy as compared with coal gas or water gas. Should the system ever come into use, it would give a fillip to water gas, which contains little nitrogen as compared with air gas, for the area of pipes required would be only about a third of that necessary with air gas.

We are full believers in the future of the gas engine, but we must confess to doubts about the propriety of transferring gas in place of electricity. Before this time arrives, however, would it not be as well to give attention to the utilisation of the huge volumes of gas already made and sent to waste before shouting about making gas from coal and transferring it in pipes? The *American Electrician* states that present voltages are insufficient to enable waste heaps of culm to be turned into gas, and electricity produced and sent 100 miles. Surely this can be done in face of the fact that water-power has been utilised and transmitted as far. To transmit gas in pipes any distance would call for very large compressing plant, so that the pipe line might be kept small. The cost of this gas-compressing plant, and the proportion of gas it would use, together with possible relay compression *en route*, would be very considerable. Mr. George Westinghouse, who is now engaged in making gas engines, naturally has an interest in the gas producer, and he is of opinion that gas can be transferred more cheaply than electricity for driving electrical generators to replace rotary transformers.

Stated in brief, the question resolves itself into the choice, on the one hand, between gas-power driven generators, step-up transformation, high pressure line and step-down transformation, and on the other hand, gas compression, pipe line, and gas-driven dynamos at the point of power demand. Obviously much depends on conditions. As with electricity, the transmission line for gas can only be brought low in cost by means of initial compression. A low pressure gas conduit is always too heavy for its internal pressure, so that by transmitting gas under pressure, a saving is made in material. Long pipe lines have been used for oil in America, with relay pumping stations, but the amount of energy to the cubic foot is vastly greater with liquid oil than with gas, of a specific gravity less than one seven-hundredth that of oil. Where natural gas escapes at high pressure in America, its transmission appears feasible, and it is a fact little known here that small motors, like steam engines, are sold in America simply to be run with natural gas by its intrinsic pressure, not by its use as an explosive, as in gas engines proper.

The gas engine has certain advantages over steam not often recognised. It is not so necessary to seek a water front for condensing purposes. The gas engine requires little water; a small bore hole will easily supply all the water needed in a station of many thousand horse-power.

But gas engines are just as liable to cause vibration as are steam engines, and cannot thoughtlessly be brought into crowded neighbourhoods wherein a rotary converter could work without attracting notice. Why, too, should heat engines be brought to discharge bad gases into crowded cities when the cleaner electricity can be employed? To transmit gas is, we doubt not, perfectly feasible, but we think in the long run it will pay to use gas at the point of manufacture and transmit the power electrically at high pressure.

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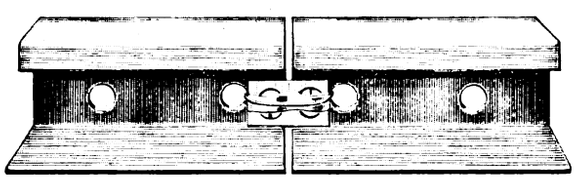
A NEW COPPER BOND.

A new type of bond, called the solid copper bond, has been designed by Harold P. Brown, and is described in the *Street Railway Journal* for October. It is not intended to take the place of his plastic bond for heavy duty, but it is intended for loads proportioned to its section. Its compact shape enables it to be sold at a low price.

The solid copper bond is made of a rectangular piece of rolled electric copper, 3 inches long, $\frac{1}{8}$ inch thick (or thicker), and $1\frac{1}{2}$ inches or more wide. A cup-shaped projection is pressed near each end so as to give a contact against rail web close to the end of each rail. Inside the cups is a piece of sheet steel supporting a pair of special steel springs; the steel is used to keep the springs from wearing into copper. These pieces are held together by a small iron strap until the bond is applied when the sharp web on the outside of the spring cuts it away and it enters the angle plate, thus aiding the conductance of the bond.

The entire bond is amalgamated to prevent rusting, and the contact surfaces are covered with the plastic alloy. The springs are proportioned to give a pressure of 1,000 lbs. per square inch when the angle plate is bolted up. The bond is always laid out to fit each particular rail and joint, and does not interfere with the mechanical fit of the angle plate. When in service the springs serve merely as



distance pieces so long as the joint is tight. If the nuts loosen or the plate wears, the springs still hold the bond in firm contact. Then tightening the track nuts also tightens the bond. The use of lock washers is advised on the track nuts to keep them fast. The springs then take up merely the wear of the plate.

To apply this bond it is only necessary to brighten the web of the rail beyond the end bolt hole with the usual hand-power grinder and emery wheel. The surfaces are then amalgamated by the Edison process and covered with a thin layer of plastic alloy. This unites with the amalgamation of the bond and maintains an electrical contact of low resistance which will not rust. The lubrication afforded by the plastic alloy permits the rails to move in any direction, without wearing away any metal of the bond.

The size of the copper will be varied to suit requirements of purchasers, up to the full area of the space between rail web and angle plate, and between end of bolt holes in rail. The manufacturer will not make a smaller size than No. 0000, since less than that amount of material will not give sufficient mechanical strength for durability.

The bond shown has a vertical cross-section of more than 0·218 square inch, while the section of a No. 0000 wire is but 0·166 square inch. The bond, therefore, has a conductance equal to one and three-tenths No. 0000 copper wires.

The depth of the special steel spring is varied to suit the clearance between rail and angle plate, and is always so proportioned, that the spring is perfectly flat when joint is tight. The steel is made for this purpose and will maintain its tension for years. On covered track in wet or alkaline soil where steel is apt to rust rapidly, both the springs and the sheet steel base, when desired, can be treated with a petroleum compound which will permanently protect them. This, however, will prevent the angle plate from taking any portion of the current through the bond contacts.

Amalgamated copper bonds of this type (but without the spring feature) have been in satisfactory service for several years. The springs are a safeguard against poor contacts when the joints loosen. As long as the joints are kept tight the bond will do its work. There is no bending or shearing strain on the copper since the bonds have sliding, lubricated contacts.

AMERICAN COMPETITION.

Considerable discussion is being evoked by the articles in *Engineering* on American competition. A Belgian considers that insufficient stress has been laid upon the very low rates of transportation which prevail in America, but he believes, if they would only set out to do it, that European roads could offer quite as cheap rates, owing to their generally better construction, and their large amount of high-class freight. American rates are very low, but American terminal charges are very high. The railroads only give station-to-station rates; they do not deliver. Yet, on the whole, their rates are low if long distances are to be traversed. Our own view of American competition is well known; it is, that American competition is rather absence of home production.

No one who knows anything of the prices charged for certain classes of American goods—prices which are now being frequently and considerably augmented—can doubt the fact that any men of capital could go into the business here and make nice fortunes. The marvel is that, with so much work looming in the near future, there should be so few manufacturers in this country for electric tramway equipment. Much of the present competition consists of the above kind. Much more is due to the fact that our own manufacturers are so very busy, and will not even quote a price for their own goods.

One correspondent of *Engineering* thinks that the existing American conditions are not stable, and considers that when the boom is over both here and in America, the big works there, which are based on a policy of maximum output, will find much difficulty in getting along. The federation of labour here has brought about, as a counterbalancing influence, the federation of capital, for labour had abused its privileges. In America, the federation of capital will probably produce a counterblast in the shape of a federation of labour, hitherto, perhaps, delayed by lack of homogeneity. Successful American competition has been due, as all of us know, to reducing men almost to the level of machines. The life of a machinist is one grinding monotony, and cannot even be tolerated at the present long American hours. Such workers, no matter how well paid, cannot ever remain good, intellectual citizens. They must either degenerate, or have greater leisure. America has trained her workers, it may be argued, to work, and we do not see why these men should not work, say, six hours a day, and still compete with men who loaf eight hours. Our own short hours have been abused by the class of men fostered by the Amalgamated Society of Engineers, and this evil influence, now extending over many years, has much to answer for in the reduced productive power of the country. The worthy Tom Mann, who did his share to stop the use of machinery, is at present writing against employers, and, like John Burns, calling for the American methods he has done so much to delay. For ourselves, we don't so much want American methods as a return to old time hard work and modern short hours.

Undoubtedly there is serious danger ahead for America in a rigid continuance of the system which has built up her competition, but America is still far from full, and can make risky experiments upon which other lands could not venture. For the moment Americans are naturally jubilant at the success of their goods in foreign countries, but we do not see that there is any special need to be alarmed. Americans would sell very little in England, or any part of Europe, if such countries could not afford to buy, and profit by the buying. Should American competition ruin Europe in the sense that some of the short-sighted American writers appear to look for as a glorious consummation of American genius, it would be but a poor look out for American business in the future. They would not export many tools to a bankrupt Europe out of pure love of export. American competition has done good to America. It has taught the thinking amongst them that it is not well to desire ill for your best customers.

France has not learned the lesson yet, and would gladly sink England below the sea, but Germans are beginning to see that, as a customer, England is better strong than weak, and even Russia values our markets. Foreign trade has made free traders of the Americans, who, only a few years ago, never tired of inveighing against the corruption of American politicians by the gold disseminated by the Cobden Club. What a poor opinion Americans must have held of their politicians at that time! We welcome American or any other competition when it is fair.

ENGINES WITH DIRECT CONNECTED DYNAMOS.

The views on the stresses in shafts, due to fly-wheel energy and load fluctuation that were lately advanced by us, have been again put forward by a correspondent in the *Engineer*, Mr. Chas. Day. Mr. Day finds himself unable to accept a claim made, we may say erroneously, by another correspondent, that a heavy fly-wheel will lessen the stress in a shaft. It will only lessen the stress on the engine side of the wheel, but it will increase the stresses on the generator side. We are glad to find so able and experienced an engineer as Mr. Day corroborating the views set out by ourselves in regard to the necessity of a good connection between the fly-wheel and the armature, whereby alone can stress fluctuations be dealt with directly from the fly-wheel without the stress passing through the fly-wheel. As Mr. Day remarks, the stresses in a traction station do not, as a rule, vary from nothing to a maximum. There is almost invariably some load upon the line when the maximum is suddenly brought on. It is, of course, a common occurrence for the load to drop from a maximum to nothing. This occurs every time the circuit breaker goes out, but the converse rarely, if ever, happens. When the circuit breaker is put in, the cars standing on a line are generally shut off at their switches, and do not all switch on again at once; and in this connection it must be remembered that a small fraction of time, say, a fourth or a tenth of a second between the switching on of cars is ample to warrant the load being called gradual. To put 10 cars into movement every second only means, with some engines, one car every stroke, and as each car goes in it renders the putting on of the next car a less proportion of the whole load. If the Glasgow affair has had no other use, it will have served to dispel many hazy ideas as to the supposed enormous stresses of traction work. It

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has also pointed out the fact that American makers of big engines do not appear to yet dare speeds above 75 r.p.m., which does not, to say the least, point to much superiority over any English maker of big engines. It is curious that in large work Americans should have elected to run at such slow speeds, for in their smaller engines they are so particularly successful at high speeds. We do not quite agree with Mr. Day, that weight of fly-wheel can have little effect on the shaft stresses under variable load, for with a heavier wheel a sudden accession of load is taken on with less variation of angular velocity in a less space interval. With heavier wheels the retardation effect of an additional load is less, and this, says Mr. Day, helps the governing. It does, in a sense, but also it reduces the inertia effect of the inertia part of the fly-wheel governor. Looked at from any point of view, the direct connection of fly-wheel and dynamo is advantageous.

THE INSTALLATION OF STEAM BOILERS.

IX.

At one time considerable discussion took place as to the relative merits of the steam dome and the anti-priming pipe. That steam domes were often found plastered all over with mud is a fact that goes a long way to discount any special value that might be attached to them. But to-day considerations of strength demand their abolition, producing as they do a large area of shell exposed to steam pressure on both sides, and, therefore, under complex stresses.

It may, however, be fairly argued that the steam drum is an advantage. A steam drum may be large enough to contain a baffle plate to change the direction of flow of steam and distribute it all over the drum area. A steam drum may also be connected to the shell by a small block. Two drum connections are usually made to the shell. This is undesirable. One rigid connection should be employed, the other end of the drum being only supported upon the shell but not attached rigidly. A thin plate support placed across the line of expansion will admit of the necessary movement, and prevent all stress on the shell or drum itself. The anti-priming pipe is, however, now usually considered sufficient. It is a cast-iron pipe extending each way from the steam valve and block, into which its top branch projects a neat fit. The top and sides of the pipe are slotted with numerous holes, the joint area of which should not exceed by more than 25 per cent. the area of the steam outlet valve. The pipe is about 8 feet long and may be 6 inches inside diameter, with one or two holes for drainage. It is carried by lugs at each end, with bolts to sling it from angle brackets double-riveted to the crown of the boiler shell, and the top of the pipe should come near the top of the boiler, but not closer than an inch to any plate. The object of the pipe is to collect steam from a considerable length of the boiler, whereby a rush of steam, which would possibly carry a lot of entrained water, is prevented. Hence the rule that the perforations should not exceed by more than 25 per cent. the steam outlet area. With too large an area, one end of the pipe might carry a big rush of steam and cause priming. It was to the vortex action of gusts of steam that steam domes owed the muddy contents which proved their failure.

The blow-out tap is usually placed about a foot in front of the front end plate, the centre of the blow out block being about 15 inches further back. As there are considerable stresses brought upon the tap, it is attached to the boiler block by a cast-steel elbow pipe, tapering from 6 inches inside diameter at the mounting block to 2½ inches at the top end. Beyond the tap the connection is copper, usually a bend to the waste main, but better a straight piece placed between the tap and the independent cast-iron waste-pipe leading to the separate blow-out box. The separate blow-out box may be 10 feet in front of the boiler, or even buried under the coal in the bunker. It may be 3 feet deep and 2½ feet square, and should have a waste pipe to the final drain, and a free outlet to the air to prevent internal pressure, and its cover should be secured so as not to lift with pressure.

The water-gauge taps should have waste pipes connected to the blow-out wastes beyond the taps in preference to a free discharge to the hearth pit. One of the most troublesome of fittings is the water-gauge. Glass is so soluble at high pressures that water-gauge glass tubes easily break, and require very careful fixing with cone washers. These are held against the tube by the steam itself. The tubes must be free, and ought to be capable of being turned round in their place, even when at work. The frequency of breakage necessitates automatic shut-off valves. It is claimed that a reliable automatic shut-off can only be obtained by means of a back tube.

There are numerous patterns of water-gauge taps with automatic action, and intending users should carefully investigate before purchase. One thing is essential: Water-gauge taps must be large and heavy, or they speedily leak and become dirty and unsightly. Their handles should be as big as can be grasped, and the whole fitting large in proportion, and they are to be bolted to facings riveted to the front end plate. The front end plate connection of the steam gauge syphon must also be large and heavy, and the dial of the gauge at least 10 inches diameter.

In the best practice the manhole mounting is surrounded by a chequer plate platform on a frame, with two or three steps down to the cover of the side flues. Over the centre of the manhole is carried right across the battery of boilers a girder of rolled steel of I section, on which runs a light trolley, with hook and left and right screw turn-buckle, to lift the manhole cover by the eye bolt, which is screwed into all these manhole covers. This facilitates removal of the cover, which is readily run aside, free of any risk or injury to its joint facing.

As the damper ropes are sometimes considered an impediment, some engineers made the side-flue dampers to swivel. When so arranged there is a short arm on the top spindle, and this arm is sunk below the surface of the covering flags, and actuated by a rod which is laid in a channel in the brickwork under the flags, and worked by a hand wheel on the front glazed brick cross wall with a gun-metal square threaded bush. The arrangement may be made very neat.

The furnace doors are usually of cast-iron, with an air grid of large area closed by a grid plate worked by a single turn of a cross bar handle placed in the centre of the door. The grids project on the face of the door, and are together with the encircling rim machined and polished. The doors are hinged to a sheet-iron or steel plate bolted to three angle brackets which are double riveted upon the furnace plate, one at the crown and one at each side. The edge of this flat plate is concealed by a flat moulding ring of cast bronze bearing the maker's name, but in no way covering the rivets of the furnace. The grate surface is placed as low as possible consistent with maintaining practically the full diameter of the furnace tube at the grate surface. Inside the plate is usually an arch of cast-iron surrounding the door and carrying the fireclay liner to protect the furnace front. A firebrick arch should protect from the dead plate right round the crown of the furnace above the dead plate. The door grids should afford an area of about 60 square inches, or 1½ inches per square foot of grate area for air admission after firing, when bituminous coal is used. Inside the door a second plate is fixed, about 3 inches from the door body, and perforated full of holes, in order to divide the inflowing air into small streams.

Grates are usually made 6 feet in length, in two bars of 3 feet each, which extend from the dead plate to the bridge. The dead plate extends about 1 foot to 15 inches from the front end plate, and the back end of the grate is set lower than the front, from 3 to 6 inches according to opinion, sloping down to the bridge end.

Bridges are often of solid firebrick, in which case they ought to have only the round edged blocks we have already named against the plate. But they are better of cast-iron, neatly fitted and bolted to the back end bearer brackets of the grate. Indeed, the bridge casting may form the bar support. The angle brackets are like all other little brackets, double riveted to the furnace sides, and the grate cross bearers are rigidly bolted to these brackets, thereby preventing possible detrusive action by the weight of bars and fuel. The cast-iron bridge then carries a firebrick top wall, and should have a door in the ash pit communicating with the flue behind the bridge for cleaning purposes.

Where scum troughs are used, they discharge by the tap

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already described upon the opposite side of the front end plate from the feed valve, by a straight down pipe through the cast-iron hearth plates into the same waste pipe as the bottom blow-out or sludge tap. This vertical waste pipe passes through the hearth plate by a hole of 1 inch greater diameter than the outside of the pipe, and the space is concealed by a brass collar on the pipe simply resting flat on the hearth plate. In the hearth pit the waste pipe is joined by a copper piece to the waste pipe of the sludge tap, or direct to the blow-out box.

The dead weight safety valve is always placed near the front of the boiler, and it should have upon it a lever, with a box end so projecting and placed as to be capable of receiving the end of a special bar, by which the fireman can

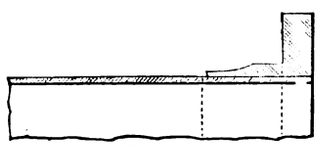

Fig. 25.

reach from the firing floor and lift the weight at least once daily to test the valve. For a similar purpose a platform of chequer plates extends right across all of a row of boilers at the back of the Hopkinson valves, in order to enable the fireman or other appointed assistant to lift the levers and blow the valves daily. If arranged that the l.w. safety valve comes next to the steam junction valve, this same platform serves for both the safety valve and for access to the stop valve. Blow-off waste pipes are often attached to the safety valves to carry off the steam. It is better not to fit these pipes, for with a good fireman safety valves should rarely act—hence the importance of a daily test to prove their freedom; but drip pipes must be provided to keep moisture off the boiler. These and the drain pipes of the steam valves require to be brought down direct by a curved pipe just over the crown covering into common waste pipes, the pressure drains being carried to steam traps discharging to the feed pump supply. These waste pipes should be carried just over the side flues, out of the way of the pathway. In some cases a platform of cast-iron diamond grid plate extends over the whole of a set of boilers, above their crowns, and free of any connection with the fittings. Such floors afford very convenient access all over the boilers to every mounting, and are very good if carefully attended to as to cleaning beneath.

It will have been observed that freedom from binding has throughout been sought in all arrangements, and where pipes leave a boiler they have been provided with means of accommodating themselves to slight movements without risk of fracture. No pipe is more important than the steam pipe. In a battery of boilers each boiler discharges to a common steam main. It is not a good practice to take a straight pipe directly from the steam outlet valve to the steam main against the back wall. It is better practice to carry the main above the boilers and connect to it by a bend from the steam valve. But it is much better to carry the boiler branch upwards by a bend from the steam valve and then some 10 to 20 feet back to the steam main along the back wall of the house or slung from the roof. This provides length of pipe to ease any movement stresses. Where space will not afford liberal treatment it is good practice to interpose a long U bend of copper between the boiler and the steam main. These are superior to telescope pipes, which are apt to leak and give trouble, and expansion discs also are not satisfactory owing to the enormous abutment resistances they require but rarely get. Boiler branch pipes are, perhaps, best slung from above. Main pipes near walls may be carried on brackets with rollers or slung from wall brackets above. There is a tendency for steam pipes to commence vibrating, an action very injurious to the joints. This occurs with pipes near an engine. The engine starts the vibration. For such it is better to rest the pipes on solid brackets without friction rollers, and in such case a wearing piece must be rigidly attached to the pipe where it rests on the brackets. These wearing pieces save the pipe being rubbed through. This system allows every freedom for expansion, yet checks vibration as by a brake. Indeed, it is permissible to actually clip a pipe to the extent of stopping vibration if the clip bolt is small and the clip light, so that expansive movements may not be unduly resisted. Needless to say, steam pipes are now made of lap-welded steel or iron for high pressures. They are screwed into steel flanges with a fine thread (Whitworth gas, not the American coarse pipe thread), and expanded tight with faced flanges. If copper is used, the flanges should be of gun-metal, and the pipes solid drawn, not brazed, and for high pressure, and anything over 8 inches, they may profitably be wire wound or hooped at short distances. The flange of a copper pipe should taper down to a feather edge when it meets the body of the pipe, as otherwise the pipe is very apt to fail at the flange where the sudden difference of rigidity occurs (fig. 25).

If a boiler be made and set in accordance with the general and detailed directions of these articles, it will be accepted by the best boiler insurance companies as a first class boiler. An inspection of such a boiler will show that no part of the interior is concealed from view, that the whole of the interior of the tubes can be seen, and the whole exterior of the shell can be actually seen, there being no contacts except along a line. All this can be done easily. Perhaps we ought to except the boiler crown. This is usually covered by a composition which is blown off if there is the slightest leak at a seam. But firebrick air-space blocks are now made to cover boilers, and they have little projections to touch the boiler. These fit close, and can be lifted off and replaced at will for inspection. The soft compositions are, however, also very good and safe, as they show at once if a leak commences.

A first-class modern-made boiler is really as accurate a piece of work as an engine, and steam users are advised ever to use and consider them as such. Their shells and furnaces are truly circular, their rivet seams are all machine made, and the best makers aim to close every rivet mechanically if the mounting blocks are attached to their respective plates before the plates are put together, and by similarly riveting up gussets in proper sequence.

A boiler thus made does not really require to be tested, but it is usual to test it to the extent of 75 or 80 per cent. beyond the intended working pressure. Formerly double the working pressure was allowed, but it is very doubtful if more than 50 per cent. excess should be put upon any boiler. Such a margin is enough to show the yield of the end plates, but larger pressures do no good, and tell nothing of the bursting pressure. A boiler made by modern methods can be made good and safe by proper selection of material, and attention to accuracy of workmanship. Some of the demands made in the foregoing articles may appear exacting, yet they are practically as easy to carry out as the shoddy work which is too frequently allowed by boiler-makers to spoil the best of their work. This is especially the case in details of finish, such as flue entrances, hearth pit covers, damper details, and other items, which are as cheaply done well as ill. In a finished boiler house it ought to be easy to get about over the whole of the boilers, to reach each safety valve for testing, and get to each steam valve without treading on the covering composition or stooping beneath steam pipes and small waste pipes, or brushing against damper chains or ropes. It is just in such items as these that many of the contractors for electrical work to-day display their ignorance of good practice by reverting to systems and methods which good practice has rejected these last 30 years.

UNITS OF MEASUREMENT.

By W. MOON.

All who try to master the C.G.S. system of units experience a difficulty in understanding them owing to the smallness of most of the units. The introduction of the practical electrical units has, in a way, severed their connection from the fundamental units, and made them almost as useless as if they were not founded upon an absolute system at all. It is very unlikely that practical men will ever adopt the C.G.S. system.

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The first essential in founding a physical set of units should have been to select as fundamental units those measurements of mass and length most commonly used, so that the value of the derived units could be more easily understood. And the unit of time should then have been selected to make the mechanical units of about the value of those in general use.

Of all the metrical measures the litre and the kilogramme are the most commonly used and understood. And as no system of units should depart from the rule that unit capacity contains unit weight of water, the kilogramme as unit of mass and the decimetre as unit of length are certainly the two fundamental units of length and mass upon which all physical units should be founded.

Hitherto the second, which is an awkward fraction of the day, has been taken as the unit of time. There is, however, a growing tendency on the Continent to introduce decimal time, and this will no doubt be done ultimately for all purposes. For this reason, if for no other, a decimal time should be used in physical units. A decimal part of the fourth of the day would be better than that of the whole of the day; since the unit of length is based on a decimal part of a quadrant of the earth, and it is advisable to have time and longitude agree. All trigonometrical functions are, moreover, nearly related to the quadrant than to the circumference, and it is the quadrant that is divided into decimal parts "grades" and not the circumference.

The $\frac{1}{4}$th of a day = 36 minutes, and the $\frac{1}{40000}$th of a day = 21·6 seconds, would be as convenient, or more convenient, for ordinary use than the hour and the minute; while for physical purposes the $\frac{1}{4000000}$th of a day = ·0216 seconds could be taken as unit of time.

This unit of time with the decimetre as unit of length gives $G = ·04577$ and $G^{-1} = 21·85$. And the weight of 21·85 kilogrammes is certainly a more rational unit of force than the dyne of about a millionth the weight of a kilogramme. The unit of power with these units of time and length is a kilowatt to within 1 per cent.

The number of C.G.S. units in the proposed mechanical units is as follows:—

	Symbol.	Dimensions.	No. of C.G.S. units in proposed units.
Length	l	L	10
Area	A	L^2	100
Mass	M	L^3	1,000
Velocity	V	$L T^{-1}$	463
Acceleration ...	G	$L T^{-2}$	$21·43 \times 10^3 G = ·04577$
Force	F	$L^4 T^{-2}$	$21·43 \times 10^6$ weight of 21·85 kg.
Work	W	$L^5 T^{-2}$	$214·3 \times 10^6 = 21·43$ joules.
Kinetic energy ...			
Moment of couple			
Power	P	$L^5 T^{-3}$	$9·923 \times 10^9$ = kilowatt nearly.
Pressure and stress per unit surface		$L^3 T^{-2}$	$214·3 \times 10^3 = 3·18$ lbs. per sq. in.
Momentum ...		$L^4 T^{-1}$	463×10^3
Conductivity of heat		$L^2 T^{-1}$	$4·63 \times 10^{-1}$ = power per unit area.
Radiation of heat ...		$L T^{-1}$	463 = power per unit area.
Caloric		L^3	$10^{-1} = 4,250$ joules.

The giving of the various units names is certainly useful as regards those most frequently used, but has led to some confusion with those less frequently employed, and the better plan seems to be to speak of the latter, as so many units of work or of pressure, for instance.

In dealing with very large or very small quantities the usual prefixes expressing multiples of the units could be used without giving the unit a name. Thus a very small force could be spoken of as so many microunits of force.

It is a great advantage to express different values in one uniform set of units. Thus the proposed unit of velocity = 4·63 metres per second, so that the average rate of walking would be $\frac{1}{2}$ a proposed unit, the velocity of a train, say, 7 units, the velocity of sound 74 units, the velocity of rotation of the earth at the equator 100 units, and the velocity of light, $64·885 \times 10^6$ units.

The introduction of decimal time would make it needless to express velocities in any other form than as a ratio of the units of length and time.

The unit of force could, of course, be used for either a stress or compression. While the unit of pressure, that is, unit force per unit surface could replace the arbitrary scales of inches now used in pressure gauges and barometers.

Allowing for the error in the B.A. ohm, Joule's equivalent in the proposed units would be about 198 for a kilogramme degree Centigrade.

Many advantages would result from doing away with this equivalent as first proposed by Sir William Preece to the B.A. in 1888. The heat of combustion would then be in units of energy directly, as also the latent heats of fusion. For if the degree of temperature is taken as unit of energy in unit volume of water, the latent heat of water would be 15,700, and of steam 105,000 proposed units, and the heat of combustion of coal $1·6 \times 10^6$ units.

Moreover, with such a scale of temperature, the thermal conduction or radiation per unit surface would be in units of power per unit surface.

The work of Tyndall and others has shown how the intensity of illumination, which has hitherto been given in arbitrary units, could be expressed in power expended in light rays per unit surface. And the power of a source of light in power radiated in light.

The efficiency of any source of light would then be

$$\text{efficiency} = \frac{\text{power in light}}{\text{total power expended}}.$$

Although light could not conveniently in practice be measured in this way, standard flames like the pentane lamp could be standardised in absolute units for practical use.

A thermometer graded in the proposed degrees might, for ordinary purposes be graded in 10^3 degrees starting from the absolute zero of temperature. The scale for most thermometers would extend from 50,000 to 75,000.

Proposed degrees, Centigrade, Fahr.,			
40,000	−70	...	
46,000	−40	−40	Mercury freezes.
50,000	−20	...	
54,000	0	32	
56,000	...	...	Mean temperature, London.
56,970	15	60	
59,940	30	86	
61,250	36·6	98	Blood heat.
73,800	100	212	
75,000	106	...	
84,000	150	311	Steam pressure, 80 lbs.
94,000	200	392	" " 250 "
99,600	230	447	Tin melts.
104,000	250	...	Temperature of fire-box of locomotive.
158,200	526	Just visible.	
252,000	1,000	Silver melts.	
450,000	2,000	...	Platinum melts.

Such a method as this of grading thermometers would keep constantly in view the great waste in the transformation of the energy of coal into power and light.

The doing away with Joule's equivalent also simplifies the calculation of the E M.F. of chemical combinations:—

Electro-chemical equivalent, copper = 65 × 10⁻⁶,
" " " zinc = 67 × 10⁻⁶,
Heat of combustion, copper = ·118 × 10⁶,
" " zinc = ·2535 × 10⁶.

$$E = \frac{w}{q} = w \text{ . equivalent.}$$

E M.F., zinc = 67 × ·2525 = 17 units,
" copper = 65 × ·118 = 7·67 "
Their difference = 9·33 units, say E.M.F. of Daniell cell.

(To be continued.)

THE SERVICE PERFORMANCE OF RAILWAY MOTORS.*

By W. B. POTTER.

The conditions imposed in railway service are so intermittent and varied, that it is not possible to establish a standard factory test that will meet all the requirements of actual practice. The General Electric Company has therefore adopted, as representing extreme conditions, an arbitrary standard, based on temperature rise of the motor of 75° C. in one hour, the temperature of the surrounding air being assumed at 25° C. The horse-power rating obtained on this

* *Street Railway Journal.*

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basis represents only one hour's continuous run, and the temperature of the motor will rise to an injurious point if it is operated for an extended time at the rated output.

While a railway motor cannot be operated continuously at the rated horse-power without injurious heating, this output can be exceeded for short periods of time, as in rapidly accelerating a car or climbing short heavy grades, but for ordinary service the average horse-power required of a motor throughout the day should not be greater than 30 per cent. of its horse-power, rated on the hourly basis, which will give a temperature rise of about 60° C.

These figures are based on a line potential of 500 volts, and the average rating of the motor may be increased approximately as the voltage is increased. For example, if a motor wound for 500 volts be operated on a potential of 550 volts, the average output may be increased about 10 per cent.

When electric brakes are proposed, a motor of greater capacity must be used, since the heating of the motor is increased from 20 per cent. to 25 per cent. by the use of electric brakes, this extra heating depending on different conditions of service. The minimum increase of 20 per cent. represents a service containing few grades and stops, and the maximum of 25 per cent. should be allowed on hilly roads with frequent stops, where the electric brake will be in use a large part of the time.

Horse-power of Motors.

The total horse-power (rated on the hour basis) of an equipment for ordinary city and interurban service may be determined approximately by the following general formulæ. The ton in all cases is taken as 2,000 lbs.

$$\text{Horse-power} = \frac{(\text{Total wt. in tons}) \times (\text{Maximum speed in m.p.h. on level})}{5}$$

If electric brakes are to be used, the formula should be as follows:—

$$\text{Horse-power} = \frac{(\text{Total wt. in tons}) \times (\text{Maximum speed in m.p.h. on level})}{4}$$

If the maximum speed is not known, it can be taken as being twice the schedule speed, since this ratio is usually found in practice.

As an example, assume a 20-ton car, with a maximum speed of 50 miles per hour, the line potential being 500 volts, then

$$\frac{20 \times 50}{5} = 200 \text{ H.P., or four 50-H.P. motors.}$$

If the line potential were increased to 600 volts, electric brakes could be used with these same motors, the gear ratio being changed to give the same speed as before.

As another example, consider an ordinary street car weighing, equipped and loaded, 11 tons, the maximum speed being about 25 miles, then

$$\frac{11 \times 25}{5} = 55 \text{ H.P., or two 30-H.P. motors.}$$

If electric brakes were to be used, then

$$\frac{11 \times 25}{4} = 69 \text{ H.P., or two 35-H.P. motors.}$$

The motor capacity required for any given service is so largely affected by the condition of track, grades, &c., that these rules should be cautiously applied, as they are simply a guide to the selection of a motor equipment, and indicate the *minimum capacity* under ordinary conditions.

The schedule speed, or speed of the entire run, including stops, is ordinarily about one-half of the maximum speed on a level track; but where stops are frequent, this ratio becomes less. In suburban service this figure may be exceeded, since the relation between the two speeds is governed by the number of stops per mile the cars are required to make, and the fewer the number the more nearly the schedule speed will approach the maximum speed. For example, if a certain equipment can make a maximum speed on a level of about 25 miles per hour, then the limit of the schedule speed with seven stops per mile will be about 10 miles to 12 miles per hour, while the same equipment, with but two stops per mile, could make a schedule speed of between 15 miles and 18 miles per hour. High schedule speeds with frequent stops require equipments with large motor capacity, and problems of this kind should always be treated as special.

Tractive Effort.

The tractive effort required to move a car or train is dependent on the rate of acceleration, grade and car friction, air resistance being included in the latter. In railway practice acceleration is conveniently expressed in miles an hour per second, that is, an accelerating rate of 1 mile an hour per second means that the rate of speed is increasing 1 mile each second, and that in 20 seconds, for example, at this rate, the speed will be 20 miles an hour. One mile per hour per second is equivalent to 1·466 feet per sec.

Excluding car friction, a tractive effort of 92½ lbs. per ton (2,000 lbs.) will produce an acceleration of one mile an hour per second on a level track, and the rate of acceleration will vary in direct proportion to the amount of tractive effort used. On the ordinary street car the tractive effort during acceleration often rises to between 200 lbs. and 300 lbs. per ton. In elevated or suburban train service, the maximum tractive effort is generally from 100 lbs. to 150 lbs. per ton, while for heavy freight work, where slow speeds are used, it may not exceed 30 lbs. or 40 lbs.

Grades are commonly expressed in percentage of feet rise in a length of 100 feet, and the tractive effort required for a grade is the same percentage of the weight as the rise in feet is to a length of 100 feet. For instance, a 3 per cent. grade will require a tractive effort equal to 3 per cent. of 1 ton, or 60 lbs. per ton. To this figure must be added the tractive effort necessary to overcome the car friction, if the total tractive effort is required.

The tractive effort necessary to overcome the rolling friction of the rail and air resistance has been compiled from a number of tests, and the approximate amounts are given in the following table:—

Fifteen-ton car, up to 25 miles per hour, tractive effort equals 25 lbs. per ton.
Fifteen-ton car, up to 50 miles per hour, tractive effort equals 50 lbs. per ton.
Twenty-five-ton car, up to 25 miles per hour, tractive effort equals 20 lbs. per ton.
Twenty-five-ton car, up to 50 miles per hour, tractive effort equals 25 lbs. per ton.
One hundred-ton train, up to 25 miles per hour, tractive effort equals 15 lbs. per ton.
Heavy freight train, up to 25 miles per hour, tractive effort equals 6 lbs. to 10 lbs. per ton.

The above figures would be considerably increased by presence of snow or dirt on the track.

Tractive Coefficient.

This coefficient is usually expressed as the ratio between the weight on the driving wheels and the total tractive effort, and is dependent upon the adhesion between wheels and rail. It has a variable value for the same equipment, being largely affected by the condition of the rails, whether wet, dry, or sanded.

In train work, it may be stated as a general rule, that the weight on the driving wheels should be at least six times the tractive effort required. For example, the weight of a locomotive necessary to haul a 100-ton train up a 2 per cent. grade would be found as follows:—

100 × 15 lbs. friction = 1,500 lbs. for friction of train.
100 × 40 lbs. for grade = 4,000 lbs. for grade.

Total tractive effort required, 5,500 lbs. for train only.

Assuming a 20-ton locomotive, we have:—

20 × 15 lbs. for friction = 300 lbs.		
20 × 40 lbs. for grade = 800 lbs.		
Total tractive effort for locomotive only	...	1,100 lbs.
Total tractive effort for train... ...	...	5,500 „
Total ...	...	6,600 lbs.

This is 16·5 per cent. of 20 tons, the weight of the locomotive, it being assumed that all axles on the locomotive are equipped with motors, and the entire weight is, therefore, available for traction.

Starting this train on the 2 per cent. grade, assuming the slow accelerating rate of one-third of a mile an hour

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per second, would require an additional tractive effort of $\frac{92 \cdot 8}{3}$ = 30 8 lbs. per ton, a total of 11,543 lbs. This would necessitate using a 35-ton locomotive, and the total tractive effort in this case is 16·8 per cent. of the weight of the locomotive, or 35 tons.

The following table is based on the results of a series of tests and shows, in a general way, the variation in the tractive coefficient under different conditions:—

TRACTIVE COEFFICIENT

	Per cent.	Sanded, per cent.
Dry rail	28	28
Thoroughly wet rail	20	25
Greasy moist rail	15	25

With ice or snow on the rails, the coefficient may be even lower, while the rolling friction at the same time may be largely increased on account of the snow. With this fact in mind, the value of four-motor equipments, even for single cars, is evident, especially on suburban service, where the cars run through an open country exposed to snow and ice.

AVERAGE ENERGY.

To approximate the capacity of the power station for any given service, the average energy required may be assumed as 100 watt-hours per ton-mile × schedule speed. As an example, assume a schedule speed of 12 miles per hour, and a car weighing 15 tons. The average kilowatt rate of energy consumption per car would be

100 watt-hours × 15 tons × 12 m.p.h. = 18,000 watts = 18 KW.

The figure of 100 watt-hours per ton-mile × schedule speed is generally correct for the ordinary conditions of city and suburban service. If the stops are a mile or more apart, the energy consumption may be as low as 60 watt-hours or 70 watt-hours, while frequent stops and very high schedule speeds may increase this figure to 120 watt-hours or even more.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this Journal by W. P. THOMPSON & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

20,666. "Improvements in regulating and starting switches for electric motors." R. DOBSON. Dated October 16th.

20,668. "Improvements in obtaining heat and vapourising fluids by electricity." R. C. SAYER. Dated October 16th. (Complete.)

20,678. "A short-circuit switch for electrical machines." R. J. HOUGHTON. Dated October 16th.

20,689. "A new or improved method of automatically extinguishing electric and gas lights at any required time, and apparatus for effecting same." F. W. SMITH. Dated October 16th.

20,705. "Improvements in and connected with electrically energised pendulum clocks." G. D. GRANGER. Dated October 16th.

20,720. "Improvements connected with electric lamps having illuminated bodies composed of second-class conductors." V. I. PEFNY. (Allgemeine Elektricitäts Gesellschaft, Germany.) Dated October 16th. (Complete.)

20,732. "Improvements in accumulators for mixed fluids under pressure." W. J. CRYT. Dated October 16th.

20,743. "Improvements in electricity meters." J. TOURTEL. (P. Rissler and H. Bauer, Germany.) Dated October 17th. (Complete.)

20,751. "An improved device for steering electrically-driven motor cars." E. ANDREAS. Dated October 17th.

20,758. "Improvements in lanterns or globes chiefly for incandescent gas lights, arc lights and the like." S. BIHELLER. Dated October 17th. (Complete.)

20,790. "An improvement in safety fuses for electric circuits." A. C. F. WEBB. Dated October 17th.

20,793. "Improved means and apparatus for regulating the speed of gas and like engines driving dynamo-electric machines." J. RICHARDSON and F. S. HIGHTON. Dated October 17th.

20,803. "Improvements in electric meters." THE BRITISH THOMSON-HOUSTON CO., LTD. (E. Thomson, U.S.) Dated October 17th. (Complete.)

20,804. "Improvements in systems of electric conversion comprising static and rotary transformers." THE BRITISH THOMSON-HOUSTON CO., LTD., and H. M. HOBART. Dated October 17th.

20,818. "Improvements in primary electric batteries." A. A. BEADLE. Dated October 18th.

20,862. "Improvements in or relating to the method and apparatus used in electrostatically measuring electric currents in a working circuit and calibrating the measuring instruments so employed." G. L. ADDENBROOKE. Dated October 18th. (Complete.)

20,877. "Improvements in the manufacture of reflecting opalescent surfaces for electric lamps or glass reflectors." THE IMPROVED ELECTRIC GLOW LAMP CO., LTD., and A. BARNES. Dated October 18th.

20,900. "Electrically illuminated billiard marking board." H. M. SALMONY. Dated October 19th.

20,903. "Improvements in apparatus for working railway points and signals by electric power." F. W. WEBB and A. M. THOMPSON. Dated October 19th.

20,906. "Improvements in trolley standards used on cars or wagons electrically propelled from an overhead wire." E. M. MUNRO, W. WOOD, H. BECKNELL, and H. J. ROGERS. Dated October 19th.

20,912. "Improvements in electric tramways on a road contact system." W. H. MERRIMAN. Dated October 19th.

20,925. "A process for directly obtaining the caustic lyes and ammonia and earth alkaline hydroxides by electrolysis." C. LUCKOW, jun. Dated October 19th. (Complete.)

20,983. "Improvements in trolleys used on overhead wires for electric traction." W. WOOD. Dated October 20th. (Complete.)

20,986. "Improvements in machines for, and the method of, making electrodes for storage batteries." W. W. HANSCOM and A. HOUGH. Dated October 20th. (Complete.)

21,054. "A new hot wire arc lamp." G. E. CUTLAND and A. G. BRYANT. Dated October 21st.

21,076. "Improvements in electric cells or batteries." B. WILLCOX. (The Columbus Electricitatsgesellschaft, Gesellschaft mit beschrankter Haftung, Germany.) Dated October 21st.

21,079. "Improvements in time indicators for use in connection with a telephonic service." R. C. J. SUTHERLAND. Dated October 21st.

21,082. "Improvements in circuit breakers." G. WRIGHT. Dated October 21st. (Date claimed under Patents, &c., Act, 1883, Sec. 103, March 23rd, 1899, being date of application in the United States.)

21,083. "Improvements in controllers for electric motors." H. P. DAVIS and G. WRIGHT. Dated October 21st. (Date applied for under Patents, &c., Act, 1883, Sec. 103, March 24th, 1899, being date of application in the United States.)

21,084. "Improvements in magnetically operated locks suitable for safety lamps or other purposes." H. MARDT. Dated October 21st. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

1,553. "Improvements in secondary storage batteries." W. M. McDougall. Dated January 23rd, 1899. A frame is moulded of rubber and powdered charcoal and has transverse apertures for the active material and is provided with vertical passages for enabling the inner or metallic portion to be inserted edgewise into the outer portion. 2 claims.

1,557. "Improved clockwork operated mechanism for switching electrical current." A. S. Scull. Dated January 20th, 1899. Relates to mechanism for making and breaking circuits at predetermined times. In one arrangement a lever carrying a forked contact is tilted to complete a circuit through mercury cups by means of a cam or snail fitted on the arbor of a wheel driven by clockwork. The cam acts on a pin carried by the lever, and after the lapse of a certain time allows the lever to tilt again suddenly and break the circuit. In order to give a quick make to the circuit, the lever is made flexible, the limit of movement being controlled by a screw, but when the end of the spring reaches the notch the lever drops suddenly. The clockwork may be stopped on any predetermined day by means of a second cam or pawl carried on the arbor of a wheel rotating, say, once in six days. The pawl engages with the end of a spring-controlled lever, and acts against a stop pin. The wheel arbors are fitted with pointers working on the clock dial. The apparatus is applicable for illuminated advertisements, &c. 3 claims.

1,810. "Improvements in electrical weaving frames or looms." H. Boulange and E. Fregnac. Dated January 26th, 1899. An electrical motor is fixed to a base plate so that its horizontal axis is level with the centre of the cam shaft. The power is transmitted through a set of cogs, a shaft and a bevel gearing to the cam shaft which drives the crank shaft through more bevel gearing. 2 claims.

2,386. "Improvements in apparatus for use in connection with wireless telegraphy." M. J. Nekemias and H. F. A. Schroeder. Dated February 2nd, 1899. Consists of a warning and communicating device, for vessels at sea, based on wireless telegraphy, by means of coherer and relay apparatus which shows visible signals to the officers of both ships, and which the officers can use by the Morse code for communication. 3 claims.

2,440. "Improvements in and connected with means for electrically lighting railway carriages." E. Dick. Dated February 16th, 1899. Consists in the following improvements in Specification 8,179, 1898: (1) The construction of the automatic commutator which consists of an electro-magnet between the poles of which a perforated parallel wound armature rotates. (2) The construction of the automatic switch. (3) The construction of the automatic regulator. Consists of a solenoid having two coils and a soft iron core, the height at which it is retained is controlled by the action of the coils. (4) To dispense with the resistance r. (5) To render the regulation independent of the number of carriages in the train. (6) To enable charging whilst the light is on. 10 claims.

4,068. "A new and useful method of manufacturing electric conductors and resistances." S. S. Bromhead. (W. C. Heraeus.) Dated February 23rd, 1899. Consists in making filaments of a mixture of argil and asbestos in equal proportions, or they may be made of the common silicate fused with ammonium platino-chloride and gum acacia and afterwards chemically treating them. 6 claims.

4,846. "Improvements in apparatus for registering the supply of electricity." L. Kahn. Dated March 6th, 1899. Relates to a meter which registers at a reduced tariff during the day. Consists of the combination with the meter of a supplementary clockwork, a rocking lever actuated by the clockwork at predetermined times, and a gear in said meter for registering ordinary and reduced rate, said gear being actuated by the rocking lever. 8 claims.

5,241. "Improvements in tumbler switches for electrical purposes." A. Watson. Dated March 11th, 1899. Consists in a sliding shutter which is adapted to be brought between the poles on the circuit being broken by the operation of the switch lever. 8 claims.

5,518. "Improvements in electric spark apparatus." T. B. Kinraide. Dated March 14th, 1899. Consists of a spark gap comprising a central post, a plurality of supporting posts, two plates, the lower plate pivotally mounted concentrically to the central post, a hanger depending adjacent to the central post, a spring between the central post and hanger and engaging the hanging at its lower end and held by the post at its upper end, three or more similar struts supporting the lower plate, and the upper plate being supported by supporting posts, a lever pivotally mounted adjacent the lower plate and loosely connected therewith at its inner end for rotating the lower plate and tipping the struts. 8 claims.

5,288. "An improvement in telephone systems." J. C. Slater. Dated March 23rd, 1899. Consists of a switchboard having a switch for each telephone in the system; an electro-magnet for each switch; mechanism for each switch whereby the electro-magnets operate the switches; a series of contact points for each switch equal to the number of the other switches, each switch being numbered, and having a corresponding numbered contact point upon each of the other switches. Telephones at outlying stations, one for each switch, and correspondingly numbered; a circuit breaker at each telephone; a battery at each telephone, and suitable connections. 14 claims.

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8,287. "Improved apparatus for extracting or reducing metals for making metallic alloys by electrolysis." H. Bumb. Dated March 23rd, 1899. Consists in using molten metal as the cathode so that through the decomposition of a molten electrolyte, metals and metallic alloys are, under a simultaneous reduction of the same, eventually obtained. 3 claims.

8,604. "Improvements in electric igniting apparatus for explosion engines." P. M. Justice. (The Pope Manufacturing Company, Incorporated.) Dated March 27th, 1899. Comprises a permanent field magnet an armature wound for alternating current with its contacts, one of the parts being rotated with respect to the other to generate current, and the other of the parts being rotatably adjustable to vary the maximum point in the current. 11 claims.

8,818. "Improvements in electric cigar lighter." W. F. Kessler. Dated March 29th, 1899. The device has a horizontal swivelling shell body containing the operative mechanism, within which the ignition spark is thrown a pendant wick tube and oil reservoir fixed in the shell, a hand lever centered on said reservoir carrying an extinguishing cap upon its inner end and provided with a pivoted sparking device adapted to throw the spark within the shell. 8 claims.

8,888. "A new or improved system of wiring electrical installations." F. Bathurst. Dated March 30th, 1899. Consists of the use of a single bare wire carried through an armoured conduit or metallic tube, with a lining made of insulating material of an elastic nature. The wire forms the positive lead and the conduit, the negative lead is not insulated and is therefore kept at earth potential. 3 claims.

7,006. "Improved means for controlling the discharge of electric storage batteries." P. M. Justice. (The Pope Manufacturing Company, Incorporated.) Dated April 1st, 1899. Relates to exhaustion of batteries below the danger point. Consists either in a visual or audible signal to the operator, or an automatic cut-out comprising two solenoids acting in opposition upon the cut-out, one of said solenoids being coarse wound and tending to open said cut-out, and the other being fine wound and tending to keep the cut-out closed, but permitting the other solenoid to open the cut-out when the potential of the car falls below the normal, and a lock to prevent movement of the cut-out. 6 claims.

7,876. "Improvements in and relating to electric meters or dynamo-electric machines." R. Lundell. Dated April 15th, 1899. Date applied for under Section 103, Act 1883, being date of application in United States, January 18th, 1899.) Consists of a field coil holder for dynamo-electric machines consisting of a wedge-shaped polar extensions of high magnetic re'uctance between the coil and its core and secured in place by the groove and catch, a brush holder having a metal supporting shank surrounded by a substantially square insulating sleeve, also a clamp for a brush holder, consisting of an eye bolt and an insulating sleeve adapted to be held by the eye bolt between two stationary ribs. 5 claims.

7,878. "Improvements in and relating to methods and means for regulating electric motors." R. Lundell. Dated April 15th, 1899. (Date applied for under Section 103, Act 1883, March 3rd, 1899, being date of application in United States.) Consists in the employment of an electric motor furnished with two armature windings, two commutators, and a field magnet so constructed that it will be possible to run with weak field strength without sparking at the brushes, and with its electric circuits so arranged, that before a change of current from series to parallel the speed of the motor is so increased by reason of the weaker field that it will approximate to the speed obtained with strong field after the change to parallel is effected. 7 claims.

8,462. "Improvements in alternating current motors." M. Deri. Dated April 22nd, 1899. Relates to Specification 2,126, 1898. Consists in the deposition of magnetic fields excited by means of alternating currents, now with an optional number of poles and now with an also optional number of poles, but different from the first, in combination with resistance introduced into the armature winding in such a manner that they convey current on starting the motor in the magnetic field with n poles, while they carry no current when the motor runs in the magnetic field having a number of poles differing from n. 2 claims.

8,889. "Automatic electrical ring off appliance for telephone stations." Siemens Bros. & Co., Limited. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated May 11th, 1899. During the use of the telephone a polarisation cell is introduced into the circuit, while at the switchboard of the telephone exchange there is connected between the point and neck of the peg, a ring-off device, so that during speaking the cells prevent movement of the device, but if the telephone receiver is hung the corresponding cell is cut out operating the ring-off device, so that the attendant is informed of the end of the speech. 2 claims.

10,135. "Improvements in controlling devices for electric motors." The British Thomson-Houston Company, Limited. (W. B. Potter, United States). Dated May 13th, 1899. Consists of a lost motion connection between the handle and the switch controlling the motors, together with means for causing the switch to follow the handle at a uniform rate. The device shown is a spring with suitable speed-governing apparatus by which the progress of the switch is regulated. 13 claims.

10,136. "Improvements in systems of controlling electrically propelled railway trains." The British Thomson-Houston Company, Limited. (H. W. Buck, United States.) Dated May 13th, 1899. Instead of using a continuous current motor for rotating the different controllers a motor controller, consisting of a Gramme ring with leads passing to it at a number of points. Within the ring is a bar magnet which operates as a revolving field. The master controller transmits two-phase currents to the Gramme ring, polarising the latter, so that a rotary field is set up with the line of polarisation, of which the bar magnet keeps step. The master controller consists of two rheostats so connected across the mains that as one is cut in the other is cut out, and the circuits of the Gramme ring are connected at four points to the rheostat switch, so that by the rotation of the latter two-phase currents are set up. 7 claims.

10,205. "Improvements in liquid feed devices for electrolytic and kindred apparatus." R. Girouard. Dated May 15th, 1899. Relates to devices for feeding liquid to electrolytic apparatus. Refers to apparatus in fig. 10 of Specification 8,001, 1894. Consists of a supply reservoir, a delivery vessel, a capillary conduit connecting the supply reservoir with the delivery vessel, the same delivery vessel mounted on and carried by the capillary conduit and vertically adjustable therewith, and an outlet from the delivery vessel. 6 claims.

10,320. "Improvements in electrodes and electrode connections in liquid feed devices, and in the construction of enclosing vessels for electrolytic and kindred apparatus." H. Carmichael. Dated May 16th, 1899. Relates to Specification 8,061, 1894, and consists of an improvement in the anode there described. Consists of a corrodible conductor surrounded and contained by a non-corrodible insulating tube closed at one end, a non-corrodible conductor embedded in the material of the tube, having its uninsulated ends emerging therefrom, the corrodible conductor joined electrically to the intruding end of the non-corrodible conductor within the insulating tube, and leading therefrom to the open end of the said tube. 13 claims.

10,413. "An improvement in dynamo machines." C. de Kando. Dated May 17th, 1899. Consists in the use of polar extensions, the sectional area of which is gradually reduced toward the extremities for the reduction of cross-induction in dynamo machines. 1 claim.

10,586. "Electric apparatus by means of which a prize is automatically delivered when a target is hit." J. Demjen and C. Schrotter. Dated May 19th, 1899. The bull's eye is mounted on a sliding pin so that it is pushed backward by the blow of the projectile and completes an electric circuit, and the current passing through which liberates the arrested clockwork of an automatic apparatus of any suitable construction. 3 claims.

10,789. "Improvements in means for electrically igniting gas." F. W. Golby. (La Societe Anonyme "Lux Nova"). Dated May 23rd, 1899. Consists of a flexible gas pipe which also acts as an electrical conductor and is inserted in the circuit of the gas opening electro-magnet and is displaced by the armature of the electro-magnet, so that the contact formed between it and a fixed pipe is interrupted so as to produce a spark. 1 claim.

10,791. "Improvements in electric lighting apparatus." A. Pischer. Dated May 23rd, 1899. Relates to lighting apparatus for the purpose of X ray and general illumination. Consists in putting the electro-magnet or induction coil in the vacuum bulb, coiling the secondary wire along the primary from lamp to lamp, coiling the secondary around the primary between the lamps and arranging the electro-magnets diametrically opposite each other. 4 claims.

10,911. "Improvements in primary batteries." A. P. Fannenberg. Dated May 24th, 1899. Relates to carbon-zinc batteries. Consists in providing the carbon-electrode slotted where it is immersed in the electrolyte in order to increase the effective electrode area within a minimum space and to facilitate the adjustment of the electrodes in relation one to the other. 3 claims.

10,892. "Improvements in electrical warp stop motions for looms." W. H. Baker and F. E. Kip. Dated May 24th, 1899. Relates to apparatus for providing a loom for weaving pile fabrics and to provide for stopping the loom when the warp thread breaks without disengaging the pawls Comprises an easing device for the pile warp; terminals of the operating electric circuit carried by the easing device and gravity circuit-closing drops on the respective pile warp threads and said easing device, each of the drops being adapted to close the circuit between said circuit terminals when its supporting warp thread breaks. 8 claims.

11,105. "Relay apparatus for closing a subsidiary circuit of an electrical installation when a current in the main circuit has a certain strength of voltage." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated May 27th, 1899. A contact device is combined with any kind of electrical measuring apparatus in such a manner that by the depression of the pointer of the measuring apparatus when this is in the position corresponding to a certain strength of the current, a contact device will be actuated, thereby closing the circuit. 1 claim.

11,110. "Improvements in electric switches." A. M. Clark. (The General Incandescent Arc Light Company, Incorporated.) Dated May 27th, 1899. Relates to electric switches adapted to effect a rapid closure of the electric circuit. Consists of means for closing the circuit between the terminals comprising a plurality of bearing surfaces one being capable of being inclined with regard to the other, a plurality of moving pieces, each freely moving or sliding upon a bearing surface and a spring connection between the moving pieces whereby an electric circuit may be opened or closed by inclining one of the bearing surfaces in regard to the other. 5 claims.

11,024. "An improved electrical switch and fuse." H. C. Gever and C. W. Cox. Dated May 26th, 1899. Relates to a compact arrangement of an electrical fuse and switch in a single casing. The casing consists of a circular box of porcelain, having an outer wall and an inner concentric wall of the same material. The fuse is in the outer chamber, and the switch in the inner chamber. 1 claim.

11,097. "Improvements in sockets or holders for incandescent electric lamps." A. Vandam and T. H. Marsh. Dated May 27th, 1899. Relates to a socket or holder in which the spring plungers for making contact with the lamp terminals are not permanently connected with the electric light leads but make connection with plugs to which said leads are permanently secure when the various parts of the socket are in position. 3 claims.

11,106. "Improvements in synchronised electric clocks." Siemens Bros. & Co., Limited, and E. T. H. H. Lauckert. Dated May 29th, 1899. Consists in an arrangement of contacts and mechanism which prevents sparking on changes of contact, and which ensure accuracy in the movements imparted. 2 claims.

11,658. "Appliance for preventing fraudulent or erroneous changing of glow lamps in electric light installations." Siemens Bros. & Co., Limited. (Siemens and Halske Aktiengesellschaft, Germany.) Dated June 5th, 1899. Consists of a small plate composed of three different layers, and which is held in the screw-socket of the lamp fitting. The two outer layers are of insulating material, and the third is of metal. These layers have central holes of increasing size in the direction of the lamp base, the latter being provided with a metal stud of a size to pass through the smallest hole to make contact with the second terminal, while a larger lamp would be short-circuited. 1 claim.

11,422. "An improvement in electrolytic apparatus." J. G. A. Rhodin. Dated June 1st, 1899. Relates to apparatus for effecting decomposition of an alkali sulphate so as to produce caustic alkali and copper sulphate, which is decomposed into sulphuric acid and metallic copper. An electrolytic cell is divided by a porous partition into two compartments. The one is charged with sodium sulphate, in which there is an anode of copper connected to the positive terminal of a battery. The other compartment contains an aqueous solution of caustic soda, and has a cathode consisting of a layer of mercury. A current is passed through, with the resultant decomposition. 1 claim.

11,985. "Improvements in motor cars driven by electrical or other motive power." W. Miller. Dated June 5th, 1899. Consists of a motor car driven by electric power constructed with two side frames similar to the frames of ordinary bicycles, each furnished with a wheel fixed on a separate axle which does not extend through, and so fixed together by transverse connecting bars, diagonal ties, and by an arched yoke carrying the front wheel, that between and behind the wheels a space is provided uninterrupted for any constituent parts of the car and driving apparatus. 1 claim.

11,948. "Electric circuit closing device." F. Wilke. Dated June 8th, 1899. Consists of a circuit closing device, in which a spring pressure, acting on a substance which yields when it becomes hot, thereby closing the circuit by the spring coming in contact with a projection. 5 claims.

12,171. "Improvements in galvanic cells." W. R. Case. Dated June 10th, 1899. Consists in a galvanic cell of the form known as a single fluid cell provided with a positive element of carbon which is chemically attacked by the electrolyte forming carbon-dioxide, and the electrolyte is maintained in effective condition by a current of air being blown through it. 4 claims.

12,172. "Improvements in galvanic cells." W. E. Crase. Dated June 10th, 1899. Consists in a galvanic cell of the form known as a two-fluid cell, having solutions of ferric and ferrous chloride, separated from each other by a porous medium, and having platinum in both solutions, and means for passing oxygen into the ferric solution. 4 claims.

12,308. "Improvements in storage batteries and method of preparing electrodes therefor." P. A. Newton. (The Nickerbocker Trust Company.) Dated June 13th, 1899. Consists in an intermediate bi-polar electrode for storage batteries having the sole electrical conducting connection between opposite sides of the electrode formed by finely divided active material, and a method of preparing the electrode, consisting in peroxidising the side of an integral body of lead oxide and reducing the other side of said body by passing an electrical current from face to face through the body, and a suitable electrolyte on the opposite faces of said body with the lead oxide constituting the sole electrical connection between the opposite side of the electrode. 19 claims.

12,490. "Improvements in and relating to electrical pendulum contacts for the operation of time measuring pendulums." A. G. Brooks. (Dr. L. Sell.) Dated June 15th, 1899. Relates to a device for the direct electrical operation of time measuring pendulums. It is based on the utilisation of the influence which power of inertia and frictional contact with the surrounding walls exert upon the motion of mercury in a vessel swinging with a given pendulum. 3 claims.

13,404. "Improvements in electric lamps." The British Thomson-Houston Company, Limited. (E. Thomson.) Dated June 28th, 1899. Consists in an improvement in that class of lamp in which the light-giving conductor is a pyro-electrolyte or is of such a nature that it is of low actual or apparent conductivity and ordinary temperatures particularly and the temperature of luminescence. Heat is caused by arcing. The lamp is self-starting. 9 claims.

13,418. "Improvements in or relating to telephones and the like." R. Hammerstein. Dated June 28th, 1899. Consists in the combination of a speaking tube or extension with a telephone or microphone for the purpose of securing a clearer transmission of sound. 8 claims.

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THE

ELECTRICAL REVIEW.

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THE

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THE PENALTY CLAUSE.

WE publish in another column of the present issue an article upon this subject, which has been written as an addition to that which may be found in the ELECTRICAL REVIEW for October 27th. Our previous treatment of the subject embraced a short sketch of the law which is applicable to the interpretation of this important clause, which finds its way into nearly every contract for the erection of electric installations. Since then certain matters have come to light which go to show that the question is one of greater moment than might be at first supposed. Among the many disastrous consequences of industrial warfare, none is more burdensome than the effect which it has upon contracts subsisting at the outbreak of hostilities. In spite of the clause—now almost common form—which prevents the actual period of time during which the strike lasts from penalising the unfortunate contractor, he dreads, and has good reason to dread, the existence of a dispute in any department of trade. So closely associated are the various industries which must combine to produce the necessary plant for the lighting of a town, that a stoppage in one department of manufacture is certain, either sooner or later, to affect the due completion of contracts, which cannot be satisfactorily performed unless all the wheels of commerce have been running smoothly. And so we may safely assume that undertakings, which at this present moment are a heavy burden to electrical engineers, have been rendered difficult of performance by the great dispute which staggered the engineering trade in 1898, assisted, possibly, by the great coal strike which preceded it. Although it affords temporary relief, the strike clause fails to relieve against the far-reaching consequences which penetrate every branch of industrial life, not only at the time, but long after the dispute has been brought to a happy termination.

In illustration of the above statement, we hear from many parts of the country bitter complaints against the penalty clause, which, if stretched to the end of its legal tether, constitutes a very powerful weapon in the hands of the municipal corporations. Thus we are told of a contract for the supply of machinery for £2,000, in respect of a breach of which a claim for £1,500 was made—and this, too, where the corporation was shown to have suffered no loss by reason of the delay. This case is, in all conscience, bad enough, but it pales before one which comes from another part of the kingdom. There the contract was for £3,200, and no less than £4,000 was claimed as, and for, liquidated damages for non-completion by a certain day! In another instance we learn that a wealthy corporation has exacted a penalty of £700 where the delay was caused—aye, and palpably caused—by congestion which has taken place owing to the dispute in the engineering trade!

Before entirely condemning the local authorities who thus force the hands of their contractors, it is only fair to say a word as to what should be the object of a penalty clause.

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If used as a means of securing the erection of valuable plant at an absurd price, it is nothing more than an abuse. But if, on the other hand, the local authority insert the clause for their own protection, and only enforce it in cases where there has been unconscionable delay and neglect on the part of the contractor, no voice can be heard to cry out against it. But we are led to believe that it *is* used as a means of oppression in various parts of the country. The labour element, which is often represented on the corporation of a town or borough, occasionally seeks to pay off old scores against the employer of labour whose contract and whose unavoidable delay come before the Council for discussion. Where the more lenient members of the board might be inclined to use moderation, a discordant note is struck by persons who avail themselves of their position on a public board to fight the battle of the trade unions.

We even hear of the penalty being demanded in cases (*a*) where the Corporation cannot possibly complete their installation, much less commence to make use of it, owing to the non-delivery of other essential parts of the machinery; and (*b*) where the existing plant with a very little extra work is quite capable of meeting all immediate wants. No doubt many Corporations adopt this course with the idea that they are advancing the interests and reducing the liabilities of the "unfortunate ratepayer." But is it not at least arguable that their very parsimony defeats itself in the long run, inasmuch as it does not tempt a contractor to use his very best materials and apply his most skilful workmanship to an undertaking which, if not completed within an almost prohibitive time, may involve a heavy loss?

A perusal of the article which we publish elsewhere in this issue will show that the Court cannot often stretch out its hand to assist the contractor who has undertaken to supply machinery within a certain time. His only way out of the difficulty must be either to combine with other contractors and refuse to sign any document which contains a penalty clause, or else refuse to take any order unless, by the exercise of superhuman foresight, he is able to decide whether it can be fulfilled or not. Whatever the method adopted, it is clear that some steps should be taken by contractors to obtain fair treatment at the hands of the local authorities who employ them. "The lowest tender" usually gains the day, but the essential feature of a tender is that the contractor has estimated his profit and expenditure beforehand. Strike out or modify the penalty clause, so that the risk shall be confined to reasonable limits, and profits, even if they are lower, will, at any rate, be more certain than they are at present.

Mechanical Stokers on Board Ship.—The *Journal* of the American Society of Naval Engineers contains an account of the test of the lake steamer *Pennsylvania*, not only in respect of its various engines, but also of its machine stokers. This test was made under the auspices of the Bureau of Steam Engineering of the United States Navy. The steamer in question is 450 feet long and has a displacement of 10,155 tons. She has quadruple engines of 1,600 H.P. and two water-tube boilers of the Babcock & Wilcox type for 250 lbs. pressure. There are three underfeed mechanical stokers, made by the American Stoker Company, and an inferior quality of fuel is employed, having a calorific value as shown by a Mahler bomb of only 11,790 B.T.U. per pound. We have before described this stoker, but may repeat that it has a central magazine, a hopper, a screw conveyor, a wind box, cast-iron air block, and an independent steam engine driving the conveyor shaft. The coal is forced slowly into the central magazine, from which it gradually overflows the air blocks. The volatile matter is driven off and burned, and the coked residue is burned on the grates at each side. The evaporation of 8·8 lbs. of water is said to have been secured, or 10·9 lbs. per pound of combustible, a result of great excellence and fully demonstrating the value of machine stoking. The day should be welcome when stoking by mechanical means becomes universal. None but those who have had actual experience of stoking in a tropical climate can be aware of the horrors of the occupation. There is no reason to doubt that before many more years the problem of machine stoking at sea will have been satisfactorily solved. Mechanical stoking has of late years made rapid progress in America. This is because all their boilers are practically underfired and there is room for the machines. The Jukes grate, once so common in Yorkshire, has been largely applied under another name in America. Its use in England has become small since underfiring has fallen into disuse, but we are surprised not to see it more used under water-tube boilers, for which it is well fitted. Internally fired boilers are more difficult to stoke by machinery, principally because there is not room in their furnaces except for nearly horizontal grates, but the larger furnaces of marine boilers afford more room for such grates as the Jukes and others than the 38-inch furnaces, until recently standard on land, where now 38 and 41, and even 44 inches are becoming usual in present-day larger boilers. Stoking ought to be just as much a duty to be performed by machinery as is feed water pumping. We did once meet with a steam boiler—it was in a printing office in Blackpool—where there was no feed pump or injector, and feed was put in by a pail at the safety valve, steam being let down every time for the purpose. We marvelled. In a few years men will make a special note, it is hoped, if they see the fuel fed by hand. Well attended stoking machines can be made economical, but they must have fair attention, like all other machinery.

Skin Effect in Aluminium Wires.—Owing to the fact that the increase of resistance of conductors of alternating currents, due to what is called the skin effect, increases with the diameter, fears have been entertained, says the *American Electrician*, by some engineers, that this effect would seriously reduce the efficiency of long-distance transmission lines using the great cross sections of aluminium necessary for carrying considerable amounts of current, especially on such lines as use a frequency as high as 60 cycles. The effect is, however, exactly the same as in copper lines of equivalent cross section. This is due to the fact that the skin effect expressed as a ratio of the ohmic resistance under alternating currents to that of the same conductor with direct currents, depends both upon the specific resistance of the material and upon the diameter of the wire or cable. An increase in diameter causes an increase in the skin effect, which is, in reality, an unequal distribution of the current, by which there is a greater density of current at the surface of the wire. If, however, the specific resistance of the conductor is greater, this greater resistance tends to prevent the unequal distribution of the current. The two elements vary in such a way, that if the diameter of the material having a greater specific resistance be made sufficiently large to give the same resistance in a given length to the flow of a direct current, then the tendency to skin effect, due to increased diameter, is just counter-balanced by the increased specific resistance. The skin effect, therefore, in a copper wire is just the same as it is in an aluminium wire, if the diameter of the aluminium wire is increased so that it has the same ohmic resistance as the copper wire. This relation can be seen immediately from the formula for skin effect, as the terms representing specific resistance and diameter of wire are so related that when material of a different specific resistance is used, the consequent change in diameter, in order to maintain the same resistance in the conductor, causes no change in the value of the fraction representing skin effect.

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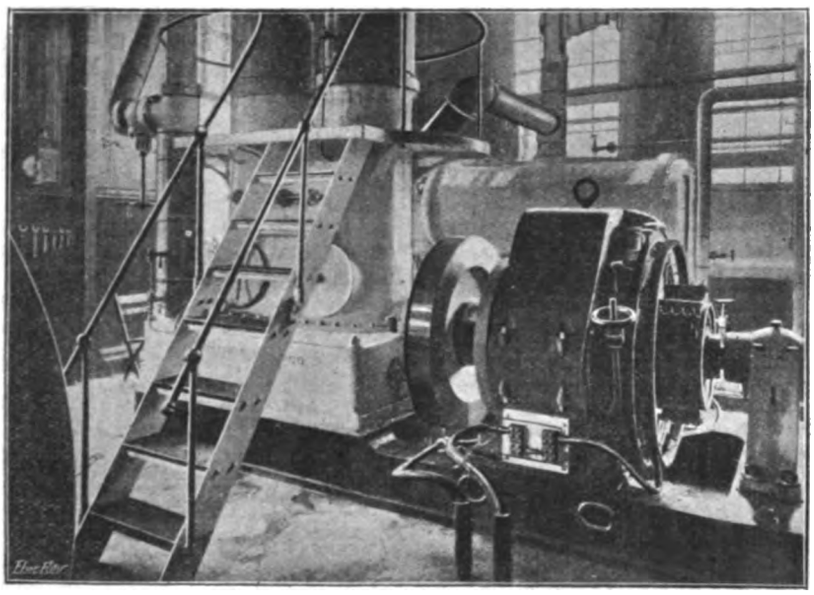
ELECTRIC POWER IN A SHIPYARD.

THE part which electricity plays in the building of the modern ship, as shown at the works of the Chicago Shipbuilding Company, embraces nearly every one of its ordinary applications, from lighting to telephone service, with the exception of heating. In the application of motors to the details of shipbuilding it is believed that the Chicago yard is in advance of all other shipbuilding plants in existence. This is doubtless due, says the *American Electrician*, to which we are indebted for the following notes and the illustration which accompanies them, to the fact that the Chicago works are of recent establishment and purely modern design.

In order to understand the various uses of electricity at this point, some idea should first be obtained of the character and extent of the yards and the work done there. The works of the Chicago Shipbuilding Company are located at 101st Street and the Calumet River, in Chicago, in the part of the city known as South Chicago. In building its plant, the company has had one great advantage over most older establishments. The whole yard was laid out in the beginning for a complete plant. All additions made since the start have, therefore, been according to the original general plan. The yard is on this account more systematically and conveniently arranged than most yards that, starting on a small scale, have had their facilities extended by a process of gradual addition.



POWER STATION OF CHICAGO SHIPBUILDING COMPANY.

The Calumet River, at 101st Street, being only 225 feet wide, the Chicago Shipbuilding Company's yard had to be laid out to build ships on a level keel and launch them sidewise. Three slips at right angles to the river were dredged out and docked, giving six building berths. These building berths are kept in use almost continually. At present there are four ships in process of construction in the yard and one has been delivered within the last few days.

Two steam locomotive trains run about on the tracks and do invaluable work in loading and unloading material. Besides the full gauge tracks a complete system of Hunt narrow gauge railroad runs from the plate and channel shops to the building berths.

In this plant some of the largest and handsomest vessels on the Great Lakes have been constructed. They are all built of steel, according to the most approved methods of modern shipbuilding, with certain peculiarities and specialties of the Chicago Shipbuilding Company in addition. As a rule the largest size freighters are built, but some handsome passenger steamers have also been turned out by the company. Notable among them are the steamships *Manitou* and *Illinois*, the pick of all the vessels running regularly on Lake Michigan.

The part which electricity takes in building these great lake vessels begins at the power house. This building is situated almost exactly in the centre of the big 25-acre tract, and supplies every part of it with light and power. It is made of iron, thoroughly fireproof, and contains the boilers, engines and dynamos, as well as considerable air-compressing machinery.

The boilers are six in number. Two are Berry boilers of 300 H.P. each. The other four are of the Scotch marine type, of 500 H.P. each. They are located in the west wing of the power house, with the usual feed pumps, &c. The stack is of steel, and is small, forced draught being used. The engine room takes up the greater part of the power house. It contains two large air compressors for the pneumatic service of the yard, the steam and electric units and the switchboard.

The main generating set consists of a 150-KW. Elwell-Parker dynamo, connected directly to a 200-H.P. compound Willans engine. For night service a 40-H.P. Edison dynamo, belt connected to a Rice engine, is used. A spare General Electric dynamo of 50 KW. capacity, driven by a compound Lake Erie engine, is held in reserve for accidents.

The switchboard is necessarily simple and ordinary. Nine lighting and power circuits run out from the board to all parts of the yard, the largest wires used being 350,000 cm. in gross sections. The entire system, light and power, is run at 220 volts, direct current. There are 35 arc lights in use and 400 incandescent.

The power circuit has on it 18 motors in various parts of the yard, aggregating over 800 H.P. The nearest is a few feet away from the switchboard and the farthest is in the dry dock shop, over 2,000 feet away. These motors range in size from 5 H.P. to 50 KW., and vary in type almost as widely. The variety of uses to which they are put is interesting.

The nearest motor to the switchboard is a 15-H.P. C. & C. It is used to give the forced draught in the boiler room. In the blacksmith shop the most recent application of motors has been made. This is a new structure of iron and glass 60 × 100 feet in floor area and 40 feet high. It is equipped with the down shaft system of the Buffalo Forge Company, which gives a blow and suction both at each forge. A 25 H.P. Crocker-Wheeler motor is belted directly without the intervention of line shafting to both blowers. Sixteen forges are thus supplied with air pressure, and have their gases removed.

The machine shop is the scene of the greatest use of electric motors in the Chicago Ship Building Company's yard and its owners consider it to be the finest specimen of a marine engine shop in the United States. It is constructed entirely of steel and glass, a large quantity of the latter material being used. It is probably the lightest shop of its kind in the country, and has been found cool in summer and easy to heat in winter. The main portion of the shop is 60 feet wide and 60 feet high to the roof trusses. There are no galleries, the work being done on the main floor, which is under the direct supervision of the foreman in charge. On either side of the central portion of the shop is a 30 feet wing. In area, therefore, the shop is really 200 feet long by 120 feet wide. There are only eight columns in this space to obstruct the view or hinder operations.

The uses of electric motors in this shop are of two kinds—to drive line shafting and to run separate tools. Besides these there is a travelling crane which is motor driven. The line shafting is located in the wings of the shop, and drives the smaller lathes and tools. An Elwell-Parker 20-H.P. motor placed on a platform in each wing is belted to the shafting. The direct driven tools are in the main portion of the shop on the floor. The entire centre portion is spanned by the electric crane, which is of the 25-ton size, made by the Brown Hoisting Company. This is driven by three Elwell-Parker motors. The columns of the shop were made heavy enough to stand two 25-ton electric cranes, and

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undoubtedly the second will be installed before long. Brackets were also put on the main columns about 25 feet from the floor, on which to support a smaller crane girder. This is intended to carry a 10-ton crane under the main cranes, which will be called on to do most of the light lifting in the shop.

The machine shop tools driven by motors are of particular interest, owing to their large size and remarkably successful operation. They include lathes, drills, planers and milling machines. A 72-inch screw cutting lathe made by the Niles Tool Works is fitted with a 5-H P. Elwell-Parker motor. The feature of the machine-driven tools, however, is the Niles Tool Works horizontal boring mill. This is one of the largest tools of its kind in the country. It has proved remarkably handy on account of the variety of work it will do and the number of operations which can be performed at one setting of the work. This tool is driven by a 5-H.P. Crocker-Wheeler motor, which will give a wide speed variation to the drills. A vertical boring mill, made by the Pond Machine Tool Company, is run by a 10-H P. General Electric motor at a constant speed.

In the plate and channel shops the various machines are all driven from line shafting turned by electric motors. Two of the latter are used, one at either end of the building. They are put at the level of the line shafts on platforms, and are belted to the shaft pulleys. They drive, through the shafting, the punches, shears, rolls, reamers, planers and counter sinks used to handle the plates for the ships' sides, and the angle shears, punches and bending machines used on the angle irons. In the channel shop there is a powerful bending machine, built by William Sellers & Co., which will bend cold a 24-inch I beam between supports 4 feet apart. All deck beams for the ships are cambered cold on this machine.

The joiner shop has the largest electric motor used in the yard. It is a 50 H.P. General Electric machine, and is used to drive the entire line shafting for the building. It is placed on a platform at one end of the building, and is belted to the shaft.

The dry dock is the largest on the Great Lakes. The The extreme length is 540 feet and width 100 feet. Sixteen feet of water is given over the mitre sill at ordinary river depth. The dock is emptied by steam centrifugal pumps with a capacity of 50,000 gallons a minute. A small oil burning plant is provided for the purpose. Beside the dock, and really forming part of it, is the repair shed, or house, where the repair work on vessels is done. A 30-H.P. Elwell-Parker motor drives the line shafting in the building, turning the various lathes, saws and tools. It is connected in the same manner as the other motors driving line shafting. This motor is 2,000 feet away from the power house.

Up to the present, the principal work in the building berths has been done by a pair of steam travelling cranes and the locomotive cranes. Now, however, 25-ton electric cranes are being installed over the berths, two for each of the four middle berths. They are made by the Brown Hoisting Company, and fitted with Elwell-Parker motors. They are a great improvement in speed and convenience over the steam cranes.

On the dock at the river front stands a huge steel sheer with legs 100 feet high. This is used for stepping masts and lifting heavy material, including the engines, into the ships after launching. It has a capacity of 100 tons. There are three legs, the back one being operated by a horizontal screw to throw the head of the sheer in and out. This screw is driven by a steam engine, but is soon to be operated by an electric motor. The sheer was made in the yard.

In the finishing of the vessels the electric work is most important. Small marine electric lighting plants are now in every ship of size, even if it is to be used only for freight. This work, as well as the general electrical supervision of the dockyard is under the charge of C. C. Mattison, the electrician of the company. As many as 40 men are frequently employed in the wiring gang. A representative of the work done is in the *Maunaloa*, a large steam freighter, is 460 feet long, delivered to the Minnesota Steamship Company a few days ago. The electric plant consisted of two 10-KW. General Electric marine type dynamos driven by high speed engines. The switchboard, made by the Chicago Ship Building Company, is of slate, with Weston instruments and switches made in the works. Ten branch circuits run from the board. The wiring is all in *moulding*. The lamp sockets are made watertight both in the engine room and hold and above deck. The work is carried on in a construction and repair shop occupying a portion of the storehouse.

The telephone system of the works is one of the handiest things on the grounds. It was installed by the American Electric Telephone Company. A 25-drop switchboard is in use, located in the office building. It has 20 telephones in the various buildings of the yard connected to it.

THE CURRENT PRODUCED IN AN INDUCTIVE COIL BY A PARABOLIC WAVE OF E.M.F.

By ALEXANDER RUSSELL, M A.

THE problem of finding the impedance of an inductive coil acted on by a wave of E.M.F. which does not follow the harmonic law presents some difficulty, yet it is necessary to work out the solution for various curves if we wish to understand how the shape of the wave affects the current produced by it. In what follows we have given the solution for the case of a parabola, as owing to its likeness to a sine curve the results can be readily compared with the ordinary theory, and hence may correct some misconceptions caused by an exclusive study of the sine curve. As the proofs involve a considerable amount of algebra they have been omitted. For the methods of solving the differential equations, &c., the reader may be referred to Perry's "Calculus for Engineers."

We will consider an inductive coil, whose resistance is R and whose self-inductance is L. We will suppose that there is applied to it (1) a sine curve wave of E M.F. and (2) a parabolic wave of E.M.F., each of which maintains the same effective voltage V between its terminals.

Equations to E.M.F. Curves:

(1) $v = \sqrt{2}\, V \sin 2\pi f t.$

(2) $v = 4\sqrt{30}\, V f^2 \left(\frac{t}{2f} - t^2\right)$ from $t = 0$ to $t = \frac{1}{2f}$.

In these equations

v = the instantaneous value of the volts,

f = the frequency,

t = the time in seconds.

These curves are shown in the figure on the next page.

Equations to Current Curves:

$$(1)\quad i = \frac{\sqrt{2}\, V \sin(pt - a)}{\sqrt{R^2 + p^2 L^2}},$$

where $\tan a = \frac{pL}{R}$, $p = 2\pi f$ and i is the instantaneous value of the current.

$$(2)\quad i = \frac{K}{R}(at - t^2) - \frac{KL}{R^2}(a - 2t) - \frac{2KL^2}{R^3} + Be^{-\frac{R}{L}t}$$

where $$K = \frac{V\sqrt{30}}{a^2};\quad a = \frac{1}{2f},$$

and $$B = \frac{4KL^2}{R^3\left(1 + e^{-\frac{R}{L}a}\right)}$$

Equations to Choking Coil Currents:

In this case R equals zero.

$$(1)\quad i = -\frac{\sqrt{2}\, V \cos pt}{pL}.$$

$$(2)\quad i = -\frac{V a \sqrt{30}}{L}\left\{\frac{1}{12} + \frac{1}{3}\left(\frac{t}{a}\right)^3 - \frac{1}{2}\left(\frac{t}{a}\right)^2\right\}$$

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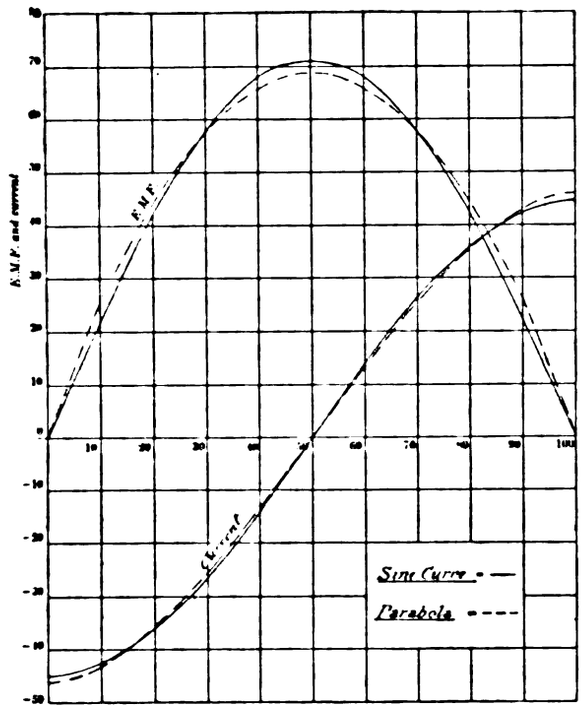
These are the equations to the curves drawn in the figure, and it is interesting to note how nearly coincident they are.



The Impedances:

(1) $\sqrt{R^2 + p^2 L^2}$

(2) $R \left\{ 1 - 40 \left(\frac{Lf}{R}\right)^2 + 1{,}920 \left(\frac{Lf}{R}\right)^4 - 7{,}680 \left(\frac{Lf}{R}\right)^5 \frac{e^{\frac{R}{2Lf}} - 1}{e^{\frac{R}{2Lf}} + 1} \right\}^{-\frac{1}{2}}$

In (2) e is the base of Naperian logarithms, and equals 2·71828. At first sight these expressions look very unlike each other, but they really are always very nearly equal to one another. For example, suppose that $2Lf$ is greater than R, then we may write them as follows:—

(1) $Lf \left\{ 0{\cdot}02533 - 0{\cdot}0006416 \left(\frac{R}{Lf}\right)^2 + \ldots \right\}^{-\frac{1}{2}}$

(2) $Lf \left\{ \frac{17}{672} - \frac{31}{48{,}384} \left(\frac{R}{Lf}\right)^2 + \ldots \right\}^{-\frac{1}{2}}$

$= Lf \left\{ 0{\cdot}02530 - 0{\cdot}0006407 \left(\frac{R}{Lf}\right)^2 + \ldots \right\}^{-\frac{1}{2}}$

Effective Values of Choking Coil Currents:

(1) $0{\cdot}15915 \frac{V}{fL}$.

(2) $0{\cdot}15905 \frac{V}{fL}$.

Effective Values of Condenser Currents:

If the waves be applied to a condenser whose capacity is K farads, the effective currents in amperes are—

(1) $6{\cdot}283\ K\ V\ f$.

(2) $6{\cdot}324\ K\ V\ f$.

The Power Factors:

(1) $\frac{R}{\sqrt{R^2 + p^2 L^2}}$

(2) $\left\{ 1 - 40 \left(\frac{Lf}{R}\right)^2 + 1{,}920 \left(\frac{Lf}{R}\right)^4 - 7{,}680 \left(\frac{Lf}{R}\right)^5 \frac{e^{\frac{R}{2Lf}} - 1}{e^{\frac{R}{2Lf}} + 1} \right\}^{\frac{1}{2}}$

The Reactances:

If we have an inductive coil and there is no hysteresis or eddy current loss, then, whatever the shape of the wave, the reactance is $\sqrt{I^2 - R^2}$, where I is the impedance. Substituting in this formula the values of the impedances given above we find the reactances.

Proof that the impedance with the sine wave is always less than the impedance with the parabolic wave.

We can show by Fourier's theorem that if I be the impedance with the parabolic wave, then

$$\frac{1}{I^2} = \frac{960}{\pi^6} \left\{ \frac{1}{R^2 + p^2 L^2} + \frac{1}{3^6} \frac{1}{R^2 + (3\,p\,L)^2} + \frac{1}{5^6} \frac{1}{R^2 + (5\,p\,L)^2} + \ldots \right\}.$$

Hence $\frac{1}{I^2}$ is less than

$$\frac{960}{\pi^6 (R^2 + p^2 L^2)} \left\{ 1 + \frac{1}{3^6} + \frac{1}{5^6} + \ldots \right\},$$

but the sum of $1 + \frac{1}{3^6} + \frac{1}{5^6} + \ldots$ is $\frac{\pi^6}{960}$, therefore, $\frac{1}{I^2}$ is less than $\frac{1}{R^2 + p^2 L^2}$, and hence I^2 is greater than $R^2 + p^2 L^2$. This proves the theorem.

It can also be shown that the ratio of the current produced by the sine wave to the current produced by the parabolic wave increases as $\frac{L}{R}$ increases. When L is zero the ratio is unity, when R is zero the ratio has its maximum value 1·0005.

In conclusion, we will state some of the results shown by the above formulæ:—

1. If we have a sine wave and a parabolic wave of E.M.F. giving the same effective volts, then the parabolic wave is more flattened than the sine wave. The maximum ordinate of the sine wave is about 3 per cent. higher than the maximum ordinate of the parabola.

2. The ratio of the area of the parabola to the area of the sine curve is 1·014. This also gives the ratio of the maximum values of the choking coil currents.

3. If both waves be applied separately to a non-inductive resistance, the effective values of the currents produced will be equal. If they be applied to an inductive coil then the current produced by the sine wave will be the greater. If they be applied to a condenser the current produced by the parabolic wave will be the greater.

4. For an inductive coil the power factor is always greater for the sine curve, and the impedance and the reactance are both greater for the parabola.

5. The impedance for the parabolic wave is not of the form $\sqrt{R^2 + q^2 L^2}$, where q is some function of the frequency. In this case also the angle whose cosine equals the power factor is not in general the angle of time lag of the current curve behind the E.M.F. curve.

STEAM TURBINES.

In his presidential address to the Institution of Junior Engineers, the Hon. C. A. Parsons discusses his steam turbine. He states that steam engines which generate 1 effective H.P.-hour with 1¾ lbs. of coal, weigh, including boiler, 20 lbs. per H P., or even as low as 8 lbs. in the case of flying machines. Oil engines weigh 39½ lbs., and use ·82 lb. of oil; hot air engines use 2 to 8 lbs. of coal; while gunpowder engines or cannon use 4·1 lbs. of cordite per H P.-hour in the shot, this weight of cordite being equal to ·7 lb. of coal. The weight of a 6-inch quick firing gun, without mounting, is 10 lbs. per average effective H.P. in the shot at six rounds per minute. In a Maxim gun the weight is only 1 lb. per H P.-hour on the same basis.

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Both the earliest known engine of Hero and its re-invention by Bianca in 1629 were of turbine type, the piston engine being modern and only dating from 1700. Solid fuel engines would be much cheaper than gas engines or oil engines if they could be worked without any trouble from the dust arising from solid fuel.

Mr. Parsons's efforts in improving turbines have been all in the direction of comparatively low speeds of rotation, an end secured by his multiple system of graduated expansion. In condensing turbo-engines of large size, the expansion may be as much as 100-fold, a ratio only possible because at every part of its structure a steam turbine acquires the temperature of the steam at that point, and there is no variation of this temperature. Such turbines have been made to give as much as 1,000 H.P., and sets of 2,000 are nearing completion. It is found that by slight modification in proportions, a centrifugal pump may be made to act up to lifts of 200 feet when driven by a steam turbine.

Screw fans and pumps are made to give economical results by suitable conical diverging outlets and inlets, whereby air or water is led up to the propeller and then made to give up its energy as pressure.

In fast and, so far, small steam vessels much money has been spent on experiments to determine the correct sizes of propellers. It is found best to divide the power amongst two or more turbines driving small propellers. Thus, if three turbines drive three shafts, the arrangement is, in a sense, a triple expansion engine, the three turbines being placed in series, taking the same steam in succession. It is found an advantage to place two propellers of equal pitch on one shaft, so securing ample blade area with small diameter. The cavitation of Messrs. Thorneycroft and Barnaby fixed by them to take place when the mean thrust on the projected blade area exceeds 11¼ lbs. per square inch, has been demonstrated to hold good in the *Turbinia*.

Wide and thin blades of coarse pitch are found best for high speeds. The now historic *Turbinia* is only 100 feet in length, 9 feet beam, and 5 feet draught, and displaces 44½ tons. She has 1,100 square feet of total heating surface, and 42 feet of grate surface. She has three compound turbines, H.P., I.P., and L.P., each driving a shaft with three propellers on it, and she has run 32¾ knots on a consumption for all purposes of 14½ lbs. per I.H.P. of the main engines.

As much as 34½ knots is believed to have been since attained, and she is still the fastest thing afloat. Steam is carried at 210 lbs. in the boilers, and 175 lbs. in the engines; 27 inches of vacuum is secured, so that the expansion ratio is 110. In larger vessels fitted with turbines, the first are two *Viper's* of the destroyer class, and they are expected to have a power of 10,000 H.P. They have an estimated forward speed of 35 knots, and, by means of a smaller turbine, will go astern at 15½ knots. One of these vessels has done a preliminary run at 32 knots. She has two screw shafts on each side. As regards the possibilities of speed in a cruiser of 420 feet × 42 feet × 14 feet maximum draught, displacing 2,800 tons and indicating 80,000 H.P., such a vessel would have eight propellers of 9 feet diameter. They would run at 400 revolutions per minute, the vessel would travel at 44 knots—over 50 miles an hour—and she could steam thus for eight hours. Such a vessel could, therefore, cross to New York in 60 hours of running time, if it could be arranged so that she could be "coaled" at every 400 miles. With oil fuel it may be supposed that runs of 1,000 miles might be possible.

Mr. Parsons considers that the turbine might be applied even to full sized Atlantic liners, with considerable advantage in respect of weight of machinery and economy of fuel. We do not see anything to throw doubt on this expectation.

THE GLASGOW TRAMWAY CONTRACT.

DURING the recent controversy respecting the placing of the Glasgow Corporation contract for engines for the electric tramway generating station, there was some difficulty experienced by those who sought to get at the root of the matter, but were handicapped by the absence of certain facts, the knowledge of which might have gone a good way toward setting at least some minds at rest. The declaration, which the original recommendation implied, viz., that English engine-makers did not know how to make tramway engines, gave rise to some soreness of feeling, and it was felt that the authorities responsible for that recommendation were not altogether unbiassed in the view they took of the situation. There certainly appeared to be some justification for looking at the matter in this way, with the limited explanations which were vouchsafed, and the criticisms offered by engine-makers in certain quarters.

We do not look upon the upshot of the controversy as by any means unsatisfactory. We had almost said that we would rather have the contract divided in the way it has been than have been given over entirely to one English maker. Certainly one effect will be to place the American and English makers alike on their mettle. If ever English and American firms were placed face to face in competition they are so at Glasgow, and the knowledge of this fact cannot fail to have a corresponding effect upon the engines supplied, as well as upon the time factor. Then, again, when the competing sets are in position at the Glasgow works, we imagine that they will be watched with all-absorbing interest, and many an engineer on the road, after passing the time of day, will inquire the latest performances of the Glasgow engines and generators. We need not attempt to predict what these performances may be, but upon whichever side the advantage lies, we may be sure it will be made good use of in seeking future contracts.

We fully agree with an engineering contemporary that the controversy has been fertile in good results; and it cannot fail to be of value in bringing out ideas and opinions which must bear fruit in future cases.

Those who have followed our articles upon this question somewhat closely should also give attention to the remarks which we are now about to make. They are based upon authoritative statements which have recently been made to us.

We are given to understand that the dimensions of the engines made by the Allis Company nearest in size to the Glasgow engines are as follows:—

High pressure cylinder, 40, as against 42 in the Glasgow specification.
Low pressure cylinders, 58, as against 60 in the Glasgow specification.
Crosshead pins, 10 × 10, as against 12 × 12.
First high pressure crankpin, 10 × 10, as against 12 × 20.
First low pressure pin, 10 × 14, as against 12 × 16.
Second low pressure pin, 10 × 18, as against 12 × 12.

That is to say, the arrangement of the cylinders is reversed from that given in the specification.

There is stated to be a corresponding difference in the dimensions of all the journals, the journals of the Allis Company being designed for a bearing pressure of approximately 150 lbs. per square inch, whereas the pressures in the specification are for approximately 110 lbs. per square inch.

Further, it is said that the high pressure piston rods in the Allis engine referred to above are all 8 inches in diameter, as against 9 inches for the high pressure piston and 10 inches for the two low pressure pistons.

The dimensions of the specification, it seems, are not to be rigorously followed by the Allis Company. The outcome of their consideration is to propose to make the shaft 2 inches larger in diameter than specified. The specification did not contain anything that complied with any standard design of the Allis Company. In fact, the patterns are being made for the engine throughout.

In the Glasgow contract the engines will be stronger in many particulars than is common to American practice, and in other particulars stronger than common to English practice. American practice is for very low bearing pressures and large diameter of shaft, but with relatively smaller crank pins, crosshead pins, piston and connecting rods. The dimensions given in the specification were agreed to by some tenderers as being proper for the purpose, and as representing the best practice.

We believe that in working out the design it was desired to take the strong points of the English engine, and the strong points of the American engine, and embody them in a single machine. Therefore in preventing English makers from adhering to standard practice they were placed on the

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same footing as American makers. The final result will be that the bearing pressures will be about three-quarters of that considered common American practice and about a half of that common to ordinary English practice. The bearing pressures on the crank and crosshead pins will be approximately two-thirds of that common to American practice, and practically the same as that common to the best English engine practice. It appears that it was not required that any tenderer should adhere rigorously to the dimensions given in the specification, and, in fact, it is stated that none of the tenders did comply exactly with the specification. The tenders recommended were equal to, or better than, the essential points of the specification. The tenders that were rejected were for engines that by common agreement between best English and American engine makers, it is alleged, could not be made to do the work satisfactorily. Messrs. Musgraves made a mistake in putting in their original proposition, and after this was corrected it seems to us that the entire order would have been theirs, if they could have promised delivery in the time required.

We may be excused for repeating that we are of opinion that the splitting of the order is probably advantageous to the Glasgow Corporation in that both firms are proposing to build machines very much stronger than has been common for traction purposes up to this time; but the advantage will not be confined to Glasgow.

It is now stated that the instructions to the engineer were that no dimensions or specified details were to be embodied as a part of the specification, but that each maker should tender to his own standard designs, it being left to the discretion of the engineer to decide upon the relative merits of the designs submitted. This point has not been generally understood. As usual, the Corporation did not bind itself to accept the lowest or any tender. But in tendering, we believe that the Edward P. Allis Company gave guarantees on steam consumption and delivery which compared very favourably with those offered by English makers; close regulation was not generally objected to.

THE PIDGEON INFLUENCE MACHINE.

CONSIDERABLE attention has recently been directed to this machine, owing to the circumstance that it is to be used in the Transvaal campaign as a generator of Röntgen rays; one of these machines being included in the Röntgen ray outfit taken out to the front by Major W. C. Beevor, of the Royal Army Medical Corps.

The present Pidgeon machine was first described in a paper read by the inventor, Mr. W. R. Pidgeon, before the Physical Society, October 28th, 1898,* and last summer a very successful machine was exhibited by Mr. Pidgeon at the conversaziones of the Royal Society. This machine is, however, not the first outcome of Mr. Pidgeon's labours in this field. In 1893 he exhibited to the Physical Society† a machine which, though not identical, contained most of the essential features of the machine we are about to describe. These essential features may be shortly specified as, first, improved insulation of all parts of the machine, but more especially the carriers; second, the combination in one machine of the rotating support, and of the fixed support for the inducing charge. The rotating plate as a support for the inducing charge was first employed by Holtz, and has been since employed in several machines, as, for example, in the well-known Wimshurst machine. The fixed plate, as a support for the inducing charge, has been used in machines by Töpler, Holtz and Voss. Mr. W. R. Pidgeon, as far as we know, has been the first to combine these two arrangements in one machine, and the combination, as often happens, has led to important and unexpected improvements. The output of the Pidgeon machine, as we shall see, is many times greater than that of the Holtz, the Voss, or the Wimshurst machine; it excites

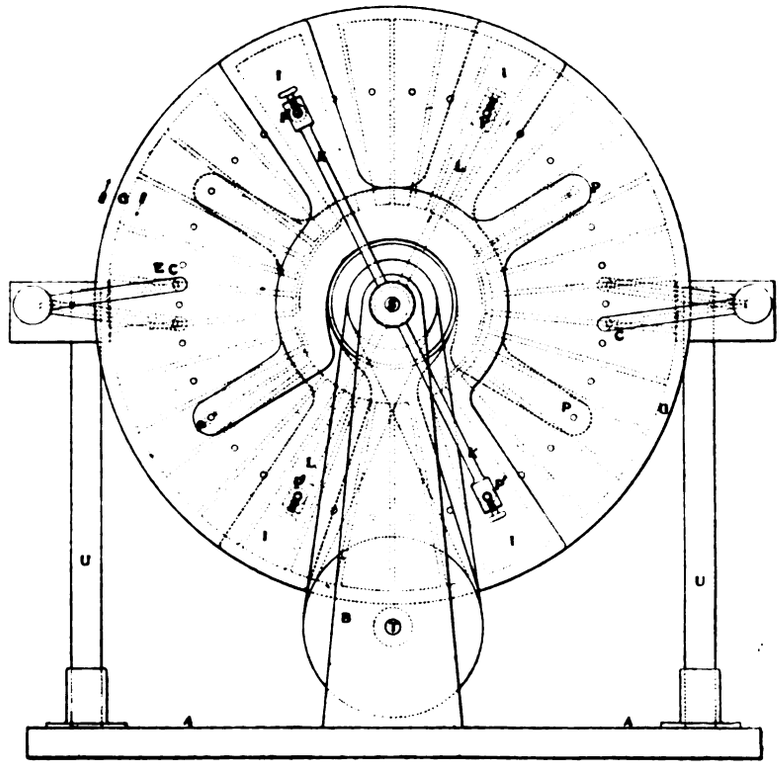

FIG. 1.

itself quite as readily as the best of these machines, and it is little affected by unfavourable atmospheric conditions.

Fig. 1 is an elevation of a Pidgeon machine, with two 15-inch rotating discs; fig. 2 is a plan view of the same machine, and fig. 3 is a diagram showing the essential electric organs of the machine, and illustrating the operations by which the electricity is produced. We shall first describe, with reference to fig. 3, the operation of the machine.

In the actual machine there are two glass discs, which are rotated at equal speeds in opposite directions. These discs are represented in the diagram, for convenience, by two circles, G and F, which may be looked upon as the traces of two oppositely rotating cylinders. The arrows show the directions in which the cylinders are supposed to rotate. The pluses and minuses show the distribution of the electricity, E, when the machine is working. Four fixed inductors, I, are placed, two opposite each rotating disc, and these inductors are replenished by small brushes, P, to which each is connected, and which touches the carriers on the rotating discs at the points shown on the diagram. Two transverse conductors or neutralising rods, P^1 P^1, touch the carriers on the discs when they are opposite the centres of the inductors I.

If we consider a carrier on the plate G while it is passing under the brush P_1^1 on the upper end of the front neutralising rod, we can see that it is almost completely surrounded by two charges of positive electricity, one on the fixed inductor I, and the other on the rotating disc F. The result will be that the carrier in contact with neutralising rod, and consequently at zero potential, will receive almost the highest possible charge at the given potential. Now, in a Wimshurst machine, for example, where the inductor, I, is absent, the charge on the carrier at P_1^1 would be less than half the amount in Pidgeon's arrangement. To this circumstance (among others) it is due that, for the same size of machine, the output of the Pidgeon machine is so much greater, and that it excites itself so quickly to its full strength. This will be evident if we follow the further course of the carriers after passing the upper front brush P_1^1. The whole series of carriers equally charged with their practical maximum amount of negative electricity, are moved round, by the rotation of the disc, into a line (shown by the — signs) from P_1^1 to the brush, C, which takes off the negative charge.

* *Phil Mag.*, December, 1898, p. 564.
† *Phil Mag.*, 36, p. 267, 1893.

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Between this line of negative carriers on the front plate and the negative fixed inductor, I, opposite the back plate, each carrier of the back plate is touched by the neutralising brush, P_3^1 as it passes. These carriers in turn receive their practical maximum charge of positive electricity, which reacts on the negative carriers at P_1^1, and so on. The charges accumulate on the carriers in geometrical progression or at compound interest, the peculiarity of the Pidgeon machine being that the ratio of increase or the rate of interest is much higher than in other machines, and, consequently, the capital increases at a much quicker rate.

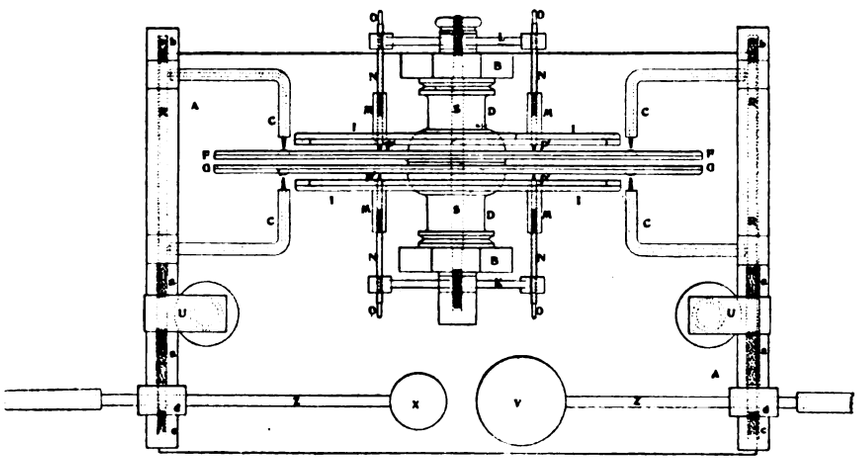

Fig. 2.

The negative carriers after passing P_3^1 touch the brush, P, and communicate a small negative charge to replenish the front negative inductor, I, as in the Voss machine. The negative charge is then completely removed from the carriers by the brushes on the negative electrode, C.

An exactly similar series of operations takes place on the other half of the machine, with the result that positive electricity is discharged to the positive electrode, C.

In the actual machine, figs. 1 and 2, we have as far as possible designated similar parts by the same letters used in the diagram, so that it will only be necessary to describe the details of the construction of these parts.

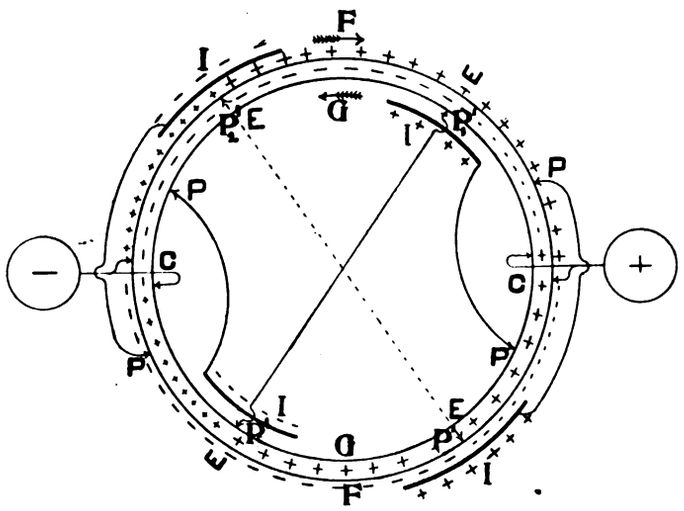

Fig 3.

On a wooden baseboard, A, are erected two tapering supports, B, through which is passed a steel spindle, S, which is clamped by nuts to the supports, as shown in the plan, fig. 2. On this fixed spindle the bosses, D, of the two discs, F, G, are rotated in opposite directions by an open and a crossed belt from pulleys on the driving axle, T. The neutralising rods, K, L, are mounted on the projecting screwed ends of the spindle, S, and clamped at a suitable angle by nuts, as shown. The fixed inductors, I, which are of tinfoil, are pasted on the back of a peculiarly shaped piece of vulcanite with four radial horns and a gap, by which it can be easily removed from the machine along with the neutralising rod by which it is supported. There are two of these vulcanite plates, one on each side of the machine. The construction and mounting of these vulcanite plates is best seen in the plan, fig. 2. The tinfoil sectors are pasted on the side of the vulcanite plate away from the rotating discs; they are then coated with a thick layer of resin and paraffin wax mixed in equal parts, with the view of preventing leakage from the inductors.

The horizontal extensions, N, of the neutralising rods, must, of course, be thoroughly insulated from the inductors through the centres of which they pass. This is effected by short, thick pieces of vulcanite tube, M, which are shouldered and screwed into the vulcanite plates, through holes cut in the tinfoil. The brushes, P^1, which make contact with the carriers, are fixed on the ends of brass rods, O, which are pushed through the brass tubes, N, till the brushes just touch the brass knobs on the carriers.

The carriers are sectors of tinfoil, which are pasted on the outside of the glass disc, each sector being separated from the next by about $\frac{1}{8}$ inch of bare glass. Over the sectors is poured the insulating layer of resin and wax already described. It would be impossible with the ordinary machines, such as the Voss or the Wimshurst, to place the sectors so close together as in the Pidgeon, since the leakage would more than counterbalance the advantage of the greater surface. The superior insulation in the Pidgeon machine contributes not a little to its large output.

On each carrier is fixed a hemispherical brass knob, the top of which just projects from the layer of wax and resin, sufficiently to be touched by the brushes of the neutralising rods and the electrodes.

All the metallic parts of the electrodes or collectors, C, are encased in vulcanite tubing. The collecting brushes are mounted on the ends of bent brass wires, which pass through bent vulcanite tubes to the brass rods R. The rods, R, are clamped to the standards, U, by vulcanite nuts *a*, screwed on a thicker part of the rod. The rods, Z, on which the discharge knobs, X and Y, are fixed, slide in vulcanite washers *d*, contact with the rod, R, being secured by a short spiral spring. The whole of the vulcanite washers and tubes covering the rod, R, are clamped together by the screwed vulcanite caps *b* and *c*.

The following are a few practical hints kindly supplied by Mr. Pidgeon, which will be of value to those who propose to make this machine:—Put on the sectors with gold size; earthing brushes should be very tiny, like small paint brushes; tiny brushes or knobs may be used on the collectors; wash the discs with paraffin before flooding with wax; heat discs also before flooding; $\frac{3}{16}$-inch ebonite of inductors towards disc, wax outside; collecting points for inductors flush with face of ebonite, so as not to scratch wax; contact knobs on sectors small, smooth, and round, projecting slightly above wax; earthing brushes should barely touch; position of earthing brushes, collectors, and exploring points as shown on drawing; all the glass must be good non-conductor, not like a great deal of the German glass, which is a moderately good conductor; paraffin with a melting point of 170° should be used, and the best resin to mix with it is what they call "golden resin." It is purer and cleaner than the ordinary stuff; mix in equal weight.

To show the relation of the output of the Pidgeon machine to that of some of the better-known influence machines already in use, we give the curves shown in fig. 4. These curves are drawn from experiments made partly by Schaffers and partly by Mr. Pidgeon. They are only to be taken as approximately correct, since the output of influence machines depends so much on careful construction and on the atmospheric conditions, that different results may be obtained from the same machine under different circumstances. The experiments, however, were made with great care, and may safely be taken as average results. The horizontal ordinates indicate the length of the spark, and the vertical ordinates the number of sparks from a unit condenser, reduced to a unit area of a rotating disc passing a diametral plane.

The curve marked P is for a Pidgeon machine; V, for a Voss; H, for a Holtz with fixed inductors; W, for a Wims-

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hurst; B, for a Bonetti machine with ebonite discs and sectors; B[1] for a Bonetti machine without sectors.* It is evident from these curves that for sparks of moderate length the output of the Pidgeon is very much superior to all the other machines; for long sparks, the Bonetti machine without sectors appears to have the advantage. The output of all these machines appears to fall off very rapidly as the spark length increases.

It has been stated more than once lately that the Pidgeon machine was merely a modified form of the Wimshurst

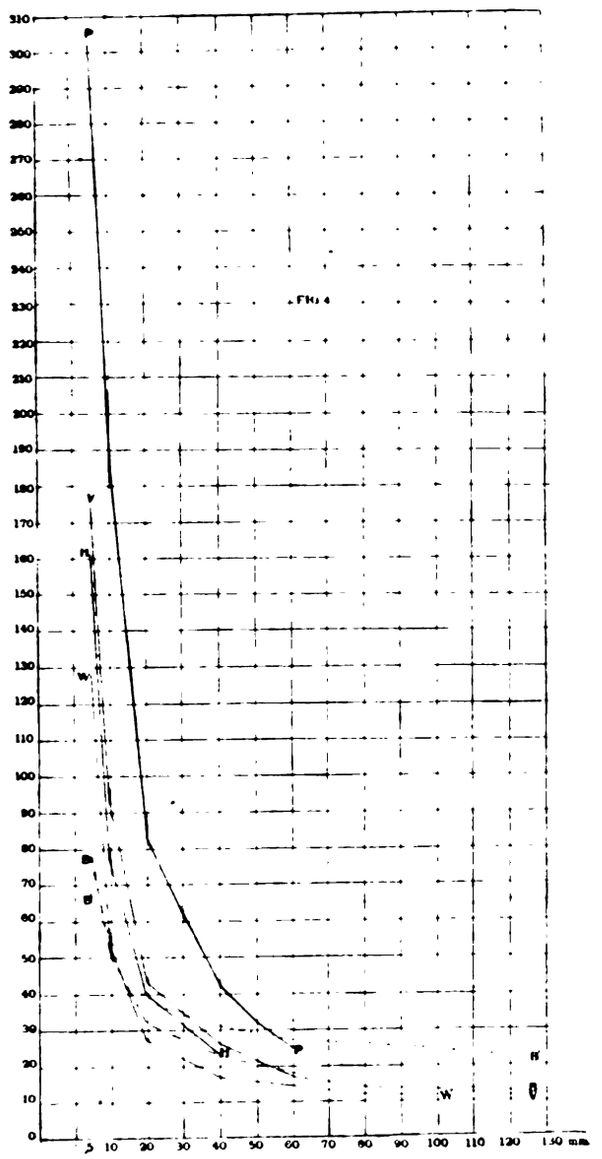

FIG 4.

machine. It will be seen from the above description that there is not the slightest foundation for this assertion. The impression no doubt arose from an imperfect or superficial knowledge of the Pidgeon and the Wimshurst inventions, and from the fact that oppositely rotating plates are used in both these machines. But the oppositely rotating plates were invented and described by Holtz in 1869, 14 years before the invention of the Wimshurst;† consequently it is Holtz and not Wimshurst that Mr. Pidgeon has to thank for this part of his invention. But Mr. Pidgeon's invention, we take it, is for the combination of two previously well-known types of influence machines; a combination which has justified its invention by the excellent results it produces. Mr. S. Bottone, in a letter to the *Daily News* of November 2nd, asserts that he was the first to point out (*English Mechanic*, April 3rd, 1896) the great advantages of the "Wimshurst" for X ray purposes. Mr. Pidgeon's machine not being a "Wimshurst," Mr. Bottone's claim as far as regards Mr. Pidgeon becomes irrelevant. Mr. Pidgeon, we are sure, makes no claim to be the first to have applied the influence machine for X ray purposes (that was done by Dr. Pupin as early as March 13th, 1896, see ELECTRICAL REVIEW), but what we think Mr. Pidgeon has done is to create an entirely new influence machine apparently better adapted for X ray purposes than any of the existing influence machines.

* "Machines Electriques à Influence," par V. Schaffers, p. 103.
† ELECTRICAL REVIEW, vol. 42, page 685.

A REPEATER FOR USE IN WIRELESS TELEGRAPHY.

MESSAGES have been transmitted in England by the Marconi system of wireless telegraphy over a distance of 90 miles. This may not yet be the limit for direct transmission, but even in ordinary telegraphy there is a limit to the distance over which a message can be directly transmitted. Very long lines can only be worked by the help of repeaters, which automatically receive and re-transmit the messages by means of a local battery. If this principle could be applied to wireless telegraphy, its range might be immensely increased. An ingenious arrangement, designed to act as a repeater in wireless telegraphy, has been devised by Emile Guarini-Foresio. We do not know whether it has worked successfully in practice, but it looks as if it ought to.

Fig. 1 is a diagrammatic view of the arrangement of the

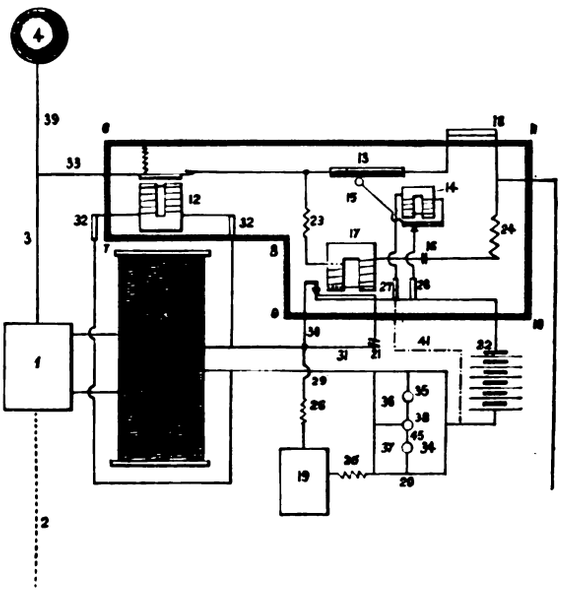

FIG. 1.

connections of one of these Foresio repeaters. The oscillator 1 is connected on one side, 2, to the earth, and on the other, 3, to the aerial conductor, terminating in a sphere, 4, of considerable capacity. The oscillator is fed by an induction coil 5. In a box, 6, 7, 8, 9, 10, 11, of soft sheet-iron, are enclosed:—an electro-magnet 12, which, every time the oscillator works, breaks the communication between the wire 3, and the sensitive tube or coherer 13, the sensitiveness of which is otherwise changed; also the vibrator 14, the hammer, 15, of which strikes and decoherers the sensitive tube 13, situated in the local circuit 16; lastly, the relay 17, and a galvanometer 18, the needle of which indicates whether the apparatus is working. The Morse instrument 19, lies outside the metal box; at 20 is a three-way switch, at 21 the switch, and at 22 the battery; 23, 24, 25, 26, 27, 28, 32 are resistances.

The conductor 29 is in connection at 30 with the conductor 31; a variant of the shunt containing the vibrator, 14 consists in placing a conductor 41 of the said circuit of the vibrator upon the conductor going from the battery 22 to the commutator 20.

The repeater can work as a transmitter, as a receiver, or as a relay. In order to make it work as a transmitter, it is necessary to close, by means of the switch 21, the circuit

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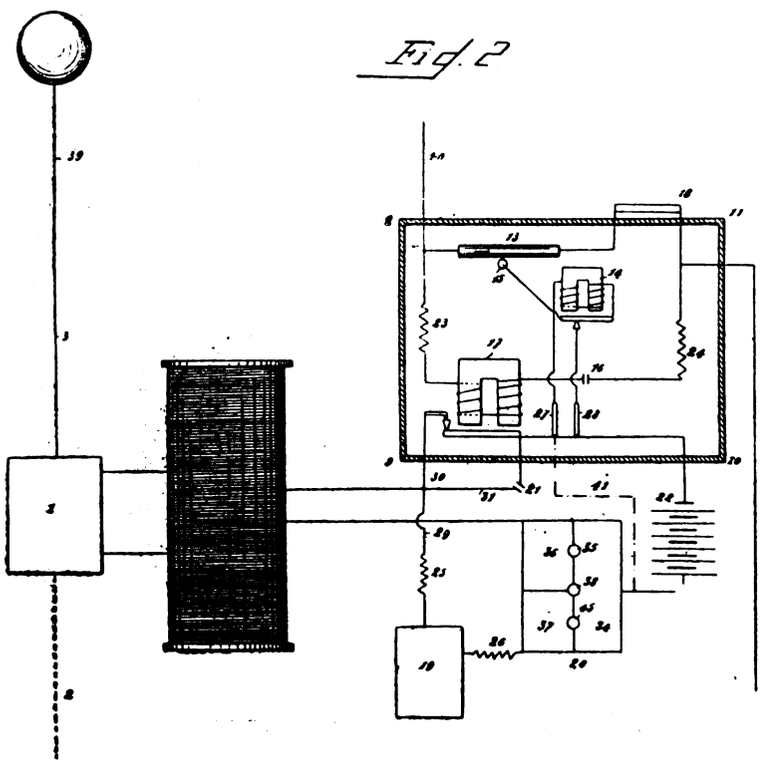
containing the battery 22, the primary of the bobbin 5, the shunt circuit containing the vibrator 14 (when the connection shown at 41 is used, the hammer of the vibrator works continuously); in this case, the plate 34 of the commutator is in communication with the plate 36 through a plug placed in the hole 35. When the apparatus is working as a



receiver, the electric waves picked up by the rod 39 are transmitted by the wire 33 to the coherer 13; what follows is the same as in the Marconi receiver; all that is necessary is, that the plate 34 be in communication with the plate 37 by means of a plug placed in the hole 45. When the apparatus works as a repeater, the events succeed each other as in the preceding case, but the relay 17, when it attracts its armature, instead of closing the circuit of the Morse instrument, closes the circuit of the coil which feeds the oscillator.

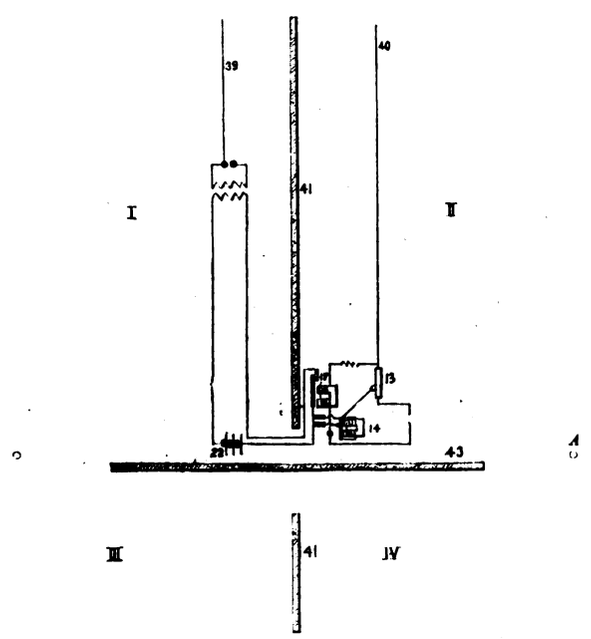


Fig. 3.

All that is necessary is to connect the plate 34 of the commutator to the plate 36 by the plug 35. If, in addition, the conductor 34 is connected with the conductor 37, and also with conductor 36 by the plug 38, this simple arrangement ensures that the signals are both registered and repeated. Since the electro-magnet, the relay and the coherer are enclosed in an iron box, these parts of the apparatus cannot be influenced by the magnetic field of the induction coil.

Instead of one vertical conductor two may be employed; one 39 in communication with the oscillator 1, and the other 40 in communication with the coherer 13, thus suppressing the electro-magnet 12.

The repeater just described is specially adapted for movable stations, for instance, in establishing communication between three ships, one of which is the intermediate station.

In the case where the repeater has to serve two stations, A and B, on *terra firma*, or in the case where several relays are employed between the two terminal stations, the repeater already described engenders confusion of signals, and the arrangement in fig. 3 is employed.

The receiver is here separated from the transmitter by a metallic partition, 41, the receiver being on the side of the terminal transmitting station, and the transmitter on the side of the terminal receiving station.

The partition prevents the radiations of the transmitter of the intermediate station returning on the terminal transmitter, or upon a preceding intermediate station. The partition, 41, may also act as a reflector.

The organs, I. and II. (fig. 3) are arranged to receive electric waves from A and transmit them towards B. To receive radiations from B and transmit them to A a second apparatus should be employed, quite distinct from the first, the organs of which are also separated by a partition, 41. In the second apparatus the receiver will be at III., and the transmitter at IV., and the two combinations are separated by a third partition, 43, which allows one only of the two to work, according as the station A or the station B is transmitting.

We doubt very much if the metallic partitions in the Foresio repeater will be effective in screening off the electric waves; or, at least, if efficient for that purpose, they would require to be of an impracticable size. This invention, however, professes to solve an important problem in wireless telegraphy, and seems to contain some ingenious hints that may help to its solution.

ELECTRIC LIGHTING IN SHOREDITCH.

Allocation of the "Profits."

The members of the Shoreditch Vestry were, on Tuesday, presented by the Lighting Committee with a report dealing with the question of the allocation of the "electricity surplus" for the past financial year. Mr. H. Winkler was early on the scene, looking for the profits which he was unable to discover, and he was only quietened on being informed that someone had gone to fetch them. Even Mr. Russell and Mr. Adams appeared with such beaming countenances as to foreshadow a lively meeting; but after all, everyone was disappointed, owing to the adjournment of the debate. We give below the report of the Committee.

The Disposal of the Profits.

The Committee stated:—

That your Committee, after very careful consideration of all the circumstances relative to the allocation of the available surplus of the electric lighting undertaking, amounting to £6,468 10s. 8d., think—in the first place—that all monies received as contribution from the rates since the inception of the electricity undertaking (being chiefly repayment of debt and interest before the works were commenced) should be repaid to the rates. This item, which is £1,255 8s. 2d., represents deficiencies in years ended March 25th, 1895-6-7 (see page 37 of 1899 accounts). On this repayment being made, no monies from the rates will be involved in the undertaking either on maintenance or capital account, as all capital has been provided for out of borrowed money.

In the second place, your Committee think the fairest way of recompensing the dust destructor undertaking for steam supplied from the waste heat obtained from the parish refuse is for the electricity undertaking to pay a sum equal to the cost which they would have incurred had the electricity been generated from coal, and from the average of 17 metropolitan stations, your chief engineer states that the cost of coal is about 1d. per unit on the total units sold, the other costs of handling the fuel, &c., being already fairly apportioned to the Electricity Department. On this basis, the cost to the electric lighting undertaking would amount to £4,297 5s. 8d., and after deducting from that sum the amount already spent for coal, viz., £1,875 13s 6d., there appears a balance of £2,921 12s. 2d. to be credited to the dust destructor accounts as representing the full value of the steam supplied to the electricity undertaking. This payment would still leave a deficit in the dust destructor accounts of £694 10s. 4d.,

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against which, your Committee think it equitable, that the value of the steam supplied to the baths and wash-houses should be set, as from the estimate of Mr. Manville (see p. 8 of the Annual Report for year ended March, 1898) it would have cost the baths more than this sum for all charges in connection with the heating of the baths and wash-houses by separate boilers.

In view also of the saving to the rates during the past year of over 1s. per ton, or £1,186 8s. 11d., on the parish refuse burnt, from the previous cost of barging, your committee think that the electricity undertaking should not be further saddled with the cost in past years of a distinct branch of the municipal service, such as dust disposal, which is payable out of the general rate and not legally chargeable to the lighting rate.

The above proposals will dispose of the deficit on the dust destructor account.

In the third place, your Committee has considered an application from the Library Committee for a grant toward the cost of the Public Libraries, which have been charged £243 9s. 9d. during the past year for electricity supplied them, and in view of the generally recognised difficulty in maintaining the two libraries from a rate limited to ½d. in the £, your Committee unanimously agreed to allocate £250 out of the surplus of the electricity undertaking to the Library Committee's account. In the fourth place there will be still left after paying the three sums above mentioned an available surplus of £2,036 10s. 4d., out of which your Committee think it best to apply £1,000 to a reserve fund, and, in view of the heavy outlay which will be incurred on the proposed new station (which will not be running for some time) think it advisable that the balance of £1,036 10s. 4d. be carried forward to next year's accounts.

Your Committee therefore recommend:—(1) That the sum of £1,255 8s. 9d. be paid by the electric lighting revenue account out of the electricity surplus to the credit of the general rates, which sum represents all monies heretofore advanced from that rate to the electric lighting undertaking. (2) That the sum of £9,921 12s. 2d. be paid by the electric lighting revenue account out of the electricity surplus to the dust destructor revenue account, and that the deficiency, amounting to £694 10s. 4d., on the dust destructor revenue account be written off as the value of steam supplied to the baths and wash-houses. (3) That an order on the treasurer be signed for £250, to be paid by the electric lighting revenue account out of the electricity surplus to the credit of the public libraries revenue account, independently of their income from rates. (4) That the sum of £1,000 be transferred from the electric lighting revenue account to a reserve fund, to be called the "Electric Lighting Undertaking Reserve Fund," and that the amount be placed on deposit at the Vestry's bankers on the best terms as regards interest obtainable. (5) That the balance of £1,036 10s. 4d. be carried forward to next year's accounts. (6) That to avoid dislocation of one quarter's rates by the receipt of the items under the first and second heads, which form a total of £4,177 0s. 4d., or nearly 1½d. in the £, this sum should be paid by four quarterly instalments, and that an order on the treasurer be now signed for £1,044 5s. 1d. (the first of such instalments) in favour of the general rate out of the electric lighting revenue account.

Mr. N. Moss, chairman of the Committee, formally moved the adoption of the recommendations.

Mr. J. J. Freeman raised a protest against the statement in the report that a saving of 1s. per ton had been effected over the previous system of disposing of the refuse. It was an assertion which no member of the Vestry could claim to be a fact. The cost of carting the refuse to the destructor was much higher than previously, and instead of four loads being collected daily, only three were unloaded at the destructor.

Mr. Wells asked where the £6,463 profit was at the present time?

Mr. H. Winkler asked whether the Vestry would be the laughing stock of the world again. He thought they ought to come to some practical settlement of the question. There had been a profit of £6,000 on the Lighting Department, and a loss of £8,000 on the destructor; let the one be set against the other. As an amendment he moved that the profits on the lighting station should be used for the purpose of liquidating the losses on the destructor.

The further debate of the question was adjourned.

CORRESPONDENCE.

Penalty Clauses.

The aspect of penalty clauses has been recently defined in your columns from a legal point of view; but it might be of some service to consider the matter from an ordinary layman's standpoint. In the performance of any work, whether it be engineering or in a business that comes under the generic term of commerce, the time element is one of supreme importance. It is, in point of fact, one of the essentials of commercial and industrial life, and without it no business could be expected to flourish. In the completion of a specific contract, one of the principal conditions naturally relates to the time in which such a contract will be fulfilled, and there is nothing unreasonable in such a stipulation. In common with a practice followed throughout the whole of the engineering and the allied industries, specifications for electrical plant invariably include a clause relating to the time of delivery; they moreover specifically state that certain penalties will be exacted if the conditions of delivery are not complied with. It is an unmistakable fact that these stipulations have been held more in the breach than in the observance, and I am afraid that the very leniency which has been displayed by the purchasers of electrical machinery has not led to any improvement in the time of delivery. I am not for a moment suggesting that the electrical manufacturers do not use their best endeavours to carry out that part of the contract, but, as a rule, they fail lamentably. It is apparent that the generous treatment accorded to electrical contractors by manufacturers and supply companies has produced an effect which is inimical to the best interests of the industry. There are doubtless many who imagine that penalty clauses are not likely to be insisted upon. Moreover, I believe there is a widely prevailing notion that penalty clauses cannot be legally enforced. How completely wrong this latter view is was clearly demonstrated in your article in the issue of the 27th ult. Assuming, however, that there had been some difficulty in enforcing these clauses, it would hardly be creditable for a manufacturer to take advantage of a legal difficulty, and, as a rule, I do not think such conduct could be ascribed to him. The one conspicuous fact, however, in the carrying out of electrical work is, that contractors are, for the most part, behind the specified period of completion, and one is almost irresistibly forced to the conclusion that contracts are undertaken without any regard to the time in which they can be completed. It is unnecessary to insist upon the bad influence such a proceeding must have eventually upon the whole of the profession. There seems to be a probability, and by no means a remote one, that the question of enforcing penalties is likely to come before the Courts, and though, at the moment, it is a little difficult to see on what grounds the case will be fought, I do not think there can be much doubt as to the result, assuming always that the penalties themselves were reasonable. In the enforcement of penalty clauses there is always the difficulty of proving damages, but without endeavouring to estimate to what extent damage is caused to the purchasers of electrical machinery by the non-fulfilment of contracts, there is not the slightest doubt that the failure to keep time is operating most disadvantageously, not only in electric lighting, but also in tramway work. The non-compliance with the terms of a contract means not only that the buyers become disgusted, but in a measure it affects the interests of the general public. Most electric lighting works, at the moment, have arrived at the position of being quite unable to add new consumers to the mains on account of the lack of machinery. But though potential consumers may be put off for some weeks, it is not unlikely that if these weeks extend into months, they may have cooled off very considerably, and will be inclined to stick to gas. Gas is an objectionable illuminant, but it must be admitted by impartial observers that the many improvements effected in burners during the past three or four years has made it more tolerable for illuminating purposes, and with the great activity displayed by the gas companies and burner manufacturers, it would be unfortunate if we are unable to meet with some readiness the demands for electric lighting that are arising.

As you have said, municipalities and supply companies are not inclined to adopt harsh measures against contractors, because they fully admit some of the difficulties that exist. At the same time, if they receive a definite promise from a dynamo or engine builder, they make their arrangements accordingly, and it needs no very keen imagination to picture the inconvenience that is bound to arise if these arrangements go wrong. The gist of the matter is, that the manufacturers should not promise to deliver plant if there is the slightest doubt in their minds. I am quite aware of the fact that, if one manufacturer did not promise delivery in a given time, it would not be difficult to find other contractors quite willing to make promises. Promises without performance are always bad, and you have endeavoured to show the disastrous effects which they are working in the development of electrical engineering. In a sense, one almost welcomes the action which, I believe, is likely to be taken in this matter, because it will have the effect of clearing away a good many misconceptions that prevail on the subject of penalty clauses, and it will certainly have a marked influence on the specific fulfilment of contracts. It may result in contractors refusing to deliver under a certain time, but there will be the corresponding advantage of knowing that, in all probability, the plant will be up to time; whereas we are now promised early delivery, and invariably the machinery is many weeks over due when it is erected. I do not, for a moment, suggest that electrical manufacturers are alone in failing to keep pace with their promises, for there is little doubt that many other branches of engineering are in a backward condition; moreover, the late delivery of electrical plant is, in some cases, due to the delay that arises in getting raw material. Still, these are things which the contractor has to reckon with, and, in tendering, he must take into account causes that may tend to make him late.

Observer.

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The Pimbley Economiser.

We hope you will allow us to say a few words on the remarks respecting this economiser in your issue of the 3rd.

First, we would say that we command an experience of the working of this economiser extending over four years, and therefore have time on our side to demonstrate what does or does not happen: and as some of the earlier economisers were put in in a very crude manner, and are working under the worst possible conditions, there have been some severe tests as to what can happen. Upon the important question of scaling or choking up we would not say that the freedom from scale and deposits is altogether due to the velocity of the water passing through the pipes, but believe other elements help to bring about this desirable result, one of these being that the water, travelling as it does gradually from one end of the apparatus to the other, would not attain that temperature which is necessary for the deposits to be thrown down until it reaches the last few pipes, and then they would not be given off in a way to scale and choke before entering the boiler, where evaporation takes place.

We do not advance the theory that rapidity of flow of water will prevent scale or choking up of pipes under all conditions of heat, or any conditions, of evaporation, and contend that the choking up of the feed distribution pipes in boilers—the very point at which evaporation begins to take place—cannot in fairness be brought in as a comparison. Here is an analysis of water with which a Pimbley economiser has dealt for four years without being once cleaned out, and from which pipes have been removed from time to time and found perfectly clean.

The following is the analysis of water passing through the economiser erected at Messrs. Porritt Bros., Bridgewater Mill, Farnworth, four years ago :—

RESULTS STATED IN GRAINS PER IMPERIAL GALLON.

1.—TOTAL SOLIDS.		3.—HARDNESS, degrees.	
Mineral matter ...	28·7	Temporary	2°4
Organic and volatile	9 3	Permanent	11°0
Total ...	38·0	Total ...	13°4
2.—MINERAL MATTERS.			
Silica	2·10		
Iron oxide and alumina	2·50	4.—SOLIDS. Per ton of coal...	9·95 lbs.
Carbonate of lime and magnesia ...	24·0		
Sulphates	14·96		
Sodium chloride ...	4·10	5.—SOLIDS. Per week ...	199·5 lbs.
Sodium sulphate and loss by difference...	2·64		
Total ...	28 70	6.—SOLIDS. Per month ...	798 lbs.

The above calculation as to the amount of solid matter passing through economisers is based on the boiler evaporating 8 lbs. of water per pound of coal.—T. ASPINALL, Analytical Chemist, Farnworth.

May we also point out that the ordinary economiser cannot be made into a circulating one, such as the Pimbley, its form of construction making it impossible.

In conclusion, will you allow us to say we are prepared to back our experience so far as to put down economisers in the worst districts in England on the "no cure, no pay," principle.

Jas. Carter & Sons.

Stalybridge, *November 7th*, 1899.

Arc Lamps and How to Maintain Them.

I have read with interest your criticism and the authors' answer thereto on the book, "Arc Lamps and How to Maintain Them." I am quite in accordance with you in maintaining that $\frac{3}{32}$-inch is much too short for an open arc. Moreover, the chance remark of the authors with reference to the Manchester arc lamps, explains to me what I have always considered the remarkably poor light given out by the Manchester arc lamps, more especially those on private circuits such as outside shop windows. If all these lamps are set to burn with $\frac{3}{32}$-inch arc, I think you will agree with me that the poor light requires no further explanation.

An Electrical Engineer.

November 6th, 1899.

Babcock & Wilcox Superheater.

With reference to your article on above, and the letter by Mr. Tatlow this week, it is pointed out by Mr. Tatlow that the formula $\frac{T_1 - T_2}{T_1}$ is not applicable to the case of superheated steam, since the heat is taken in at different temperatures. He, however, working out from quantity of heat supplied, obtains an increase of efficiency of 2 per cent. in a way not quite obvious. A more satisfactory method of comparing the two results obtained, with and without superheated steam, would be by comparing the thermal efficiencies, with the engine assumed to be working on a Clausius cycle. The formulas for engines on this cycle are :—

1st efficiency (without superheated steam)

$$= \frac{[T_2 - T_1]\left[1 + \frac{L_2}{T_2}\right] - T_1 \log_e \frac{T_2}{T_1}}{T_2 - T_1 + L_2}.$$

2nd efficiency (with superheated steam)

$$= \frac{[T_2 - T_1]\left[1 + \frac{L_2}{T_2}\right] + \cdot 48\,[T_3 - T_2] - T_1 \left[\log_e \frac{T_2}{T_1} + \cdot 48 \log_e \frac{T_3}{T_2}\right]}{T_2 - T_1 + L_2 + \cdot 48\,[T_3 - T_2]}.$$

Where the following are absolute temperatures

T_3 = superheated steam (462° F.).
T_2 = boiler steam (337° F.).
T_1 = exhaust (212° F.).

Working out we get

1st efficiency = ·141 ;

2nd efficiency = ·1535, an increase of 1·25 per cent. of efficiency, or an improvement of about 8·9 per cent., and not 72 per cent. as calculated from a consideration of Carnot's formula, which must clearly be wrong in this case, since it assumes a cyclic action, and the heat all supplied at one temperature.

James C. Small.

November 4th, 1899.

Re Answers to Situations Vacant Advertisements.

I was much interested by the paragraph on the above subject, which appears in the ELECTRICAL REVIEW of November 3rd, 1899. In this day of "Employers' Federations," when inquiries and answers respecting this and that workman, pass and repass between the various employers of labour, is it any wonder that a man *in work*, on applying for an advertised post, which may be (according to the advertisement) a decided improvement for him, is afraid to "show too much of his hand"?

Personally, I should be glad if I could accept your assurance that all the information asked for by advertisers is treated by them as private and confidential. With some firms I've no doubt this is so, but I'm sorry to be forced by circumstances to believe that with many firms this is not so, and there have been cases where the information given by an applicant has been used to his detriment. This lack of *faith in the advertiser*, the fear that were the desired information given, the advertiser might communicate with one's present employer, is, I suppose, practically the only force at work which makes applicants occupy the position complained about. So long as an advertiser is not prepared to declare himself in a more recognisable form than as "Box No. So and So, ELECTRICAL REVIEW," so long may he expect incomplete applications. I've known cases of men actually applying to their own employers through the adoption of these artifices, and in some cases this would bring about instant dismissal.

Let the advertiser set the example by declaring his true identity. He will then receive fewer, perhaps, but more complete applications.

Commercial.

[There are black sheep in every fold, but we do not think electrical employers as a rule are open to the sweeping charge of breach of confidence which is made by "Commercial."

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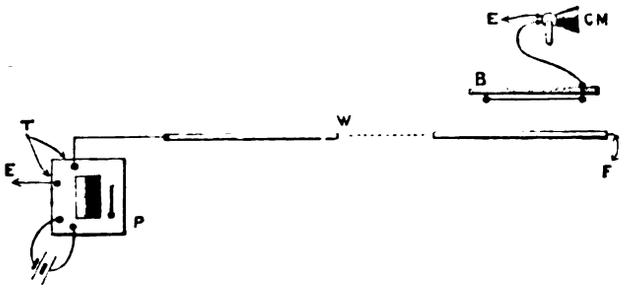
The man desiring a change can safeguard himself against any possible irregularities of this kind by requesting the advertisement manager of the ELECTRICAL REVIEW not to forward the letter of application if the advertiser is known to be such and such a firm. This is no uncommon occurrence, and it is a very simple procedure. The applicant may be pretty sure that our own advertisement department is beyond reproach in this respect. We are inclined to believe that the man who withholds necessary information stands to lose more than the employer who desires it. Finally we would add "Nothing venture, nothing win."—EDS. ELEC. REV.]

Telegraphing to Trains in Motion.

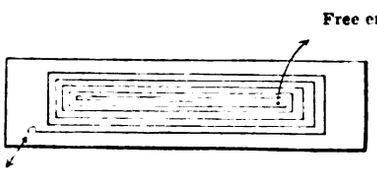
In connection with the investment of Mafeking, mention was recently made of communication having been established between an armoured train and the town by means of the phonopore telephone. There was nothing probably very special in this, but it gives rise to the thought as to what might be the advantage of being able to communicate with the armoured trains when they were in motion. It is doubtful whether this could be successfully done by the Marconi system, but an experiment which I made a short time since leads me to believe that such communication could be most simply established by working on the phonoporic system.

My experiment was purely a laboratory one, and was made as a preliminary towards seeing if it was possible to communicate with a driver of a train by means of the note of the phonopore transmitter, or of an ordinary induction coil.

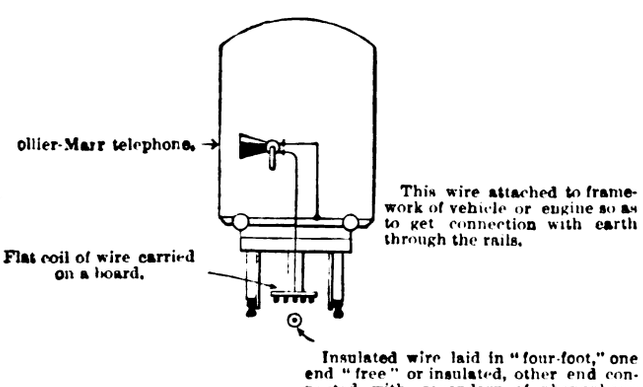
In one room I had a phonopore transmitter, one of the secondary terminals of which was connected to earth, and



T, Secondary terminals; P, Phonophone telegraph transmitter or induction coil, with Morse key; W, Insulated wire; B, Board, with flat coil of wire attached; C M, Collier-Marr telephone; F, Free end.



FLAT COIL OF WIRE ON BOARD.


Collier-Marr telephone.
This wire attached to framework of vehicle or engine so as to get connection with earth through the rails.
Flat coil of wire carried on a board.
Insulated wire laid in "four-foot," one end "free" or insulated, other end connected with secondary of phonophone transmitter or induction coil.

the other to an insulated wire which reached into an adjoining room. The other end of this wire was left free or insulated. This comprised the transmitting circuit. The receiving circuit consisted of a flat coil of wire, on a board about 4 feet in length, one end of this coil was left free, and the other end connected to the earth through a Collier-Marr receiver.

By placing the flat coil over the wire connected with the transmitter, signals could be distinctly read in the telephone when the distance between the coil and the straight wire was as much as 12 inches.

I enclose a rough sketch of the experiment I made, and also one showing how I think it could be turned to practical account.

The reason I did not continue the experiments was, that the practical advantage of giving such a communication was not sufficiently apparent, that was for the particular purpose I had in view.

The arrangement I have shown, would, it is clear, I think, require but little modification to make it available for communicating either way.

C. M. J.

Signalling Without Contact.

If permissible, I should like to offer a little criticism on the paper read by Mr. Boult before the British Association, and which recently appeared in the ELECTRICAL REVIEW.

Mr. Boult makes a statement with regard to the present fog-signalling system, which is calculated to convey a wrong impression. He speaks of the driver assuming that the line is clear if he does not hear a detonator explosion. This is not substantially correct. What a driver assumes on approaching, or passing, fixed signals which cannot be seen in dense fogs, is that the fixed signals are at danger, unless he sees the fogman's green hand-signal. It is a mistake to suppose that, in a fog, a driver goes blundering on, relying absolutely upon the explosion of a detonator to acquaint him of danger. If such was the case, could the late Sir George Findlay have written *in the highest praise of the results attained?*

Mr. Boult aims at giving, what, perhaps, no other inventor has previously seriously attempted, an *invariable danger signal.* This is most essential, although what would be better still would be an *invariable danger signal except when an all right signal is to be given.* A danger signal and an all right signal in quick succession may be confusing. But can Mr. Boult claim an invariable danger signal? Can no circumstances be conceived in which his danger signal would not be invariable? Must not his danger signal, if his system is to come up to Board of Trade requirements, give a *nearer* approach to absolute certainty than may be attained by fallible humanity? Can the duplication of fundamental parts be said to constitute certainty? The necessity for duplication implies uncertainty. The analogy of the detonator does not strictly apply. Nothing can be much simpler than a detonator. And because the failure of two such simple things may be remote, it does not follow that the same degree of remoteness applies to Mr. Boult's system, for the fundamental parts of his apparatus are numerous, and nearly all more liable to failure than a detonator, consisting as they do of pivoted movements, tremulous bells, and battery cells, each in turn having fundamental parts. Nor does it appear that all the fundamental parts of Mr. Boult's apparatus are in duplicate. The little semaphore arms are not. Moreover, are the permanent magnets on the road invariable? May they not lose in power in course of time?

I do not understand how Mr. Boult can claim simplicity for his system. The fundamental principle is simple, but there is nothing simple about the apparatus and its circuits. In fact, the system would practically convert the cab of the engine into a signal box so far as electrical apparatus goes. The driver of an express train would require a man to attend to the signalling apparatus. Taking a length of line, with four block sections to the mile, and a train moving at 60 miles per hour, the driver, in one minute, would probably receive 30 signal indications, without counting duplicate spots and route indications. But what I think would be worse, would be the liability of the indicator being misread. With the road blocked ahead, the driver, when inside the distant, and before reaching the warning magnets, would have his home semaphore showing off, and inviting him to run on.

Then as regards the route indications. Is not Mr. Boult wrong in suggesting that the worst results of a driver thinking he was on the right road when he was not, would be loss of time? What if one of the roads was to a bay platform?

F

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Mr. Boult's route indicators are dependent upon electro-magnets on the road, and consequently liable to failure, and to give wrong indications—a serious matter.

How is Mr. Boult going to deal with single lines? On many trunk lines there are short sections of single road.

Mr. Boult has referred to the different senses which fail to do all that is wanted, according to his standard of requirements, and, in conclusion, I would point out that there is one important sense, which the introduction of his system, or, in fact, any other mechanical system, would soon destroy, that is, the sense of alertness to danger, which is the secret of the success of the present system.

C. M. J.

LEGAL.

ELECTRIC CONSTRUCTION COMPANY *v.* IMPERIAL TRAMWAYS COMPANY, THE BRITISH THOMSON-HOUSTON COMPANY (THIRD PARTIES).

THIS case was commenced on Tuesday before Mr. Justice Cozens-Hardy in the Chancery Division. It was an action brought by the plaintiffs for an injunction to restrain the defendants, their servants and agents, from infringing the letters patent granted to Thos. John Handford, No. 9,527 of 1885, of which the plaintiffs were the holders. The infringement complained of was the use of electric motors supplied by the defendants on the Middlesbrough, Stockton and Thornaby tramways. The British Thomson-Houston Company were added as third parties, but they were treated as defendants. The patent sued upon having expired, the plaintiffs asked for damages in lieu of the injunction they claimed in their writ.

Mr. Fletcher Moulton, Q.C., Mr. Bousfield, Q.C., and Mr. Grey appeared for the plaintiffs; and Mr. Cripps, Q.C., Mr. Astbury, Q.C., and Mr. A. J. Walter for the defendants and third parties.

MR. MOULTON, in opening the case, said the patent of Mr. Handford related to dynamos or motors mounted on cars or carriages for the purpose of propelling them. The invention was a special way of mounting electric motors so as to obviate very great inconvenience which would otherwise be met with in connection with their use. In the pleaded defences to the action there was a denial of infringement, and an allegation of invalidity of the patent.

MR. ASTBURY: The substantial defence is as to the invalidity of the patent.

MR. MOULTON said that that was substantially the great question. The objections to the plaintiffs' patent were, he believed, as wide as usual, but the defendants did not allege disconformity.

HIS LORDSHIP: That is a comfort.

MR. MOULTON, continuing, said the defendants further alleged that the plaintiff's invention was not new, and that it formed the subject matter of a prior grant which was in the Patent Office, but not published. There had never been a decision on this point, but those who were responsible for the defence said it was a good one. The third paragraph of the defence raised the question in another form, and said that the man who applies for, but whose patent is not published, is the true inventor. The defendants further said it was not subject matter for letters patent.

HIS LORDSHIP: Is that under a separate head or merely formal?

MR. ASTBURY: We say there was no subject matter in this invention. It is important therefore.

MR. MOULTON, continuing, said that the subject of Handford's invention was the mounting of electric motors on electric cars. Of course, electric cars were driven either by a current which came from batteries situated on the car or by currents communicated from fixed conductors to the cars. The current had to pass round the dynamo in the car, and then it was made to revolve at a great number of revolutions per minute, and the power had to be communicated to the wheels, which was the driving power, and the consequence was that it had to be communicated by gearing straps, or something of that kind, so as to drive round the axle of the wheel. A dynamo was always very massive, heavy, and bulky, and it had to revolve with great accuracy. In the first place, it was necessary to have the dynamo, which acted as a motor, so mounted that disturbance did not throw it out of gear. The method of fixing the dynamo to the car invented by Mr. Handford had, he believed, been universally adopted in electric traction for getting over the difficulties he had mentioned. The dynamo, which acted as a motor, was so mounted that the disturbance did not throw it out of gear, and that shocks produced as little effect on it as possible. Mr. Handford fixed his motor by having it sleeved on the driving shaft, and its armature worked on a parallel shaft. If a jolt came to the driving wheel it did not give a jolt to the whole motor, which relieved itself by a slight rotation. If the motor was balanced on the axle a blow would be communicated to the whole motor. The rotation of the motor caused by a jolt was partly checked by means of springs which held the motor at one end, and another function of the springs was to prevent the serious jolt of the car. His learned friends said that that was not subject matter for letters patent. Well, if that was not subject matter for letters patent, what was? The learned counsel then referred in great detail to the plaintiff's complete specification in which the claim for the invention was as follows:—"The motor of an electric railway car or carriage having its field magnet centred or sleeved upon a driving axle, its armature supported directly upon the said field magnet, and having a shaft separate from the driving axle and gearing communicating motion from the armature shaft to the driving axle. (2) The motor of an electric railway car or carriage, partly or wholly separated by springs from the car body, carriage body or truck, and having its field magnet centred or sleeved upon a driving axle, its armature supported directly upon the said field magnet, and having a shaft separate from the driving axle and gearing communicating motion from the armature shaft to the driving axle. (3) The motor of an electric railway car or carriage centred upon the driving axle at one end, and having spring supports at the other end." The learned counsel said that the utility of the invention could not be denied, and he did not think it could be denied that there had been infringement.

MR. DUGALD CLARK, examined by MR. BOUSFIELD, said he had examined and made himself acquainted with the plaintiff's specifications and the alleged anticipations. He had also been shown drawings of the alleged infringements. As he understood the specification, the inventor dealt with two things: Firstly, to so arrange his electric motor that it should remain in gear with the driving wheel. He also desired to so arrange his motor that it was not exposed to rude shocks. Those objects were accomplished by the invention.

In cross-examination by MR. CRIPPS, MR. DUGALD CLARK stated that the object sought to be attained in the attachment would not be the same whether the motor was electric or steam. In the steam motor the problem was a very different one, and the connection of the motor to the axle, to be worked successfully, required very different conditions altogether; it was necessary that the driving-wheel should remain in gear and the motor should not be exposed to road shocks, and it was necessary in every case to suspend the motor so that it should remain in gear. In steam power that was dealt with at a very early date, but the first attempts were failures. Roughly speaking, the same objects had to be attained with either steam or electric power; but the great liability was as to shock, and so far as that was concerned, most of the locomotives were not free from shock. Undoubtedly an object was to reduce shocks. He (Mr. Clark) did not know that the supporting spring was an essential method of the plaintiff's arrangement, but some method of spring was essential. The object of the spring between the field magnet and the body of the car was to suspend the end of the motor in such a way that the truck could move without moving the motor appreciably. His own opinion was, that this was one of the essential features of the plaintiff's invention. He called them springs of suspension. It was a novelty at the time to have a motor centred or sleeved upon the driving axle. He believed it was not novel to have an armature supported on a field magnet. In an electric motor, he believed it was novel to have a shaft supported from the driving axle; he could not call to mind any electric motors that had had it. In steam motors there was such a thing. There must always be the gearing communicating motion from the armature to the driving wheel. Except as regards the spring, they had had all the other elements of plaintiff's claim—but not in combination with a motor, and the relieving of the axle of dead weight indicated what the inventor was trying to do, that was, the avoiding of shock, which was shown by the springs, and making the motor one-sided. He (Mr. Clark) had seen an extract from the Official Gazette of the United States of America Patent Office, dated June 30th, 1885, and it showed the plan of what was now being claimed, but he found no description, and without that it would be unintelligible. Knowing it now, he could recognise it, but as the plan stood it would leave the whole thing for invention, because, although shown sleeved at one end of the driving axle, and with the other end attached in some way to the frame, there was nothing to show that there was not a rigid frame; and in that case there was no invention whatever. There was no sign of elastic attachment, which he (witness) took to be the whole essence of the invention. There must be an elastic attachment of some kind, equivalent to a spring.

WITNESS, in answer to questions with reference to Reckenzaun's electric motor, said it was not centred on the driving axle. It was bolted to the frame, and the invention which it was the object of the plaintiff to make, was not present. There was no centring in the sense of the word as used in plaintiffs' specification. Eliminating the spring element, they had in Reckenzaun's a frame which wasn't sleeved to the axle, but the same as if they had the truck made without springs and the motor fixed to the frame. So far as the field magnet was concerned, it was all one rigid mass. Directed next to Finney's electrical invention, Mr. Clark said the frame of that motor was attached to the driving axle; it was not sleeved on the axle in the sense in which the word sleeved was used; there must be some elasticity of movement, otherwise there was no sense in the word, and, therefore, in the plaintiff's case it must imply springs or spring connection. The point of plaintiff's invention was suspension of the motor, and that must be by spring connection or its equivalent. Mr. Clark, in reply to further questions, said that in Adams's invention the action was altogether different; and it showed he had no idea of avoiding shock, the armature being in the very position where it would receive the worst usage. Adams missed the object of plaintiff's invention by his concentric and equal arrangement. The same spring attachment was found as in plaintiff's, but there was nothing in that, because it must be attached in a certain way to do certain things. One of the objects—he would not say the main object—of plaintiff's invention was to attach the field magnet in such a way that it would always occupy the same relative position to the wheels and armature, and not be disturbed by the spring connection between the body of the car and the wheel, and to do that in such a way as to avoid shock. Adams's invention had actually been used in the United States, but it was not successful in avoiding shock. It was quite obvious it would not do so.

MR. CLARK was also cross-examined by MR. CRIPPS with reference to the Jensen (Edison) invention, and Hermann's, Benn's, Pyott's, Garland's, Longstaff and Pullen's and Cryders. In the case of

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Hermann's steam road wagon, the motor for the driving power was sleeved or centred on the driving axle, along with the boiler and all the other parts, and the arrangement was such that working on a rough road, all the teeth of the gear wheels would be broken off. He quite admitted that the theory in this case was the same as plaintiff's, but it was applied in an utterly impossible way. The specifications to which his attention had just been called came the nearest to plaintiff's, so far as the other elements of the invention outside the spring connection was concerned. In that of Longstaff and Pullen, all the weight was concentrated over the driving wheel, and although there was a spring at one end, it would not produce the effect produced by plaintiff's spring, for the same reason as Adams's arrangement did not.

The hearing was then adjourned until next day.

On Wednesday, 8th inst, the hearing was resumed.

Mr. Dugald Clark, re-examined by Mr. Fletcher Moulton, gave it as his opinion that the plaintiff's invention was a practical one for overcoming defects in mounting electric motors. The problem of getting over practical defects for mounting steam motors was not the same as for electric motors—it was quite different. A steam motor was one in which all parts remained in the same position relatively to one another. With regard to electric motors, there was rotation round axles. It did not follow that a successful method of supporting steam motors would be successful with electric motors. He had had several specifications with reference to steam motors put to him, and to the best of witness's knowledge they had all been failures.

They do not show the systems which have been adopted for suspending steam motors?—Not one of them.

To the best of your belief, did anyone of these specifications become common knowledge, or come into common use?—No; not one of these came into common use.

Are they quite different from the plaintiff's specification?—Yes, quite.

Re-examination continued: Hermann's was not a practicable thing at all?—Quite impracticable.

The Witness was then referred to Bean's specification, where he said the motor was not supported in the same way as the plaintiff's invention.—In Bean's arrangement the motor boiler and truck all shared the same oscillations, and the consequence of that was that he could only drive chain gearing. He could not run the thing with tooth gearing.

In Pyott's there was a rigid truck. The essence of his invention was to make a truck with adjustable wheels. The object of his construction altogether was to allow a rigid bogey to run round a curve, and the engine in this case was attached to a rigid bogey. That was not the plaintiff's invention. There was no possibility in Pyott's of saving shocks or anything of the kind. The problem with which Pyott was dealing was not a mechanical problem with regard to shock. Longstaffe's was a very complicated method of supporting, and in the opinion of witness not at all a practicable one. In the first place, the weight of the motor was not supported in the same way as it was in the plaintiff's invention. In Longstaffe's the motor was right on the top of the driving wheel, and was rigidly connected with the driving wheel, where it would receive all the shocks.

Is it in that respect Adams?—Yes; in that respect it is like Adams.

Re-examination continued: In his opinion, Cryders' invention was not practicable for many reasons. All the suspension systems presented great difficulties in getting steam supplied for the cylinder.

Mr. Jas. Swinburne, examined by Mr. Moulton, said he had studied carefully the plaintiff's specification. In his opinion it clearly described the invention which the previous witness had referred to in his evidence. The invention was a useful one. He had given a considerable amount of attention to electricity and electric motors. In his opinion the plaintiff's invention proved of exceptional utility in connection with electric traction. It was enormously used. The problem solved by Handford was so arranging a motor that it got a minimum of shock and a minimum of communicated motion, and that was most desirable for the motors in use in the year 1885. The invention of Handford consisted of a combination, and although sleeving a body on an axle was known, and springs were also known at the date of the patent, the combination was new. There was nothing in the drawings which had been put in to teach him the plaintiff's invention. They did not show the essential mechanism of the plaintiff's invention. There was nothing in those drawings which showed the spring support. He did not think that the public could have learned the plaintiff's invention from those drawings. In Reckenzaun's the motor was not in any sense sleeved on the driving axle. In Finney's the motor was rigidly fixed to the frame. There did not appear to be any springs in the whole affair. It could not be said that that was the plaintiff's method of suspension at all. That was exactly what it was not. In Adams's the motor was put right on the top of the axle, on the centre of the axle, so that all the shocks were communicated to every part of the motor. In witness's opinion there could not possibly be a worse method of support. The springs there used were not in any sense the springs used by Handford.

Cross-examined by Mr. Cripps, the witness said that springs would be practically essential for electric motors on tramcars. The spring, which was the essence of the plaintiff's specification, was not indicated in Reckenzaun's.

Re-examined by Mr. Bousfield, the witness repeated that the features of the plaintiff's invention were sleeving on the driving axle and spring suspension from the moving car. In the other cases which had been put to him, the problem which plaintiff dealt with was not dealt with.

Lord Kelvin was next called, and examined by Mr. Bousfield. You have, I think, given a good many years of your life to electrical problems of one sort or another; let me ask you first of all, suppose in 1885, the date of this specification, you had your mind directed to the question of how best to attach a motor to a thing like a tramcar with a body connected by springs to the wheels, was there anything in common knowledge at that time, with reference to steam engines and other kinds of motors, which would have helped you to a solution of the difficulties of that problem?—No, there was not.

Then, taking these specifications—which I do not think it is suggested were part of common knowledge—taking the specifications with reference to these devices relating to steam engines, do you think they would have helped you to a solution of this problem as to how to attach an electric motor most advantageously to a thing like a tramcar with a body supported by springs on wheels?—No, I don't think so.

Counsel was proceeding to question Lord Kelvin with reference to the Jensen (Edison) invention, when

Mr. Cripps asked if it were worth while?

Mr. Bousfield said that in that case he would go on to Adams.

His Lordship: The witness has said, subject to cross-examination, that there was previous to that time nothing in common knowledge; I think you had better leave it there.

Mr. Bousfield, to witness: Given that thing to be solved, what do you say, taking one of two or three illustrations, of Finney's method?

Mr. Cripps said they had the actual specifications.

Mr. Bousfield said he wanted to take the matter shortly, and to classify the different specifications which had been suggested as anticipations.

Mr. Cripps objected to the form of the question, which was not pressed.

Mr. Bousfield: Lord Kelvin, is a method in which a motor is rigidly fixed on to a framework, rigidly attached to the axle with the wheels, in your view the same as plaintiff's?

Mr. Cripps: We are all agreed it is not. I certainly have not suggested it.

Mr. Bousfield: Can you point out, Lord Kelvin, any difference between Finney's method and a method such as I have described?—In Finney's method there are no springs.

Take the case of a pair of axles with bearings, carrying a rigid framework and a motor rigidly carried on that framework, that you say does not suggest the plaintiff's?—No.

Can you distinguish Finney from a thing of that sort that I have just put to you?—Perhaps you will tell us in your own way in reference to Finney.

His Lordship: Lord Kelvin, in your view, what is the difference between Finney's and the plaintiff's?—That there are no springs.

Mr. Bousfield: Can you see any one of these specifications which is like the plaintiff's?—No.

Cross-examined by Mr. Cripps: I understand the point of difference you refer to is, that you don't find the springs in these other cases which have been put to you?—That is one essential difference.

And you look on the the spring as an essential feature of the plaintiff's invention?—Yes. Without springs, it would be the play of Hamlet with the part of Hamlet left out.

Mr. John Alex. Henry Blackburn, manager of the plaintiff company, was next called as a witness. He said he had had a very large experience in the working of electric motor traction, and for the last four or five years had been more or less engaged in investigation as to the different types of motors which had been in use from time to time.

Mr. Cripps did not see what that went to show in this case, and the witness left the box.

Mr. Bousfield then addressed his Lordship. He said he thought the problem before this inventor was a fairly clear one; he came in at a time when it was thought that electricity could be usefully applied to tramcars, and the problem was, how to avoid shock? Plaintiff's method had been the only successful one, and it had been universally adopted.

Mr. Cripps opened the case for the defence. His first point was, the matter was one of pure construction, and nothing else, and that question was whether, in claim 1, the inventor had not disclaimed—to use a common expression—the spring element in the invention. He argued, on the evidence so far before the Court, that the spring element was an essential element of plaintiff's invention, because in the body of the patent one saw constant reference to the word spring, but when they came to the end, there were found three claims, all based on the spring element, and in claim 1 not so, yet the Court was asked to read the spring element into claim 1, from which he (counsel) contended it was specifically eliminated. Mr. Cripps, apart from the question of construction, contended that the four elements, other than the spring element, which plaintiff claimed had been anticipated in specifications to which the attention of the Court had been called, and he further argued that in certain other specifications there was the equivalent of plaintiff's spring attachment.

The further hearing was adjourned.

Tevenan v. Vanderburg.

In the Queen's Bench Division, Dublin, on Saturday, before Mr. Justice Boyd, the case of P. J. Tevenan v. J. Vanderburg came on for hearing. It was an application on behalf of the plaintiff for an order that he be at liberty to issue a writ for service out of the jurisdiction. Mr. John Bartley said that the plaintiff, who resided in Dublin, was employed by a Mr. Sax, who resided at East Molesey, Surrey, to do clerical and agency work with him for the intended defendant, who resided at 55, Thistle Road, Newington, London, and had his place of business at 21, Mincing Lane, London. Mr. Sax came

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to Ireland as agent for Mr. Vanderburg, his father-in-law, in order to work up contracts and business in connection with lighting by electricity in Dublin and in Ireland generally. He employed the plaintiff at a salary of £6 per week, of which £93 6s. 9d. was still due and unpaid. Sax also agreed that the defendant would pay him for board and lodging £3 per week, and on foot of this £20 7s. was still due. The contract was made in Ireland, and the work was all done here, where the action could be most conveniently and cheaply tried. The total sum due was £113 16s. 3d.

Mr. Justice Boyd made the order sought.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending Nov. 8th, 1898.		Week ending Nov. 7th, 1899.	
Adelaide	Value £1,148	Adelaide	Value £180
Bombay	54	Alexandria	106
Boulogne	17	,, Teleg. wire. ..	89
Brisbane	414	Amsterdam	88
Calcutta	50	Antwerp	90
Cape Town	60	Beira	75
Colombo	225	Bombay	86
Durban	775	Boulogne	40
East London	351	Brisbane. Teleph. cable ..	890
Gothenburg. Teleg. mat. ..	22	Buenos Ayres	2,326
Hamburg	120	,, Teleg. mat. ..	925
Launceston..	90	Calcutta	86
Madras	76	,, Teleg. wire	104
Malta	2 6	Cape Town	877
Melbourne. Teleg. mat. ..	491	Channel Islands. Teleg. poles	120
Montreal	123	Colombo. Teleg. mat.	10
Ostend	64	Copenhagen. Teleg. wire ..	23
Rosario	239	Demerara. Teleg. cable ..	448
Rio de Janeiro	65	,, Teleg. mat. ..	57
St. Petersburg	20	Durban	141
Shanghai	156	,, Teleg. mat.	8,166
Stockholm	470	,, Teleph. mat.	160
Sirlina. Electric detonators ..	63	East London	257
Sydney	655	Gothenburg..	116
Wellington	942	Hamburg	121
Yokohama	2,916	,, Teleg. mat. ..	435
		Hobart. Teleg. wire	19
		Hong Kong	40
		,, Teleg. mat. ..	24
		Jamaica. Teleg. mat.	14
		Madras	244
		Mauritius. Teleg. stores ..	35
		Melbourne	188
		Ostend	80
		Port Elizabeth	40
		Rangoon. Elec. mining machy.	1,000
		Rotterdam	175
		Shanghai	994
		Singapore	87
		Stockholm. Teleg. mat. ..	167
		Sydney	1,891
		,, Teleg. mat.	76
		Tokio. Teleph. cable	1,278
		Valparaiso. Teleg. mat. ..	144
		Wellington	112
Total ..	£9,008	Total ..	£15,974

Foreign Goods Transhipped.

Brisbane. Teleph. appar.	Value £65
Piraeus. Electrical goods ..	28
Total ..	£93

Allen & Co. v. Universal Process Company.—In the Westminster County Court on Thursday, November 2nd, Messrs. Allen & Co., electrical engineers, sued the Universal Process Company for work done for the defendants. It seemed that the defendants' arc lamps were cut very rapidly, and the plaintiffs arranged to keep them in repair for £10 a year, payable quarterly. This was exclusive of 30s. for putting them in repair at the start, and carbons. During the first quarter defendants telephoned to them to send round and see to the lamps whenever required, and attention was then given. For some time telephone messages were received during the second quarter, but afterwards no communications were received, and when asked for payment they said plaintiffs ought to have sent fortnightly to do the work. Plaintiffs' answer to that was, that having put in special carbons the necessity for repair did not so often occur. The defence was that the plaintiffs should have sent periodically but they did not.—His Honour said the practice seemed to have been for the plaintiffs to have been sent for, and thought the contract might have been ended at any time but it had not been.—Judgment for the plaintiffs for the amount claimed, with costs.

Bankruptcy Proceedings.—On 3rd inst. S. F. Walker, electrical engineer, Cardiff, was again examined at the Cardiff Bankruptcy Court. Mr. Belcher, who appeared for the trustee, complained that debtor had not complied with the order made upon him at the last Court to supply details showing how he made up the totals in his deficiency account. Mr. Gilling, for the debtor, pleaded that the bankrupt had misunderstood the order. Debtor was further examined by Mr. Belcher with reference to his furniture at Severn Road and Bath, which was claimed by his wife. Debtor said all the furniture was bought by his wife with money supplied to her by her mother. He was prepared to supply an inventory of the furniture. He denied that he had a valuable scientific library. The books consisted mainly of the records of a number of societies to which he belonged. The examination was adjourned, debtor to supply the required accounts by December 1st.

At a sitting of the London Bankruptcy Court, held on the 3rd inst., before Mr. Registrar Brougham, Archibald Edward McKechnie, described as of Newton Road, Bayswater, applied to pass his public examination upon accounts showing liabilities £908 and assets 6s. In the course of his evidence the debtor said that for some years after 1880 he was in America, and was assisting in the promotion of various electrical companies and the development of electrical patents. He made £10,000 out of those patents, but sunk £7,000 in an unfortunate railway investment, and had spent the remainder. Witness came to England in July, 1896, with £2,000. Since his residence in this country he had lost £370 in connection with a scheme to form a company to put a new cycle lamp on the market, and now his money having all run out, he was dependent upon loans from relatives. The examination was ordered to be concluded.

Catalogues, &c.—Messrs. Green & Boulding, of Bunhill Row, E.C., send us an illustrated pamphlet (dated October, 1899), descriptive of the Buffalo automatic injector which they claim to embody all the essential points of an efficient and economical boiler feeder. The same list describes the Tripp metallic packings.

The Unbreakable Pulley and Millgearing Company have sent us a circular of their wrought-iron split pulleys and adjustable swivel bearings, and a reproduction from a photograph of friction clutch countershafts in swivel bearings made by them for a firm of Manchester engineers.

Messrs. C. Nurse & Co., of Walworth Road, S.E., have issued an illustrated price list (312 pp.) of engineers' and joiners' tools and machinery of all kinds. The book is very fully illustrated with cuts of a large variety of tools and other articles.

Copper.—We gather from a daily paper that Messrs. James Lewis & Son's monthly report on copper, dated November 1st, contains the following:—

Confidence in the ability of the Amalgamated Copper Company to maintain values at their present level has been somewhat severely shaken by the weakness of the American market and the pressure to sell American electrolytic copper to European consumers at lower prices, the fall in the quotation for Lake copper to 17½ cents on the 20th ult. inducing a raid on the market by dealers and speculators, which brought about a fall from £75 16s. 3d. on the 17th to £72 17s. 6d. on the 24th. With some of the leading sellers buying back at the decline, and American support, a reaction to £74 8s. 9d. followed, but values subsequently fell away again to £72 10s. on the 31st. Closing values are £72 5s. for cash and £72 10s. for three months' prompt—a fall since the 2nd ult. of £2 16s. 3d. and £3 7s. 6d. respectively. The detrimental effect of the large shipments of Chili copper out of stock here to Baltimore and New York for conversion into electrolytic copper—5,170 tons to date—is now apparent in the large quantity of the latter quality offered for sale, competing with English best selected ingots, which were becoming very scarce and for which a premium of £7 per ton over standard had been paid. For best selected ingots there is a good demand, with buyers at £80—Birmingham terms—for November, and sellers at the same for December and January delivery. Lake copper in New York has fallen to 17 cents per pound, at which a large sale has been made by the Calumet and Hecla Company to American consumers. This represents a fall of £6 18s. in the course of the month. Electrolytic has been largely sold for export to the Continent at low prices and still presses for sale, English consumers showing little inclination to buy except for their immediate wants. The shares of the Amalgamated Company have sold down to 86 dollars. As a result of the control by this company of the Anaconda Copper Company, it is stated that the latter will not issue any report of its operations for the year ending June 30th last—holders of the shares in this country being kept in ignorance of the company's position.

The Copper Market in October.—Messrs. H. R. Merton and Co.'s circular of November 1st shows that during October stocks have declined by 1,524 tons, and that the price of standard copper has likewise fallen—£2 17s. 6d. per ton. The stocks on September 30th totalled 28,328 tons, and on October 31st 26,804 tons. The supplies in October amounted to 19,799 tons, but of this total no less than 2,994 tons found its way to America, so that the supplies for consumers in this country only reached a total of 16,805 tons. As the deliveries on this side totalled 18,329 tons, the fall in stocks was 1,524 tons. It is remarkable that the shipments to America were higher than any yet recorded in one month, since this noteworthy feature of the present position of the copper market came into existence. Messrs. H. R. Merton & Co. now devote a special column of their return to "Shipments of 'Standard' to America," and from this we take the following figures:—

June	1,875	tons.
July	500	,,
August...	—	,,
September	2,276	,,
October	2,994	,,
Total ...	7,645	tons.

It would be remarkable if the country which produces more than one-half of the copper supply of the world were unable to increase the output of its mines sufficiently to supply the home demand—and most people see in these purchases of copper on American account on this side of the Atlantic, merely attempts to rig the market in favour of the New York syndicate. The success in this direction has not been very striking, for in spite of the 7,645 tons shipped from this country to New York, or other American ports, the price of G.M.B.'s has fallen from £76 15s. on May 31st to £72 17s. 6d. on October 31st, the fall having occurred chiefly during the last two months. We hope that this downward tendency in the price will continue until copper has again reached its normal level of value. The supplies of copper in October amounted to 19,799 tons, and were made up as follows:—

From North America ...	8,135	tons	
,, Spain and Portugal ...	2,548	,,	
,, Chili	2,550	,,	(to Europe and U.S.)
,, Australia	1,800	,,	
,, other countries... ...	4,766	,,	

All of these, with the exception of the shipments from North America, were above the average for the preceding 12 months,

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the deliveries from the outside countries being just double those recorded for October 1898. No new copper mining companies have been floated during the past month in this country, but in America the Stoddart Copper Company has been formed to purchase and work properties situated in Arizona. The military operations at the Cape and in Natal will hinder copper mining and development work in that quarter of the world, and the activity spoken of by Lord Loch at the annual meeting of the Standard Bank of South Africa, is likely for the present to be entirely suspended.

Correction.—In last week's article on "Electro-Pneumatic Signalling," we state on page 704 that the works of Messrs. McKenzie & Holland are at "Gloucester." This should have been *Worcester*.

Enclosed Rheostats.—The Ward Leonard Company, of America, has just taken out a new patent (October 24th, 1899), for an enclosed type of rheostat. This form has, we understand, become the favourite type for motor starters during the past few years. In the most approved form the resistance material is in the form of a reflexed ribbon which is embedded in sand, which sand is the filling material of a shallow box made entirely of iron or having one face of slate. The patent above referred to thoroughly covers the essential features of this form of rheostat box. A typical claim in the patent is as follows:—

Claim 23. "In a resistance box, the combination of a box having two large parallel surfaces and a relatively narrow edge, one of the large surfaces being in the form of a cover, a resistance within the box arranged in steps or sections, terminals to which said steps or sections are connected, and a removable filling of mineral insulating material surrounding said resistance."

For Sale.—In our advertisement pages will be found particulars of a sale of machinery, plant, and stock-in-trade of Messrs. S. F. Walker & Co. (in bankruptcy), at Cardiff, on 14th inst.; also of a sale to take place at Globe Works, Leeds, on November 21st.

Furious Driving.— Before Mr. Curtis Bennett on Tuesday, Henry Leitner, of 207, Piccadilly, was convicted of furiously driving an electric motor-car at Regent's Park, the alleged rate being 19 miles an hour. Mr. Leitner had been cautioned a few days before, and he promised not to offend again. Mr. Curtis Bennett fined him 20s. with 2s. costs.

Good Dividend.—The Allgemeine Electricitäts Gesellschaft, of Berlin, is declaring a dividend of 15 per cent. for the past financial year.

Hart Accumulators.—The Edison & Swan Company have just concluded an arrangement with the Hart Accumulator Company, whereby they are granted the sole agency for this firm's accumulators and manufactures in Glasgow and Dublin. Any inquiries for the Hart cells from these centres, the Edison & Swan Company ask, should be sent to their Glasgow and Dublin branches, 153, West George Street, Glasgow, and 12, Dawson Street, Dublin.

Liquidations, Dissolutions, &c.—A petition presented by a creditor (George Trenam, 7, New Court, Lincoln's Inn), for the winding up of the Milver Portable Electric Battery Syndicate, was before Mr. Justice Wright on 1st inst, and was adjourned to November 15th.

A meeting of the Shropshire Electric Light and Power Company will be held on December 4th at 9, The Square, Shrewsbury, to hear an account of the winding up from Mr. W. W. Naunton, liquidator.

The London and Lancashire Electric and General Engineering Company, will meet at Broad Street Avenue, E.C., on December 4th, for a similar purpose. Liquidator, Mr. F. A. Franklyn.

The *London Gazette* contains notice of the release of liquidator (Mr. Samuel Wheeler) in the case of the Collier Audible Telephone Company, Limited, of 5A, Coleman Street., E.C.

Creditors of the Thames Ironworks and Shipbuilding Company (old company), must send particulars of debts, &c., to the liquidator, Mr. H. P. Hussey (Orchard Yard, Blackwall) by December 16th.

Messrs. J. Pearson, G. Normanton, N. Brocke, W. Emmott and others, trading as the Electrical Development and Light Regulating Syndicate, have dissolved partnership. W. Emmott and F. Whiteley will continue the business under the old style. Debts, &c., to be received and paid by Mr. G. M. Riley, solicitor, Post Office Chambers, Halifax.

Single-phase Motors.—With reference to an article on the Heyland single-phase motors that recently appeared in our columns, Mr. A. C. Eborall has asked us to state that the starting resistance for these motors can be of any usual pattern, as no special construction is needed. The particular resistance illustrated is a standard construction of the Helios Company, of Köln-Ehrenfeld.

Trade Announcements.—Messrs. Nisbett & Sutherland have taken into partnership Mr. E. Marcuson, and will henceforth trade under the style of Nisbett, Sutherland & Marcuson, at the old address, 61, Chandos Street, Strand, London. The firm make a speciality of storage batteries of exceptionally light weight.

Messrs. Hiscock & Middleton, electrical engineers, of 164, Forest Lane, Forest Gate, E., have given up their premises at East Street, Barking.

Wheeler Condensing Plant.—The National Supply Company, of Preston, have decided to adopt the Barnard-Wheeler cooling towers for the extension of the condensing plant at their station at Preston. It will consist of the above-mentioned cooling towers with fans for forced draught, capable of cooling the circulating water for the Willans engine of 1,500 H.P., a Wheeler surface condenser, and a set of electrically operated air and circulating pumps. The above firm is exceedingly busy at the present time with the installation of cooling towers, having just finished the erection of one of 7,000 H.P. for the Central London Railway at their Shepherd's Bush station, and a tower for the Metropolitan Electric Supply station at Willesden of 8,500 H.P. capacity, in this latter case a complete equipment of their vertical air and circulating pumps have been included. At the Brighton electrical station a cooling tower has been erected on the roof, of 2,500 H.P., being an extension of the existing tower, which is of equal capacity. At the Belfast Corporation electricity works a tower of 2,500 H.P. is in process of erection, and at the Croydon station a tower of 800 H.P. has been erected over a part of the existing cooling pond. The Wheeler Condenser and Engineering Company have also in hand at the present time towers for the London United Tramways, at their new power station at Chiswick, of 3,500 H.P.; for the Sunderland electricity works, of 3,000 H.P. capacity; and for the Isle of Thanet light railways, of 2,500 H.P., besides a number of other towers of smaller capacity, and in each case the above firm are supplying their well known surface condensing sets in conjunction with the towers.

ELECTRIC LIGHTING NOTES.

Austria.—A Dresden firm is establishing a central station in the town of Ybbsitz (Lower Austria). The water-power of the Notbach is being applied, the plant comprising two turbines and three dynamos.

Bala.—The District Council has adopted the resolution which was passed by a ratepayers' meeting there lately, and has appointed Mr. Peers, consulting electrical engineer, of Manchester, to make a report on the subject.

Barmouth.—The District Council has decided to apply for a provisional order for electricity supply, and has appointed Mr. F. J. Warden-Stevens consulting engineer, to report on a suitable scheme.

Barnard Castle.—The District Council on Saturday last agreed to support the application of the Northern Counties Electricity Supply Company for a provisional order empowering them to provide an installation at Barnard Castle, subject to the Council retaining the right to have included in the order such reasonable clauses as they may deem necessary in the public interest.

Battersea.—The Vestry, on Wednesday, decided to enlarge the scope of the electric lighting scheme to the extent of increasing the expenditure by £5,381 for mains and lands. It was also resolved to issue advertisements inviting tenders for the supply of arc lamps and lamp columns.

Berwick-on-Tweed.—The Corporation is considering the question of electric lighting, and Mr. A. A. Campbell Swinton has been retained to advise it.

Birmingham.—The electricity supply failed, for the first time, for about 1½ hours on Monday last, and in some parts of the city it was cut off all night. The difficulty was said to be due to the blowing of a main fuse in the electricity works.

Blackpool.—The electrical engineer has reported to the Lighting and Tramways Committee in favour of extensions of the electricity works, at an estimated cost of £42,515. The scheme includes plant for both lighting and traction, as well as a storage battery for use in connection with the latter. Mr. Quin looks upon economisers as a convenient means of overcoming faulty design; he therefore intends to dispense with them, and to instal quick-steaming boilers having sufficient heating surface in themselves. A 1,200-KW. steam alternator is recommended as a suitable unit for the present and future extensions; as the maximum lighting load is at present 1,200 KW., a large increase is evidently looked for. Two 300-KW. sets are included for traction, and a 400-ampere battery. Ten 50-KW. transformers, and three new sub-stations are to be installed. The Committee has approved of the report, which will be laid before the Council very shortly.

Bolton.—Col. J. T. Marsh, R.E., Local Government Board Inspector, held an inquiry on Tuesday last with respect to an application by the Corporation for leave to borrow £100,000 for electric lighting purposes. Supply was begun in 1894, since when £68,222 has been expended. The present loan is for extensions, as follows:—Buildings, £11,911; condensing plant and cooling tower, £6,811; boilers, pipes, engines and generators of 2,400 KW. output, £47,524; mains, £23,536; transformers, £7,325; meters, £5,634. The plant at present installed is of 3,000 H.P.; there are 43,740 lamps connected, and the output in 1898-9 was 416,635 B.T.U., yielding a net profit of over £1,200. There was no opposition.

Bombay.—The applications for permission to establish stations and lay down cables, &c., for the supply of electric light and power in the city of Bombay have been referred to a Committee of the Corporation for consideration. *Indian Engineering* says that the sense of the Commissioners was that it was essential in the interests of the public that they ought not to create a monopoly by accepting the application of one party only.

Brookwood Asylum.—Application has been made by the Surrey County Council for a loan of £71,270 for the purpose of enlarging the Asylum at Brookwood, which is now filled to overflowing with pauper lunatics. The plans as laid before the Public

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Works Loan Commissioners include an installation of electric light at a cost of £5,700, three new engines being required of 100, 60, and 30 H.P. respectively, to supply current for 900 16-C.P. lamps.

Brierley Hill.—The *London Gazette* for 7th inst. contains notice of the application of the Urban District Council for a provisional order.

Calcutta.—Proposals are on foot for putting electric light and rotary fans in St. Paul's Cathedral, Calcutta. An Indian exchange says that the fans will be especially welcome, since the present punkahs render the preacher invisible at every stroke! A trial is now being arranged.

Charlcombe.—The Parish Council is desirous of obtaining an electricity supply from the Bath Corporation Works.

Chertsey.—The District Council has consented to allow the Woking Electric Supply Company to obtain a provisional order for lighting the western boundary of the district, without opposition, and has under consideration a similar application, covering the whole district, from the Electric Power Distribution Company.

Cork.—After some vacillation and misunderstanding, the Corporation has finally accepted the recommendation of the Public Works Committee that 600-watt arc lamps be adopted for the lighting of the town, to burn all night.

Dundee.—Reporting recently to a meetir of the Tramway Committee, the city electrical engineer intimated that in consequence of the backward state of the new buildings and the non-delivery of new plant, the existing plant would be insufficient to cope with the coming winter demand, and suggested that no further consumers should be added to the list. The committee resolved to give public notice that the department would be unable to receive applications for the supply of electrical energy until further notice.

The first annual supper of the employés of the electricity station was held on the 1st inst. at the Royal British Hotel. Ex-Provost Brownlee presided, and he was supported by Mr. W. H. Tittensor, chief engineer, and his assistants.

Durham.—At a meeting of the Town Council last week the Electric Lighting Committee presented a report stating that of four offers received for taking over the provisional order for electric lighting in Durham, they considered none so favourable as that of the County of Durham Electrical Power Distribution Company. This company offered to supply electricity for public lighting at 2½d. per unit, and for private lighting at 7d. per unit for the first 100 units and 2½d. beyond this quantity. The company undertook, in conjunction with the British Electric Traction Company, to promote a light electric railway from North Road, Durham, *viâ* Neville's Cross, to Brandon. It was decided that the Council transfer its powers under the Electric Lighting Acts to the County of Durham Electrical Power Distribution Company upon the terms mentioned in their offer.

Ealing.—The accounts of the Electricity Department for the year ending March 31st last show a net profit, after paying all charges, of over £65. The total capital expenditure amounts to £77,177 9s., half of which was devoted to the mains. The gross revenue was £8,771 18s. 5d., and the gross profit £3,624 6s. 9d. During the year over half a million units were generated. It is hoped that a large profit will be realised next year.

Erdington.—The District Council has resolved that application be made to the Board of Trade for a provisional order under the Electric Lighting Acts to supply electricity for public and private purposes within the district of Erdington.

Germany.—The Westfalischen Electricitäts Gesellschaft, of Dortmund, has secured a contract to establish a large electric power station at Berringhof (Ruhr). The plant will comprise three large turbines and dynamos and a battery of accumulators, and will supply electrical energy for lighting and power purposes at Menden, Frondenberg, and Wickede.

Gloucester.—The City Council has decided to borrow £10,000 from the Capital and Counties Bank on account of the amount required for electricity works.

Great Yarmouth.—Mr. G. W. Willcocks, M.I.C.E., held a public inquiry on behalf of the Board of Trade on Friday last relative to an application by the Corporation for sanction to a further loan of £27,000 for the extension of their electricity supply undertaking. The outlay is required for additional plant to meet the increasing demands of private consumers, to extend the electric light across the harbour to Gorleston and Southtown, and to supply motive power to the tramways, which the Corporation are about to construct. The surveyor stated that the municipal electric light works in Yarmouth were started in 1894 with 700 8-C P. lamps for customers, and some arc lamps for street lighting. This year the number of 8-C P. lamps had increased to 18,900, and the arc lamps for street lighting to 62. The financial position of the undertaking had steadily improved, and in the quarter ending September 30th, one of the worst in the year, £77 was earned over and above all charges. He estimated the clear profit for the year would not be less than £500. Mr. R. Martins, chairman of the Electric Lighting Committee, also gave evidence in support of the application.

Halifax.—At about 7 p.m. on Monday last, according to the *Bradford Observer*, the electricity supply suddenly ceased, extinguishing the public and private lighting, and bringing the tramcars to a standstill. Supply was renewed after about an hour's stoppage. The fault was said to be in connection with one of the generators.

Hanley.—Major-General Crozier, R.E., inspector of the Local Government Board, held a public inquiry on Tuesday with respect to an application by the Town Council for sanction to a loan of £5,000 for electric mains, transformers, meters, &c. There was no opposition.

Hartlepool.—The Hartlepools Electric Tramways Company, Limited, is desirous of negotiating with the Town Council for the acquisition of the electric lighting order which the Corporation has recently obtained.

Heaton Norris.—Notice, signed by the clerk to the Heaton Norris Urban District Council and the town clerk of Manchester, appears in the *London Gazette*, announcing the intention of the former body to transfer its electric lighting provisional order to the Manchester Corporation.

Heckmondwike.—On Thursday last week Mr. W. R. Slacke, one of the inspectors of the Local Government Board, held an inquiry into the District Council's application for sanction to borrow £14,000, for electric lighting plant. It was stated that the British Electric Traction Company had agreed to take the electrical energy required for their proposed tramway through the township from the Council's works, and that a good general demand was expected. The scheme included a house-to-house connection, and the price proposed to be charged would average 5d. per Board of Trade unit.

Ingleton.—The Electric Light and Power Company having submitted tenders for the supply of electric light, the Committee recommended the Council to accept a tender for 30 16 C P. lamps, to be lighted, cleaned, and maintained all the year round for the Council for the sum of £65 per year for three years. This was agreed to.

Leyton.—On account of delay in the delivery of two gas engines, the question of providing plant to cope with the growing demand has become urgent; the District Council has, therefore, authorised the purchase of two boilers, &c., at a cost of £1,368, to supply steam to one of the steam dynamos already ordered. The loan of £30,000, which was applied for in May last, has only been sanctioned by the Local Government Board within the last fortnight, and then only in part; this accounts for the urgency of the matter.

Littlehampton.—The District Council is considering a proposal laid before it by Messrs. W. R. Lees & Co., Douglas, offering to obtain a provisional order and to lay down plant for supplying electricity to the town.

Liverpool.—On 17th inst. a Local Government Board inquiry is to be held into an application of the City Council for sanction to borrow £300,000 for the purposes of electric lighting.

Llandilo.—The District Council has received a report from Mr. J. C. Howell upon the tenders sent in for carrying out the electric light scheme there. Mr. Howell selected two tenders, one from Messrs. Lewis & Fletcher, for overhead cables, and another from Mr. Bertram Thomas, for underground. Both tenders are to be adjusted to place them on the same basis.

London, E.C.—At the sitting of the Court of Common Council last week, says the *City Press*, Mr. Algar (Candlewick) brought up a report from the Streets Committee recommending that in a Bill to be introduced into Parliament next session a clause should be inserted giving the Corporation the power to deal with pipes, cables, wires, &c., under the public ways of the City. The Committee recommended also that a City inspector should be appointed, at a salary of £200 a year, under the Overhead Wires Act. The Court approved.

The town clerk read a letter from the National Telephone Company, asking to be permitted to lay their mains under the streets simultaneously with the Postmaster-General, whose application is under the consideration of the Committee. Mr Algar moved that the communication should be referred to the Streets Committee for consideration. Mr. Deputy Pannell (Bassishaw) having seconded the motion, it was carried.

The Streets Committee recommended, relative to the Electric Lighting Order Confirmation (No. 20) Act, 1899 (Charing Cross and Strand Electricity Supply Corporation, Limited), that Mr. A. A. Voysey should be appointed the electrical inspector under that order, and that the company should be asked to contribute £500 per annum towards the expenses of the inspector.

With respect to applications from the Charing Cross and Strand Electricity Supply Corporation for permission to lay mains, &c., on the south side of Fleet Street, from the City boundary to the corner of Bouverie Street, and on the south side of Bream's Buildings and a portion of Fetter Lane, the Committee stated that they had informed the company that no objection would be offered to the proposed works on their satisfying the Corporation that they had complied in every respect with the City of London Electric Lighting Order Confirmation (No. 20) Act, 1899. The work, moreover, would have to be done under the direction and to the satisfaction of the City engineer.

On the subject of a letter from the City of London Electric Lighting Company in regard to the proposed alteration in the standard pressure of supply, the Committee recommended as follows:—"(1) That the condition agreed to by the Court on October 5th, with regard to the price of supply, be adhered to, and the company be informed that in the event of any abnormal conditions arising, as suggested in their said letter, it would be open to the said company to ask the permission of the Corporation to increase the price of supply; and (2) that the City of London Electric Lighting Company be informed that the means of testing the public and private supply, as at present existing, are not satisfactory, and that a copy of a memorandum prepared by the electrical engineer on the subject

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be forwarded to the company, with an intimation that an acceptance of the testing arrangements specified therein shall not prejudice the rights of the Corporation under the Provisional Orders, 1890 and 1891." The Court approved of the recommendations of the Committee without discussion.

The same Committee presented a report relative to an application from the Pearson Fire Alarm Syndicate for permission to lay wires underground, in tubes, across Whitecross Street to the corner of Silk Street. The Committee recommended that the application should be complied with, subject to the terms and conditions agreed to by the Court on July 27th last. The Court agreed.

A special meeting of the Mile End Vestry is summoned for November 27th for the purpose of passing the necessary statutory resolution to apply for a provisional order to supply electricity for public or private purposes.

London, S.W.—There is trouble in store for the Westminster Electric Supply Company; the Vestry of St. George's has received complaints from a number of residents in the neighbourhood of Eaton Square on the score of showers of grit and condensed steam from the chimney of the electricity works, and has resolved to take legal proceedings.

Lytham.—Messrs. Medhurst & Page have presented their report to the District Council as to the cost of establishing an electric lighting scheme for the town. The estimated cost of the installation is £24,000. The consideration of the report was deferred, after a short discussion on the main features of the scheme.

Nantwich.—The District Council on Friday last decided to apply to the Board of Trade for electric lighting powers. Two schemes, one providing for the lighting of the district at a cost of £11,000, and the other for the lighting of the town at a cost of £7,000, are being considered. The expert engaged by the Council estimates that the larger scheme would produce a profit of £1,000 after the third year.

Nelson.—The Corporation having made application to the Local Government Board for sanction to borrow £12,000 for electric lighting purposes, Col. J. T. Marsh, R.E., one of the inspectors to the Department, held an inquiry there last week, to receive evidence in regard to the said application. The money is required for additional plant to meet the growing demand for electric light in the town.

Northumberland County Asylum.—On the recommendation of the Asylum Committee, the County Council has decided to confer with Messrs. Swinney, Morpeth, as to a scheme for lighting the Asylum with electricity.

Nuneaton.—The District Council has decided to apply to the Board of Trade for a provisional order authorising the Council to purchase the undertaking of the Nuneaton Electric Company, Limited, and for other powers.

Oldbury.—The Midland Electric Light and Power Corporation is making proposals to the District Council for the supply of electricity in this district.

Poplar.—The Board of Works had under consideration last week a recommendation from the Electric Lighting Committee to the effect "that the electrical engineer have power to dismiss any member of his staff, and that all appointments be made on that condition." Inconceivable as it would seem to be, this very proper and business-like recommendation was vigorously opposed, and in the end was replaced by an amendment limiting the engineer's summary powers to employés on weekly or hourly wages, while other members of his staff may only be suspended and reported. The weakness of the latter system is well known to all who have had experience in practical work. The best thing to do now, apparently, is to pay *all* the staff by the week or hour, and so bring them within the meaning of the resolution!

Ripley.—The District Council has decided against the proposal to apply for a provisional order for electric lighting.

Runcorn.—The District Council last Thursday resolved to engage an electrical engineer to report as to the supplying of electricity to the town for power and lighting purposes.

Southborough.—The District Council has decided not to concur in the proposed application of the Tunbridge Wells Council for the extension of the area of supply prescribed by its electric lighting provisional order.

Stamford.—The Corporation is considering the question of establishing electricity works in the borough, and has appointed Mr. F. J. Warden-Stevens to advise in the matter.

Tipton.—At a meeting of the Urban District Council of Tipton last week, Mr. Mason asked the clerk if any reply had been received from the Midland Electric Corporation in reference to the proposed electricity station at Tipton. The clerk stated that he had written to the company upon the subject, but had not yet received a reply. Mr. Mason said that since the company had purchased a site in the parish, four Birmingham firms had entered into negotiations for the acquisition of land for the purpose of transferring their business to the Tipton district.

Trowbridge.—The District Council is considering the question of supplying the district with electricity. It is stated that a local firm may undertake the work.

Warrington.—On Wednesday Major-General Crozier, R.E., held an inquiry on behalf of the Local Government Board with reference to an application of the Corporation to borrow £44,966 for electric lighting purposes, and £9,336 for the provision of a central depôt in Parr Street. Evidence was given by the town clerk and other officials in support of this application.

Wolverhampton.—At a meeting of the Council last week a report was presented by the Electric Lighting Committee, stating that the Committee had under consideration a scheme for the extension of the undertaking, involving a considerable capital expenditure, which it was proposed to submit to the Council in December next. Having regard, however, to the extreme difficulty in obtaining electrical machinery, except upon very long notice, owing to the fact that the leading manufacturers are exceedingly busy, the Committee desire the authority of the Council to obtain and accept tenders immediately for two 700-I.H.P. direct coupled steam dynamo sets, at an estimated cost of £11,000. This plant will form part of the scheme previously referred to, but it is absolutely necessary, in order that the plant may be installed previous to the winter of 1901, that tenders for the same should be invited and accepted immediately. The constantly increasing demand for electrical energy, both for lighting and power purposes, renders it extremely probable that the whole of the plant in respect of which the expenditure of £29,000 was sanctioned by the Council in October last, will be taken up in the course of the next few months. The Committee accordingly recommended that they be authorised to forthwith advertise for, and accept, tenders as stated, and to apply to the Local Government Board for their sanction to a loan for the purpose.

The Lighting Committee's report for the year ended March 31st last shows a net profit of £1,004. There are now over 21,000 lamps connected, while the energy supplied to private consumers has increased by 44·77 per cent.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Barnsley.—The Town Council at a private meeting last week was in favour of promoting a Bill next session to construct and work tramways in Barnsley and the districts round about. It seems that powers have been already granted by the Light Railway Commissioners to the British Electric Traction Company. A Sheffield paper which advocates the municipal scheme says:—"It is long since the company announced their intention of applying for further powers for constructing additional lines in the district, in the direction set out in the scheme of the borough surveyor. They will not be able to proceed whilst the Town Council's application to Parliament is awaiting decision." It does not say much for the fair-dealing of the Barnsley Council if, having arranged one thing with the British Electric Traction Company who have incurred expense, it should at this late hour want to rescind its resolutions.

Belfast.—The Council held a special meeting to consider the question of acquiring the tramway system and adopting electric traction.

Cardiff.—It is a pleasing testimonial to the benefits of electric traction to find tradesmen and others petitioning that the proposed route *vid* Clifton Street and Broadway be not eliminated from the tramway scheme.

Croydon.—The Corporation having agreed to equip the overhead system of electric traction, have now resolved to lease the undertaking to the British Electric Traction Company, Limited.

Dublin.—On 23rd ult. an electric tramcar knocked down two pedestrians (respective ages 60 and 58), injuring them both, so that they had to be detained in hospital. The car driver has been charged with carelessness in the management of the car, and with causing the injuries. He was last week remanded on bail. We do not know what may be the measure of blame attachable to the driver in this instance, but we think that tramway officials should use their best endeavours to prevent reckless driving of electric cars, and bring erratic souls to book.

On 30th ult. an electric car crashed into a cart which was sanding the streets. The horse was thrown, the driver of the cart was flung out, and injuries to his head resulted. Later accounts say that the cart belonged to the tramway company, and that the horse had to be destroyed.

Dudley and Sedgley.—A start has now been made to equip this tramline for electricity, workmen having commenced operations at the Dudley end of the line.

Dundee.—The Tramways Committee last week considered the question of tramway extension to the north of the town. It would be impossible to secure Parliamentary powers during the coming session of Parliament, therefore a scheme drawn up by the burgh engineer was meantime deferred.

Farnworth and Kearsley.—The Urban District Council of Kearsley, near Bolton, has resolved to join the neighbouring authority of Farnworth in the promotion of a Tramway Bill. As to the working of the lines, an arrangement has been made for a term of 21 years. The Council has instructed Mr. Ellis, the Bolton electrical engineer, to arrange with them respecting the equipment.

France.—The central power station in connection with the new electric tramways in Sedan, is practically completed. The lines are expected to be open for traffic within a few weeks.

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Glasgow.—The Board of Trade representatives, Colonel Sir Francis Marindin and Mr. Trotter, were to visit Glasgow on Wednesday to inspect the extension of the electric tramways recently completed from Glasgow Cross to Govanhill. It was expected to have cars running from Springburn to Govanhill yesterday.

Last week the trolley pole of an electric car broke at a street corner, and the following car was requisitioned to push up behind so as to get it to Springburn depôt. The second car succeeded in getting off the rails and blocked the other lines, so that traffic both ways had to be suspended for about an hour.

Gomersal.—At the meeting of the District Council last week, it was reported that the British Electric Traction Company had made an agreement with a deputation of the Council to apply in the coming session for powers to construct a branch from Liversedge to the Gomersal boundary at Birkenshaw, in connection with their electric tramway from Dewsbury to Cleckheaton, and to carry out the works within two years from the date of the order. A draft agreement to this effect was submitted, and it was understood that it would receive the seal of the Council after its clauses had been gone through in committee.

Halifax.—New York *Electricity* for November 1st, says:—"Mr. H. Whitley, vice-chairman of the Borough Tramway Committee of the Halifax (England) Corporation, accompanied by Mr. H. F. Street, electrical engineer, returned to England on the 21st ult. after a six weeks' tour in this country. They had been investigating the subject of electric traction, and were deeply impressed with what they saw in our principal cities."

Hawaii.—We read in the *Western Electrician* that construction work on a new railway to be built on the island of Hawaii will soon be commenced. The road will be known as the Kohala and Hilo railway and will connect the port of Hilo, the principal city on the island, with Mahukona and Kohala. It will have a total trackage, including branch lines, of 130 miles, and will open to cultivation a large fertile territory heretofore inaccessible on account of the lack of transportation facilities. The road is to be operated by electricity, which will be generated by water-power. Three power plants will be built, each plant to be of sufficient size to furnish power to run the entire road in case of necessity. These plants will be located at either end and near the centre of the road. It is expected that the company will start with 100 20-ton cars and six electric locomotives, similar to the type in use in the Baltimore and Ohio tunnel at Baltimore. The company has been incorporated under the laws of the Hawaiian Islands, and is capitalised at $3,000,000, the greater part of the stock being held by Americans. American and Hawaiian capitalists are interested in the scheme.

Hemel Hempstead.—It is stated that three parties (the British Electric Traction Company is one) have offered to lay down a tramway here.

Hungary.—The authorities of the Raab-Oedenburg-Ebenfurther Railway are about to carry out some experiments with electric traction, by means of accumulators, on the railway between Esterhazza, Kis, and Csell.

Ipswich.—A meeting of owners and ratepayers has approved the Council's proposal to purchase and extend the tramways, and employ electricity for working them in connection with the lighting scheme.

Liverpool.—The Walton District electric tram service was inaugurated on 5th inst. The route commences in Castle Street at the junction of Lord Street, and proceeds down Lord Street, along Whitechapel, across the Old Haymarket, and up Byrom Street, Scotland Road, Kirkdale Road, and Walton Road to Spellow Lane, returning by the same thoroughfares as far as Byrom Street, where the line turns down Dale Street and so into Castle Street. Probably something like 70,000 people travelled on the cars during the day. Eighteen cars are employed to secure a practically continuous service.

Llanelly.—The Borough Council last week decided to adopt a scheme by which the British Installation Company will acquire powers to light the town with electricity and lay down a system of electric traction which will embrace the outlying villages of Felinfoel, Llwynhendy, and Pwll. The Council agree to dispose of their provisional order to the company, and will assist them in application in Parliament for the necessary powers. It is understood that the scheme will involve a total expenditure of between £80,000 and £100,000.

London.—The *Daily News* says that next week the London County Council will receive from its Highways Committee a report recommending that, in connection with the project for embanking the Thames from Victoria Tower Gardens to Lambeth Bridge, a double line of tramways, to be worked by underground electric traction, be constructed, at an estimated cost of £6,000, along Millbank Street, which, under that great improvement scheme, is to be widened to 70 feet.

Manchester.—On Tuesday evening last, Mr. Ernest T. Williams, assistant electrical engineer to the Corporation of King's Lynn, gave a lecture to the members of the Union Chapel Mutual Improvement Society, Manchester, on "The Rival Systems of Electric Tramway Traction." Manchester hopes before long to possess electric trams, and for some time past a controversy has been waging in the city newspapers on the relative merits of the different systems. Consequently, a considerable interest was taken in Mr. Williams's lecture. Mr. Alderman Bax occupied the chair. He recommended the Manchester citizens to rest assured that in carrying out the "trolley" system of tramway traction, the Electrical Committee of the Manchester Corporation were, under the circumstances, adopting the most suitable system for their city. The lecture was illustrated by means of lantern slides.

The lease of the tramways by the Manchester Carriage and Tramways Company expires in April, 1901. It is hoped, however, that arrangements may be effected with the company under which it may be possible for the Corporation to start running some of the electrically propelled tramcars some time during the year 1900. If anything should be accomplished in this direction, it is probable that the first cars will be run on the Cheetham Hill Road, Rochdale Road, and Bury New Road routes. On the invitation of the Tramways Committee, a large number of the members of the City Council and others interested inspected on Tuesday and Wednesday samples of the tramcars from which the type of car to be ultimately adopted in Manchester will be evolved.

Manchester to Liverpool.—From the *Manchester Guardian* we gather the following notes regarding this proposed electric railway scheme:—Another step towards the realisation of the scheme for an electric railway between Manchester and Liverpool has now been taken. A syndicate, with a capital of £40,000 in 400 shares of £100 each, is being formed "for the purpose of taking all the necessary steps in connection with applying for and obtaining in the ensuing session of Parliament an Act for the formation and incorporation of a railway company; for the construction and working of a high-speed electric railway between Manchester and Liverpool, on what is known as Behr's Monorail system." The preliminary prospectus states that "at present the Exploration Company, Limited, of London, holds the right of option of acquiring Mr. Behr's patents, but they have concurred with Mr. Behr in entering into an agreement with the syndicate, under which, in the event of the proposed Act of Parliament being obtained and the requisite capital subscribed, Mr. Behr and the Exploration Company bind themselves, at the request of the syndicate, to grant to the railway company to be formed, a license for the use of the invention for the purposes of the railway on any one of the following terms at the option of the directors of the railway company:—

1. A cash payment of £60,000, to be made when the railway is opened throughout for public traffic.
2. Twelve yearly payments of £6,000 each, the first to be made when the railway is opened throughout for public traffic.
3. A yearly royalty to be paid in perpetuity by the railway company of 25 per cent. of the net profits in each year, after payment out of the profits of each year of 5 per cent. on the paid-up share capital of the railway company for each year.

Under the above agreement, and as part of the terms of the assent of the Exploration Company thereto, and as remuneration for their trouble and services in connection with the business, that company is to be entitled to one-third of all net profits of the syndicate after the holders of the original share capital of £40,000 shall have received, either by way of dividend on their shares or in any other form from the syndicate, either by distribution of capital, or assets, or otherwise, an amount equal to the amount paid up in cash on the £40,000 of share capital. In order that the survey of the line may be completed, and the Parliamentary plans be prepared and deposited within the time prescribed by the Standing Orders, the survey has already been commenced, the Exploration Company having become responsible for the cost, which, with the other expenses incurred in connection with the business, are to be repaid by the syndicate. It is not anticipated that so large a sum as the £40,000, at which the capital of the syndicate has been fixed, will be required, but it has been thought prudent to provide for that amount, so that the syndicate might be placed in a strong position. The Exploration Company have requested Messrs. Mather & Platt, Limited, to give them the advantage of their wide experience and resources in carrying out, at their works, such tests of electrical plant as may be found necessary, and in perfecting details of the same; and in consideration of their having agreed to do so, the Exploration Company have entered into the preliminary contract with Messrs. Mather & Platt for the construction of the electrical and power plant for the proposed railway upon terms which the directors consider satisfactory. The directors of the syndicate are Mr. J. S. Bergheim, London (director of the Midland Electric Corporation for Power Distribution, Limited); Mr. E. Tootal Broadhurst, Manchester (Messrs. Tootal Broadhurst, Lee & Co., Limited); Mr. D. Cunningham, Liverpool; Mr. J. H. Macmillan, Manchester (managing director of Messrs. Salis Schawbe & Co., Limited): Mr. William Mather, Manchester (chairman of Messrs. Mather & Platt, Limited); Mr. William Dalton, Liverpool; and the Hon. R. J. Strutt, of Witham, Essex.

Perth (Australia).—The *Financial Times* says that the Perth electric trams have started running, and promise to be a great success. At present only one line has been constructed, but the cars are being well patronised.

Portsmouth.—The Town Council on Tuesday approved of the intention of the Tramways Committee to make application to the Board of Trade for a provisional order under the Tramways Act, authorising the Council to make certain extensions. At a meeting of the Electric Lighting Committee on Tuesday the question of the cost of producing current at the electric lighting station for the purpose of electric traction was under consideration. The cost of producing 1,500,000 units of electricity for tramway purposes was estimated at £5,637 10s., and eventually the Committee decided to offer to sell it to the Tramways Committee at $1\frac{1}{16}$d. per unit, which would yield £6,640 12s. 6d., and give a profit of £1,003 2s. 6d. The Committee, however, made the further offer that they would not accept or require more than £350 profit per million units.

(*Continued on page 765.*)

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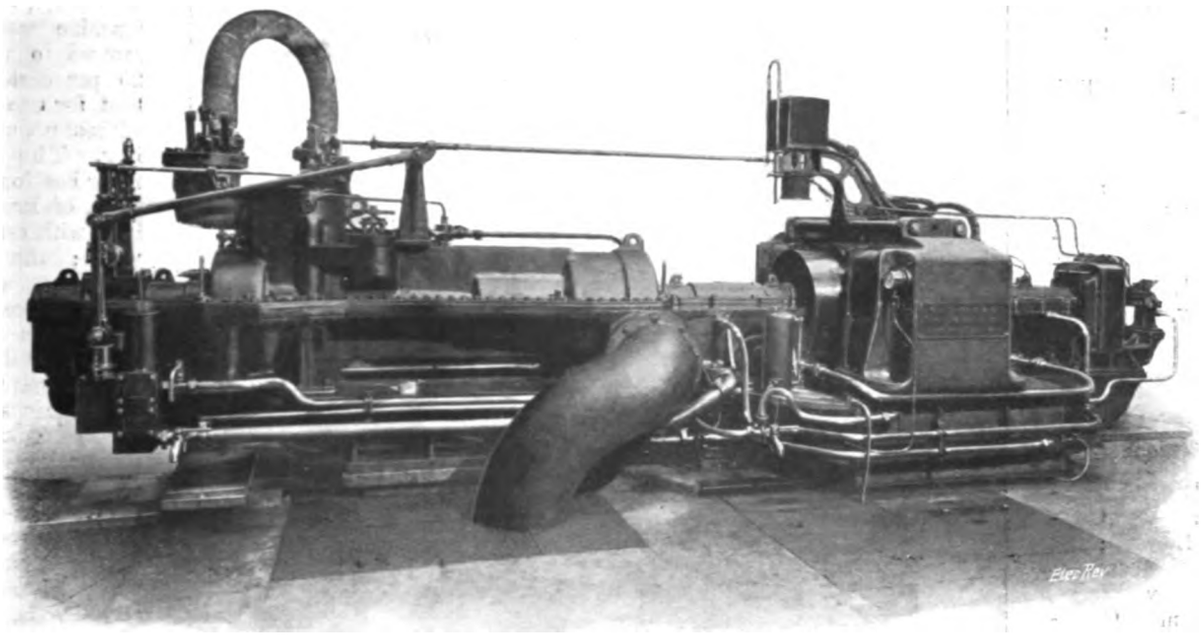
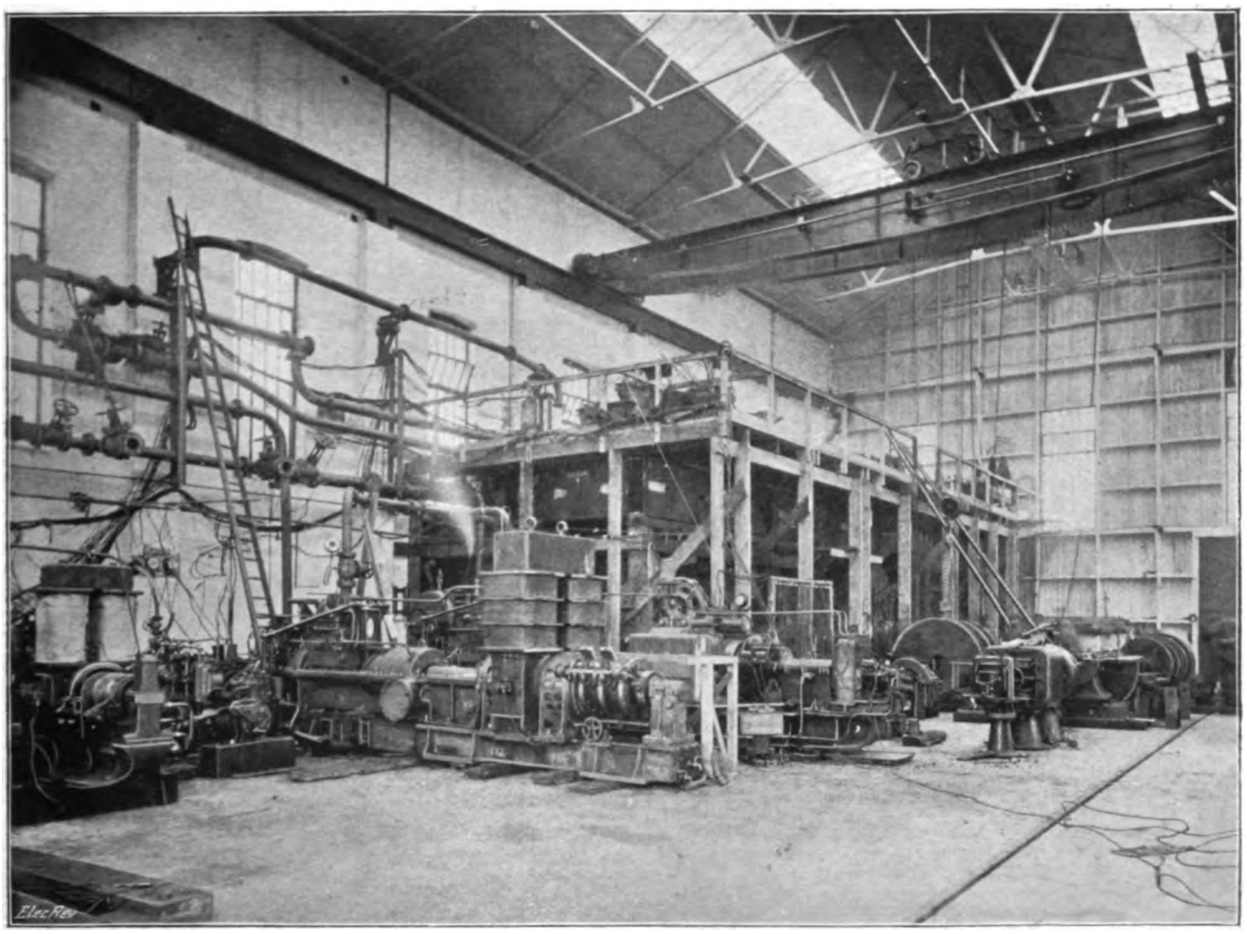
MESSRS. C. A. PARSONS & CO.'S HEATON WORKS.

THERE can be but few of our readers who are not familiar with, at least, the external appearance of the Parsons steam turbines; these extraordinary machines, the first practical steam turbines to be developed, possess a kind of fascination of their own, spinning as they do, silently and smoothly, at a velocity which is almost inconceivable!

The turbine, in its earlier days, had a hard struggle for existence; British engineers, accustomed to low speeds, looked askance at such a startling innovation as was implied by speeds of 8,000 and 10,000 revolutions per minute, at which the small machines turned out 12 years ago used to be run. Like many another, however, the inventor, the Hon. C. A. Parsons, was not to be daunted by a somewhat cool reception; he steadily went on experimenting, constantly increasing the size and output of his engines, until the value



500-KW. TURBO-ALTERNATOR.



TEST HOUSE.

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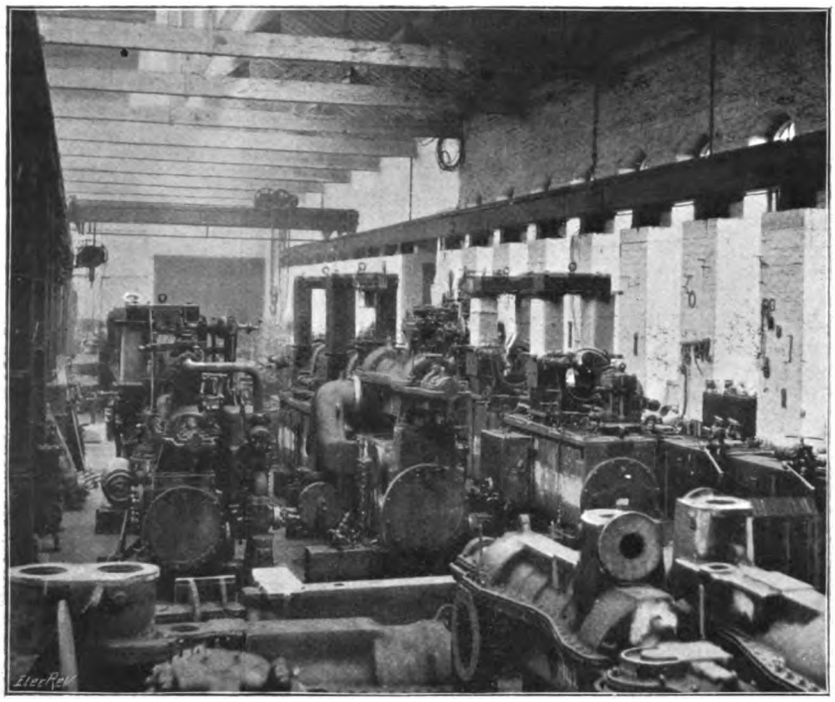
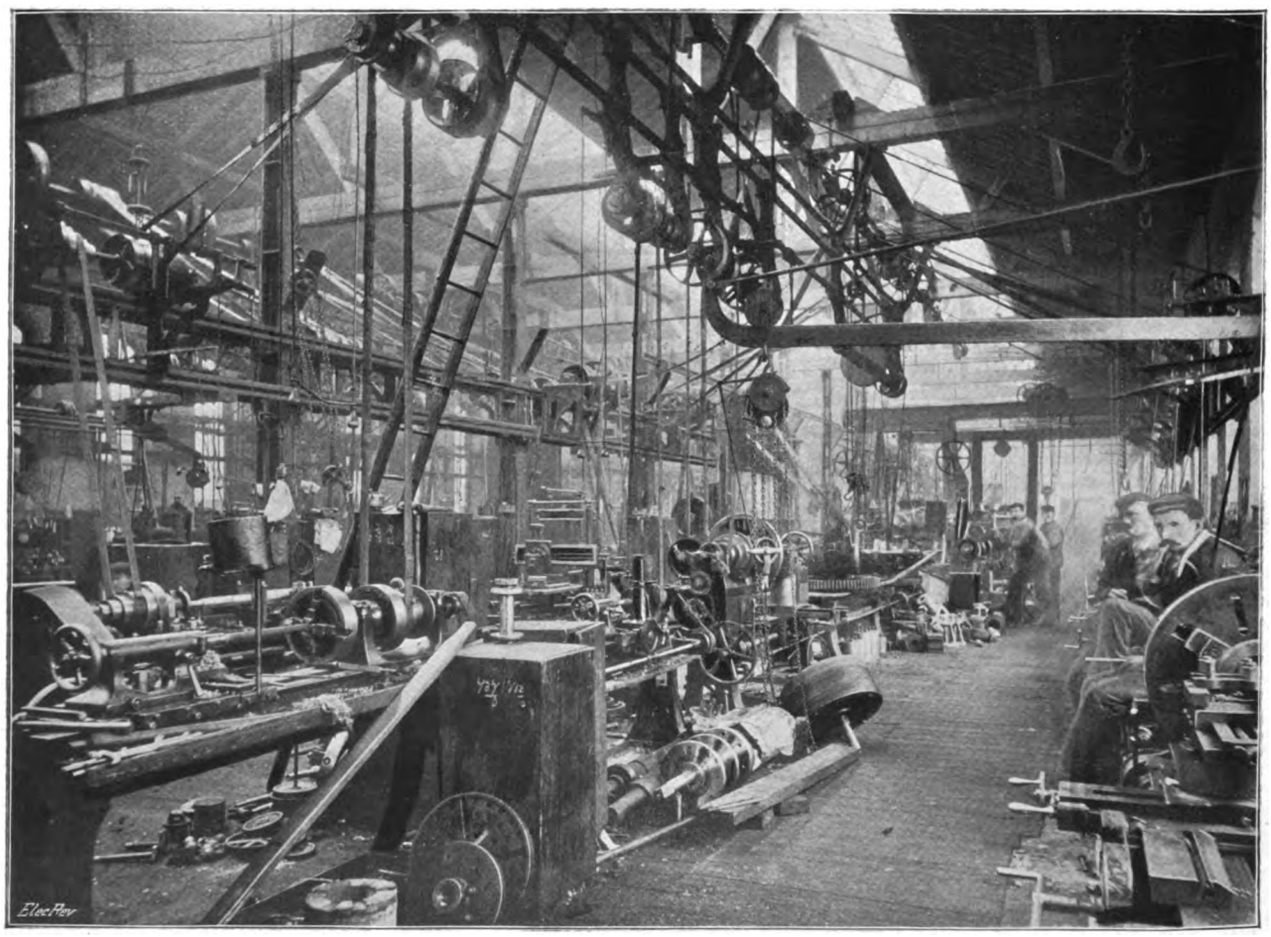
of his work was recognised, and his machines had won an assured position in the eyes of the engineering world.

That this has been attained is evidenced by the fact that at the present time the work in hand at the Heaton Works amounts to a total of 9,000 KW., and includes two 1,000-KW. turbo-alternators for the municipal authorities of Elberfeld, Germany; two 500-KW. sets for the Cambridge Electric Supply Company, Limited; one 500-KW. set for the Chatham, Rochester, and District Electric Lighting Company, Limited; two 400-KW. sets for the Newcastle and District Electric Lighting Company, Limited; and plants for Woolwich Electricity Works, Morecambe Corporation, Shipley Urban District Council, Morgan Crucible Company, Limited, London, and various other clients.



Fitting and Erecting Shop.

The view which we give of a 500 KW. turbo-alternator and exciter, which was recently supplied to the Newcastle and District Electric Lighting Company, shows well the general arrangement which is typical of these machines. A similar set (for Cambridge) was undergoing a 6-hour trial at the time of our visit, and may be partly seen in our view of the new test house; the normal output was 250 amperes at 2,000 volts, 2,700 revolutions per minute, 90 periods per second, but the machine was guaranteed to run at 25 per cent. overload for two hours without undue heating. The alternator has four field poles, of laminated iron, with cast-iron yokes; the armature has a perforated core, provided with special ventilating devices, and massive collecting rings with copper gauze or brass wire brushes—usually the latter. The exciter, which is mounted on the main shaft, gives 24 amperes at 88 volts, or 0·4 per cent. of the output of the alternator. The governor, which is of the same type as has been in use almost from the commencement, consists of a solenoid connected as a shunt to the terminals of the exciter armature; this acts on a light soft iron core coupled, by means of a long lever, to a mechanical device, which admits steam to the cylinder in



Turning Shop.

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puffs of longer or shorter duration. By adding to the solenoid a thick wire coil in the main circuit, acting in opposition to the shunt coil, the characteristic curve of the alternator may be given any desired form, the advantages of compound winding being thus obtained.

The 500-KW. set in question is combined with its own surface condenser, the latter being underneath the bedplate, while the air and circulating pumps, which are mounted on the frame of the turbine, as well as an oil pump for forced lubrication, are all driven by means of worm gear from the main shaft. A "run-away" governor of the ordinary centrifugal type is driven in the same way, and would cut off the steam in case of accident before an excessive speed was attained.

The full load was thrown on and off in our presence, without any perceptible effect upon the running except a slight change in the pitch of the sound emitted; the terminal pressure only varied about 2 per cent. A load of 585 KW. was also put on, with no marked effect. The steam consumption was afterwards worked out, and was found to be 23·2 lbs. per KW.-hour, condensing; no part of the alternator or exciter rose in temperature to the limit of 70° F. above the surrounding air, which is guaranteed by the makers.

ARMATURE WINDING SHOP.

In our view of the test house, partly concealing the 500 KW. set, will be seen a 200 KW. two-pole direct current machine, running at 1,400 volts, 2,200 revolutions per minute, for Morecambe. This dynamo is self-exciting as a shunt wound machine, the field magnet bobbins being wound in sections for greater facility of insulation and security against breakdown. The armature is a smooth core drum, bound with piano wire, with barrel winding (which was invented in Messrs. Parson's shops) at the ends. The commutator is very strongly bound together at the middle and ends with massive steel rings. The brush-holders are carried in a very heavy cast-iron frame, and are adjusted by means of screw gear under the commutator, from one side. It is noteworthy that the brushes on all these machines are held in contact with the collectors by gravity, heavy tails being cast on the holders for this purpose. The turbine is generally similar to the one already referred to, but the condenser is in this case separate.

ARMATURE BUILDING SHOP.

The small 8-KW. two-pole plant close by is destined for H.M. torpedo-boat destroyer *Viper*, which is being fitted with turbine engines of 10,000 H P. for the British Admiralty by the Parsons Marine Steam Turbine Company, Wallsend. The dynamo is rated at 100 amperes, 80 volts, at 4,000 revolutions per minute. The set includes condenser and pumps, as in the case of the 500-KW. set.

The most striking feature of the test house, however, is the pair of 1,000 KW. generating sets for Elberfeld, which are being erected in the background. Each of these machines is of the four-pole type, giving 250 amperes at 4,000 volts, 1,500 revolutions per minute, 50 periods per second, and is complete with its own surface condenser and pumps; this is the reason why the machines appear to stand so very high — when they are in their final position the condensers will be below the floor level. It is a remarkable fact that, though these large sets are to be tested completely in all respects, they will not be fixed down in any way. The turbines for these sets have both high and low pressure cylinders, as in the large marine types.

The test house, which measures 105 feet × 50 feet, and is very lofty, is provided with two travelling cranes lifting 5 and 10 tons respectively, and with a large surface condenser, pumps, and two measuring tanks, for carrying out accurate tests up to an output of 2,000 KW. The circulating water is supplied by a Parsons propeller pump, running at 4,000 revolutions per minute, and driven by an electromotor; it might, of course, be driven by a steam turbine equally well. Although the propeller, which is very similar in appearance to a marine propeller, is only about 6½ inches in diameter, it is capable of delivering 90,000 gallons of water per hour against a head of 12 feet. Close to the test house there is a large cooling pond for the condensing water.

The boilers are of various types and ages, with a combined capacity corresponding with the electrical output of 2,000 KW. Here, again, we find a turbine driving a fan at 3,000 revolutions per minute, and inducing a draught of 3 inches of water.

The machine shops are in two bays, 380 feet long × 50

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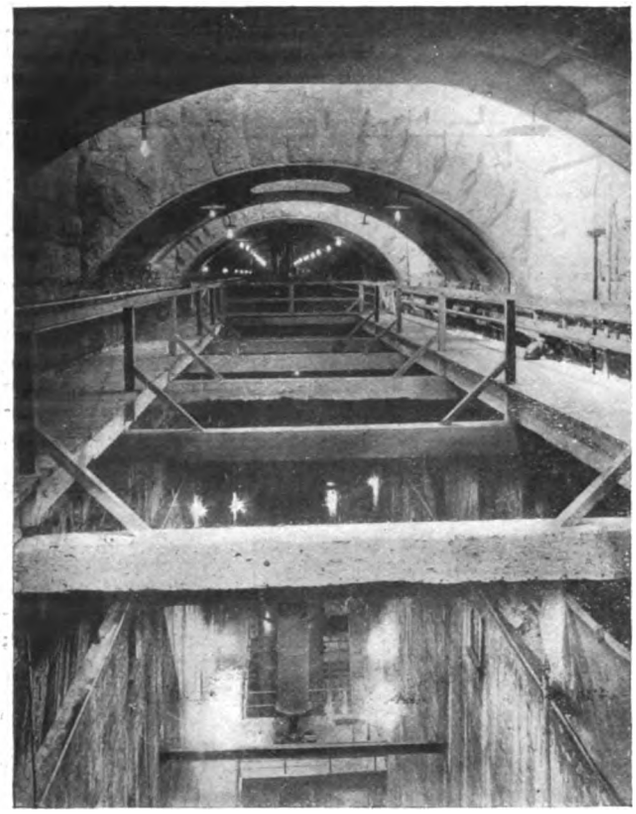
feet wide; they consist of turning, fitting, and erecting shops, armature building and winding shops, and tool shop.



Niagara Power Works (see page 765).

There is also a brass foundry, forge, pattern shop and store, and a store for materials.

In the turning and fitting shops are numerous boring, turning and planing tools, forming the usual equipment of an engineering works; the more interesting features are the turbines and dynamos in course of construction, with which the shops are crowded. The whole of the parts of the turbines are made in these shops; we noticed large pump pistons and valves, gun-metal worm wheels, cylinders and spindles being fitted with blades, of various sizes up to 1,000 KW. A three-phase plant of 150 KW. was being built for a power transmission plant at a large Yorkshire colliery; this may be looked upon as a sign of the times. One of our photographs shows three sets for the Morgan Crucible Company, for power transmission; two of these are of 150 KW. each, the dynamos being coupled tandem, and one of 60 KW. Here, again, the condenser and pumps form part of the machine. No provision whatever is made for holding-down bolts. The brush gear, which is very massive, is so arranged that it can be lifted bodily away without disturbing any other part of the machine.

The bedplate of the 500-KW. set, of which several examples are in hand, is cast in one piece, weighing 5 tons; this is the heaviest part. The total weight of a 500-KW. turbo-alternator, without condenser, amounts to 18 tons; this works out to about 80 lbs. per KW.

In the armature winding shop armatures for 500 and 1,000 KW. alternating were in hand, as well as various direct current armatures from 400 KW. downwards, the latter being of the smooth core type. On account of the high speed and small surface, the question of temperature rise is in these armatures of great moment; hysteresis and eddy losses in particular have to be carefully provided for by means of ample core ventilation. In our view of this shop, a 500-KW. armature may be seen suspended in the sling. The two small armatures in the foreground are of special interest; one of these is a 12-KW. armature, built in 1887, and running at 10,000 revolutions per minute, while the other is for 16 KW, built in 1889, and running at 8,000 revolutions per minute. They appear to be as good as new, in spite of the enormous number of revolutions that they have made at these high speeds! The speeds in use at present are far lower; but this, we were informed, is merely on account of the noise inseparable from the extra-high speeds.

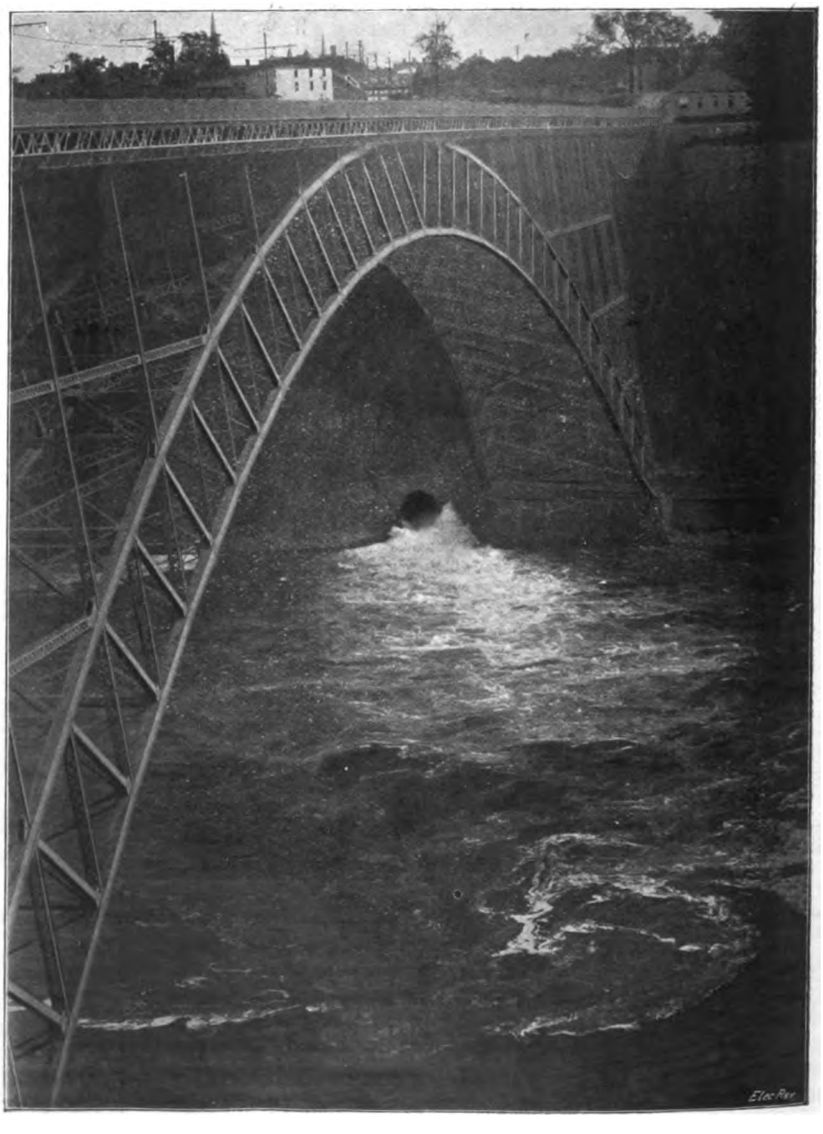
Transformers are also built in these shops, up to an output of 50 KW.

The machinery is driven in part by a gas engine, but the power required has outgrown the capabilities of this machine, and several electromotors have been put down, of 4, 12, and 18 HP, to assist in driving the shafting. The pattern shop is also electrically driven.

The tools are served by three 5-ton cranes, which traverse the whole length of the shops.

A siding from the main line of the North-Eastern Railway runs right into the works alongside the machine shops, and provides a ready means of despatching the finished products to their destination.

So great is the pressure upon the shops, that the works are about to be quadrupled in size, and will ultimately be increased to six times their present extent. A space of 11 acres is available for extensions; the building now in progress consists of two bays, and measures 388 feet × 80 feet, while new offices have already been erected, and will shortly be occupied; electrical driving will be adopted throughout the new workshops. The rapid advance, of which these large extensions give evidence, is full of significance, indicating the extreme prosperity of the electrical



Niagara Power Works (see page 765).

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engineering profession, and the fact that our manufacturing firms are determined to take steps to cope with the press of work resulting therefrom. We hope that the new shops will soon become as full as the present ones, and that the flowing tide may never turn!

NIAGARA POWER WORKS.

THE announcement that the Niagara Falls Power Company is to build a new wheel-pit and power house naturally directs attention to the things this company has accomplished since it broke ground for its tunnel on October 4th, 1890. The first section of the wheel-pit and power station were hardly completed before the contracts were let for an extension, and only this summer the company has added a new section to its transformer station.

One of the illustrations on the opposite page shows a view down into the wheel-pit. This view is one taken beneath the stone-arched floor of the dynamo room, and through the gloom of the pit may be seen the turbine shafts and the huge penstocks that supply the turbines with water.

The new wheel-pit is to be connected to the main tunnel by lateral tunnels. There is no more interesting view at Niagara than that in the gorge illustrated in our other photograph. Here is to be seen the portal of the tunnel of the Niagara Falls Power Company. It will be observed that it sends a terrific force of water out into the lower Niagara river, and the stream from the tunnel shoots right across until it almost washes the Canadian shore. The view is one looking right into the tunnel from the Canadian bank.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page* 760.)

Preston and Blackburn.—For the tramways in Preston it is understood that the Corporation favour a 4-foot gauge and the overhead trolley system of electric traction. No absolute decision as to the working of the lines by the Corporation, or leaving them to a company, has yet been arrived at, but the feeling in the town is distinctly favourable to municipalisation. In Blackburn a feeling exists that the two towns should be brought into connection. This would, undoubtedly, be a great public convenience, and it has the merit of being perfectly practicable. The 4-foot gauge, which Messrs. Lacey, Clirehugh & Sillar recommend for Preston, is the same as now exists at Blackburn, and a length of six miles only will separate the terminus of Blackburn's system from that of Preston.

Putney.—The Light Railways Commissioners have been memorialised by the Conservators against the County Council's scheme for a trolley line across Putney Heath towards Kingston.

Radcliffe.—On Monday the District Council held a special meeting to consider a recommendation of the Electric Lighting Committee, that a provisional order should be obtained for electric traction. The Committee had been in communication with the Manchester Corporation on the matter. The latter were not allowed to lay lines in Radcliffe, but if Radcliffe laid the lines Manchester could work them for a period of 21 years, and would pay the entire cost of the line with interest on the money borrowed, in addition to paying the cost of obtaining a provisional order. As a matter of fact, Radcliffe was applying for a considerably greater length of line than could be leased to Manchester. No arrangements have as yet been made with Manchester. The minutes of the Committee were eventually adopted without opposition.

Reyton.—The District Council on Monday last resolved to take steps for establishing electricity works in the district in connection with the tramway scheme, and for other purposes.

South Lancashire.—Notices were published on Monday last of the South Lancashire Tramways Company's intention to promote a Bill in the next session of Parliament to acquire powers for the construction of an important network of new tramways, tapping a large industrial district, and affecting 18 different local authorities. One main line will run from St. Helens through Newton and Leigh to Bolton; another through Tyldesley to Swinton, there to connect with the Manchester tramways; and a third through Atherton and Hindley to Wigan. The scheme is enlarged from the company's original light railways proposal.

Switzerland.—The *Times* says that the completion has just been celebrated of a funicular railway up to the Schatzalp at Davos-Platz. It commences at the rear of the Kurhaus, and is about 2,200 feet long. The force used to propel the cars is electricity, which is generated in the valley near the ice rink by dynamos driven by gas engines (an English patent), the mixture of air and gas being exploded, not, as is usual, by a jet of gas, but by an electric spark. This is one of the first funiculars in Switzerland to use electricity as a motive power. The line is an excellent piece of engineering, and many ingenious devices are adopted to ensure safety and promote easy and smooth working. The line cost more than double the price estimated—the amount expended being about 500,000 francs—and, as the sanction of the Federal Government has been sought to increase the fares fixed in the original concession, the railway will not be fully opened until perhaps December. The line can be used, however, by parties sufficient to fill a car—32 persons—and the cars are now running daily. An electric tramway is shortly to be inaugurated between Platz and Dorf.

Tipton.—A meeting of the Urban District Council was held last week, when a report was submitted by the Tramways Committee, which dealt with the proposals of the British Electric Traction Company in their efforts to provide electric tramways for the district. Mr. J. A. Lycett had attended the Committee meeting on behalf of the company, and had stated that it would not be worth the company's while to pay a wayleave. In reply to questions, Mr. Lycett stated that the company had not agreed to pay wayleaves in connection with the South Staffordshire undertaking. If the Council, however, would forego the concession he had previously offered, he would recommend the company to pay a wayleave. The Committee ultimately adopted a resolution recommending that the Council defer concluding arrangements with the South Staffordshire Tramway (Lessee) Company, so as to give them an opportunity of offering terms in the form of a wayleave, or annual payment, towards the cost of repairing the highways over and along which the tramways were laid.—The report was adopted.

Wakefield.—The Council on 6th inst. considered the proposals to promote a Bill for the construction of a tramway system for the city and district. The scheme was shelved.

Wolverhampton.—The Tramways Committee of the Town Council have prepared a report dealing with the question of constructing a tramway track to Heath Town on a surface contact system. The method is the invention of Mr. Thomas H. Parker (son of Mr. Thomas Parker), who thus describes it:—

The system consists essentially in a number of metal studs placed on the track between the two tramlines, these studs being approximately somewhat less than the length of a car apart. The studs project slightly above the normal level of the road setts, but not sufficiently to form an obstruction. Underneath the car is a bar runner, or "skate," slightly longer than the distance between the two studs. This runner slides on the surface of the studs, making contact with one before it leaves the other, and if the studs are connected with the main cable conveying the current of electricity from the generating station, the car can collect the current continuously as it moves along the line. So far, this is simple enough, but the difficulty lies in the fact that studs cannot be left permanently connected with the main conductor, otherwise the leakage in wet weather would be very great, and if anything like a practical voltage were used, horses would be subject to dangerous shocks, hence the necessity that all studs should be dead, with the exception of the one from which the car is collecting the current. When a car reaches a stud, it must be put into circuit, or made alive, and cut off when it leaves it. This involves the use of a switch at each stud, to be operated by the car. The means employed to operate these switches mechanically, and with certainty, necessitates a small slot in the road. This is formed by placing an extra rail alongside the ordinary tram rail in such a manner as to leave a slot of, say, ½ inch, and provides a small conduit, which, being only the depth of the rail, does not interfere with the laying of pipes, or those already laid. The switch is placed in an iron box below the ground close to the slot, on either side of the rails, and carries on its spindle a star wheel, with four arms which project up into the conduit. At each end of the car is a tongue, or wiper, which projects down into the slot. As each wiper passes a switch it moves the star wheel a quarter of a revolution. The first quarter of a turn switches the current on, and the second switches it off again in whichever direction the car is moving. The star wheel and wiper are of such a form as to make the movement certain and practical. The current required from each switch is only sufficient to supply one car at a time, hence it need only be small, and both that and the star wheel, which are connected together, can be removed, examined, or replaced in a short time without interference with the traffic. Every part necessary can be made watertight and danger proof.

The system has been exhibited to the Tramways Committee by means of a working model, but they delayed issuing specifications for the construction of the proposed new tramway pending the construction of an experimental tramway on the land adjoining the works of the syndicate in Wednesfield Road, Wolverhampton, with which the invention is connected. The syndicate propose that three-quarters of a mile of track shall be laid on the Wednesfield Road to test the system. The Corporation will have, in any case, to construct an ordinary tramway there, and the syndicate propose to put in the extra line and the electrical work necessary at their own expense, and if the system is not adopted, to remove it and restore the track to its normal condition. The borough surveyor estimates that the cost to be borne by the Corporation for the construction of this portion of the track, will be £3,800. The committee strongly support the experiment, being of opinion that it will enable them to determine whether a surface contact system has been invented, which will prove both practical, thoroughly efficient, and inexpensive, points which have handicapped all previous forms of this system. Should it prove effectual, the committee will, no doubt, adopt it throughout their various extensions, as their desire is to obtain, if possible, an underground system, which has the merits of the overhead system, without the objections offered by overhead wires and poles.

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TELEGRAPH AND TELEPHONE NOTES.

Cables in War.—The *Standard's* New York correspondent telegraphs that the annual report of Mr. Greely, the chief signal officer, which has just been published, contains passages of interest to several English cable companies, and also touches upon telegraphy during the war with Spain. Mr. Greely recommends the laying of a cable immediately between Cuba or Porto Rico and the United States, in order to avoid the passing of messages over lines belonging to English corporations. Mr. Greely estimates that the cost of such a cable would be $600,000. He foreshadows the laying of a cable shortly between Formosa and Luzon, thus giving an alternative route to that afforded by the Eastern Company. A Pacific cable scheme is supported as being necessary, equally for military as for commercial purposes. Mr. Greely supplies a fresh reason for Admiral Dewey's failure to use the cable to Hong Kong after cutting it at Manila. The Hong Kong end was sealed by the Eastern Extension Company upon the demand of Spain, whose subsidy made compliance prudent, but when the company protested against the United States constructing cables in the Philippines, an adverse report by Mr. Greely was followed by a denial of the rights it claimed in the Archipelago. Mr. Greely proposes that an international cable conference should be called in order to consider the questions of rights, privileges, and immunities during war, and to formulate a universal code. He approves of the suggestion that wireless telegraphy should be employed in the United States possessions in the West Indies.

Duplicate Cables.—The Eastern group of companies who so warmly advocate duplication of all cables would do well if they employed the cable now at the Cape on board the ss. *Anglia* to duplicate the broken-down Mozambique-Delagoa Bay cable. Should they have already started to lay this cable from Cape Town towards St. Helena, it may not be too late to telegraph to the ship to cut and buoy. This may yet be done, as the cable from the Cape to St. Helena is about 1,000 miles longer than that required to duplicate the Mozambique-Delagoa Bay cable, originally laid 20 years ago.

Edinburgh Telephones.—The Lord Provost's Committee of the Town Council has considered the expediency of making an arrangement with the National Telephone Company in connection with the telephone service within the city. After hearing explanations by the town clerk, the Committee considered it would be expedient in the public interest to enter into a provisional agreement with the company, which would safeguard the rights of the Corporation in their streets, give a more efficient telephone service, and an alteration in rates which would benefit subscribers and lead to an extension of the benefits of the service. There would also be a substantial rent paid to the Corporation by the company. The agreement would expire with the company's license in 1911. A clause would be inserted in the agreement protecting the rights and position of the Corporation at that date.

Indian Telegraphs.—*Indian Engineering* says that the Government of India's review of the operations of the Telegraph Department last year is a record of sustained advance and successful administration. The traffic was somewhat lighter than in the previous year, which was an altogether abnormal one, but was larger than any year preceding that, the total number of messages transmitted being over 4½ millions, while the average speed of transmission on the principal lines was 23 minutes, against 26 minutes in the previous year. One of the features of the year was a considerable extension of telegraph facilities to outlying districts, where 94 new offices were opened in co-operation with the postal authorities. The report ends with an appreciative reference to the valuable services rendered by Mr. Reynolds and to the success with which the Department has since been working under Mr. Pitman.

Reasonable Rates v. Monopoly.—On Tuesday Sir Edward Sassoon, M.P., delivered his inaugural address as president of the Folkestone Chamber of Commerce, and as chairman of the Imperial Telegraph Committee of the House of Commons, he made some interesting remarks on the subject of Imperial telegraph communication, to the *Times* report of which we are indebted for the following somewhat full extract:—The question of revision of high telegraphic rates to our colonies and dependencies abroad has very seriously engaged my attention. The Chancellor of the Exchequer, to whom I introduced a House of Commons deputation, promised to lay before the Cabinet the prayer of the deputation for a thorough and searching inquiry. The recess and the present anxious time had adjourned the matter, but it was not shelved. The telegraph companies must not put off the commercial and social bodies of the community with indefinite promises and still more meagre and indefinite performances. We say they have a virtual monopoly; they hold up their hands with horror. Let me give you one instance. The companies pay annually a sum of £7,000 to the Turkish and Egyptian Governments for the so-called use of a telegraph line between Constantinople and Cairo. Now, what use do they make of that line? Practically none, that is, because they desire to prevent others from profiting by the existence of that line by the despatch of messages at a tariff far cheaper than theirs. Does not this artificial and arbitrary method prevent competition, and, if competition is hindered, is not a monopoly created thereby? Another point. A telegram can be sent from London to Fao, at the head of the Persian Gulf, at a cost of 6½d. per word, but thence by cable to India, not much more than a third of the total distance, the charge leaps up to 4s. Does that not savour of monopoly? It would certainly seem so, when we find that the charge per word from England to Gibraltar over a cable the same length as that from Fao to Karachi is only 3½d. or 12 times cheaper. The curious thing is that the line from Fao to the Indian frontier is the property of the Indian Government; so that, when that Government is working in the direction of revision, we are not justified in asking why this unholy collusion has been, and is at the present moment, allowed to exist to the great detriment of our commerce. When the inquiry is instituted light will be thrown upon the reasons why the Turkish land lines along the Euphrates Valley are so useless to Indian traffic. I asked the Foreign Office for a copy of the agreements entered into between the Turkish Government and the cable companies, which was refused, and yet when recently the German bankers connected with the Anatolian Railway desired to lay a cable in the Black Sea between Kustendji (in Roumania) and the Bosphorus, the Eastern Telegraph Company objected, and our Ambassador at Constantinople supported this protest, and demanded from the Porte a copy of the agreement under which this cable was to be laid. What is the result of such action? Simply the squeezing out of competition and the loss of a prospect of lower rates to India. Then it has been bruited about that the Indian Government, through their representatives here, are carrying on negotiations with the telegraph companies for a reduction of rates on the basis of the grant of a subsidy to them, the companies. Are we to understand that no abatement of rates can be obtained without the imposition of fresh burdens on the community, and, what is still more obnoxious, the conclusion of an agreement for a prolonged period which may confirm the monopoly against which we now protest? Some people make a great point of the utility, strategically speaking, of an all-cable line in time of war. We join issue on that subject. Sir Charles Dilke showed that the all-British cable was a myth, because the bulk of the wires are switched on in Lisbon and other places which form no part of our Empire, and I alluded to the undoubted vulnerability of cables and the ease with which they can be cut, instancing the severing of the cables within the immediate sphere of hostilities that prevailed during the Spanish-American war. This statement Lord Tweeddale thought right to traverse, and I thereupon took steps to get a corroboration of my facts, and I hold in my hand an account written by Lieutenant Cameron McR. Winslow, the American naval officer who, while under fire, actually did during May of last year sever two of the Cuban cables. I will not further emphasise this point, but as chairman of the company to which the cable from Hong Kong to Manila belongs, Lord Tweeddale hardly needs to be reminded that this cable was cut by Admiral Dewey. This strange and inexplicable contradiction throws a lurid light upon the straits to which these companies appear to be reduced in buttressing their unjustifiable tariffs. It is noticeable that, while using every influence which they command, and while appealing to our own Government for support at ever turn, on the general grounds that their lines are British, that the Government should protect them abroad, and assist them in obtaining and rendering more secure their foreign concessions, the Eastern group of telegraph companies and their associates use the position so secured to bleed their supporters to the uttermost. The Government and the British public may plead in vain for a decrease in the established tariff to the East, and I am afraid that the many occupations of our Government departments have made these departments blind to the fact that, in assisting the pseudo-patriotic aims of the Eastern Telegraph group, they have been weaving for themselves a web that tightly enmeshes the best interests of that public whom they doubtless desire to serve. I am determined that, so far as lies in my power, this scheming shall at least be carried on in the full sunlight, and subjected to such criticism as may prevent us from falling deeper into the quagmire of monopoly. I am not without hope that, when thoroughly alive to the circumstances, Her Majesty's Government will take up a strong position and insist that past and present favours granted to these companies shall be paid for by the establishment of reasonable telegraph rates between Great Britain and our Eastern Empire, and that failing such treatment all Government assistance to the existing companies shall cease, and that competition shall be encouraged, instead of being discountenanced, as has been the case up till the present hour. When receiving a deputation from the Eastern Telegraph group recently, Mr. Chamberlain pointed out to the deputation that, given any crisis in South Africa, he had noticed that their cables broke down. On the same occasion Sir Michael Hicks Beach made pointed reference to the claims made on the Treasury by the companies in question. How correct both of these statements were is shown by the position at this moment. How critical the state of affairs is in South Africa at present it is needless to say; and yet, just when most required, the cable from Delagoa Bay to Mozambique—the solitary cable—breaks down, and we must now rely for news of the most vital importance upon the long land line which runs through Natal to Cape Town. The broken cable was laid some 20 years ago, at the time of the Zulu war, in consideration of substantial aid given by the Government to the Eastern group, and, although the proprietary company has received since then State assistance amounting to considerably over £1,300,000, it appears that the clear duty of at least duplicating this cable has not been attended to, although this is the second occasion within the last six months on which this cable has broken. This case is an instance of one of the results arising from the State-aided monopoly. Sir Edward concluded by expressing the hope that all chambers in the Empire interested in the cheapening of rates would forward resolutions to Her Majesty's Government, so as to strengthen the hands of the House of Commons' Telegraph Tariff Reduction Committee.

Telegraphs in China.—The *Times* refers to an article in the St. Petersburg *Novosti* on the Russian posts and telegraphs in China. With regard to the telegraph, it is stated that that remains exclusively in the hands of the Chinese, save at Chuguchak and Kuldja. The Chinese system is connected with the submarine cable of the Great Northern Telegraph Company, which runs to Vladivostok and beyond, and also with the Russian land system at Blagovieshtchensk, Novokievsk, Sartakh, and Kiakhta. From the last-named

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place the Chinese line runs at present only as far as Urga, the line from Urga to Kalgan, which is required to connect Kiakhta with Peking, not yet being completed. It is expected to be finished, however, in the course of the next few months, and then St. Petersburg will be in direct communication with Peking *viâ* Kiakhta. At present Russian telegraphic communication with Port Arthur has to pass over Chinese lines, but the Russian Post and Telegraph Department will shortly be able to use a wire placed on the telegraph posts of the Russian Eastern Chinese Railway, and then the all-Russia tariff will be charged for messages to Port Arthur and Dalny.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Corea-Japan	Aug. 7, 1899 ...	Aug. 19, 1899
Gibraltar-Tangier	Oct. 19, 1899 ...	Nov. 2, 1899
Havre-Waterville	Oct. 25, 1899 ...	...
Jamaica-Colon	June 30, 1899 ...	...
Latakia-Cyprus	June 20, 1899 ...	...
Tamui-Sharppeak	... ...	Nov. 7, 1899
Trinidad-Demerara (1871 original)	Oct. 20, 1899 ...	...
Do. do. (1891 duplicate)	Oct. 6, 1899 ...	...
Zanzibar-Mombasa	Oct. 27, 1899 ...	...
Lourenco Marques-Mozambique ...	Oct. 31, 1899 ...	...
Landlines.		
Colombian Government lines to Bogota	Oct. 31, 1899 ...	...
Communication with Mafeking ...	Oct. 13, 1899 ...	...
Communication with all offices beyond the Orange River ...	Oct. 18, 1899 ...	...
Communication beyond Burghersdorp, Cape of Good Hope, and Estcourt, Natal	Nov. 6, 1899 ...	
Communication with interior of Colombia, excepting Amalfi, Ambalema, Buga, Cartago, Ibague, Manizales, Medellin, Palmire, Pasto, Popoyans, Reinedos, Sonson, and Santo Domingo... ...	Nov. 6, 1899 ...	
Cuban Government lines	Oct. 30, 1899 ...	...
Lines from Haiti to Gros Morne and Port de Paix...	Aug. 18, 1899 ...	Nov, 7, 1899

Underground Telegraph Wires at Edinburgh.—At a sitting of the Railway and Canal Commissioners, held in Edinburgh on 31st ult., the Commissioners further considered the application on behalf of the Postmaster-General for the settlement of differences between the Postmaster-General and the Corporation of Edinburgh in connection with the laying of telegraph wires under the streets of the city. The Corporation, in their answers submitted, subject to their objection to any consent being given, that if consent were given it should only be under condition that the Postmaster-General should be bound in the option of the Corporation—

(1) To lay the wires under the directions and to the satisfaction of the defendants, and to pay defendants annually one-half of the sum received for use of the wires; or (2) to allow defendants within six months to lay the said wires at their own expense and as their own property, the Postmaster-General to pay an annual rent at the rate of 7 per cent. upon the cost of laying and renewal.

Mr. Colam, tramway engineer for the city of Edinburgh, said it was exceedingly impracticable to lay underground wires on the lines shown in the plan. Judging by their experience of the underground portions of South Bridge, he thought it would be a great pity if the Corporation allowed any more interference with that street. Mr. Gibson, the superintending engineer of the Post Office district in which Edinburgh is situated, was then called, and said he did not anticipate any particular difficulty in putting a pipe in South Bridge or any harm to the street. It was absolutely certain that from time to time the street would have to be cut because of the existing pipes. They selected the South Bridge because it was the most direct route, and one in which they had a pipe already. They did not consider the interests of the Corporation at all. At the close of the evidence the Dean of Faculty for the Corporation said the application was a round about one, as the service was to be obtained for the National Telephone Company for the Post Office to enable the Telephone Company to get into the streets without the consent of the Corporation. The Telephone Company were unable to get this application directly, and it was thus sought to obtain it indirectly. It would be a serious matter were the traffic of the streets disturbed, which the Corporation was bound to protect. The Corporation was the owner and was bound to repair, and therefore nothing could be laid on the bridges except with the consent of the Corporation. Lord Stormonth Darling here observed that in regard to narrow or crowded thoroughfares parties might have conferred in regard to deviation of route. The Lord Advocate, for the Postmaster-General, said he confessed the position he must assume must necessarily be to take up his lordship's decision in the Glasgow case. It seemed to him that what might be called the question of using the wire—not for proper Post Office service in the restricted sense, but for the purpose of the National Telephone Company—was absolutely settled by this Glasgow case. The question of physical impossibility in South Bridge might, he thought, be dismissed at once. There would be no great engineering difficulty. Judgment was reserved, Lord Stormonth Darling stating that if there were no alternative proposal laid before them of the South Bridge route within three weeks, they would take the case as it at present stood.

CONTRACTS OPEN AND CLOSED.

OPEN.

Accrington.—November 18th. The Corporation wants tenders for cables, wires, street boxes, and connections for electric lighting. See "Official Notices" November 3rd.

Battersea.—December 4th. The Vestry wants tenders for arc lamps and posts. See "Official Notices" this week.

Birkenhead.—November 14th. The Corporation wants tenders for 13 single-deck and 31 double-deck electric motor cars, also for boilers, economisers, mechanical stokers, steam dynamos, booster and battery. See "Official Notices" October 20th.

Birkenhead.—November 14th. The Corporation wants tenders for switchboard and instruments for the South End tramway generating station. See "Official Notices" October 27th.

Bray.—November 20th. The Council wants tenders for jet condensing plant for electricity works. See "Official Notices" November 3rd.

Bury-St.-Edmunds.—November 22nd. The Town Council invites tenders for electric light fittings for certain public buildings. Specifications, &c., at the Borough Surveyor's office, Town Hall.

Croydon.—November 13th. The Guardians want tenders for electric wiring and fitting at the workhouse, infirmary, and union offices. See "Official Notices" October 27th.

Darwen.—November 27th. The Corporation wants tenders for one Lancashire boiler and accessories, one tramway switchboard. See "Official Notices" this week.

Denmark.—December 28th. The Corporation of Aarhus is inviting tenders for the water-tube boiler plant, steam dynamos and switchboard, accumulators for electricity works. From our "Official Notices," November 3rd, further particulars may be obtained.

Essex.—November 27th. The Governors of Felsted School, Essex, are inviting tenders for boiler, two 27-KW. steam dynamos, condenser, pipework, accumulators, cables, and switchboard for electric lighting. See "Official Notices" October 27th.

France.—November 14th. Tenders are being invited by the French Post and Telegraph authorities in Paris for the supply of 10,000 metres of pipes 80 mm. diameter for pneumatic despatch tubes. Tenders to be sent to Le Sous-Secretariat d'Etat des Postes et des Telegraphes, Rue de Grenelle, 103, Paris.

Glasgow.—November 14th. The Corporation wants tenders for two 800-H.P. compound vertical auxiliary engines for the new tramway power station at Port Dundas. See "Official Notices" October 13th.

Glasgow.—November 20th. The Electricity Department wants offers for 10 miles of 2-inch cast-iron pipes. See "Official Notices" October 13th.

Greenock.—November 23rd. The Police Board is inviting offers for leasing the tramways within the burgh, and converting them into electric trolley lines. See "Official Notices" this week.

Hoylake and West Kirby.—November 15th. The Council is wanting tenders for Lancashire boilers, superheaters, economiser, steam engines, alternators, motor alternator, crane, wiring, steam, &c., piping, switchboards (high and low tension), batteries, transformers, concentric mains, &c., &c. See "Official Notices" October 13th.

Islington.—November 22nd. The Vestry wants tenders for condensing plant for the electricity works. See "Official Notices" November 3rd.

Lambeth.—December 6th. The Vestry is prepared to receive tenders for 25 arc lamps and posts. For particulars, see "Official Notices."

Leeds.—November 13th. The Corporation wants tenders for wiring, electric lamps, switches and fittings, for the Union Street Baths. See "Official Notices" November 3rd.

Middlesbrough.—November 22nd. The Electric Lighting Committee wants tenders for condensing plant and pipe-work for the electricity works. See "Official Notices" October 20th.

Mistretta (Sicily).—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Palermo, stating that tenders are invited by the Municipality of Mistretta, not later than December 31st next, for the establishment of a service of electric lighting in that town. Such particulars as have been received may be examined on personal application at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 5 p.m.

Newcastle-on-Tyne.—November 30th. The Tramways Committee wants tenders for two 1,000-H.P. steam dynamos for electric tramway works. See "Official Notices" October 27th.

Newington.—November 13th. The Vestry wants tenders for a 400-KW. steam dynamo and continuous current transformer for the electricity works. See "Official Notices" November 3rd.

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North-Eastern Railway.—November 15th. The directors are prepared to receive tenders for the erection of a combined electric lighting and hydraulic pumping station, including chimney 120 feet high, at York. Plans and specifications on application to Mr. William Bell, the company's architect, at York.

Poplar.—November 16th. The Board of Works wants tenders for laying mains upon the solid system for three-wire continous current, viz., about 17 miles of five-core network, six miles of six-core feeders, also service cables and accessories. See "Official Notices" November 3rd.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

Portsmouth.—November 17th. The Council invites tenders for the supply of 40, 60, or 80 electric tramcars. See our "Official Notices" November 3rd.

Portugal.—November 22nd. Tenders are being invited, until 22nd inst., by the Royal Company of Portuguese Railways, for the supply of 8 tons of galvanised iron telegraph wire. Tenders to be sent to La Compagnie Royale des Chemins de Fer Portugais, Santa Apolonia. Particulars may be obtained from the offices of the company, 28, Rue de Chateaudun, Paris.

Spain.—November 23rd. Tenders are being invited until November 23rd by the municipal authorities of Chiclana de la Frontera (Cadiz province) for the concession for the electric lighting of the town during a period of five years. Tenders are to be sent to Le Secretariat del Ayuntamienti de Chiclana de la Frontera (Cadiz), whence particulars may be obtained.

Swansea.—November 20th. The Corporation wants tenders for five Lancashire boilers with jet condensing plant, feed pumps, economiser, piping, &c., for electricity works. See "Official Notices" November 3rd.

Wolverhampton.—November 13th. The Lighting Committee wants tenders for two 500-kw. direct coupled generating sets for the electricity works. See "Official Notices" November 3rd.

Wimbledon.—November 22nd. The District Council wants tenders for two 350-kw. steam alternators. See "Official Notices" this week.

Wrexham.—November 8th. The Council wants tenders for boiler house plant, engine house plant, dynamos, switchboard, mains, posts, battery, meters, crane, and buildings for electricity works. See "Official Notices" October 13th.

CLOSED.

Asylum Lighting.—The contract for the electric lighting of the North Riding of Yorkshire Lunatic Asylum at Clifton, York, has been given to Messrs. Crompton. Mr. A. A. Campbell Swinton is the consulting engineer, and the work will be carried out to his specification.

Blackburn.—The Corporation has placed orders with Messrs. Mavor & Coulson for two 260-kw. traction steam dynamos to the specification of Messrs. Lacey, Clirehugh & Sillar.

FORTHCOMING EVENTS.

Friday, November 10th.—At 5 p.m. Physical Society meeting in the Physical Laboratory of the Central Technical College, Exhibition Road, South Kensington (by kind invitation of Prof. Ayrton, F.R.S.) Agenda.—1. "Contact Electricity." By Mr. F. S. Spiers. 2. "On the Heat of Formation of Alloys." By Mr. J. B. Tayler.

Tuesday, November 14th.—Institution of Civil Engineers. "The Waterloo and City Railway," by H. H. Dalrymple-Hay, M.Inst.C.E.; "The Electrical Equipment of the Waterloo and City Railway," by B. M. Jenkin, Assoc.M.Inst.C.E.

Wednesday, November 15th.—Society of Arts opening meeting. Address by Sir J. Wolfe Barry.

Thursday, November 16th.—At 8 p.m. Institution of Electrical Engineers' opening meeting. Presentation of premiums and inaugural address, by President S. P. Thompson, F.R.S.

Newcastle-on-Tyne Association of Students (Institution of Civil Engineers), Durham College of Science, address by President J. H. Holmes, M.I.C.E., on "The Rise and Progress of Electrical Engineering."

Saturday, November 18th.—At 3.30 p.m. The Institution of Junior Engineers. Visit to the City and South London Railway Works, Stockwell.

Friday, November 24th.—Institution of Mechanical Engineers. Lord Chas. Beresford, C.B., M.P., on "Openings for Mechanical Engineers in China." President, Sir W. H. White.

Tuesday, November 28th.—Manchester Society of Junior Electrical Engineers. Meeting at Deansgate Hotel, Manchester. Paper by Mr. J. H. Henderson on "Aluminium, Its Treatment and Use, as Applied to Electrical Engineering."

Wednesday, December 6th.—Institution of Electrical Engineers' annual dinner, Grand Hall, Hotel Cecil.

NOTES.

Consulting Engineer or Tradesman?—Editors find it necessary to rule that anonymous letters shall not be published, but sometimes it becomes desirable to make an exception to prove its existence. A correspondent who dubs himself "Consulting Engineer," but fails to disclose his name and address, sends us the following communication, which we publish, because it is upon a question of general interest at the moment:—

"I am much interested in the correspondence which appears in this week's issue between a 'Consulting Engineer' and a firm of contractors.

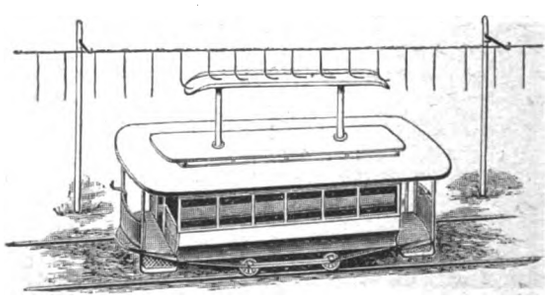
"Provided that these descriptions are accurate, I quite agree with the position taken up by the contractor, but, at the same time, it is quite possible that the 'Consulting Engineer' was one of these numerous tradesmen who also act in dual capacity of 'Consulting Engineer' and Contractor, and openly advertise themselves as such.

"Whether it be the case of the 'Consulting Engineer' acting as the contractor, or of the contractor acting as the 'Consulting Engineer,' both positions are equally illogical and indefensible, and I am inclined to think, judging from the headings of letters that I receive, that the latter class is a very numerous one, and I do not think it would be unreasonable to ask our Institution to take steps to define the respective spheres.

"They alone can do it, and until this is done clearly, the gentleman who acts in the dual capacity, derives considerable benefit from the pecuniary point of view, whatever the moral aspect of the case may be. It appears to us the first essential of a 'Consulting Engineer' is that he should have no trade interest.

"At the same time, I should like to remind your correspondent that while no consulting engineer is entitled to trade prices except for his own personal use, he is, nevertheless, entitled to know what the trade discounts are, for I confess that I personally could never draw my estimates without this information, so long as manufacturers adhere to the practice of giving different trade discounts, varying from 5 per cent. to 75 per cent., according to the class of article required.—A CONSULTING ENGINEER."

An Insulated Trolley Line.—The *Street Railway Review* says: "Among the startling inventions which appear from time in the electric railway field comes one from Ft. Myers, Fla., in the shape of an insulated trolley wire, which, according to its inventor, Capt. W. O. Rew, possesses manifold merits of the highest order, and which has elicited



the most flattering comment on the part of electrical engineers and street railway men wherever the model illustrated herewith has been submitted to expert criticism. On the top of the car is a metal trough making contact with pendant wires from the overhead line. The pendant wires are to be insulated to within a few inches of the lower end."

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The Ashton Dynamos.—We reprint from the *Ashton-under-Lyne Reporter* the following letter from Messrs. Lacey, Clirehugh & Sillar, consulting engineers to the Ashton Corporation :—

ASHTON ELECTRICAL WORKS.—THE DYNAMOS.

SIR,—We understand that an impression exists in the minds of some that the dynamos which have been installed by the Ashton Corporation for generating electricity for the purpose of supplying light and power both to the town and the Oldham, Ashton, and Hyde Electric Tramways are not satisfactory. In justice, therefore, to the manufacturers, Messrs. P. R. Jackson & Co., we think it only fair, as consulting engineers to the Corporation, to make the actual facts public. Three dynamos are at work, each of which should be capable of giving 500 B.H.P., and it is a condition in the specification that each machine, before being finally accepted, should be tested at full load for six hours, and that at the end of that period no accessible part of the dynamo should have a temperature higher than 70° F. above that of the surrounding atmosphere. The first dynamo tested complied with the specification in every way, but the armatures of the remaining two heated above the specified limit. Messrs. Jackson, on being notified of this, at once admitted the error and offered to rectify it, and this is at present being done. The fault has in no way militated against their use, as they have been in daily service on the tramways and lighting ever since. There are several features in the dynamos which are quite new, and have enabled results to be obtained which, as far as we are aware, have never been approached before. When it is remembered that the Ashton Corporation are the first who ever supplied power for tramway and lighting purposes simultaneously from the same machine, and that there has never been any intermission in supply since the opening of the works, we think you will understand how unfair it is to attach blame to the manufacturers, whom we consider worthy of a considerable amount of credit. We would also point out that the total capital expenditure on the works is the lowest per horse-power installed that has ever been known in this country, and in addition, the whole of the material employed is of the highest quality, also that the Ashton Corporation are the first municipality to undertake the supply of power to a tramway company, from which source a large revenue is already coming in.

From the above, you will see that there are so many novel features in the works, that it could hardly be expected that everything would immediately work perfectly; but there is no doubt that if properly managed, the works will be a source of very great profit to the town.

We are, yours faithfully,
LACEY, CLIREHUGH & SILLAR.

78, King Street, Manchester,
November 2nd, 1899.

Appointments Vacant.—The District Council wants an assistant engineer for the electricity works. See "Official Notices."

The Corporation of Aberdeen wants a mains engineer at a salary of £117 per annum. See "Official Notices."

The Huddersfield Corporation wants an electrician-in-charge, at a salary of £2 per week. See "Official Notices" this week.

The City and South London Railway Company wants two assistants to take charge of an accumulator sub-station. See "Official Notices."

Cable Interruptions.—Mr. F. C. C. Neilsen, the representative in England of the Great Northern Telegraph Company, Limited, writes as follows :—"I observe that in the table of interruptions in the last number of the ELECTRICAL REVIEW, the Corea-Japan cable appears as having been interrupted since August 7th last. Permit we to point out that this cable was repaired on August 19th, and that the restoration was duly notified by Berne, telegraphically on August 20th, and in Notification No. 501 on September 1st."

Re Thawing Pipes by Electricity.—As we go to press Messrs. Drake & Gorham write as follows :—"We notice your extract from the *Canadian Engineer*, and can bear out your statement that it would be too much to expect the London water companies to bring out such a modern method. We have what we believe to be the patent for this application of electricity, No. 1,315, January 21st, 1893, and although our experiments show that mains laid too near the surface could, when frozen, be put into working order without the necessity for breaking the roads, we were unable to get the water companies to take an interest in the invention. It should be pointed out that it is not necessary to thaw all the ice in the pipe, but merely that immediately in contact with the wire, so as to make a small passage through which the water under pressure can flow. It will then be found that the water itself soon does the rest."

Personal.—We understand that Mr. W. J. Milne Menzies is about to sever his connection with the Consolidated Telephone Construction and Manufacturing Company. Mr. Menzies' long term of service with this company—15 years—is a guarantee of a wide knowledge of the telephone manufacturing business, and it goes without saying that in the course of his experience he has been brought into touch with some of the best buyers (railway companies and Government departments), which cannot fail to stand him in good stead, whatever may be his sphere of future operations.

Some days ago the employés of the National Conduit and Cable Company, New York and London, presented Mr. W. H. Murphy, Mr. Regan's (superintendent) principal assistant, with a handsome gold watch and chain. He had made himself very popular with the officials of the Dublin United Tramway Company, for whom the company have laid the electric cable. The chairman complimented Mr. Murphy upon having gained the good opinion of one and all, and he trusted he would assist his chief in making Glasgow, where they were going, what they had made Dublin, one of the best equipped electric tramway cities in the world.

The Hastings Electric Lighting Committee have appointed Mr. C. S. Pasley (formerly one of the assistants at the Westminster Electric Supply Company's Works) to fill the vacancy of assistant engineer at the Hastings electricity works. There were 67 applications.

Mr. Robert Birkett has been appointed borough electrical engineer at Burnley in succession to Mr. R. Wright, who goes to Bootle.

Mr. S. E. Britton, chief assistant at the Southampton electricity works, has been appointed resident electrical engineer at Barking. His friends at Southampton have presented him with a handsome tantalus as a token of their esteem.

Mr. A. Nichols-Moore, of the City of Hull Corporation tramways, has been appointed engineer-in-chief on the staff of the Blackpool and Fleetwood Tramroad Company.

We hear that Mr. C. H. Wheeler, president of the Wheeler Condenser and Engineering Company, of New York and London, has arrived in London. The above firm have a large number of contracts covering their cooling tower and condensing plant under way at the present time.

Lectures.—The Technical Instruction Committee of the West Riding County Council are making arrangements for an exhibition, representative of technical and secondary education, to be held at Leeds in December. The Committee are also arranging for Prof. Oliver Lodge to give a short course of lectures after Christmas at some convenient centre, on "Electrical Vibrations."

At a meeting of the Municipal Technical School Engineering Society at Birmingham last week, Mr. R. Hornby read a paper on "Electricity Meters." Commencing with an historical review of the development of electricity meters, the lecturer proceeded to describe the Edison, Edmondson, Forbes, Thompson, and Hookham meters. The lecture was illustrated by specially prepared lantern slides.

The first meeting of the Liverpool Engineering Society for the present session was held on 1st inst. at the Royal Institution, Liverpool. The inaugural address was delivered by Mr. A. Bromley Holmes, M.Inst.C.E., president, who gave a historical sketch of the progress of electric appliances throughout the century, dealing at some length with the question of electric traction.

Marconi to the Front!—Yesterday's *Star* says that Laffan's New York agent telegraphs as follows :—"Signor Marconi states that he has sold all his patent rights in America, it is reported, for a million dollars and a large royalty. His assistants have started for South Africa; he, himself, will soon follow."

The correspondent of the *Daily Telegraph* quotes Mr. Marconi as saying : "He would like to go to the front himself, but the directors of his company seemed to think he might be killed."

Society of Engineers.—Before this Society on Monday, Mr. Sherard Cowper-Coles read a paper on "The Electrolytic Treatment of Complex Sulphide Ores."

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Foreign Competition.—An esteemed contemporary has taken up this question, and, in response to a leading article, has received some correspondence. Mr. Bailey, of the City Electric Light station at Bankside, has had some useful experience of delay in getting goods. Mr. Bailey has never in 10 years known one instance where a guarantee of punctuality has been carried out. He gives actual dates. He also points out that the cause of delay is attributed to want of raw material. We know that lack of strip is a common excuse with the maker of lap-welded tubes. Generally he sums up that the credit of our home industries is jeopardised by the restricted and unsatisfactory output of iron and steel makers. Mr. Wordingham also writes and shows how he has been driven to purchase American—very properly Mr. Wordingham declines to use the word "foreign" in referring to America—machinery by reason of the ridiculous delay of home firms. At the same time, another writer complains that home firms have not been allowed to tender on standard plant, though standard plant has been accepted from America. He also girds at the London County Council, who have led the way in sending work to be done in Europe by sweated workmen without asking questions, and have demanded stringent and foolish conditions from home firms on pseudo-Socialistic lines. This writer does not fear American competition as likely to be soon planted in our midst, as he anticipates they will have as much trouble with trades unions as have home firms. Just at present, however, we do not know that militant trades unionism is giving much trouble. Mr. Barnes is, for the moment at least, fairly crying out for what employers wished in 1897, and for the moment we think employers are to blame for delays. They certainly appear to be infatuated with the present profitable state of business, and to be neglecting the future. They are, in fact, doing business of such a profitable order, that they seem blind to all else, and we fear they are in many cases practically inviting competition from abroad by, to say the least, the *brusqueries* of their present tone in dealing with customers. If orders are to go abroad at all, by all means let America be preferred. The attitude of the European press at the moment should alone entitle us to prefer our trans-Atlantic friends.

The Charing Cross Company and the City Supply.—At the Court of Common Council last week, the Streets Committee recommended the application of the Charing Cross and Strand Electricity Supply Company, for approval of a site at Marsh Gate Lane, Bow, as a generating station, subject to the Corporation in any purchase which it might make not being compelled to pay more than £2,250 an acre for the whole 7½ acres, and to the plans for the erection being approved. The Court approved of the site, and also empowered the same company to lay mains, &c., on the south side of Fleet Street, and a portion of Fetter Lane. The Court also decided to inform the City of London Electric Lighting Company that their means of testing the public and private supply was not satisfactory.

Sweet are the uses of Advertisement!—We reprint the following from the advertisement pages of the *Municipal Journal and London* for November 3rd, 1899, without comment :—

THE FUTURE OF THE TELEPHONE

Local Authorities and others interested in the Development of

LOCAL TELEPHONE EXCHANGES

Can obtain information on the Legal, Engineering, and Commercial aspects of the question from

MAJOR-GENERAL C. E. WEBBER, a Past President of the Institute Electrical Engineers, and a Consulting Telephone Engineer.

27, CHANCERY LANE, LONDON, W.C.

The Lawton Gas Engine.—It appears that Messrs. Lawton & Parker, of Manchester, make a gas engine of ¼ H.P. This is illustrated in the *Engineering Times*, and is a simple-looking machine that is said to be largely sold, and it is claimed to be capable of driving a dynamo for 10 16-C.P. incandescents, and to be a well-made machine. No particulars are given as to its dimensions or speed.

Society of Arts.—The following are among the arrangements for the 1899-1900 session :—

November 15th.—Opening address of Sir John Wolfe Barry, K.C.B., V.P.Inst.C.E., F.R.S., chairman of council.

Papers for meetings after Christmas :—

"Electric Traction." Charles H. Gadsby.

"Steam Motors for Common Roads." By John I. Thornycroft.

"A National Repository of Science and Art." By Prof. W. M. Flinders Petrie, D.C.L.

"The Electrical Induction Motor on Mountain Railways." By Prof. Charles A. Carus-Wilson, M.A.

Major Philip Cardew, R.E., "The Control, Regulation, and Measurement of the Supply of Electrical Energy." Three lectures. May 7th, 14th, 21st.

Two lectures, suitable for a juvenile audience, will be delivered on Wednesday evenings, January 3rd and 10th, at 7 o'clock, by Mr. Herbert Jackson, on "The Phenomena of Phosphorescence."

The Institution of Civil Engineers.—Next Tuesday's meeting will be devoted to the papers on the Waterloo and City Electric Railway. At subsequent meetings the following papers will be submitted for discussion :—

"The Purification of Water after its Use in Manufactories." By R. A. Tatton, M.Inst.C.E.

"Combined Refuse Destructors and Power Plants." By C. Newton Russell, Assoc.M.Inst.C.E.

"The Treatment of Waste Water from Factories." By W. O. E. Meade-King, M.Inst.C.E.

Tunbridge Wells.—On Wednesday, the members of the Lighting Committee were entertained at luncheon at the Calverley Hotel, by the chairman, Mr. E. Elvy Robb, for the purpose of meeting Sir William H. Preece, on the occasion of his visit to the Corporation electricity works. The company included several prominent townsmen, and some representatives of the London technical and local press. Several important speeches followed the luncheon, in which references were made to the probable introduction of municipal electric tramways, dust destructors, and telephones, but we must reserve our comments upon these till next week.

Electrical Supplies for United States Fortifications.—The United States Secretary of War has appointed a board of officers, consisting of Lieutenant-Colonel Alexander Mackenzie, Corps of Engineers; Major M. C. Martin, Quartermaster's Department; Major James Allen, Signal Corps; Captain William Crozier, Ordnance Department, and Captain J. R. Williams, Seventh United States Artillery, to meet at the War Department at the call of the president of the board, to make recommendations concerning the proper source of supply, by the staff departments, of all electrical appliances and apparatus in use at fortifications and the materials and accessories relating thereto, with the view of furnishing uniform types and providing for the control, responsibility and efficiency of the apparatus. The *Western Electrician* says that other subjects to be considered are the proper means by which repairs to guns and gun carriages at fortifications shall be made, and by which department the necessary tools and appliances for such purpose shall be furnished; the qualifications of electrician sergeants and the character and scope of examinations for their appointment, and the proper source of supply by the staff departments of the tools and implements required for the use of the battery mechanics for each heavy battery of artillery.

Turning the Tables.—We have often gathered from quack advertisements that diabetes could be marvellously cured by the aid of electricity. Whatever may have been our doubts thus far as to the genuineness of such claims, they cannot now fail to be dispelled in presence of the following American story. We give full and ungrudging credit to the *Western Electrician* for this tall tale :—

George Darling, of the O. B. Cook Company, fell off a Citizens' electric car when it was going a 12 mile gait and landed on his head. He had the diabetes for two years previous to the accident, but is now pronounced cured. Dr. Obets says that he was cured by the shock. Darling had thought of suing the street railway company for damages, but it is now reported that the officers of that corporation are considering the commencement of a proceeding against him to recover an adequate amount of fees for expert treatment.

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Improved Trolley Poles.—The following comes to hand as we go to press:—"You have overcome one difficulty in the working of this trolley pole, for your correspondent 'W. H. S.' Can you suggest how the inventor proposes to raise the pole when perchance it leaves the wire? —R. W. T."

[We regret that we do not know the inventor's intentions in this respect, but probably a light bamboo rod with a forked end would answer the purpose.—Eds. Elec. Rev.]

Army Reserve Men.—The employés of the Arc Works, Chelmsford, of Messrs. Crompton & Co., Limited, have resolved to contribute 1d. per week each to a voluntary fund for the wives and children of soldiers taking part in the South African war. The movement was set on foot by the Arc Works Sick Benefit Society.

NEW COMPANIES REGISTERED.

Thanet Constructional Company, Limited (64,065).—This company was registered on November 3rd, with a capital of £300,000 in £10 shares, to adopt an agreement with the Isle of Thanet Electric Tramways and Lighting Company, Limited, and an agreement with William M. Murphy, to construct, maintain, and work light or other railways and tramways, electric lighting and power and other undertakings in the Isle of Thanet, Kent, and to carry on the business of electricians, engineers, contractors, omnibus, van, motor, and rolling stock manufacturers and dealers, &c. The subscribers are:—W. M. Murphy, 39, Dame Street, Dublin, with 11,997 shares; H. B. Pecton, 6A, Austin Friars, E.C., with 6,000 shares; British Thomson-Houston Company, Limited, 83, Cannon Street, E.C., with 4,000 shares; V. A. Waldron, 10, Anglesea Street, Dublin, stock broker, with 6,000 shares; E. A. Lazarus, 52, Threadneedle Street, E.C., bank manager, with 2,000 shares; J. J. O. Connor, 27, Lower Sackville Street, Dublin, drapery manager, with 1 share; J. F. Murphy, Dartry, Upper Rathmines, Dublin, barrister, with 1 share; W. H. Brigge, 39, Dame Street, Dublin, civil engineer, with 1 share. The number of directors is not to be less than three nor more than seven; the first are to be appointed by the subscribers; qualification, £500; remuneration, £200 each per annum.

Tramway Traction Company of South America, Limited (64,076).—This company was registered on November 4th, with a capital of £60,007 in 200 shares of £250 each, and seven shares of £1 each, to adopt an agreement with Albert W. Rosy, Annibal Falcao, and Charles Georgi, to promote, conduct, or manage any commercial, financial, mining, electrical, and industrial undertakings, and to carry on the business of tramway and railway contractors, and suppliers of electricity and other power. The first subscribers (each with one share) are:—P. B. Potter, Ravensleigh, Water Lane, Brixton, clerk; A. C. Downing, 8, Victoria Gardens, Notting Hill Gate, W., clerk; P. J. Hellis, 1, Merthyr Terrace, Castlenau, Barnes, S.W., clerk; W. H. Thompson, 8, Dalebury Road, Upper Tooting, S.W., gentleman; E. Puchard, Richmore, Hampton Wick, gentleman; E. Cadett, 84, Grove Lane, Denmark Hill, S.E., gentleman; and F. Durant, 114, Tachbrook Street, S.W., clerk. Registered without articles of association.

CITY NOTES.

Eastern Extension, Australasia, and China Telegraph Company.

The half-yearly meeting of this company was held at Winchester House on Wednesday, the Marquis of Tweeddale presiding.

The Chairman said that the report for the half-year ended June 30th would be deemed highly satisfactory. The gross revenue had amounted to £324,361, which was an increase of £47,079 on the corresponding half-year. The result was due to increased traffic all over the company's system, but more especially owing to the increase of traffic from China and Manila. The working and other expenses had amounted to £107,266, or an increase of £4,293. This was partly accounted for by the opening of new offices in the Philippines, accompanied by the greater number of staff for dealing with the increasing traffic. The usual dividends of 5s. per annum had been paid for the half-year, and after transferring £5,000 to a special reserve fund in connection with the now proceeding removal of the head offices, and £100,000 to the general reserve fund, they carried forward £13,279. During the period under review the general reserve fund had been debited with £68,901 in connection with the renewal work to the Saigon-Hong Kong cable, the extension of the Manila-Pansy cable to Iloilo, and the laying of a direct cable between Iloilo and Cebu. Unfortunately, the political situation in the Philippines showed no improvement, and it seemed that further heavy fighting must ensue before American rule could be firmly established. He hoped that before the next meeting a more satisfactory state of things would prevail there. Shortly after he addressed the last meeting, H.M. Government decided to co-operate with certain Australian and Canadian Governments in the laying of a State cable across the Pacific Ocean. The directors of this company, and of the Eastern Company, protested against the Government entering into competition with private enterprise, and pledging the credit of the country for such a purpose, more particularly as the company had proposed to lay a cable through what was an admittedly better strategic and commercial route to the Cape, and on terms more advantageous to the Governments concerned. A deputation waited upon the Chancellor of the Exchequer to express grave objection to so serious an attack upon private interests, and the remarks addressed to them made it clear that the Government was not disposed to withdraw from its promise to assist the Colonies in the manner indicated. At the same time it expressed the opinion that the loss to the company would not be so large as seemed to be anticipated, and further, that there was no intention whatever of competing with the company on other than fair and equitable terms. After careful consideration of the situation so created, the directors came to the conclusion that the interests of the company would be best served by at once offering to meet the often-expressed desire of the Australian Colonies for an alternative cable route, and a reduced tariff. They accordingly submitted a proposal for extending the new Cape cable to Australia without requiring any subsidy from the Australian Governments and at once decreasing the tariff to 4s. a word, to be followed by further reductions on a sliding scale down to 2s. 6d. per word as the traffic responded to the reductions. The only condition attached to that proposal was that the company should have the same freedom of dealing with the Australian public as prevails in this country and elsewhere. Without such freedom the company would be entirely dependent upon the Governments for the collection, transmission, and delivery in Australia of the traffic, making it impossible for them to carry on their business on equal terms with their competitors. That proposal had been very favourably received by the Press, Chambers of Commerce, and mercantile communities generally in Australia, and they had reason to believe that it would be eventually accepted. The moment they received satisfactory assurances on that point the laying of the cable from the Cape to Australia would be proceeded with without delay. With regard to the Pacific project, they would remember that the Imperial Government decided to limit their subsidy payment to £20,000 per annum, but that decision caused some dissatisfaction in Australia and Canada. The Government therefore reconsidered their offer, and they are now prepared to take part in the working, management, &c., of the cable. An advisory board representing the Government and the Australian and Canadian colonies had been, or would immediately be, appointed for the purpose. That cable when laid in two or three years would divert some of the company's traffic—that was self-evident; but still they might, with their two independent cables and access to their own offices in the principal Australian towns, look forward to the coming competition, when it came, without any serious or great apprehension. They would observe from the report that it was proposed to alter the trust deeds of the staff pension and superannuation funds so as to admit of the retiring age being altered to 55 years instead of 60. That change was very desirable, inasmuch as they found the existing age limit too high, and tending rather to the retention of employés who were no longer able to give efficient service. To do this, the company's contribution to the pension fund would have to be increased from 2½ per cent. to 4 per cent. The sum required from the company to make up the back payment was, roundly, about £11,000, and if the amount were spread over 20 years, as was proposed, it would only represent a few hundred pounds per annum in addition to the increased contribution. The Marquis of Tweeddale then moved the adoption of the report.

Mr. F. A. Bevan seconded the motion, which was carried unanimously.

The necessary resolution for effecting the alteration in the pension fund trust deed having been passed, a few remarks were offered by shareholders, and in reply,

The Chairman said that by the change in the pension age limit it was not meant that they would compulsorily retire all officials at 55, but only where there might be inefficiency due to age. He had read Sir Edward Sassoon's speech to the Folkestone Chamber of Commerce. He made the old charge against this company of monopoly. He (the hon. marquis) had to meet this when he addressed the Chancellor of the Exchequer, and he pointed out that they had no monopoly at all between this country and Australia or India. There were various routes, and the word monopoly did not apply to them in any degree whatever. The Government were going to lay a cable, which they could not have done if the company had enjoyed a monopoly. In reference to the statement about interruption to the cables, he pointed out that there was only one cable interrupted, viz., the East Coast cable; the West Coast cable was working as well as it possibly could do. With regard to the East Coast, everything had been done that could be done to ensure its speedy repair. They had no fewer than three cable repairing ships on the East Coast, distributed over the coast ready to repair any fault. He confessed they were not a little disappointed that that particular fault in the Mozambique cable had not been repaired by this time. There was no interruption between this country and the Cape so far as telegraphic communication was concerned. It was impossible to prevent interruptions taking place, they arose from a variety of causes, artificial and natural. If the Government had only listened to the directors two years ago, they would have had a third cable now working to the Cape. It was not the company's fault that there were not now three. They were laying it now, having recently got approval and permission to land. The new cable would be on the West Coast of Africa.

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A Shareholder asked what would be the cost of extending the cable from the Cape to Australia, and whether it would be provided from reserve or the issue of capital.

In reply, the Chairman said that the cost of the cable would be borne partly by the Eastern and partly by this company. The share of the Eastern Company would be something like £1,000,000.

A vote of thanks to the chairman, directors, and staff brought the meeting to a close.

The West India and Panama Telegraph Company, Limited.

The directors' report for the half-year ended June 30th, to be submitted to the meeting on 15th inst., reads:—

"The directors submit the accounts for the six months ended June 30th, 1899. The amount to credit of revenue is £30,929 10s. 8d., against £39,612 14s. 2d. for the corresponding half-year of 1898, and the expenses have been £21,492 4s. 8d., against £21,704 17s. 5d., leaving a balance of £9,437 6s., which, with £4,920 0s. 8d. brought from last account, makes a total of £14,357 6s. 8d., with which it is proposed to deal as follows:—

	£	s.	d.
First preference shares—			
Dividend, six months to June 30th, 6s. per share.. ..	10,868	18	0
Second preference shares—			
Dividend, six months to June 30th, 6s. per share.. ..	1,400	14	0
Ordinary shares—			
6d. per share (free of income-tax)	2,208	0	6
Balance to current half-year's account	879	14	2
	£14,357	6	8

"The total receipts show a decrease of £8,683 3s. 6d., as compared with the corresponding period of 1898, when they were abnormally large consequent on the Spanish-American war. The expenses of repairing cables during the half-year amounted to £8,334 8s. 3d., being £572 15s. 1d. less than those for the corresponding period. The St. Lucia-St. Vincent cable which was interrupted by the hurricane of September last year has been finally restored. The cost of renewing the original part of this section, amounting to £2,616 8s. 4d., has been charged to reserve. In August last another disastrous hurricane passed over some of the West India islands, causing great loss of life, and much distress followed. The directors, feeling sure that their action would meet with the approval of the shareholders, forwarded a donation of £100 to the Lord Mayor's relief fund. Telegrams relating to the hurricane and distress fund were transmitted free of charge as on the previous occasion. The Jamaica-San Juan (Porto Rico) cable was interrupted by this hurricane, which also damaged some of the company's landlines, all of which have since been repaired. A contract has been entered into for the manufacture and delivery in the West Indies of 310 knots of cable for stock. The directors are pleased to report that the Danish colonies of St. Thomas and St. Croix have renewed their subsidies for a further term of five years."

Prospectus.

On Wednesday the list of applications closed of an issue of £125,000 4½ per cent. perpetual second debenture stock of the Brush Electrical Engineering Company. This issue has been made in order to redeem the outstanding £50,000 4½ per cent. redeemable second debenture stock, to pay off bank loans, and to provide for further extensions to the Loughborough works. £75,000 has just been offered at £105 per cent., the balance being reserved in order that holders of the existing £50,000 4½ per cent. redeemable second debentures may have the option of exchanging same for the present issue of stock at par.

Improved Electric Glow Lamp Company. — A meeting of this company was held at Cannon Street Hotel yesterday (Thursday) morning, but our representative was refused admission.

Personal.—Mr. Charles S. Drummond has been appointed a director of the British Electric Traction Company.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending November 4th, 1899, were £189 7s. 11d.; November 4th, 1898, £192 4s. 1d.; aggregate for half-year to date, £19,061 3s. 8d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending November 3rd, 1899, were £3,189 17s. 8d.; corresponding period, 1898, £2,566 9s. 6d.; increase, £572 18s. 2d.

The City and South London Railway Company.—The receipts for the week ending November 5th, 1899, were £1,045; November 6th, 1898, £1,027; increase, £18. Total receipts for half-year, 1899, £18,823; total receipts corresponding period, 1898, £18,302; increase, £21. Miles open, 3½.

The Dover Corporation Electric Tramways.—The receipts for the week ending October 28th, 1899, were £179 19s. 10d.; October 29th, 1898, £190 9s. 5d.; decrease, £10 9s. 7d. Total receipts to date, 1899, £8,643 3s. 11d.; corresponding period 1898, £7,174 19s. 1d.; increase, £1,468 4s. 10d. Miles of track open, 1899, 3; 1898, 3. Car miles run, 1899, 4,794, 1898, 4,413. Number of cars, 1899, 11; 1898, 11. The receipts for the week ending November 4th, 1899, were £175 13s. 11d.; November 4th, 1898, £165 6s. 5d.; increase, £10 7s. 6d. Miles of track open, 1899, 8; 1898, 3. Car miles run, 1899, 4,756; 1898, 4,808. Number of cars, 1899, 11; 1898, 11. Total receipts to date, 1899, £8,818 17s. 10d.; corresponding period, 1898, £7,340 5s. 6d.; increase, £1,478 12s. 4d.

The Dublin United Tramways Company.—The receipts for the week ending Friday, November 3rd, 1899, were as follows:—D. U. T. Co., horse cars, £808 17s. 3d.; ditto, electric cars, £2,670 5s. 11d.; D. S. D. Co., electric cars, £693 8s. 6d.; total, £3,671 11s. 8d.; corresponding week last year—D. U. T. Co., horse cars, £2,238 17s. 9d.; ditto, electric cars, £334 18s. 1d.; D. S. D. Co., electric cars, £735 16s. 4d.; total, £3,368 12s. 2d.; increase, £307 19s. 8d. Aggregate to date, £78,275 2s. 6d.; aggregate to date last year, £75,473 19s. 9d.; increase to date, £2,801 2s. 9d. Worked:—The mileage open is 37 miles electrically, 7 miles by horses, as against 18 miles electrically, and 29 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways. — The receipts for the week ending November 5th, 1899, were £601 November 9th, 1898, £234; Car miles run, 12,038; 1898, 8,584. Number of cars, 1899, 28; 1898, 10. Total receipts to date, from April 1st, 1899, £18,893; 1898, from June 29th, 1898, £5,175. Miles of track open, 12; 1898, 8¼.

The Liverpool Overhead Railway Company.—The receipts for the week ending November 5th, 1899, amounted to £1,873; corresponding week last year, £1,451; increase, £422.

The South Staffordshire Tramways Company.—The receipts for week ending October 3rd, 1899, were £696 19s. 9d.; November 4th, 1898, £662 13s. 0d.; aggregate receipts for 44 weeks, £29,355 7s. 9d.; 1898, £27,886 16s. 6d.

STOCKS AND SHARES.

Wednesday Evening.

It is a pleasure to be able at last to report that signs are apparent of a distinctly better time for electrical shares in the near future. This is, of course, the season when supply shares, in particular, come into favour. The investing public refuses steadfastly to look at anything in the nature of an electric lighting concern in the summer time; consequently, prices sag. Besides this reason, there has been a concatenation of other circumstances to keep quotations flat; politics and dearer money being the two chief causes. Now, however, a feeling of confidence is beginning to creep round the market, in spite of the hardening of discount rates, caused by the Treasury Bills emission. Electric lighting descriptions are being freely dealt in again, and Citys were the first to respond to the more active tone. The winter is at hand, when the company may reasonably look for better receipts, on account of the additional users it has secured during the summer months. Competition by the Charing Cross Company is still far off, and the passing of the last dividend has, it is supposed, put the City Company into a strong financial position. While the outlook for the future is still hazy, and no one can foresee what may be the result of the reduction of rates, the shares are distinctly a speculative investment.

St. James's and Pall Mall mark another advance, the new issue being safely disposed of by now. Westminsters are hard, and the next rise seems most likely to occur in shares of this steady investment type, for the amount of public money lying dormant is tremendous, and people will not for ever be satisfied at getting the miserable rate of interest that a bank allows upon deposit accounts.

No attempt has been made to start a market in the new Alliance Electrical Preference shares. The amount of the public issue being so trifling, there can never be anything approaching a free market in them, and the investment is coldly regarded for this reason. The Stock Exchange always dislikes a security—however good—in which dealing has to be a matter of negotiation.

Telegraph securities have brightened generally, and Eastern Ordinary has again scored. "The public wouldn't look at the stock when it was flat," exclaimed a jobber in the market, "but now that it is rising, see how they come for it!" Extensions have also hardened, but shareholders are beginning to grumble as much as the newspapers at the rigour exercised by the press censor at the theatre of war. He is lessening their chances of a good dividend, they pathetically say. Anglo-American issues are better, the Deferred stock regaining favour as a gambling counter, and the Preferred coming into demand from investors who must have a 5 per cent. return with as little risk as possible. Moreover, the Yankee Railway Market continues exceedingly strong—always a good omen for bulls of Anglo Telegraphs. Globe Ordinary have appreciated a trifle, but the Preference can be bought at 15½, or a shade less, and Submarine Cables Trust are up 1, but West India and Panama shares have been sold and are ½ down, it being feared that the recent hurricanes have done more serious damage than was at first reported.

National Telephones shed a small fraction as the result of the decision arrived at by the Glasgow Corporation with regard to wayleaves. The reason for the fall seems distinctly trivial, and there are some who say that its effect should have been to enhance instead of decrease the value of National Telephone shares.

Very little has to be said about the more miscellaneous varieties. British Electric Traction Pref. are a thought weaker, but no change has taken place in the Ordinary. New General Tractions are 4 and Potteries Ordinary 13½.

Henleys are still denied a quotation in the Official List, but this is likely to be remedied shortly. The Ordinary are 12¾ to 13¾, and the Preference 5⅜—⅝.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Oct. 31st.	Closing Quotation, Nov. 8th.	Business done during week ended Nov. 8th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	65 — 68	65 — 68	66½	66
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	116½—117½	116½—117½	116¾	116½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	16½— 17	17 — 17½	17¼	16½
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	15⅝	15½
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2½— 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	180 —190	180 —190	...	...
1,232,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	103 —105	103 —105	104	103¼
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20 xd	19 — 20 xd	...	...
12,981	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½ %	3½ %	11⅜— 12¼	12 — 12½	12	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101 —104	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½ %	7 %	7 %	156 —161	157 —162	161	158
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	99 —102	99 —102	100½	99
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,482,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	117 —122 xd	117 —122 xd	120½	118
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	15 — 15½	15½— 16	16	15 5/16
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 2,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—2,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
220,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	118 —123	118 —123	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,348	100	5 %	...	...	99 —103	99 —103	...	...
46,800£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
300,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—6,000	25	4 %	...	...	102 —105%	101—104%xd	...	...
180,237	Globe Telegraph and Trust	10	4½ %	4½ %	5½ %	11 — 11½xd	11½— 11⅝	11⅝	11½
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15½— 16 xd	15½— 16	15⅞	15⅝
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 31	30 — 31	30½	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52 xd	48 — 52 xd	49½	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	106¾	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ⅛xd	¼— ⅛	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1 xd	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	5⅛— 5⅜	5 — 5¼	5 3/16	5
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	13½— 14½	14 — 15	14½	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	13½— 14½	14 — 15	14⅜	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5⅜	5¼— 5½	5½	5⅜
1,239,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —102	100 —102	101	100 3/32
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅜— 1 xd	⅜— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,339	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,361	Submarine Cables Trust	Cert.	...	...	...	128 —133	129 —134	132	...
56,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	4⅜— 5¼	...	...
151,782£	Do. do. 5 % Debs.	Stock	...	..	...	105 —108	105 —108	...	...
300,000£	West African Telegraph, 5 % Debs.	100	5 %	%	...	99 —102	99 —102	100	...
20,008	West Coast of America, Nos. 1—20,000 and 58,001—58,008	2½	...	...	...	⅛— 1	⅛— 1	...	...
180,000	Do. do. 4% Debs., 1—1,500 gua. by Braz. Sub. Tel.	100	...	...	...	102 —105	102 —105	...	...
269,531	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	104½	...
89,321	West India and Panama Telegraph	10	1 %	%	...	1½— 1⅝	1½— 1⅝	1⅝	...
24,568	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10⅝	10½— 10⅝	10⅝	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8½— 9½	9 — 10	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	5 %	5 %	...	104 —107	105 —108	106	...
168,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7½— 8½	7½— 8½	...	...
12,009	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	9½— 10½	9½— 10½	10¼	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	6 — 6½	6⅛	...
24,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	8 — 9	8 — 9	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	110 —113	111 —113	111½	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11 — 12	11½— 12½	11¾	11½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	12½— 13½	13 — 14	13⅜	13½
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,009	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10 — 11	10 — 11	...	...
30,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	111 — 114	111 —114	113½	111½
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5½	5 — 5½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 4	3½— 4	...	...
46,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 6⅝	6½— 6⅝	6½	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	15 — 16	15⅝	15½
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14 — 15	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½— 16½	15½— 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	15 — 16	15½— 16½	16	...
20,000	Do. do. 7 % Pref., 20,001 to 40,000	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3⅞— 4	3⅞— 4	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½— 15½	14½—15½	14 15/16	...

* Subject to Founder's Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.
† Quotations on Liverpool Stock Exchange.
‡ Dividends paid in deferred share warrants, profits being used as capital

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Oct. 31st.	Closing Quotation Nov. 8th.	Business done during week ended Nov. 8th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2⅜— 3¼	2⅜— 3¼	3⅛	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	16½— 17½	16½— 17½	16⅞	...
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13½— 14½	13¼— 14	14	13¼
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	128½	126½
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	12	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6⅝	6½— 6⅝	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅞— 2⅛	1⅞— 2⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2¼— 2⅜	2¼— 2⅜	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	109 —113	110 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½%	15 %	13 — 14 xd	13 — 14	...	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	113 —116	113 —116	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10⅜	10¼— 10⅜	10⅜	10¼
178,303	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5⅛	4⅜— 5⅛	5	4 15/16
71,447	Do. do. Def. do.	5	...	...	...	5 — 5⅛	5 — 5⅛	...	...
630,000£	City and South London Railway	Stock	1 9/16 %	1⅞%	2⅛%	63 — 66	63 — 66	64½	63½
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6½— 6⅝	6½— 6⅝	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	3 11/16	3⅝
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛%	6 %	6 %	2 — 2⅛	2 — 2⅛	2 1/16	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛%	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	95	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2 — 2⅛	2 — 2⅛	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3⅛	3 — 3⅛	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	103 —106	104 —107	105½	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	¼— ⅜	¼— ⅜	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21½	21½
800,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	102	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3½ %	3½ %	8⅞— 9	9¼— 9½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½— 13⅝	13½— 13⅝	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	39½	38
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9⅜	9¼— 9⅜	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5¼— 6	5¼— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	101 —104	102	...

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
British Aluminium, Ordinary, 9—10; 7 % Pref., 9¼—10½.
Brompton and Kensington, 4½% Debentures of £100, 105—108.
National Electric Free Wiring, 10s. paid, 6s.—8s.
Smithfield Market Electric, 1—3.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12½—13½; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 18½.

* From Birmingham Share List.

Bank rate of discount 5 per cent. (October 5th, 1899).

MARKET QUOTATIONS, Wednesday, November 8th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	22/-	22/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) .. per ton	£29	£29	..
a „ „ .. .. per ton	£27	£27	..
a Bleaching powder .. .. per ton	£6 1	£6 10	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzols (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£26	£26	..
a Lead, Nitrate .. .. .. per ton	£25	£25	..
a „ White Sugar .. .. per ton	£31	£31	..
a „ Peroxide .. .. .. per ton	£37 10	£37 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3½d.	3½d.	..
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a „ Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8½d.	..
c „ Tube (brazed) .. .. per lb.	10½d.	10½d.	..
c „ Wire, basis .. .. per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	2/-	2/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£86	£88	£2 dec.
g „ Wire (basis price) .. per lb.	10½d.	10½d.	..
g „ Sheet .. .. .. per ton	£86	£88	£2 dec.
g „ Rod .. .. .. per ton	£86	£88	£2 dec.
h German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	7/-	7/-	..
h India-rubber, Para fine .. per lb.	4/3 to 4/5½	4/2½ to 4/5	½d. inc.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	69/10½d.	69/6	4½d. inc.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£14 5	£14 5	..
g Lead, English Ingot .. .. per ton	£17 12 6	£17 12 6	..
g „ „ Sheet .. .. per ton	£18 16	£18 16	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£9 5	£9 5	..
d Mica (in original cases), small per lb.	2d. to 8d.	2d. to 8d.	..
d „ „ „ medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large per lb.	8/6 to 7/6	8/6 to 7/6	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p r'l'd str'p & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. .. per oz.	£3 11	£3 11	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£143	£146	£3 dec.
g „ foil .. .. .. per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/11	1/11	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7¾d.	7¾d.	..
j „ Best Flax, 6 lea. .. per lb.	5d.	4¾d.	¼d. inc.
j „ Hemp, 8 ply 10 lbs. .. per lb.	8¾d.	8¾d.	..
j „ Russian, 10 lbs. .. per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove .. per ton	£14	£13 10	10s. inc.
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£26	£26 5	5s. dec.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
Messrs. Henry G. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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STANDARDISING IN ENGINEERING CONSTRUCTION.

The general consensus of opinion in regard to cheap production is that standardising is at the base of economical manufacture. It is by standardising that repetition work is made possible to the fullest extent.

Sir Benjamin Browne, who deals with the question in the *Engineering Magazine*, does not think much of the Atbara Bridge argument, because for some reason which has never been made plain, the order was sent to America, without any English bridge builder having had a chance of trying. Where, he asks, is the line to be drawn between standard and special design? He does not believe in varying a lot of bridges for the sake of a trifling difference in span, his thought evidently being that in case of a number of bridges varying in span from, say, 20 feet to $20 + x$ feet, the whole of them might well be made of $20 + x$ feet span, rather than they should be made of several different spans. All being the same they could be made more cheaply, even though the total material might be greater in quantity.

The general feeling is that English engineers are too fond of their own designs, and the influence of Great George Street is indicated as having, in certain cases, seriously injured British trade, notably in bridges and locomotives. But it is not only Great George Street that is to blame. Our Midland and other railways are themselves guilty of demanding the most rigid adherence to hard and fast specifications for locomotives on the part of English builders, and have ordered from America engines to practically no specification. Need we say that Americans claim this as a sort of tribute to their unsurpassable ability to design and make engines, whereas, all it shows is the mistake of the railroad officials in getting behindhand with their engines, and having to order them in a hurry? The North-Western and the Lancashire and Yorkshire do not seem to have got themselves into the same fix. We recently commented on the lame and impotent explanation offered by Mr. Jones, of the Midland. Mr. Jones seemed to be much impressed with the fact that the imported engines would come over in wooden cases, and these wooden cases would not be all the same size. Seeing, too, how many foreign and colonial lines are engineered in Westminster, need wonder be excited if American engines are sometimes found to be preferred after a trial of English engines, designed by some inexperienced youth who has paid a heavy premium to his supposed teacher? The American locomotive is usually designed by an expert, just as are the locomotives built to the designs of English *builders*, but Westminster men cannot possibly be locomotive experts. Sir Benjamin is very severe on the Boards of Directors of our railways who so mismanage their lines. Here, again, we find fault with the English system. American railways—railways being their chief industry—command some of the best men. How very few English directors are really experts in railroading! Occasionally we see a retired manager go upon the Board when he is worn out, and clearly to go on the Board is a sort of halting place on the road to the grave. To be born a duke is also a sort of patent to a good railroad directorate, but our Board dukes have cost the country millions in bad policy. Civil engineers, says Sir Benjamin, will cause their assistants to get up designs for cranes, wagons, and all kinds of things that can be purchased like tin tacks almost, off ticketted shelves of the manufacturers, and of course infinitely better than the designs of a tyro. It is, he says, a great waste of time and energy to design on first principles articles of which other men have made specialties. Yet this is the Great George Street plan, which has not even the merit of Pecksniff's methods, for he did choose a perfect model.

The furthest development of standard work is certainly seen in America, where a manufacturer will sometimes make not merely one type of lathe, but only one size of that type.

Sir Benjamin deplores the abolition of the sub-contractor in the workshop. The contract system gave a man a chance of doing better for himself, for his hands were less tied than a foreman's, and he could bargain with men individually. Now, if trade is to be kept, the making of goods must be standardised as it has been in the textile trades. A huge spinning mill, for example, sets out to make 32s. yarns, and will make these or vary very little from this number, so little, that all the preliminary machinery will remain unaltered in its drafts and twists the year round. Textile machinery has long been standardised, and one hears of very little competition being successful against Lancashire. Much of the competition, we may say all, that is so much talked of at present, is chiefly due to want of business methods, and the worst cases that have arisen can be clearly traced to Great George Street influence. We have seen men of years of experience vainly endeavour to point out the errors in designs to young sprigs in Westminster, whose ideas savour of some half-century old book from which, doubtless, their ideas were culled. But all this is everyday experience to specialists in manufacture who see thousands of pounds wasted and are unable to stop the folly.

THE MORRIN CLIMAX WATER-TUBE BOILER.

Probably the principal reason why large vertical shell boilers have been so unsuccessful has been that, there being no provision for regulating the circulation in the way of providing separate up-flow and down-flow passages for the water, it was impossible to avoid priming. There was so great a column of water through which steam had to make its way, that the water must have been full of struggling steam bubbles, and when at all thickened by contained mud or soda, the action of the steam must have been similar to that observed when a workman holds his coffee can over the smithy fire, and, by allowing too much heat to enter the can, empties it of all the coffee, leaving water only in the can. In the Morrin water-tube boiler the vertical type is adopted, yet without the faults of the shell

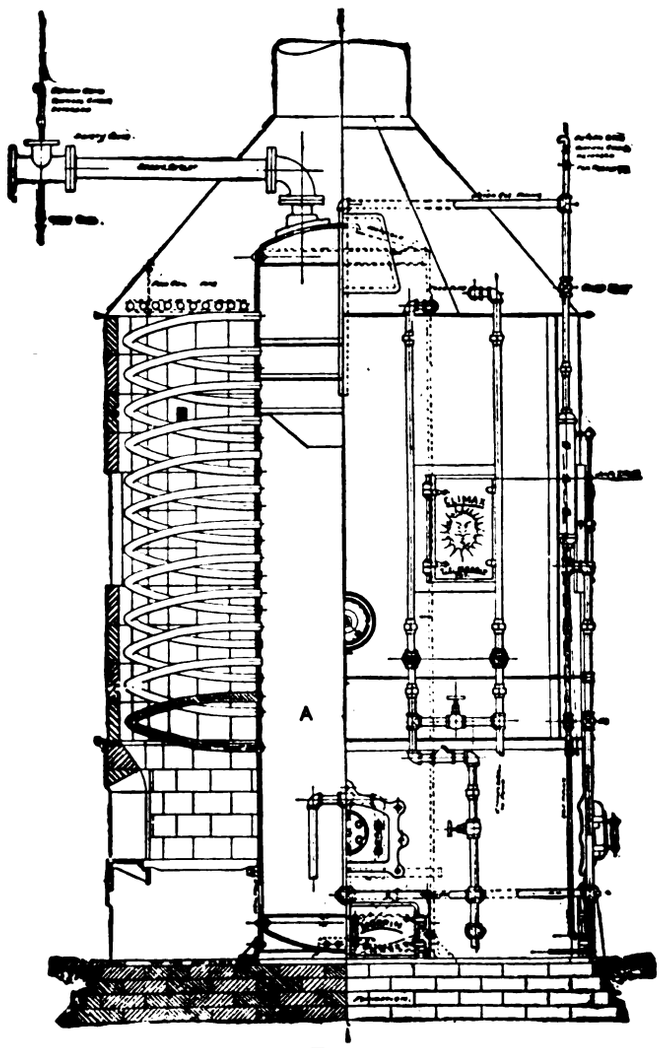

Fig. 1.

boiler—not but that a vertical shell boiler could be made to supply dry steam if proper provision were made for circulation. The Morrin boiler, as shown by figs. 1 and 2, consists of a central small diameter shell, large enough to work in for the purpose of using a

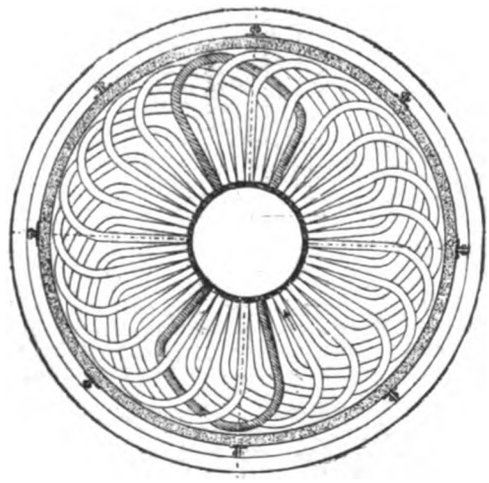

Fig. 2.

tube expander. Into this shell are expanded a large number of specially formed tubes, the particular beauty of which is, that though there may be 1,000 tubes in a large boiler, they are all alike, and consist of a straight length radiating horizontally from the shell towards the

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outer casing, about half way to which the tube begins to curve laterally and upwards. Arrived near the casing the curvature, which had become flatter after the first bend, again becomes sharper, and the tube is turned in again radially to the central shell, which it enters at a height of about 18 inches above the lower end. It requires about six such loops of tubes to fill out the whole circle, but circumferentially on the shell between the two ends of a tube there will be three other tubes. Thus there are 24 tubes in a circumference, and a large number of such spirals in the height of the boiler. Their size is 1½ to 3 inches, and their number is 280 to 1,000, according to the size of the boiler, their aggregate length being similarly 1,000 to 12,000 feet.

The central shell is carried below the firegrate, and forms a convenient mud drum. The firegrate is annular, surrounding the inner shell, and the furnace space is formed by omitting a sufficiency of the lower tubes. Though much of the inner shell is removed by the holes for the tubes, this is made up by increased thickness. Indeed, the shell plate must be thick, on account of expanding the tubes into it.

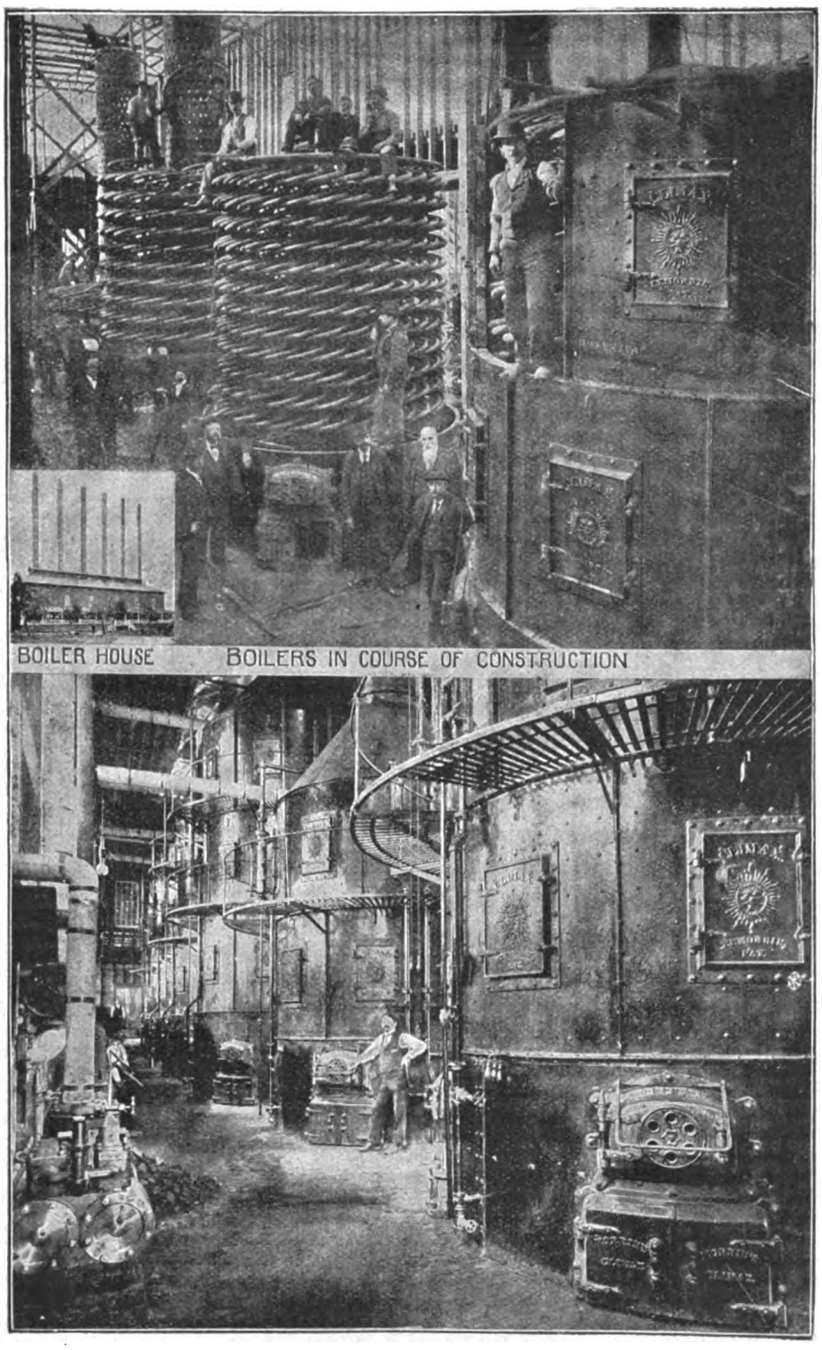

FIG. 3.

The furnace is lined with a special firebrick, to assist combustion. The shell of this boiler is necessarily welded longitudinally, so as not to interfere with the tube spacing. In the upper part of the shell is a deflector plate, to throw down any water that may be carried up, and there are then several diaphragms placed in the shell whereby the steam which arrives beneath the diaphragms can only pass by them by traversing the tubes. In this way several passes of these upper tubes must be made by the steam, greatly to the advantage of dryness. Indeed, 80° of superheat are claimed. Above all is placed a coil of 100 to 300 feet of pipe as an economiser or feed water heater, and this should be useful as a heat abstracter from the gases before they finally escape. The general design of this boiler is good. Any tube can be removed without removing any other tube. A few spare tubes serve for a whole battery of boilers, all being alike. All tube ends are accessible internally, and a tube can be cut out and replaced in a couple of hours, or less. It is claimed that a 1,000-H.P. boiler only occupies a space 17 feet diameter. Having an annular grate, the boiler must be accessible all round for firing at usually four doors, though in places the back of the grate may be blanked off, and the front enlarged if required.

An advantage of this type of boiler is, that low water is not easily attained; that is, the water may fall a long way down without danger. There is no definite line for low water, and the heat is pretty well taken out of the gases by the time they reach the upper tubes. For coke, or for smokeless coal, this should prove an excellent boiler, and doubtless it can be adapted to use bituminous fuel, the furnace being already surrounded laterally with firebrick. It is claimed that this boiler may be used with good effect to burn waste gases from furnaces, and it is much used in America to follow plain cylinder boilers rejecting gases at too high a temperature. With good water, it should prove a durable boiler, and with scale-forming water its lower end forms an admirably devised collector.

We understand that the United States Commissioners of the Paris Exposition, 1900, have selected the Morrin patent "Olimax" water-tube boiler for supplying steam to the whole of their section, and a United States cruiser has been placed at the disposal of the American manufacturers for transporting the boilers from Brooklyn to Havre. The large boilers installed will be under the superintendence of Messrs. B. R. Rowland & Co., Limited, 12, Exchange Street, Manchester, who have the sole rights of manufacture outside the United States, and no expense will be spared in making the installation an ideal one.

ELECTRIC RAILWAYS IN AMERICA.

THE current issue of the *Street Railway Review* is a special one, and is a decidedly monumental number. One of the last articles is that descriptive of general practice in America, as shown at Chicago, which may be taken to represent the latest practice in the newer sections of that city.

Horse cars have practically ceased to exist in America. In this country, thanks to the class of men who are apt to pose as the people's representatives, we seem destined to use horses for some time to come. An English road surveyor, too, will take so exaggerated a view of his duty, that, rather than suffer his roads and footways to be defiled by a single pole, he will deprive, if he can, fifty or sixty thousand people of transport facilities. By many municipalities and surveyors, the Light Railway Act is reduced almost to a dead letter, and obstruction is being put in the way of progress never intended by the Legislature. In America over 90 per cent. of street railway mileage is electrical. In New York and Washington alone has the conduit system been adopted. Everywhere else the overhead construction is employed, its advantages being greater than its imaginary disfiguring properties. The third rail has come into considerable use on high speed lines. No important application has yet been made of any surface contact system.

The paper before us shows how very different American practice is from our own. Very little concrete substructure is employed. It is thought too rigid and unyielding, but more probably, as Prof. Short points out, the long-established roads of England, with their many years of compacted depth of metalling, are suited for supporting concrete, and such roads necessarily cannot yet be found in America, where track construction still involves the use of wooden ties, after the manner of English light railway construction. The ties are laid on a layer of broken stone or gravel in a trench at 24 to 36 inches centres, and the rails, 7 inches to 9 inches deep, are spiked to these, the paving blocks, in cities, being placed on sand, laid above the level of the ties, which are filled in between by broken stone or gravel. Tie rods are rarely used. As in England, rails are used up to 60 feet in length, the joints being variously broken or opposite, according to opinion; the latter tend, when down, to pitching, as against the peculiar rolling caused by alternating or broken joints when low.

Cast welded joints are increasing, they give excellent riding tracks. Electric welding is high in cost, but promises well. Bonds when used are supposed to have a slightly better conductance than the rails

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they connect. Double bonding, so common in England, is stated to be frequently done, and cross-bonding is "usual," while plastic or amalgam bonds are coming into use. Double-truck cars are coming to be the mark of progress, and practice appears to be drifting in the way of such cars, 30 to 35 feet long, as, indeed, we fully believe they will become standard in this country. Trailers are but little used, as they cost more for labour per passenger. Trucks are of maximum traction type, carrying 60 to 70 per cent. on the drivers. American climatic conditions being so wide in range, there is great effort to secure a sort of combination summer and winter car easily convertible.

Of the American motor we cheerfully speak, for it seems to us that it is in their car motors that Americans have been easily first. There is really no sufficient reason for this. Motors are put to special stresses, but are not difficult to make. They can be copied, if need be, direct from American motors; but the one thing needful is good sound material for the insulation. Secure this, the rest is easy. There are among our own motor makers some who realise this, and their motors are all right. There are others whose insulation would disgrace a schoolboy's experiments, and such attempts to save on insulation must inevitably end in failure. Good though it is, it is an easy thing to make others as good as the American motor, and even better, but a silk purse never yet was made out of a sow's ear.

In power stations Americans have been forced by actual experience to come round to the English system of direct connection, and at the present time they are still trying to square the necessity of direct connection with the old-time speeds of rotation, from which they ought to have found themselves freed by the direct system. No doubt as the errors of the system of very slow speed are forced home they will adopt English methods throughout. It is curious that while making such huge progress in electrical traction American engineers should have had to adopt English practice in direct connection. Steam piping in duplicate is passing away, and better designed single systems are now in favour. In copying so much from American practice, English engineers copied, we believe, the use of duplicate steam pipes, but we think the duplicate and the ring main have disappeared in favour of well-designed single systems. The duplicate main, badly designed with its numberless valves, was always an invitation to disaster, and altogether useless, costly, and unnecessary.

In other respects such as fuel economisers or flue feed heaters, American steam practice has acquired much from us. The use of fan draught does not seem to have extended much into traction work in America, though it is progressing in other lines. We might profitably follow on the lines of mechanically-produced draught more than we have yet done. Though so old in England, progress has been slow in respect of fan-induced draughts. The largest engine generator yet built in America has a rated capacity of 4,500 KW.; many of this size are on order for the larger stations. Corliss valve gear is almost universal. The costs of generation have "been proved possible" to be as low as ·25d. to ·38d., but in by far the larger number of stations the cost is more like ·5d., a figure which should be easily possible in an English station of ordinary size.

There is a growing tendency—not yet materialised in plant, but only on paper—to use three-phase high pressure current with substation rotary converters, in order to keep down costs of copper. Such a system requires careful consideration: the cost of lost energy and of plant will soon overbalance the saving of copper; but, of course, it cannot be overlooked that in laying down copper, the cost of an insulated main is somewhere about double the cost of the copper itself, and each additional cable saved represents a good economy. Obviously, too, a buried copper conductor when dug up is only worth half its cost price if copper is at the same market value, the insulation being worthless except as fuel.

Feeder conduits are usually of vitrified brick or of iron pipe, the former as carried out to a considerable extent in Dublin in this country, the latter as in the most approved English practice. Aluminium has been tried for feeders, but it is too early to speak of results. Obviously the cost of insulation will be greater with aluminium. In overhead work there is little to choose between English and American practice. All details are practically American, and English makers follow American forms, but pole work is perhaps less elaborate; the American pole is ugly as compared with the tapering pole made by the English makers, but the elaborate brackets demanded by English municipalities are not asked for so much in America, where the wiser plan is followed of keeping the poles as unobtrusive as possible. Chicago, which fills so large a portion of the article under review, is supposed to be very congested at busy times of the day, but a picture of a light hour in the busy part of the city does not convey much of an impression of special congestion to one accustomed to London. Yet London has few trams, and these only horse worked, while a comparatively small city like Chicago, though unblessed with a County Council, has tramways aggregating 955 miles, and about 70 miles of elevated railroad in addition. The map published by our contemporary shows lines in almost every street at the centre of the city.

The cable system is rapidly disappearing from Chicago. The City Railway Company, which has electric, cable and horse roads, reports net car earnings per mile of 9·8 cents, 5·7, and −10·7 cents, on the three lines respectively. Various Chicago companies show operating expenses of 46·1 to 60·6 per cent.

As regards the Chicago power stations, one of the newest, that of the Southside Railway Company, was originally equipped with cross compound engines, with cylinders 26 inches and 54 inches × 48 inches, driving 800 KW. Westinghouse generators. Its two new engines are to be of 1,600 KW. capacity, with cylinders 34 inches and 70 inches × 54 inches, and capable of working up to 4,000 H.P. It is curious to note the low speed, only 80 per minute, which still clings to American practice, even for 160 lbs. pressure. Water-tube boilers are used with chain grates and conveyors. The chain grate is that so common at one time in this country, when under-fired cylindrical boilers were in vogue. The grate is an excellent one, and is familiar to our readers as Juke's. It has been much adopted in America, being as suitable for water-tube boilers as for under-fired cylindrical boilers. One station, only capable of running at first 90 cars, can now run 130 regularly, chiefly because of the gain in experience of the motormen. We fully believe this, and are of opinion that a meter in every car is very desirable as a check on mileage current consumption. In feeding boilers, the feed goes first through a heater, then to the pumps, and finally through the economiser. There is a huge water cooling tower 64 feet long × 34 feet high × 16½ feet wide, which will cool the water by 30° to 40°. Air is blown through it by five fans. The low cost quoted is attributed largely to an accumulator of two sets of 263 cells, each set of 750 KW. capacity. They can each deliver 2,400 amperes to the line, and have run up as high as 4,300.

The Chicago City power stations have rope-driven plants with small units. Of the 14 principal power stations, the capacity varies from 400 KW. up to 9,600 KW., with a total nearly 54,000 KW., of which, as regards boilers, 23,600 H.P. capacity is of Babcock & Wilcox type, 10,000 of Sterling type (Sterling boilers have small tubes nearly straight and not far removed from the vertical), 8,400 H.P. Campbell and Zell, and various others. Green economisers, not long ago hardly known out of England, are installed in large numbers. Water-cooling plant of 10,000 H.P. has been furnished to one station, and 7,500 H.P. of condensing plant has been fitted to another station. Direct acting steam pumps are much used, which we think a mistake for feed purposes. Such pumps have their use and place, but not as feed pumps for ostensibly economical plant.

As regards overhead construction, iron poles of 900 to 1,200 lbs. are used with wooden poles in the "alleys" between streets. The Union Traction Company use No. 0 hard drawn copper trolley wire, and No. 6 silicon bronze guard wire, which is used also for span wire in the business districts, while $\frac{5}{16}$ stranded and galvanised is used in the suburbs.

The Chicago City Company, however, use No. 00 trolley wire to help out the general feeder system, and a $\frac{3}{8}$ seven-strand galvanised iron span wire, but there are no guard wires on this company's system, as they are *believed to be a menace to life and property*, and where once installed have since been removed. All the details of overhead construction in the shape of hangers and pull-offs are of brass, except in one or two instances. Iron nowhere joins upon iron. Iron material wasted away rapidly, and the rust caused short circuits. Brass has better value as scrap when worn out. American contractors in England, please note.

India-rubber is useless as insulation; it soon cracks, and the cracks fill with coal dust and cause shorts. Treble insulation is made between trolley wire and ground—namely, at the ordinary straight line hanger, a fibre spool in the span wire about a yard from the pole, and another fibre spool at the pole band. A trolley wire span of 115 to 120 feet is allowed, at 75° F. temperature, to sag, 8 to 10 inches; in cold weather only 5 or 6 inches sag is allowed. The height above the ground is 19 to 19½ feet. Clinched ears are used, as they are less likely to let the wire down, and they will move on the wire if the trolley catches a span wire. The abolition of the sweated or soldered ear is of somewhat doubtful advantage. Certainly there is the risk on soldering that the copper wire may be softened and will pull apart. The tensile strength of soft copper is far below that necessary to withstand the pull required to keep the sag moderate.

Latticed poles are no longer employed; the best new construction is all done with tubular poles of the customary three sections—7 inches, 6 inches, and 5 inches—weighing 850 to 900 lbs., with extra strength for corners and anchor poles. In setting poles, their bases are painted with tar or other preservative mixture, and the bottom of the hole is lined with a slab of hard wood, to allow easy adjustment, the hole being filled round the pole with concrete. An iron thimble, 12 inches diameter, encircles the pole at the surface, and the space between pole and thimble is cemented up, and finished with a sloping roof to shed water. This precaution might well be adopted here in place of the finishing of the concrete at the surface level, where the pole is almost sure to be attacked by corrosion. For this purpose cement is superior to tar, which is apt to crack and let in water. Poles, where rusty, are steel brushed and painted first in red, then with a graphite paint, and usually require repainting every three years; trolley wires are found to oxidise most quickly when adjacent to the river. Poles are expected to last 20 or 30 years, which does not seem long, their annual depreciation being set down at 3½ to 4 per cent. Cedar poles depreciate 6½ to 7 per cent., and endure 14 to 15 years. Obviously these figures can only be assumptions, as no pole line has been many years in existence. The crossover insulation is composed of red fibre, 1 inch × 3 inches, attached to a central plate. The trolley wires are not cut, but are carried above the crossover, and no burn-out has yet occurred. Red fibre appears to do better in America than it has so far been found to do in this country. The section insulator is similar to the crossovers, but is hooded over to protect the fibre from rain. After exposure to weather fibre is apt to become harsh and brittle owing to the washing out of the substance which renders it pliable. This substance, we believe, is glycerine, which is easily dissolved out by moisture. At all section insulators and insulated crossovers there is hung from the span wire a small target with a star painted on it so as to call attention to the point and indicate to the motormen when to shut off current for the moment to prevent arcing. Garton lightning arresters are usual, but other types have all been tried. They are frequently inspected, and are tested by placing paper in the gaps and examining for punctures. Yet with all precautions the motor armatures are often damaged and underground lead-covered cables are burned, and this has occurred with an arrester on each side of the feeder points.

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Return feeders are of two sizes, 350,000 c.m. and 211,600 c.m. Cables of 500,000 c.m. are found too heavy and are hard to maintain on the poles.

Underground cables are enclosed in vitrified conduit, the four duct sections of which are made 6 feet long. Within two or three miles of the power house the return circuit cables are allowed 25 to 30 per cent. more copper than the outgoers, to prevent electrolysis. Tower wagons are large and capacious van-like structures, with a tower rising from the roof. They are fitted with shelves for line material.

Owing to the high price of copper, the North-Western Elevated Railway has purchased 150,000 lbs. of aluminium feeders, of which half is already fixed. It has a section of 1,300,000 c.m., and is used uninsulated. It is supported every 9 feet, and anchored, and is much cheaper than copper per unit of current-carrying capacity.

The Calumet Company is coming back to wood as insulating material for hangers and strain poles. The bell shells are cast as usual, and filled by a wood block soaked in kerosene, and then boiled in paraffin wax.

Though as many as five cars are run as a train, but little has been done in regard to power brakes. Christensen brakes, with independent motor compressors, are used on the South Side Elevated lines, and a little on some other lines, but the Metropolitan line uses chiefly the New York air brake. Electric brakes have not become popular.

Electric heating is very general on Chicago cars.

The permanent way does not seem to be at all first-class. Joints are very apt to be low, the soil is wet and soft, and concrete is not employed. The rail is about 7 inches deep, and only 85 lbs. to the yard, with the usual flat table in place of the groove, and an overall top breadth of 5⅛ inches. The elevated lines use an 80 lb. rail.

The Falk system is standard on the three principal surface systems, one company alone having now nearly 100,000 such joints. It is claimed that with careful sand blasting of the rail ends, the cast joint is electrically so good, as to obviate any need of copper bonding, which is nearly always omitted, but cross bonds are put in at about every 500 feet.

By April, 1900, a line closely resembling the Liverpool Overhead line will be in operation. This is the North-Western Elevated, seven miles long, with two miles of double and five miles of four tracks, the two inside tracks being for fast service. There will be three stations to the mile for local trains, but quick trains will stop only at every third station, and will average 30 miles velocity with 12-second stops. The station offices are below. The structure is chiefly of plate girder type. Pneumatic riveters are used in erection, and before painting the structure is steel brushed by electric power and flexible shafts, operated from the nearest trolley circuit. Two coats of paint at once follow upon the brushing. The paint is 20 per cent. oil, 40 per cent. graphite, and 40 per cent. iron oxide; 80-lb. rail is used, with 45-lb. conductor or third rail. The electric railway interest in Chicago is very great, and in a less, but at the same time hardly less proportionate degree, the electric line is bound up with the prosperity of almost every city and town in the Union. The absence of good roads and other peculiarly local circumstances have doubtless had much to do, in conjunction with the ease in obtaining "franchises," in fostering the electrical railroad. Our own backwardness, however, is not all due to the opposite causes. Much, of course, is due to the pernicious influence of the Tramways Act, and its unfortunate Section 43, or, perhaps, we ought to say, to the unfortunate quality of intellects which arbitrated on this section, with such disastrous findings. But the chief obstacle has, of late, undoubtedly been the jealousy of municipalities, and if every little municipality is to run and work its own tramlines within the narrow circle of its own boundaries, it seems impossible to hope that sound and paying general systems can ever be built up. It is a pity that in inspecting so many foreign lines at the expense of the ratepayers they profess to serve, the various deputations sent from our English towns should have seen so little and so narrowly—so little, we mean, of the tramways, and so narrowly in regard to the real issue—the facility of intercommunication between contiguous districts, which is so readily obtainable with electric traction.

GENERATION AND ELECTRICAL DISTRIBUTION OF MOTIVE POWER.

Discussion on Mr. Raworth's Paper read before the Manchester Association of Engineers.

Mr. Saxon opened the discussion by stating that it would be remembered that two papers had been read before the Association previously on electric power for cotton mills, one in 1892 and one in 1895, but at the present time they were no nearer than they were then. Now they had another paper with practically the same proposals. He was of opinion that Mr. Raworth's scheme was of such magnitude as to be impracticable. In order to get the 50,000 H.P. which Mr. Raworth spoke about, it would mean that there would have to be about 50 cotton mills taking an average of 1,000 H.P. each. Anybody who knew about the capital required for cotton mills, and where it came from, would agree that it was not likely that the capital could be found to build these mills. Then, of course, there was the capital required for the large generating station itself. The capital cost of this must be enormous, and to his mind the proposal was altogether impracticable.

Mr. Hans Renold gave some interesting data as regards the use of electric power in his works. He stated that the power was supplied by the Manchester Corporation, and he had paid 1½d. per unit for it, although he heard that it would be reduced after September to 1¼d. per unit. He had had many inquiries at his works as to the cost of driving as compared with steam. It seemed to him that that was the first question that everybody asked, but he thought the first question that ought to be asked was, what do you get for your money? For cleanliness and convenience there was no comparison between the two, and to his mind the great saving by the use of electricity lay in the fact that each department could easily see what power was being taken and could prevent waste immediately. He had some 100 H.P. motors installed, and since they were first in use in November, 1896, he had not had to carry out any repairs whatever, the only thing required being just the turning up of the commutators on three of the motors; these commutators had been worn through the machines being overloaded. Its convenience was very great. He had been puzzled for some time how to get power to his smithy which was across the yard away from the main building, but now with electric driving he had simply to run a pair of wires across the yard and switch the current on. The same remark applied to his pattern makers' shop, and in all these places by means of the ammeter they could tell exactly what power was being taken. He gave some interesting figures respecting the power taken to drive the shafting in his shops, and stated that with all the losses the cost to him to drive his machine tools was about ¼d. per hour, the cost for the largest lathes when working fully loaded being ½d. per hour. He thought that electric driving was more in accord with a modern workshop; one of the great advantages was that they could increase the power required from time to time with ease. When additional power was required all they had to do was to connect up by means of the wires and everything was then ready for them to start work. This was an important point, especially in a rapidly extending business where it was impossible to say what the ultimate power required would be, and he thought all these conveniences would warrant engineers going thoroughly into the matter of electric driving in the future before putting down steam driving plant.

Mr. Holmes said so far from no advance having been made during the last five years in the use of electric driving, he would say that his experience went to show that there had been a very large increase in the number of motors used during the last few years, and gave figures relating to the increased supply, year by year, of the Lundell motors.

Mr. Wordingham, as an electrical engineer, was naturally interested in the extension of the use of electrical energy in all possible directions, but at the same time he believed that sound progress could only be made on a solid basis of fact, and he regarded hypothetical figures which could not be substantiated in practice as likely to greatly damage the cause of true progress. He did not wish to take up much time, but as a direct attack had been made on the Manchester Corporation, he would ask the indulgence of the members for a few minutes. Mr. Raworth had evidently thrown down the gauntlet, and it was only left for him as the electrical adviser and the one responsible to take it up. This he did willingly, as Mr. Raworth's figures were so exaggerated that it would be an easy task. 1½d. per unit was stated to be a low price for a municipal service, implying that companies' charges were lower. What were the facts? There was no purely power station of which he had the returns, but he would cite the results in lighting stations, concluding that power stations would be *pro rata*. The average price taken over the whole country for municipal stations was 4·79d., for companies' stations 5·79d. The lowest price charged by municipal stations was 2·99d. at Edinburgh, and the highest 5·85d. For companies' stations the lowest price was 4d., or 30 per cent. over Edinburgh, while the highest price was 7·73d. at Hastings and Harrow, or nearly 2d. higher than the highest municipal station. He thought Mr. Raworth meant only to compare municipalities with the very large distribution companies which he had spoken of. These companies were very much in the air and were very much talked about. In Manchester they were actually constructing a station of 14,000 H.P., and were about to construct one having an ultimate capacity of 100,000 H.P. The site was purchased and the plans were in an advanced state. That was doing something. He proposed to examine, firstly, the items constituting the cost of supply; and, secondly, the possible saving to be made by large stations over small. He would here call their attention to the fact that the author made a verbal correction in reading his paper. On page 12 he so altered the wording as to make his estimates apply to generation only, no account being taken of any other expenses or even distribution. His estimate of ·384d. per I.H.P., he compared in the next paragraph with the Manchester price of ·93d., which, of course, included all expenditure. The items of costs of supply divided themselves into standing charges and running charges. The standing charges were those which were incurred for being able to work at a given rate, and were consequently fixed by the maximum power of the station. The running charges depended upon the number of hours the plant was worked. The standing charges were made up of interest charges on capital, cost of attendance of a certain number of men prepared to run the plant when wanted, and the cost of the coal necessary to be burnt to make up for radiation losses; this was an enormous item, and no one but a central station engineer could conceive the amount. The running charges were cost of additional coal for running engines, feed water, additional wages, oil, repairs, &c. All these were generation costs. The distribution costs were made up of interest on capital, cost of providing mains, cost of staff necessary to maintain them and to make the connections to consumers' premises. It was obvious, therefore, that the cost per H.P.-hour depended upon the number of hours the energy was used, because the standing charges

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were inversely proportional to that. The amount of the standing charges and running charges, and their relative proportion to the total cost, was one that was not easy to accurately appraise, but this was done most carefully by the late Dr. John Hopkinson, than whom there was no greater authority, and whose name would assuredly carry weight amongst Manchester engineers. Dr. Hopkinson estimated that the cost of being ready to supply did not differ greatly from £9 per annum per H.P., and that the running charge was approximately ·295d. per H.P.-hour, so that on this basis the cost of Mr. Raworth's H.P.-year, reckoning 2,754 hours to the year, would be £15 8s. instead of £1 19s. 11d. The difference was substantial. Dr. Hopkinson's calculations were based upon actual prices for machinery, &c., and the engines were calculated to consume 2¼ lbs. of coal per H.P.-hour, assuming an evaporation of 9 lbs. of water per pound of coal, 20 lbs. of water per H.P.-hour, while the coal was assumed to be the best smokeless, costing 20s. per ton. Undoubtedly the steam consumption was high, and Mr. Wordingham assumed that it could be reduced to 12 lbs., and the price of coal to Mr. Raworth's 7s.; the figures then were approximately £8·80 per H.P.-year, or well over four times that calculated by Mr. Raworth. Dr. Hopkinson's figures worked out after careful study to about ¾d. per H.P.-hour, against the ·93d. charged by Manchester. Mr. Wordingham went on to check Dr. Hopkinson's figures for capital expenditure by actual results, and also by recent estimates by Mr. Parshall. The capital cost per horse-power installed, taking the mean of 81 generating stations established in the country, as given by Mr. Garcke, was:—Land and building, £14·99; plant and machinery, £27·75; mains, £25·68; meters, £3·28; instruments, £0·95; provisional orders, £1·86; or a total of £74·51. It was difficult to see how Mr. Raworth's ideal station could obtain its plant for less than one-sixth of that sum, for although the cost of land and buildings may be reduced, this would be counterbalanced by the heavy cost of the high pressure mains. Mr. Parshall, in a report to the Glasgow Corporation, estimated that in a station of nearly 20,000 H.P., employing engines of about 4,000 H.P. each, the cost of coal per H.P.-year would be £1 14s. The cost of oil, water, waste, supplies, labour and maintenance, all of which were apparently included in Mr. Raworth's labour, management, repairs, stores, was £1 3s. 6d., or a total of £2 4s. 10d., as against Mr. Raworth's 18s. 5d. Mr. Raworth stated that the Trafford Park Power Company were taking contracts at ·56d. per H.P.-hour. Mr. Wordingham hoped that if there were any shareholders besides those who were their customers, they would be satisfied with the result; he would not like to step into their shoes. He preferred figures derived from actual practice in many towns to estimates worked out on paper. It would interest members to know that the very low prices quoted were based upon estimates of cost founded on boilers fired with gas in connection with an ammonia recovery plant. As an advocate of a single large station under certain conditions as against a number of small ones, he might perhaps be allowed to point out on what grounds the saving was to be anticipated. Briefly, the items of saving were lower cost of management, cheaper land, because the station would be a high pressure one and could be placed at practically any point, large generating sets with correspondingly diminished cost per H.P. and diminished cost of attendance, and lastly, and above all things, improved load factor caused by the superposition of a number of different classes of demand, owing to the residential districts being tapped. In a place like Manchester, the city load fell off rapidly at about 6 o'clock. If consumers could be catered for when they went home, a new load was experienced, greatly prolonging the length of use of the plant. The case of Mr. Raworth's station was very different; he would serve 100 square miles of territory, but there would be a number of towns having similar load factors superposed upon one another, and the resultant load factor would be the same as any one of them, while the station would be handicapped with the enormous cost of the high tension cables. In conclusion, he would say that he did not feel that the Manchester municipal station had anything to fear from the hypothetical stations referred to in the paper, nor would Manchester consumers be able to purchase their energy at a lower rate than that at which it was supplied by themselves through their Corporation.

Mr. Lester Taylor had had very great opportunity of watching the rapid progress that electric driving was making, and the list given in the author's paper was very insignificant as compared with lists that might be furnished. There was no doubt that electric driving was very much more convenient than any other form of driving, and in nearly all instances the firms who had used it liked the power. He stated that in some installations special apparatus had been fixed to enable the consumer to record the current taken by any one machine. The apparatus consisted of a distributing box into which the ammeter circuit could be plugged, and by this means waste could easily be detected. Some consumers were not altogether satisfied with electric driving, but in each of those instances he had noticed that these firms had tried to sub-divide the power to too great an extent; there was a limit to this sub-division. He found that portable motors had been called very much into use. There was no doubt that electric driving was most convenient, and he thought it should receive the serious attention of the members of the Association.

Other members spoke respecting the power required by the shafting and machinery in cotton mills, but they were generally of opinion that even the costs given by Mr. Raworth were too high for them to consider at present. Then the electricity got into the cotton on the spindles, one gentleman remarked, and they did not want any of that.

Mr. Raworth replied that the discussion had been one of the liveliest that it had ever been his pleasure to have heard on his papers. With regard to Mr. Saxon's remarks, he had never stated anywhere that the energy would be to supply cotton mills alone, it was intended to supply workshops of all descriptions and power generally. He certainly never expected that capital would have to be found to build new mills round the supply station. He was pleased to hear that Mr. Hans Renold agreed with him in his scheme and thanked him for his interesting figures. Mr. Wordingham thought that he (Mr. Raworth) implied in his paper that municipal stations did not supply current at so low a price as did companies. He never intended to convey any such meaning, and as far as Manchester was concerned, he thought that through their very able adviser, Mr. Wordingham, backed up by his chairman, Alderman Higginbottom, they had done a very great deal towards popularising electricity for motive power. Mr. Wordingham stated that the annual capital charges, or rather standing charges, per horse-power were £9, and that in addition to this 0·295d. per H.P.-hour had to be added as a running charge. These figures were tabulated by Dr. Hopkinson some years ago, and although the prices of machinery generally were very much lower than they are at the present time, still the proportional cost was much lower now on account of the larger units employed. With regard to the Trafford Park Power Company, this was not being worked in connection with a gas ammonia recovery plant. It was worked by a steam plant with Universal engines, and the cost per horse-power for engines and dynamos was as low as £4. He was pleased to hear that Manchester was erecting a generating station and he wished it every success. He was glad Mr. Holmes's sale of motors during the last few years had increased so enormously. With regard to Mr. Lester Taylor he agreed that electric driving was very much more convenient, and also that it was necessary to exercise great care as regards the sub-division of the motors. In some cases it might, for instance, take 20 1-H.P. motors to drive 20 machines, but a motor of 10 H.P. would be required to drive the lot. He would like to inform the members that the electricity which got into the cotton was not of the same character as that which was put into the motor. The electricity which got into the cotton was called static electricity, and had nothing to do with that supplied to the motor. He thanked the members for the manner in which they had listened to his paper.

Mr. Hy. Webb, the chairman, proposed a vote of thanks to Mr. Raworth, which was heartily responded to in, as he called it, the good old Lancashire fashion.

A NEW INCANDESCENT LAMP FACTORY.

An article appeared last week in a contemporary, describing the factory which has been erected by the Berrenberg Electric Lamp Syndicate, Limited, for the manufacture of incandescent lamps on the system devised by Mr. Berrenberg. The main feature of this process is the use of so-called "mechanical" instead of mercury pumps. The great difficulty, up to the present, has consisted in the poor vacuum obtainable with the former apparatus. Mr. Berrenberg, by an ingenious device, has now removed this objection. Two sets of pumps are used, one for producing a fairly good vacuum, the other for obtaining the highest vacua for the exhaustion of the lamp bulbs. By enclosing the valves and joints of the second pump in a casing exhausted by the first, inward leakage is entirely stopped.

In this way a very high vacuum is obtained, free from mercury vapour, which is known to be detrimental to the useful life of the lamp. From both these causes the makers claim a long life and freedom from blackening for their lamps. Further, it is stated that, thanks to the good vacuum, the filaments can be more highly incandesced than in the case of lamps exhausted with mercury pumps, and that consequently the efficiency of the lamps is very high. Curves are given, showing that a 100-volt lamp of 16 C.P. nominal has an average candle-power of over 15 C.P. for 1,000 hours, with an efficiency of from 2·4 to 3·0 watts per candle-power during that period. If these figures can be realised in everyday work, there can be no doubt that they will constitute an immense improvement upon the lamps at present obtainable. We fear, however, that other claims put forward in the makers' own statements are somewhat too optimistic; apart from the absurd statement that "the consumption of current in 5, 8, 10, 16 and 25-C.P. lamps is only 2·5 watts," and that lamps of 600 C.P. take *one watt* (!), the makers aver that no energy is wasted in heat, and that their use will effect "a saving of from 5s. to 15s. per lamp in electric current, according to cost of current;" considering that the average annual receipts per 8 C.P. lamp only amount to 6s. or 7s., the last claim can only be founded on some such quibble as "we spoke of a 100-C.P. lamp," or "we did not say an *annual* saving." Such exaggerations recoil on the head of their perpetrator in the long run, and, at the same time, discredit the trade in general.

REFUSE DESTRUCTION.

We have before us a copy of a report or general observations made to the Municipal Council of Geneva, by Ami Wagnon, Président du Conseil Administratif, Délegué à la Voirie, on the question of the sanitation of towns by refuse incineration. The author of this report has brought together a great deal of useful material on the subject, and for much of his information he acknowledges his indebtedness to a number of English engineering and other technical journals. Like a modern orator of note, he appreciatively quotes the ancient laws of Moses as proving the necessity of employing the best methods of sanitation.

Refuse there is, and refuse there always has been, we can't get

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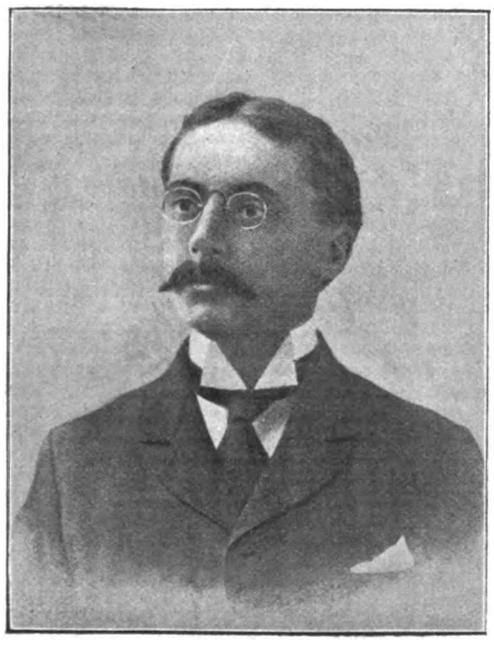
away from that, the difficulty is to remove it in the speediest, cleanest, healthiest, and most economical manner. The enemy of health is split up into two parties, "the direct organic emanations, sewage of houses and factories," and garbage or "kitchen refuse and sweepings of all kinds."

At Geneva there is an urgent demand for an altered system of transporting and disposing of refuse deposits, therefore M. Wagnon has studied simultaneously the complete re-organisation of refuse carts, and the destruction of refuse by incineration, and has collected information showing what is being done in different countries, describing, in the course of his notes, an up-to-date destructor plant. The method of putrefaction, method of sorting, manufacture of manure and direct utilisation, are among the matters dealt with. These are followed by a reprint of extracts from a report by a Brussels Commission which came to England in 1897 to study refuse burning furnaces. The Horsfall system, established at Leeds, Oldham, Bradford, Edinburgh, &c., is described and well spoken of. Some notes and illustrations are given of the Horsfall furnaces (36 cells) at Hamburg, stated to be the largest installation of the kind in the world; also of the destructor at Powderhall, Edinburgh. The Horsfall system employed at Oldham, which has been worked since 1891 in connection with electricity works, is detailed, and notes are given of results obtained when working. The report gives expression to the opinion that the Horsfall destructor is the best that can be used for a town which is desirous of securing freedom from refuse and its ill effects.

TRANSMITTING PICTURES BY ELECTRICITY.

In the Electrical Review, Vol. xliv., p. 926, we described an invention of Mr. Ernest A. Hummel, by which pictures had been successfully transmitted over a telegraph line 1,500 miles in length. Another American inventor, Mr. William P. Dunlany, has been successfully working at this subject, as will be seen from the adjacent illustration,* where the transmitted portrait is placed side by side with the original photograph for comparison.



In transmitting a picture or drawing, it is first stereotyped on a flexible metal plate. The outlines of the picture are left exposed while the remainder of the surface of the plate is covered with non-conductive paint. This is the reverse of Hummel's method, where the picture was drawn in insulating ink on tinfoil. The flexible plate, in the Dunlany apparatus, is bent round a brass cylinder, which is rotated by an electromotor. An arm bearing a tracer is gradually moved from right to left by a fine threaded screw until the whole picture is covered by the tracer. Both sending and receiving instruments are governed by a simple synchronising arrangement which is not described. The tracer at the sending point controls the current on the wire, and closes the circuit whenever it comes in contact with the exposed lines of the picture.

At the receiving end, the apparatus is similar to that at the transmitting point. The projecting arm over the cylinder is, however, provided with a stylus controlled by an ordinary telegraph sounder. Around the cylinder are wrapped several sheets of paper with carbon copying sheets between them. The sounder bearing the stylus closes down on the cylinder and copying paper, recording the most minute lines in the original picture as the tracer at the sending point passes over them.

In transmitting written or printed matter, the process is the same, except that the copy is either written or copied on a flexible brass or metal plate, the circuit being broken whenever the tracer strikes the ink, which is non-conductive. In this case the receiving instrument is reversed, so that it records on the paper the opening instead of the closing of the circuit. The synchronising arrangement is so constructed that no matter how many receiving machines there may be cut into line, it is not necessary to have an operator to care for them. It is said that the operator at the transmitting point can easily correct or regulate the speed of all. Pictures have been transmitted by the Dunlany apparatus over a line 650 miles in length.

* *Western Electrician*, September 9th, 1899.

THE PENALTY CLAUSE.

(From a Legal Correspondent)

The article upon this subject, which was published in our issue of October 27th, may be usefully extended by a discussion of the following proposition:—Let us suppose that

a Corporation enters into a contract with a firm of electrica engineers, who undertake to supply all the dynamos for the installation. By a clause in the contract, as drawn up, the Corporation is entitled to demand a penalty of £50 a day for overtime. Owing to pressure of business, the engineers are unable to complete their part of the agreement for several months after the day specified, with the result that the amount of the penalty exceeds the contract price. What, then, are the rights of the parties? Can payment of the entire penalty be enforced, although the inevitable result of such payment must be that the engineers not only furnish the dynamos free of cost, but pay a large sum in addition? We are assuming an almost impossible, but yet not unheard of, state of facts, for this reason, that every sound principle of law which is applied to the interpretation of contracts, should be capable of being pressed to its logical conclusion.

We have said that such a state of things is not unheard

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of. There have been a large number of penalties enforced during the last three months. In one which has been brought before our notice, the contract price was £3,000, while the sum demanded as and for liquidated damages was no less than £4,000!

As we have already pointed out, the question whether the amount named in the contract is to be regarded as "liquidated damages" or a "penalty" depends upon the difficulty or ease which the Court is likely to experience in arriving at the true measure of the actual damage sustained. It may therefore be assumed that if a case similar to that under discussion was brought before the judge, his Lordship would be entitled to say, "The damage caused by one day's delay cannot be easily estimated, and the parties must be held to their bargain as far as possible. Although it would be preposterous to enforce the payment of such sums for an indefinite period, yet the contractor has made this bargain in full knowledge of all the facts, and unless he declares the contract off within a reasonable period, and thereby exposes himself to an action for breach of contract, his legal liability to pay the penalty must continue." As we shall see hereafter, there are a number of causes which may operate to prevent the Court from arriving at any such conclusion. That the Court does not go out of its way to assess damages may be gathered from the following case:—

A purchaser of the materials of certain old buildings was to remove them himself, and to repair those not to be removed, and cope the walls not to be taken down. He gave a bond that he would have the materials removed and the work completed by a day, or pay £10 "penalty" for each week he should be behind.—Held, that the breach was incapable of measurement, and the so-called penalty was really liquidated damages.—Bonsall *v.* Byrne (Ir. R. 1, C. L. 573).

An instance of the enforcement of a penalty which amounted to unliquidated damages in a very considerable sum, is afforded by the following case:—The plaintiff contracted to supply 5,414 tons of iron rails to a foreign company, delivery to commence by February 15th, 1873, and to be completed by April 15th, 1873, subject to payment of a penalty of 7s. 6d. per ton if makers should exceed the time named. The workmen in the employ of the defendants struck work, and defendants did not deliver any rails until the month of May. There was no strike clause. The whole quantity was not delivered until the month of September. *Held*, that the sum of 7s. 6d. per ton per week was a liquidated sum which the defendants were bound to pay to the plaintiff, but that it was only to be calculated from May 15th.

Another instance of the enforcement of a large penalty was afforded last year in the case of Thomas *v.* London Sewing Machine Company (15 T. L. R. 38). There a contract for service contained a clause to the following effect:—"If at any time during the said term the company shall by notice determine the agreement and the engagement hereby created without assigning any reason, the company shall thereupon pay to the said Thomas, by way of compensation and in full discharge of his rights and claims, the sum of £1,000." The jury having found that the plaintiff was not properly dismissed, Mr. Justice Matthew awarded the whole sum mentioned to the plaintiff by way of liquidated damages. He said:—"In any case I would have had great difficulty, in view of the terms of the agreement, in assessing the damages at any other sum than £1,000."

It should, perhaps, have been mentioned in our former article upon this subject, that the question whether payment of the full sum will be enforced sometimes depends upon whether the contract is, or is not, capable of being broken in one or more different ways. Thus, in the case of Law *v.* Redditch Local Board [(1892) 1 Q. B. 127], a contract made with the defendant corporation for the construction of certain drainage works, provided that the works were to be completed in all respects on or before April 30th, 1889, and that in default of completion the contractor should forfeit and pay to the urban authority the sum of £100, and £5 for every seven days during which the works should be incomplete after the said time.—Held, that as there was only one event, the non-completion of the works by the specified date, upon the happening of which the sums of £100 and £5 per week were to become payable, those sums must be considered as liquidated damages and not as penalties.

We have said that his Lordship *would be entitled* to decree the payment of a penalty for an indefinite period. It is obvious, however, that a preposterous figure would soon be reached, and the Court, although in an ordinary case it would be reluctant to attempt the assessment of the damage, would be driven to do so in an extreme case, and to declare, in effect, that the sum mentioned in the contract was indeed a *penalty*, and therefore capable of readjustment.

Although the strike clause prevents the time during which the strike lasts from "running" as against the contractor, it does not indemnify him from the disruption of business which generally follows in the wake of a trade dispute. Thus the great strike in the engineering trade brought about a congestion of orders which it was impossible for the undertakers to fulfil within the limited time after the men had returned to work. There has been no expression of judicial opinion as to how far the Court will allow the strike clause to cover the remoter damage. In the absence of authority it would seem that where no liquidated damages have been fixed, or where the Court has decided that the sum set apart shall be regarded as a *penalty*, and therefore capable of readjustment, all the evil consequences, both present and future, of a strike might be taken into consideration.

A further question sometimes arises, namely, suppose the corporation would have been unable, owing to the non-delivery of the boiler and engines, which were in the hands of one contractor, to make use of the dynamos if they *had* been delivered by another contractor within the time specified in his contract, would this excuse him from liability which, in the ordinary course of events, would have been consequent upon delay? No doubt such contingencies could and would be taken into consideration by a merciful corporation who were anxious to assist their contractors as far as possible. We are given to understand, however, that generosity is not an element upon which contractors should place much reliance in their dealings with the vestry or other local authority. For the determination of the legal point we are once more reduced to a consideration of first principles, without reference to judicial opinion. In the first place, it may be said that in all actions upon contract, if the plaintiff is unable to prove damage, his remedy will be *nil*. Of course, if the judge decides at the outset that the damages are "liquidated," the case is at an end. We may assume, however, that when considering the question whether the full penalty is to be demanded or no, the Court will inquire, Has there been any damage? If such a question is gone into, the defendant will clearly be entitled to call rebutting evidence to show that, by reason of other persons' delay, his own default caused no damage of a substantial character.

Yet another consideration forces itself upon our notice. If the corporation are able, by putting a little extra pressure upon their existing installation, to do the work for which the new plant has been ordered, is this an element which can be regarded in assessing the damages? Here, again, the absence of direct authority prevents us from giving a very satisfactory opinion; but it may be said that upon general principles of law, assuming the Court has decided the momentous question as to whether the sum named is "penalty" or "liquidated damages," evidence may be admitted to show that the damage occasioned by the delay was not so great as at first supposed. Thus, in the case of Oldershaw *v.* Holt (12 A. & E. 590), where the action was for breach of an agreement to build upon land, the defendant was allowed to show that the plaintiff had re-entered upon it under the covenant and let it to another tenant.

As we have stated, this opinion is put forward with some hesitation, as no direct authority can be cited in support of it. Yet one point is clear enough, namely, that there is no duty on the part of the contractor who supplies the dynamos to see that the boiler maker supplies the boilers in good time.

The contractor sometimes duly performs his contract, and has the machinery ready packed for delivery on the day named in his agreement with the corporation. Suppose they refuse to take delivery, has the contractor any remedy? This question appears to be answered by the 37th Section of the Sale of Goods Act, 1893, which says, "When the seller is ready and willing to deliver the goods, and requests the buyer to take delivery, and the buyer does not within a reasonable time after such request take delivery of the goods, he is liable to the seller for any loss occasioned by his

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neglect or refusal to take delivery, and also for a reasonable charge for the care and custody of the goods. Provided that nothing in this section shall affect the rights of the seller where the neglect or refusal of the buyer to take delivery amounts to a repudiate of the contract."

With regard to the form of the contract which should be entered into with the District Council, or other local authority, it is important to notice that a penalty clause is sometimes compulsory, and if it is omitted, the whole contract is vitiated. Thus the Public Health Act, 1875, Section 174, Sub-section 2, provides, with respect to contracts made by an *urban* authority under the Act, that every contract, whereof the value or amount exceeds £50, "shall specify some pecuniary penalty to be paid in case the terms of the contract are not duly performed." In the case of the British Insulated Wire Company *v.* the Prescot Urban District Council [(1895) 2 Q.B. 463], the plaintiffs agreed to light the streets within the defendants' district for a period of five years for an annual sum. The contract contained no penalty clause, in consequence of which it was held not binding upon the defendants.

Upon the hearing of an appeal in this case, it was stated that the Local Government Board would sanction the payment of the arrears due under the contract which the Divisional Court had held to be invalid.

When we come to look at both sides of the question, it will be clear to all that the penalty must, in certain cases, be capable of being enforced to the last penny. A covenant providing for the payment of compensation for breach of contract is inserted not only for the purpose of defraying the increased expenditure which such a breach of contract may entail, but also for ensuring that the party under obligation to fulfil within the time named will use every means in his power to attain that end. It amounts, in fact, to a guarantee that the contractor is "ready and willing" to complete, that he will not embark upon other undertakings of an onerous character which might hamper him in the performance of his original agreement. Bearing these facts in mind, every contractor who stands aghast at the magnitude of the penalty which his employers are empowered to demand, should remember that if he accepts orders which are likely to occupy his men during the period which should be devoted to staving off the infliction of the penalty, he must set the profits earned by the execution of such orders, against the penalty which the non-fulfilment of the original contract of necessity brings in its wake.

If he sees clearly some time beforehand that he cannot possibly complete his contract, his wisest course is to serve a notice to that effect upon the corporation at the earliest possible date. That body will then be entitled to seek performance elsewhere. In a subsequent action for damages, the amount recoverable would be very materially reduced if the defendants were in a position to prove that the plaintiffs had ample opportunity of obtaining the execution of their order in another quarter. The ordinary clause providing for payment of a sum as a penalty, or as liquidated damages of so much per week or per day for the amount of delay, does not apply if the builder abandons the contract, or the employer enforces a forfeiture. For in such a case the date of completion cannot be ascertained, and the remedy of the employer in default thereof is provided for by the forfeiture clause or lies in an action for damages. [Ranger *v.* G. W. Railway Co. (1854), 5 H.L.C. 72, 118.]

Nor does it apply if the time for completion is extended. Thus, where an architect had power to extend the time for completion of the works, and to certify for payment, the works were greatly delayed. The architect certified without taking any account of the penalties:—Held, that he had extended the time, and no penalties were recoverable: Laidlaw *v.* Hastings Pier Company (1874), Ex. Ch., "Jenkins and Raymond's Architects' Legal Hand-book," 4th edition, p. 238.

ELECTRICAL DISTRIBUTION OF MOTIVE POWER.

The discussion on Mr. Raworth's paper on this subject, split up, as we had anticipated, into two lines of criticism; some speakers followed the proposals to supply power from a general power supply, others only touched upon the internal distribution of power by electromotors.

Mr. Wordingham's facts and figures were skilfully handled to prove that municipal stations could supply as cheaply as any company, but the figures quoted are not very convincing. The engineering of a purely power supply is a very different problem from that considered in a supply for lighting; it also differs from an electric tramway supply, and if the general power distribution service is to be confined to power supply only, and lighting is not to be supplied by the service, then the supply can no doubt be much cheaper, and the first cost of plant and distributing must be much less than in the combined supply system. The average demand for power would approach the maximum demand much nearer than is possible in any system supplying lighting as well as power. We, therefore, are inclined to agree with Mr. Wordingham, with regard to the colossal proposals to supply hundreds of square miles with electrical energy for all purposes, that the municipal supply would be quite as cheap. We believe there is room for purely power supplies, wholly apart from lighting, the standing charges connected with the latter supply being too heavy to be carried along with a power supply.

Mr. Wordingham was quite right in taking the proposed large schemes as combined power and light supplies, for in so doing he could discuss them from the point of view of practical experience in supplying power and lighting from one station. At the same time we regret that no one seemed to consider the possibilities of a supply designed for power only.

Mr. Saxon practically agreed with our own views in the matter of cotton and other mills; these large concerns get their power at a price per horse-power per annum much below any figure yet touched by electricity suppliers.

The contribution of Mr. Hans Renold is of interest, as he describes a case in which he finds it better to distribute power inside a factory by electro-motors than by mechanical means; in fact, he took up the secondary distribution part of the subject, and proved that in his case it is advantageous to adopt electrical distribution, even at 1½d. per unit delivered.

On this secondary distribution question the speakers, without advancing any solid foundations for their opinions, seemed to incline to the belief that sub-division of power was carried too far. Mr. Raworth even went to the extent of saying that it might take 20 1-horse motors to do the work of one 10-horse motor driving the lot; that is to say, assuming that all the machines are at work simultaneously, that the 1-horse motor's efficiency would be about 40 per cent. only. But in one of the tables in the paper we find a 1-horse motor (Lundell) with an efficiency of 74 per cent. and a 10 H.P. 84 per cent. efficiency, a difference of 10 per cent. only.

Therefore, to put the case properly, 10 1-H.P. motors would deliver without shafting 7·4 H.P., or 0·74 H.P. to each of 10 machines. It is very doubtful if the one 10-H.P., burdened with a shaft and 10 belts, would deliver as much power to each machine, because on the same basis it would only deliver 8·4 H.P. to the shaft which, with its 10 belts, would easily swallow up the remaining 1-H.P. due to the higher efficiency of motor.

Further than this the shaft would, with all its losses, run on all the time, even if driving only one machine; what would the efficiency of the 10-horse motor shafting and belting be then?

The fact of the matter is, that it is only by sub-division of the motors, and the consequent abolition of the constant losses in shafting and belting, that the secondary distribution can be shown to have economical results. This question of sub-division has not been carefully enough considered; it is a point requiring the utmost care in working out before advancing any statements for or against the limit to which sub-division ought to be carried.

An examination of a table appended to the paper proves that in most cases of shafting transmission, whether for large or small machines, the shafting uses more power than the machinery which it drives; while other tables, giving details of a few actual cases of secondary distribution successfully in use, prove that there is no

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doubt now as to the superiority in every respect, of electric distribution inside the factories. In many cases primary distribution is in use successfully at 1½d. per unit, and we have no doubt that at 1d. per unit it would compete with 90 per cent. of the engines in daily use.

REVIEWS.

Manual of Electrical Undertakings. By Emile Garcke. 1899-1900. Fourth year. London: W. Alderson Smith, Donington House, Norfolk Street, Strand, W.C.

For the convenience of those who are closely watching electrical developments there is no more useful book than this *Manual*. To those who want to find out the financial condition of any electrical company (whether connected with the telephonic, telegraphic, lighting, traction, or manufacturing branches of the electrical industry), the book is indispensable, and it gives a valuable collection of serviceable data of other kinds. Section I. is devoted to telegraph concerns, and Section II. to telephone undertakings. Section III., devoted to electricity supply undertakings, is naturally the most extensive. It opens with general statements, recording the fate of the General Power Distributing Bill in Parliament, and the passing of the Electric Lighting Clauses Act, and details at some length the present situation in the City of London and the threatened competition. The total capital of 87 supply companies to date is given as £9,265,793 (this includes ordinary, preference, and debenture capital); the loans authorised to be raised by municipalities number 124 for 1898, with a total of £8,531,167; the capital expended by 65 companies and 93 municipalities in 1898 was £14,975,741.

The number of lamps connected (8 c.p.), and units sold, in 1898 is given as—

	Lamps.
70 companies	2,943,297
88 municipalities	2,716,586
158	5,659,883

	Units.
41 companies	42,672,384
64 municipalities	42,476,726
105	85,149,067

The price obtained for current is given thus:—

37 companies	5·51d. per unit.
61 municipalities	4·35d. „

For these 98 undertakings the average working expenses per Board of Trade unit sold (exclusive of depreciation and sinking fund) are:—

Generation	1·79d.
Distribution	·25d.
Rent, rates, and taxes	·22d.
Management	·49d.
Special	·06d.
	2·81d.

The detailed figures appearing under the different headings in the electricity supply section are brought together in a ready form for comparison, showing diagrammatically the average revenue per Board of Trade unit of energy sold, and the cost of production in different towns.

The "Traction" Section IV., also contains a mine of information which is essential to the rapidly increasing body of electric traction engineers. The railways and tramways constructed and constructing are particularised, and the present position thereof is noted, a list also being given of lines which are in course of promotion. A table is given which shows the total capital of the electric traction companies in this country up to date of publication as £19,639,530.

The amount of capital expenditure on electric traction by 11 municipalities is set down as £1,169,429, a figure which has been doubled, we should imagine, by municipal schemes lately set on foot in London, Manchester, and a host of other towns, although the money can hardly yet be termed expenditure. A second table shows the total capital expenditure and total length of tramways opened at June 30th, 1898. The capital, directors, officials, system, and so forth of the various traction concerns are given in detail. Section V. deals with electrical manufacturing undertakings, VI. with miscellaneous, VII. is a directory of officials, and VIII. gives a complete list of the electrical companies registered since 1856. The work is an ambitious one, but the compiler has succeeded in his attempt, and deserves great credit for the large amount of arduous work which its production has entailed.

A Standard Dictionary of the English Language. Prepared by more than 200 specialists and other scholars under the supervision of Isaac K. Funk, D.D., LL.D., editor-in-chief, &c. Complete in one volume. New York and London: Funk & Wagnalls Company. 1899.

Our opinion of this work is now precisely what it was in 1894, when we reviewed the earlier edition, in fact, it would be almost impossible to find words for praising it too highly. This opinion has been strengthened by some years' use in the Electrical Review editorial offices, where we have found it of very practical service. We suppose there never was a time when the need was so widely recognised for everyone who could afford it to possess a really first-class dictionary or encyclopædia. This has been very distinctly proved by the successful issues of such works by the publishers of certain London newspapers, who, we imagine, have derived a considerable profit from this enterprise. It is a sign that there must be something more than ordinary kudos to be obtained therefrom, when so firmly fixed an institution as the Printing House Square publisher launches out into the furniture dealing trade by selling a special line of bookcases, and by expressing practical approval of the hire-purchase system. But for those who want a cheaper dictionary—costing under a five-pound note—and complete in one volume, instead of half-a-dozen or more, Funk & Wagnall's is certainly to be recommended. For convenience of handling and reference, we prefer it complete in one piece, at any rate, for ordinary purposes, and in such matters as excellence of binding, artistic effects in printing and illustration, the dictionary before us leaves nothing to be desired. In regard to the text, frequent references have inclined us to the belief that "dictionary" is a modest term with which to describe it; an "encyclopædia" would be a more correct description, for it explains many things in considerable detail, more than one would find in an ordinary dictionary. The artist's pencil has been made good use of for placing representations of things before the reader's eye in a more interesting way, and the exquisite coloured plates of all kinds of birds, decorations of honour, remarkable ancient coins, flags of all nations, national coats of arms, familiar flowers, solar spectrum and typical colours, Röntgen ray apparatus and skiagraphs, &c., furnish instructive material for hours of never flagging interest. An important addition which we observe in the present edition is an atlas of the world. The electrical terms throughout the work have been very carefully selected and explained by Mr. R. W. Pope, as on the former occasion.

Magnetism and Electricity for Beginners. By H. E. Hadley, B.Sc., A.R.C.Sc. 1899: MacMillan & Co., Limited.

"This little book is primarily intended to meet the requirements of students preparing for the elementary stage of the Science and Art Department's examination," &c. Needless to say, therefore, it deals with magnets, single and divided touch, needles, nails, iron filings, sealing-wax, ice pails, universal dischargers, Leyden jars, &c., &c.—we all know them so well! Happily, however, a good section on current electricity follows; the various phenomena are dealt with in a clear and well-arranged style, and numerous experiments, many of them possessing features of novelty, are described, with hints for the rigging-up of simple apparatus for performing them. The latter, indeed, is a marked characteristic of the book. A special feature is a chapter on force, mass, weight, &c. We admit the necessity of this, for we

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have known students who, after taking a three years' course in electrical engineering at a technical college, have been unable to distinguish between weight and mass, while acceleration was Greek to them. Yet they could solve differential equations!

The author rightly devotes much space to fields of force, potential, and energy. At the end of each chapter is a summary, followed by a number of test questions largely obtained from examination papers.

We object to the author's treatment of the couple on p. 37; a couple, applied as he indicates, would cause continuous rotation, not oscillation. The wording on p. 145, on negative potential, is obscure to a tyro; and experiment (ii.) on p. 240 would succeed as well without the presence of zinc, since iron filings are soluble in dilute sulphuric acid. On the whole, however, while we pity the author for having to write to such a syllabus, we welcome the book as one of undeniable merit.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

21,210. "Improvements in the method of and means for adjusting or setting of the points of tram lines and trolley wires of electric and other tramways." G. Barker. Dated October 24th.

21,219. "Improvements in electric cut-outs and in electric switch devices applicable thereto and serving as holders therefor." J. Sachs. Dated October 24th. (Complete.)

21,232. "An improvement in ear trumpets applicable also to telephone receivers and the like." L. A. Jacobson. Dated October 24th. (Complete.)

21,248. "An improved method of and means of mounting incandescence electric lamps." W. R. Lambert. Dated October 24th.

21,267. "Apparatus for enabling the positions of foreign bodies visible by the X rays to be located, and for guiding the operator in searching for and extracting the same." C. Remy. Dated October 24th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, April 4th, 1899, being date of application in France.)

21,276. "Improvements in magnetic separators." W. Clark. (C. F. Courtney, New South Wales.) Dated October 24th.

21,283. "An automatic electric switch." M. B. Ryan. Dated October 25th.

21,293. "Improvements in switch apparatus for use in the surface contact system of electric traction, and in operating switches used in such system." T. H. Parker. Dated October 25th.

21,302. "Improvements in or connected with electricity measuring instruments." C. Sondermann and R. Berlow. Dated October 25th. (Complete.)

21,311. "Improvements in an apparatus for exhibiting electric signals, advertisements and the like." A. J. Boult. (F. Y. Dalziel, France.) Dated October 25th. (Complete.)

21,318. "Electric motor." A. Fanti. Dated October 25th.

21,320. "Improvements in apparatus for separating magnetic from non-magnetic particles." J. Y. Johnson. Dated October 25th. (T. J. Greenway, S. Australia.)

21,329. "Means of maintaining and renewing the charge of electric accumulators, working motors for carriages, boats and other vehicles." P. E. Placet. Dated October 25th. (Date applied for under Patents, &c., Act, 1883, Sec. 103, May 27th, 1899, being date of application in France.) (Complete.)

21,354. "Improvements in apparatus for electrically winding up or giving tension to driving springs." H. Aron and Aron Electricity Meter, Limited. Dated October 25th. (Complete.)

21,355. "Improvements in apparatus for measuring multiphase electric currents." H. Aron and Aron Electricity Meter, Limited. Dated October 25th. (Complete.)

21,375. "Improvements in or connected with trolleys or collectors for electrically operated carriages." R. H. Wilkinson. Dated October 26th.

21,378. "Combined maximum and integrating electric meter." F. S. Halsey Dated October 26th. (Date applied for under Patents, &c., Act, 1883, Section 103, March 27th, 1899, being date of application in United States.) (Complete.)

21,392. "Improvements in or relating to contact devices for electric railways and tramways." A. J. Boult. (H. Laval, France.) Dated October 26th.

21,400. "Tanning by aid of electricity." A. T. Wedelin. Dated October 26th.

21,413. "Improvements in safety fuses for electric circuits." J. Sachs. Dated October 26th. (Complete.)

21,429. "Improvements in or relating to incandescent electric lamps." C. Wolfhardt. Dated October 26th. (Complete.)

21,445. "Improved means for use in operating from a running car switches employed with a surface contact system of electric traction." T. H. Parker. Dated October 27th.

21,447. "Improvements in the method of forming armature coils for dynamos and electric motors and in apparatus for use therein." T. H. Parker. Dated October 27th.

21,470. "An automatic charging device for electric motor carriage." A. Muhlberg. Dated October 27th.

21,498. "An improvement in receiving apparatus for wireless telegraphy." J. A. Fleming. Dated October 27th.

21,509. "Improvements relating to the utilisation of the momentum of railway trains for the production of electricity." L. de Montgomery. Dated October 27th.

21,542. "A multilocular polytonic coherer." S. M. Bottone. Dated October 28th.

21,562. "A separator for plates of secondary batteries." H. Leitner. Dated October 28th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

2,849. "Improvements in electric switches." A. E. Tanner, F. A. C. Leigh and G. Hill. Dated February 4th, 1898. Relates to switches particularly adapted for use in lampholders. In the construction a block of porcelain is formed with a flat face, or is hollowed to receive the switch mechanism, which consists of a pivoted contact lever operated by a key, or preferably by a push rod. The rod is fitted with a pin working in a slot in the lever. A spring gives a quick break. One of the fixed contacts is connected to one of the leading-in wires, and the other to one of the terminals of the lampholder. The base may be fitted with extensions to separate the terminals. 2 claims.

3,032. "Steering torpedoes electrically." W. Jamieson, J. Trotter and A. A. Govan. Dated February 7th, 1898. Consists in the application of electric waves or oscillations of high frequency for steering torpedoes. The coherer is connected at one terminal to the conductor outside the torpedo for receiving the electric vibrations, while the other terminal is connected to earth. A battery is in series with the coherer and with the relay. The armature of the relay is in series with the battery, electro-magnet, two solenoids, and the selector switch. The selector switch consists of a tube in two parts, which are insulated from one another and capable of rotation on bearings. The tube carries a disc having four teeth in two planes, and the tube is rotated by a spring. Brushes connect the tube to the solenoids. The armature of the electro-magnet has a catch which is always behind one of the teeth on the disc. If the torpedo goes off its course, electric waves are sent to the torpedo, and reach the coherer which operates the relay, closing its secondary circuit. A current then flows through the selector to one of the solenoids, the iron core is sucked in to right or left, and the rudder is turned. When the waves are stopped the vibration due to the screw propeller restores the coherer to its original resistance, and the catch which first was drawn forward from behind one tooth, now swings back from the second tooth, and thus allows the selector to rotate half a revolution, ready, when electric waves are again sent, to turn the rudder in the opposite direction. If the rudder is required to be operated a second time in the same direction, two waves must be sent from the transmitter in quick succession. In a modification, the solenoids are replaced by an electro-motor, which rotates the rudder shaft. 2 claims.

3,188. "Improvements in the manufacture of carbons for electrical purposes." C. L. Saunders. Dated February 8th, 1898. Relates to a process for preparing carbons for electric arc lights and for other electrical purposes. Consists essentially in effecting the necessary intimate and uniform mixture of the materials employed in a wet state by the use of some of the ingredients in a liquid form. Any apparatus may be used. The crushed coke, lampblack, graphite, or other form of carbon is placed in a closed macerator having an agitator, and therein mixed with a suitable solvent for hydro-carbons, such as benzene, carbon bisulphide, eucalyptol, dead oil, &c., and with pitch, tar or oils, and any other desired ingredient, such as sulphuric acid, phosphates, cyanides, wax, or salts of sodium, strontium, &c. The slimy mixture obtained passes gradually into a vapour-tight wet-grinding machine, and from thence to a still having agitator arms. The solvent driven off passes to a condenser, thence to a separator for retaining water, and afterwards to a storage tank, from which it is carried back to the macerator. The dry powder left in the still is transferred therefrom, while still hot, to the cylinder of a forcing press, and forced into carbons of the required form. By adding the solvent only, the hydrocarbons present in coke may be dissolved out, the solvent recovered by ordinary distillation, and the heavy hydrocarbon obtained separately. The addition of pitch, &c., is then made, and the process proceeds as above. 6 claims.

3,204. "Improvements in electric arc lamps." C. A. Vigreux and L. V. Brillie. Dated February 8th, 1898. Relates to arc lamps. The carbon-holders, of which the upper one is heavier, are hung by cords from opposite sides of two pulleys secured near the ends of a shaft on which is also secured a toothed wheel in gear with a pinion on a brake wheel. This is loose on an axle which rocks on knife-edges and has an arm to which is pivoted a ring carrying a brake block on the left side, and the cores of series and shunt solenoids, the core being heavier. The arm may be weighted, or acted on by a spring. In a modification, the brake ring is connected to an arm of the rocking axle by a light spring, tending to disengage the brake. Either core and solenoid may be replaced by a weight. One core carries the piston of a dash-pot provided with a valve permitting rapid approach of the carbons, but preventing their rapid separation when the arc is struck. The valve may be a disc supported by light springs slightly above the piston, which is perforated and provided with a circular groove in its upper surface. In another modification for lamps of larger power, the carbon holders are suspended by pulleys in bights of the cords, the outer ends of these cords being attached to a special striking lever. This has a core situated over a series solenoid which produces a displacement of the striking lever, either lasting during the operation of the lamp, or only to bring the brake mechanism into operation, as desired. Jaws are hinged together and are closed on the carbon by a screw acting in opposition to a spring. The holders are attached to vertical rods and guided by sliding and fixed arms on insulated vertical rods, which form parts of the lamp frame. The pivot of the upper holder is hollow to receive its guide rod. 9 claims.

3,218. "Improvements in electric motors and dynamo-electric machines." H. H. Lake. (E. Cantono, Italy.) Dated February 8th, 1898. Relates more particularly to means for controlling the speed of motors by varying the excitation of their field-magnets, but the invention is also applicable to the regulation of the output of dynamos. The machine is composed of a pair of ring armatures situated one on either side of a central field-magnet, and mounted so as to be capable of a limited longitudinal movement on the shaft. Between the two armatures are interposed springs or buffers which tend to separate them, a tendency which is opposed by the attraction of the field-magnets. When by means of a rheostat or otherwise the field excitation is changed, the armatures approach or recede from the field-magnet, and corresponding variations of speed or output are produced. Each armature is built up of an internal ring on which a thin band of soft iron is wound, and this is enclosed in an external ring. The core thus formed is supported by wings radiating from a sleeve sliding on the shaft. To adjust the shaft longitudinally a ball bearing is provided at one end, the central double cone of which can be turned upon the screwed end of the shaft. This cone has several internal notches, any one of which may be caused to receive the key after a fraction of a revolution. The field cores are cast in one with their supporting crown, which has a small cross-sectional area. To facilitate the dismounting of the armature the upper pole and part of the crown may be detachable. The machine is enclosed in a casing composed of two parts secured to either side of the crown. Each of these two parts may have a removable cover. When the machine is used as a dynamo to charge accumulators, it acts automatically to regulate the output. 6 claims.

3,498. "Improvements in electrical cut-out apparatus." J. Andrews. Dated February 11th, 1898. Cut-outs in which the circuit is maintained by a normal or direct current, or broken by a return or excess current. A pivoted lever carries a spring end which fits between contact springs mounted on insulators. The lever is provided with projections against which the heel of a pivoted tumbler lever strikes when released by the spring detent. The lever carrying the detent is engaged by a stop on a shunt motor armature, and is only released when an inverse current tends to turn the motor backwards. The motor armature is normally held against a stop so as not to rotate by the direct currents. The catch lever and stop are so adjusted and shaped to give great sensitiveness. The shunt armature coil may be omitted, and a spring employed to hold the core in a suitable position to release the catch when an abnormal increase of current occurs. Springs or weights may be employed to hold the armature in the required position; a cam action may be employed instead of the stop. 3 claims.

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THE

ELECTRICAL REVIEW.

VOL. XLV. NOVEMBER 17, 1899. No. 1,147.

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THE

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1900

Edition

NOW IN PREPARATION.

H. ALABASTER, GATEHOUSE & CO.,

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THE BOARD OF TRADE AND ELECTRIC TRAMWAYS.

THE report of Mr. A. P. Trotter, Inspector of the Board of Trade, on the series of accidents on the Dublin tramways, has just been issued, and it contains some interesting, if not curious, conclusions. The report deals with four accidents, each of which was due to the rising of the trolley head above its ordinary position. In the first two accidents, the trolley head tore down the overhead wires, the third resulted in a trolley pole being broken, and in the last accident a detachable trolley head came off. Although these accidents are somewhat trivial in their nature, it is obvious that one or more of them might result in loss of life, and, in the interests of the public, as well as of electric tramway undertakings, there would be wisdom in adopting precautions which should tend to prevent a recurrence. It can hardly be doubted that all overhead equipment, as well as the trolley pole, is peculiarly liable to mishaps, similar to the ones under review; indeed, there are few electric tramway systems in this country which have not, at some time or other, experienced considerable annoyance from the trolley jumping a wire. One cannot help recognising the improvements that have been made in the various parts of the trolley pole, but it is clear that we have not yet arrived within a measurable distance of perfection. It may be taken for granted that, at some time or other, the trolley pole will jump the wire, and one has to seriously consider how the trolley head may be prevented from working mischief as soon as this happens. Unfortunately, the overhead wire system is handicapped by the necessity of using guard wires, and there are many instances on record where these have been completely torn down by the trolley pole. Mr. Trotter's report carefully reviews the standard practice in trolley work, and he clearly points out some of the troubles that may arise in the methods now in vogue. He states that where the Dickinson system is used to a moderate extent, the trolley wire being nowhere more than 5 or 6 feet from the perpendicular to the centre of the track, a trolley rope may be employed in the ordinary way, but it would be better to secure it to the foot of the trolley pole by a hook and ring. This, unfortunately, would remove the trolley rope entirely out of the immediate control of the conductor, and if, as happened in Dublin, a passenger were ignorant enough to mistake the trolley rope for a bell rope, he might just as easily interfere with the rope (which would be within his reach), if the suggestion of Mr. Trotter were carried out. One of the most serious troubles that is likely to arise from trolleys jumping the line, although the matter is not seriously dwelt upon by Mr. Trotter, is in the case of tramways using a span-wire system, for it is obviously easier, in the case of the trolley leaving the overhead wire, for it to catch in the cross wire than in the conductor itself. It is quite true that trolley heads have been devised which, to some extent, minimise troubles of this nature; but it is doubtful as to the extent to which they may prevent a

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recurrence of accidents, similar to those of Dublin. There is one point, however, which Mr. Trotter brings forward, which is deserving of the very greatest consideration. He points out that the centre pole arrangement, with brackets on each side for carrying the trolley wire, is used to a limited extent in Dublin, and is said to be unsuitable, on account of the unsystematic driving of cars, wagons, &c.; but it is difficult to see that even an Irishman's idea of unsystematic driving would be such as to cause him to collide with centre poles; nor do we think that an Irish jaunting car would gain much advantage by colliding with a heavy tramway pole. We emphasise this portion of the report because it is said that some of the brackets used in Dublin are of great length, several extending 20 feet. After a careful survey of most of the tramway systems in this country, we are inclined to the opinion that long-arm brackets are distinctly unsightly, and the wonder is, that local authorities have not, when raising objections to overhead wire systems, pointed out this somewhat aggressive feature of overhead equipment. Besides, we do not think that these long-arm brackets are altogether necessary, and we certainly are of opinion that they may do electric tramway practice a good deal of harm. We admit, without reservation, the difficulties that are met with in overhead wire construction, and although at times it may be necessary to adopt long-arm brackets, yet we are familiar with many instances where some other method might have been adopted with great advantage. At the present stage of electric tramways practice, it would be most unfortunate if the public were to become dissatisfied with the way in which systems are laid out; it is important to adopt those methods which give the maximum of safety and are compatible with neatness of design, and it can hardly be denied that long-arm brackets are being somewhat overdone. An almost cynical reference is made to the electric shocks that might be experienced on tramways, and Mr. Trotter observes that an electric pressure of 500 volts has been chosen because the result of shocks, due to light or brief contact, is not serious. The employés often receive them, but generally from carelessness. We are inclined to think that this is hardly the right view to take of the question, because, though 500 volts is generally safe, no efforts should be relaxed to make it impossible that the public should come in contact with the wire, for, after all, it is possible to kill even with 500 volts, and that possibility should never be lost sight of. It is unnecessary to labour this point further, but even if 500 volts were not sufficient to kill a person, it might effect very serious injury; and it is not so much the passenger on an electric tramway who runs the greatest danger, but the man in the street who comes in proximity to a fallen wire. The recommendations put forward by Mr. Trotter are little more than mild suggestions. He looks upon guard wires as a necessary evil, and suggests that they should be so well connected to earth by connecting the poles to the rails that any serious rush of current would melt the fuses in the feeder boxes. It might be desirable to add to the present tramway equipments such a fuse, though we are afraid that many tramway authorities would seriously object to it. One of the most important remarks, however, is on the form of guard wires. Apparently Mr. Trotter is not prepared to recommend wooden strips in the place of guard wires, and after seeing those in operation at Liverpool, one is inclined to think that they not only make the overhead line appear heavy and cumbersome, but they would not prevent a fallen wire twisting round the live conductor and thus becoming charged with a current of electricity. The adoption of a system of guard wires carried on the telegraph or telephone wires, is, however, in common use on the Continent, but, after all, is there any system of guard wires which would absolutely prevent a telephone or telegraph wire coming into contact with the live portion of a tramway system? We are afraid not. But what would be a distinct improvement is the practice commonly adopted on the Continent of the telegraph and telephone wires being compelled to cross the electric tramway at certain specified points. That, of course, would not get over the difficulty of telegraph wires running alongside the tramway; indeed, we do not know of any guard which would prevent a wire being blown sideways on to a trolley wire. The proposals, however, of Mr. Trotter are not likely to cause any hardship to tramway companies; indeed, they are exceedingly moderate, and we are sure that no owners of tramways would object to carrying them into effect if there is any probability of their ensuring a greater safety of the public.

Physical Society Meeting.

MR. F. S. SPIERS, in a paper read last Friday at the Physical Society, describes his attempts to obtain positive evidence as to the effect of the enveloping medium upon the contact potential differences of two metals, and thus to settle once for all the cardinal question in dispute between controversialists with regard to the seat of electromotive force in a voltaic cell. Our readers may remember that the experiments of Pfaff and Pellat, upon contact potential differences of pairs of metals in various gases, led to the assumption that, so long as there is no visible chemical action, the effect is almost independent of the gaseous envelope; and that Hankel pointed out that the potential difference of the two metals in contact is in some measure affected by the condition of the surface. More recently, Brown has shown that while, in air, copper is negative to iron, it is positive to iron in a medium of sulphuretted hydrogen. But as none of these experimenters took precautions to remove the air-films from the metals, there is in all cases doubt as to the exact nature of the enveloping medium. With great perseverance Mr. Spiers has tried to get rid of the air-films by replacing the air by hydrogen, in a heated glass tube, afterwards exhausting the hydrogen. The primary object being to remove the air-film, this may be an improvement on the method adopted by Bottomley, who enveloped the metals in melted wax; but it appears to be rather more than likely that in attaining his primary object, Mr. Spiers has introduced secondary actions of sufficient importance to vitiate the results. We notice that he is dealing with differences as small as $\frac{1}{50}$th of a volt, measured by a compensation potentiometer after the manner of Pellat and Kelvin. There can be little doubt as to the accuracy of the measurements, but there does appear to be reason to hesitate before accepting the author's interpretation of the observed potentials. In his experiments there are many conditions that might account for a stray $\frac{1}{50}$th of a volt. The electrification of the glass tube is one of them, the thermal differences are another, and there may even be an actinic effect. We fully appreciate the difficulties of his experiments, and we have nothing but praise for his brave attempt to carry them through; it is to be hoped, however, that when the investigation reaches its final shape, identical, or nearly identical, readings will be obtained from a second, third, fourth, and perhaps a fifth apparatus. The discussion did not amount to much. Dr. Armstrong had probably in view the experiments of Brereton Baker, who showed that moisture is essential to the combustion of phosphorus, sulphur, and similar substances in oxygen; he suggested, therefore, that since it was almost impossible to remove the oxygen film, it might be worth while to try to remove the moisture, and so prevent oxidation. Dr. Lodge maintained complete control of his powers of argument, and while making it perfectly clear, in a few words, that he surrendered nothing of his old views on contact electricity, he suppressed his controversial instincts with complete success. Indeed, we never remember an occasion of the kind where one who could say so much, did say so little.

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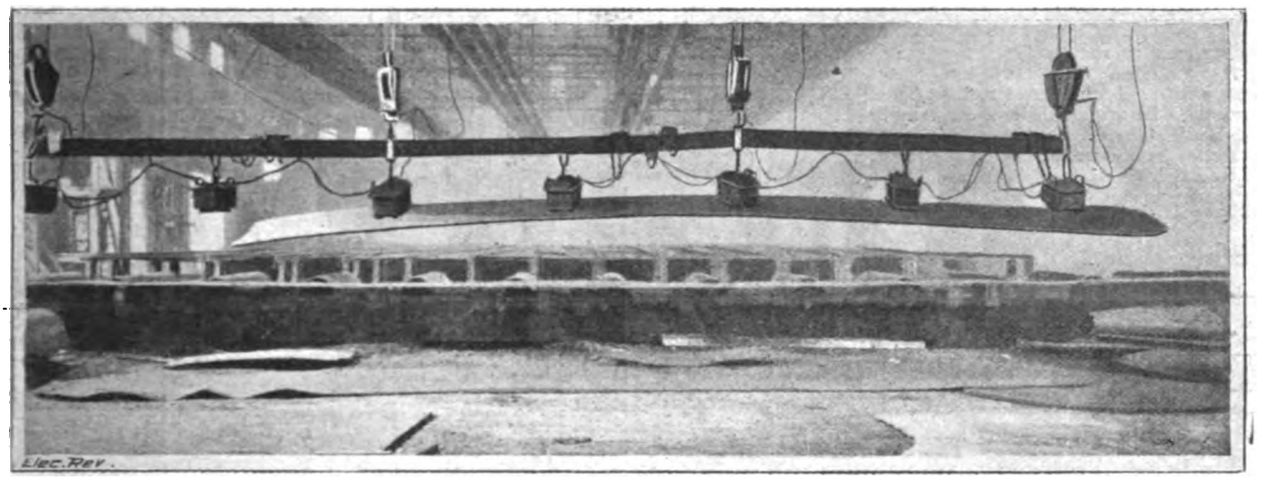
ELECTRICAL POWER IN STEEL WORKS.

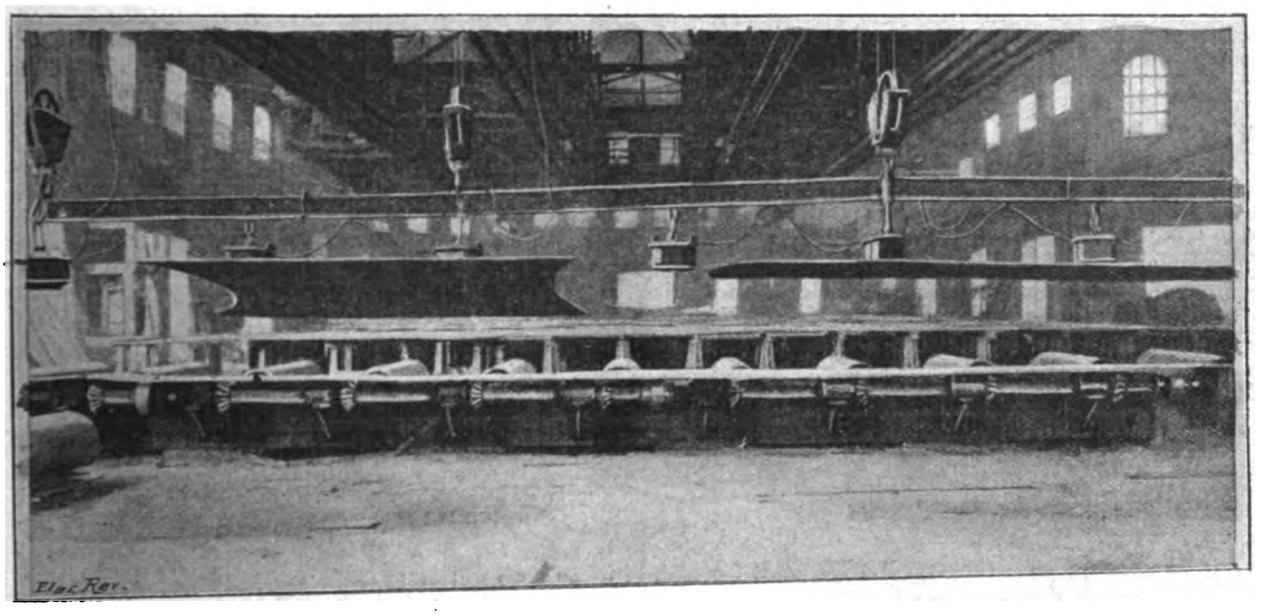
The illustrations herewith reproduced from the *American Electrician*, show electro-magnetic cranes carrying plates from the rolls to the shears, and carrying a long plate, also, in the works of the Illinois Steel Company, who have made very extended use of electric power for all the purposes of steel manufacture. The Illinois Steel Company's works covers an area of 450 acres in South Chicago. In the open hearth steel department, motors of 1,200 aggregate horse-power are employed, and motors of the same capacity in the slab mill. Their use is not confined to cranes, but they are used to work charging cars, to lift ingots, to drive transfer tables, &c. In the open hearth department are cranes of 75-ton capacity each, employed to handle ladles. The large cranes each carry two travelling hoists, one of which is of 20-ton capacity for turning ladles to empty them of slag. There are seven motors on the large cranes, another of which is to be installed, while there are two 30-tons and a 40-tons crane in the same department. In the new crane, steel wire ropes will be used in place of chains.



Electro-magnets Carrying One Long Plate.

The charging cars referred to are employed to place metal in the furnaces. They run on a very wide gauge track and carry a long arm, which can tilt up and down, and turn half over, as well as advance and retreat. All these movements are controlled from a distance by one operator. The metal to be loaded is cut up and placed in suitable pans of cast-iron. These are placed on racks along the face of the furnaces. The ram picks up the boxes by a special dovetail looking recess. It moves to the furnace front, the ram is extended, the box inverted, and its contents dumped upon the molten mass inside the furnace, all without excessive exposure of the operatives to heat. While so much used for plate lifting and carrying, electro-magnets here find a limit set on their powers. They cannot lift hot plates without injury to their insulation.

The central generating plant includes two 400-KW. Westinghouse generators, coupled direct to tandem compound Porter-Allen engines. The current is direct, at 250 volts.



Testing an Electro-magnet: Weight, 120 lbs.; Load, 3,000 lbs.; Current, 2½ amperes at 110 volts.

There is also a 600-H.P. vertical McIntosh & Seymour engine direct coupled to a 300-KW. Westinghouse generator.

The arc light plant consists of six T.H. machines, driven in pairs by three 100-H.P. Westinghouse motors, and there is also a 60-KW. alternator for incandescent lights. About 50 per cent. is saved in power cost by the electrical system over the steam power formerly employed.

COST OF CENTRAL STATION PLANT.

Now that electric lighting is settling down into a steady business, one can predict with a fair amount of accuracy the lines on which the electric lighting of a given sized town will move. It is, therefore, possible to arrange the size of the station and the output of the initial generating sets so

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Approximate Cost of Various

Population of town, say	29,000	30,000	45,000
8-c.p. lamps fixed	4,500	6,000	9,000
8-c.p. lamps alight at one time	3,000	4,000	6,000
Kilowatts of plant required (without spare)	90	120	180
Total kilowatts of plant installed...	135	180	270
Buildings, engine and boiler houses, accumulator and test rooms, workshops, offices, &c.	£2,200	£2,700	£3,000
Chimney with lightning arrester, flues, &c.	550	650	650
Foundations for engines, boilers, &c., no piling...	270	300	350
Weighbridge, 3 tons...	35	35	35
Overhead traveller and rails, hand power	5 tons, 25 ft. span, 130	6 tons, 30 ft. span, 160	6 tons 30 ft. span 160
Two boilers, with injectors and fittings	1,660	1,950	2,300
Economiser, with motor	220	260	260
Steam, exhaust, drain and feed pipes, valves, hangers, chequer plating water meter, &c.	800	900	1,000
Water storage tank	60	60	60
Pumps, one steam and one electric, for boiler feed, and an electric centrifugal pump for filling tank.	280	320	320
Feed water heater	120	120	150
Three engines of the high speed enclosed type	45 kw. each	60 kw. each	90 kw. each
Three dynamos	550 revs. 2,060	500 revs. 2,560	450 revs. 3,290
Balancing machine (two armatures) with sp. arm., field coil, &c. ...	200	250	360
Booster (one motor two dynamos) with sp. arms., field coils, &c. ...	170	210	280
Main switchboard, works switchboard, meters, resistances, and connecting cables	500	650	850
Testing instruments...	80	105	135
Accumulators with glass boxes, acid, stands, cell testers, hydrometers, &c.	550	700	850
Workshop tools, barrows, pipe spanners, oil filter and tank, &c. ...	45	50	60
Station and office lighting	70	80	90
Total cost	£10,000	£12,000	£14,200
Cost per kw. of plant installed	£74	£65·75	£52 5

that they are in proportion to the units that will be required later on. It is almost as great a mistake to start with 60 kw. sets for a town of, say, 150,000 inhabitants, as it would be to lay down a 300-kw. steam dynamo for lighting a village.

In the accompanying table the writer has indicated what he considers should be the sizes of the initial plant for towns of various populations, and has filled in under each one figures indicating approximately the cost of the various items which go to make up a complete central station plant. In order to have some basis to work on the following assumptions have been made:—

(*a*) The system of distribution to be by continuous current on the three-wire system with 440 volts across the outers.

(*b*) The number of lamps on the second line is taken as the probable lamp connection before, say, the end of two years, and it is further assumed that about two-thirds of this number will be alight at one time.

(*c*) The kilowatts of plant in use, given in the fourth line, are arrived at by multiplying the numbers in the third line by the watts required per 8 c.p. lamp.

(*d*) It is proposed that three generating units be laid down, one being regarded as a spare.

(*e*) The buildings are assumed to be large enough to hold plant of a capacity equal to three times the estimated number of lamps connected, as given on the second line.

Buildings.—This item of buildings is one which may vary within exceedingly wide limits, according to the amount of ornamentation and finish introduced into the architect's plans. A plain substantial building with stone facings and a height to eaves of about 35 feet should not cost more than about 5½d. per cubic foot. Walsall was about 3d., Bedford 3½d., St. Mary, Newington Vestry, 5d. The iron roofing to the engine and boiler houses accounts for about 10 per cent. of the total cost. An iron building with offices, &c., suitable for central station work runs out at a little over 1d. per cubic foot.

Chimney and Flues.—The cost of the chimney depends to a considerable extent on the nature of subsoil, the usual amount of excavation required to reach a good foundation being 15 feet. The sizes of chimneys vary only very slightly, 140 feet high, with square base and round shaft, 7 feet inside diameter, lined one-third of the way up with firebrick, is the favourite size for stations such as we are now considering, and a chimney such as this would cost about £650. The exhaust to atmosphere should be taken right up the centre and carried to, say, within 20 feet of the top. The work of erecting this pipe is generally undertaken by the contractor for the chimney, but the cost is included in the "steam and exhaust piping" item, which is given on the thirteenth line in the table.

Steel chimneys are quite common in the States, and are likely to come into use over here. They have an elegant appearance, a chimney 125 feet high being only 5 feet diameter, whilst its weight would be 11 tons, and price about £200. It is, of course, lined with firebrick right to the top, but can be erected in one month against five months for an ordinary brick chimney of similar capacity.

Cost of Foundations.—The cost of foundations for engines, boilers, &c., is a very elastic item. If a good deal of piling is required, as happened at Stafford, for example, where the station is situated on a bed of peat, many months of work are required before any concrete can be put in.

Continuous current low pressure stations must of necessity be situated in the midst of the populated area, or near places of business which are liable to be affected by vibration; a great deal of care has therefore to be taken in setting out the engine foundations. The concrete block is generally in one piece, cut off entirely from the walls, and the usual depth is 7 feet with a bottom floor of, say, 9 inches. The engine room floor may be further cut off from the walls by leaving a space of, say, ¾ inch all round.

(To be continued.)

KASHMIR ELECTRIC RAILWAY.

The proposal to connect Kashmir with the Punjab by a light railway worked by electricity brings prominently to the front the question as to how far it is wise to substitute electricity for steam on a railway of such importance.

An article in a recent number of *Indian Engineering* discusses this question in a manner which shows that the writer certainly does not hold a brief for electrical traction. To those who are even fairly acquainted with what has already

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ITEMS OF CENTRAL STATION PLANT.

					Column showing the percentage of the various items to the total cost. Approx.	Average cost of the various items per kw. of plant installed.
60,000	80,000	100,000	125,000	160,000		
12,000	16,000	20,000	25,000	30,000		
8,000	10 500	13,000	16,500	20,000		
240	320	400	500	600		
360	480	600	750	900		
£3,500	£4,000	£4,500	£5,000	£5,600	20 %	£9·72
750	750	850	850	1,000	4½ %	2 1
400	450	500	570	650	2¼ %	1·1
35	40	40	40	40	¼ %	·1
7 tons 35 ft. span 200	7 tons, 35 ft. span 200	8 tons, 40 ft. span 240	8 tons, 40 ft. span 240	10 tons 45 ft. span 290	1 %	·55
2,600	2,950	3,230	3,600	4,000	15 %	7 25
330	360	400	450	500	2 %	·91
1,100	1,200	1,320	1,450	1,650	7 %	3 05
80	80	90	100	100	½ %	·22
350	350	400	450	500	2 %	·97
150	170	180	200	210	1 %	·41
120 kw. each	160 kw. each	200 kw. each	250 kw. each	300 kw. each		
400 revs 4,250	350 revs. 5,360	300 revs. 6,350	275 revs. 7,570	250 revs. 8,750	25 %	11·8
470	£600	700	850	1,000	3 %	1·3
350	450	560	640	810	2½ %	·97
1,000	1,200	1,400	1,550	1,750	6 %	2 8
165	190	215	240	270	1 %	·46
1,000	1,150	1,300	1,450	1,600	6 %	2·8
70	80	85	90	100	½ %	·21
100	120	140	160	180	¾ %	·28
£16,900	£19,700	£22,500	£25,500	£29,000	100 %	£47·00
£47	£41	£37·5	£34	£32·2		

been done in this field, the well-worn phrase that "the science is yet in its infancy" sounds a little out of date, and the assertion that "the practice of electrical experts in Europe and America differs in many respects," suggests the thought that precisely the same statement might be made about steam railroad engineering. Again, while it is quite true that the length of the proposed line far exceeds that of any other electric railway hitherto attempted, it is not right to infer that the difficulties to be met with on account of the length are vague and unknown, since they will be of the same order as difficulties that have been already encountered and successfully grappled with on shorter lines. To those who are unacquainted with the technicalities of electrical engineering, it may appear presumptuous to say that the conditions of operating a new line of such a length can be foreseen and provided for with certainty and accuracy; but such is the case, and it is this that constitutes one of the surest guarantees of the future progress of the science of electric railway engineering.

It would, of course, be a mistake to forget that a line nearly 200 miles long must be constructed in a way that will ensure satisfactory working, without the close supervision given to electric roads in cities and towns; but at the same time we must not ignore the fact that much of the vigilance required to operate a city or a suburban line is due to conditions which are absent in such a line as we are now considering. For instance, it is mainly the exigencies of street traffic, and the difficulties of crossings, that oblige us to use an overhead conducting system; but these conditions are absent in the proposed Kashmir Railway, and there is nothing to prevent the use of auxiliary rails, except perhaps in the section between Islamabad and Srinagar; but here the track would be practically level, and there would be no risk of accidents from landslips, falling rocks, or avalanches.

The cost of construction will depend materially upon the ruling gradient and the curve adopted, and the influence of electrical traction on these two factors in the problem is a matter of great importance. The statement in *Indian Engineering* that it is claimed that electrical motors can haul heavier loads and mount steeper grades than steam locomotives requires some modification. The ability of a locomotive to haul a load behind it is limited by the adhesion of the driving wheels on the rails. So long as only a part of the weight of steam locomotives was on the drivers, it might have been said that electric locomotives, with motors on each wheel, could haul heavier loads. On mountain railways, the use of bogie stock has become almost a necessity, and it has been a great problem for steam railroad engineers to apply driving power to every wheel of a locomotive of this type. The problem has, however, been successfully solved, in spite of the difficulties due to the inflexibility of the system, and it may be questioned if any electric locomotive of equal weight will ever be constructed having greater hauling ability than, for instance, one of Mallet's articulated compound locomotives, with double bogies, each carrying two or three coupled axles and a pair of outside cylinders. But the application of this principle is limited to the locomotive, and it is here that the superior flexibility of the electric system comes in by enabling us to place motors on the axles of the carriages or trucks without in any way detracting from their value as traffic carriers, so that, if it were necessary, every wheel in the train could be made a driving wheel. Therefore, while it is not the case that an electric locomotive can haul a heavier load than a steam locomotive of equal weight, we may say that the electric system can deal with heavier loads and grades than the steam system can.

There seems no room to doubt that electrically-driven trains can be run with safety on lines having abnormally sharp curves. Electric railways have been constructed, and are now running satisfactorily with sharper curves than would be considered possible on steam railways, and for this cause one might reasonably look for a marked reduction in the cost of construction.

The question is raised in *Indian Engineering* whether electric motors can be adapted to such small gauges as might be required on a mountain railway. There is abundant evidence on the Continent and in this country to show that the electric motor is perfectly well adapted to small gauges. At the same time, the consideration of efficiency in working would point to the selection of as wide a gauge as possible, and it may be doubted whether it would be wise to make it less than a metre. This conclusion is strengthened by the fact that a wide gauge renders easier the task of placing motors on the axles of the cars, while a very narrow gauge might necessitate the use of locomotives only, and the consequent loss of one of the most valuable features of the electric system.

While discussing the probability of the proposed railway

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proving remunerative, *Indian Engineering* curiously omits to consider the saving that would be effected by the use of water-power. There is frequently a tendency on the part of the advocates of electrical traction to over-estimate this saving; but it is going rather too far in the other direction to ignore it altogether.

The fuel item, in many cases, constitutes but a small proportion of the total expenses of working a railway, and the saving due to the use of water-power may consequently be a matter of minor importance. In the case of the Kashmir Railway, however, the high price that would have to be paid for coal makes this question one of considerable magnitude.

Some interesting statistics bearing on this point may be found in the Administration Report on the Railways in India for 1898-99. The figures there given for the North-Western State Railways, which include the short line already constructed to Jammu, from whence the proposed electric railway is to start, show that the total working expenses per train-mile are set down at Rs. 1·95, made up as follows:—Maintenance of way, works, and stations, Rs. 0·58; locomotive expenses, Rs. 0·74; carriage and wagon, Rs. 0·15; traffic, Rs. 0·29; general and miscellaneous, Rs. 0·19. Of the Rs. 0·74 for locomotive expenses, as much as 4·57 Annas is spent on fuel, or 14·6 per cent. of the total working expenses. In this case the cost of coal averages 12·50 rupees per ton.

Now, in the proposed railway to Srinagar, it is estimated that coal would cost from Rs. 20 to Rs. 25 per ton, so that the fuel item would amount to between 22 and 26 per cent. of the total working expenses, taking these on the same basis as on the North-Western system. There is, however, reason to suppose that narrow gauge locomotives working on such extreme variations in grade as on the Kashmir line would not have the efficiency of the normal gauge locomotives on the North-Western system, so that the fuel item might mount up to as much as 30 per cent. of the total working expenses. It is clear, therefore, that the saving to be effected by the use of water-power is considerable, and has an important bearing on the financial prospects of the undertaking.

THE LEGAL RELATIONSHIP OF ELECTRIC LIGHTING OR POWER CORPORATIONS AND MUNICIPAL AUTHORITIES.

The recent resolution of the Municipal Corporations Association to promulgate the establishment and working of electric installations under the auspices of the various local authorities throughout the country, naturally directs our attention to the powers under which such bodies may acquire the right to thus engage in commercial enterprise. It is not our purpose to discuss the expediency of the transfer of such undertakings from private companies to those of a municipal nature, but it is important for all of those who are connected with the supply of electricity, whether for the purposes of lighting or the transmission of power, not only to realise that they may at some time be ousted by a local authority, but to understand the conditions under which the local authority may exercise its power.

By the Electric Lighting Act of 1882, Section 3, the Board of Trade was empowered to license any local authority as defined by the Act, or any company or person, to supply electricity . . . . for any public or private purposes within any area, subject to certain provisions contained in the Act. This would seem to include power and lighting installations.

Local Authority—What Is.

The definition of the term local authority, for the purposes of the Electric Lighting Act of 1882, is contained in Section 31 and the first schedule to the Act. In the City of London the mayor, commonalty and citizens, acting by the Commissioners of Sewers, exercise the powers of the local authority. In those parts of the metropolis which the Metropolitan Board of Works was formerly authorised to light they acted as local authority, but, of course, their duties, &c., are now in the hands of the London County Council. Other "local authorities" of the metropolis are the "Vestries" mentioned in Schedule A, and the "district boards" enumerated in Schedule B of the Metropolis Management Act, 1855, which has been altered by the Metropolis Management (Amendment Act), 1885, (48 and 49, Vict., c. 33). In urban and rural sanitary districts, the urban and rural sanitary authorities are the local authorities for the purposes of the Electric Lighting Acts.

It is important to notice that, by the London Government Act, 1899, the whole administrative County of London is to be divided into metropolitan boroughs, and for that purpose it is made lawful for Her Majesty, by Order in Council, to form each of the areas mentioned in the 1st Schedule to the Act into a separate borough. Whenever such a borough is constituted, the powers, duties, and liabilities of the elective vestry shall be transferred to the new Council of the borough.

Consent of Local Authority.

By Section 3 of the Electric Lighting Act of 1882, the Board of Trade is empowered to license . . . . any company or person to supply electricity within any area, subject to the consent of the local authority to such application first had and obtained. By the Act of 1888, Section 1, this consent is now required in the case of a provisional order also; but if it is refused, the Board of Trade have power to dispense with the same where they are of opinion that, having regard to all the circumstances of the case in which the consent of the local authority is refused, such consent ought to be dispensed with. No provisional order shall authorise the supply of electricity by any undertakers within the district of any local authority unless notice that such provisional order has been, or is intended to be applied for, has been given to such local authority on or before July 1st in the year in which such application is made.

Powers of.

Of the supervision which the local authority may exercise over the undertakers, the following sections will furnish examples:—

By Clause 9 of the form of Provisional Order under the Act of 1882 and 1888 (now reproduced in Clause 10 of the schedule to 62 and 63 Vict. c. 19), the local authority may, by withholding its consent, prevent the undertakers from placing any electric line above ground, except within the premises in the sole occupation or control of the undertakers. In the event of such lines being laid without the sanction of the local authority, application may be made to a court of summary jurisdiction, which can order the defendants to remove the wires. [E L.A., 1882, Section 14.]

By Clause 11 of the form of Provisional Order under the Acts 1882 to 1888 (see now Clause 13 of the schedule to the Electric Lighting Clauses Act, 1899), no box or apparatus shall be placed above ground, except with the consent of the local authority, body, or person by whom the street is repairable. The local authority may also, with the approval of the Board of Trade, prescribe the hours during which the undertakers are to have access to such boxes. If the undertakers remove or displace such boxes without the consent of the local authority, they become liable to certain penalties. The following case will give some idea as to what are considered to be boxes. In the case of the Wandsworth District Board of Works *v.* County of London and Brush Provincial Electric Lighting Company [*Journal of Gas Lighting*, August 13th, 1895, Vol. 65, page 345], the company sought to excavate and construct certain large chambers under the streets for the purpose of containing transformers. The chambers proposed to be used were 10 feet deep, 7 feet 6 inches long, and 5 feet 6 inches wide. The local authority contended that these were not "boxes" within the meaning of the provisional order, and further, that they could not be used for the purpose of holding transformers. Stirling, J., refused to grant an injunction restraining the company from making these excavations.

Chambers may also be constructed in churchyards, and a faculty will be granted for the purpose. [Sniress Will on "Electric Lighting," page 137.]

Compulsory Purchase.

By Section 27 of the Act of 1882, it was provided that where undertakers were authorised by provisional order or

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special Act to supply electricity within any area, the local authority of the district might, after the expiration of a period of 21 years, or after every subsequent period of seven years, purchase, compulsorily, the undertaking upon the terms "of paying the then value of all lands, buildings, works, materials, and plant, suitable to and used by them for the purpose of their undertaking," nothing being allowed for compulsory purchase or goodwill; such value to be determined, in case of difference, by arbitration. It was soon found that these terms offered no inducement to the enterprise of electric lighting. Accordingly, by Section 2 of the Electric Lighting Act, 1888, the section above referred to was repealed, and a new section for effectuating purchase was substituted, in which the period of 21 years was changed to 42 years, and the recurring period from seven to 10 years. The Act of 1888 also provides that upon such purchase all lands, buildings, works, materials, and plant of the undertakers shall vest in the local authority, freed from any debts, mortgages or similar obligations of the undertakers, and that the powers of the undertakers shall absolutely cease and determine, and shall vest in the local authority.

It should be noticed that (by Section 2) the local authority are empowered to acquire an undertaking within six months after the expiration of a period of 42 years, *or such shorter period as is specified in that behalf in the provisional order or in the special Act.* By this means the local authority, whose consent, be it observed, is to all intents and purposes a condition precedent to the grant of a provisional order by the Board of Trade, have it in their power to make terms with undertakers which shall provide for the taking of the installation over by the local authority within a much shorter period than 42 years.

Again, where the local authority are entitled to demand a sale within a period of 42 years, or any less period as specified in the special Act or provisional order, they may exercise their option after every recurring period of 10 years.

The undertakers are compelled to sell all lands, buildings, works, materials, and plant of such undertakings suitable to, and used by, them for the purposes of their undertaking within the jurisdiction of the local authority, the values in case of difference to be settled by arbitration, subject to the *value* being regarded as the fair market value at the time of the purchase. Regard must also be had (1) to the nature and condition of the buildings, works, materials, and plant; (2) to their state of repair; (3) to the circumstance that they are in such a position as to be ready for immediate working; (4) to their suitability to the purposes of the undertaking; (5) to the loss occasioned by severance, where a part only of the undertaking is acquired by the local authority (*e.g.*, in cases where only a part of the system is within the jurisdiction of the purchasing local authority). No addition, however, is to be made in respect of compulsory purchase, or of goodwill, or of any profits which may, or might have been, or be made from the undertaking, or of any similar considerations.

This is the clause which appears to press with the greatest hardship on the proprietors of electric lighting installation. The absence of a clause providing for an allowance of 10 per cent. over and above the purchase money, by way of compensation for compulsory purchase, has done much to stifle electric lighting enterprise on the part of private companies.

With the exception of the determination of the price, all other questions arising between the parties are to be settled by the Board of Trade, who may also fix the date from which the purchase is to take effect, upon which date all lands, buildings, works, materials, and plant of the undertakers shall vest in the local authority which has made the purchase. The property becomes vested in the local authority freed from any debts, mortgages, or similar obligations of the undertakers.

It is important to notice that, by Section 3 of the Act of 1888, notwithstanding anything in the last preceding section contained, the Board of Trade may, by any provisional order to be made by them under the Electric Lighting Act, 1882, vary the terms upon which any local authority may require the undertakers to sell. It is conceivable that, under this section, the Board of Trade might have power to decree the payment of some small sum by way of compensation, for it is expressly said that "the Boards shall have power to vary the terms, notwithstanding anything in Section 2."

There have not been many cases relating to sale compulsory of electrical undertakings. A case from Sheffield, in 1897, serves to show that the provisional order may provide for payment otherwise than in cash, and that, unless the corporation or local authority in question has statutory power to make payments in such a manner, the power of compulsory sale may fall into abeyance.

A provisional order, authorising an electric lighting undertaking, came into operation on June 27th, 1892. It gave the Corporation of the City of Sheffield power to purchase the undertaking compulsorily on terms of issuing or transferring to the undertakers such an amount of the Corporation stock as will produce, by the interest thereon, "an annuity of 5 per cent." on capital properly expended. Another provisional order, coming into operation June 28th, 1892, took away a power the Corporation had, but had not exercised, to issue irredeemable stock. The statutes confirming the two orders received the Royal Assent on June 27th, 1892. It was decided that the statutory price for the undertaking was an amount of irredeemable stock; and that the Corporation were not, by implication, authorised to issue irredeemable stock for the purpose of purchasing the undertaking; and that, therefore, the power to purchase compulsorily was, so long as the Corporation had no power to issue irredeemable stock, in abeyance. [Sheffield Corporation *v.* Sheffield Electric Light and Power Company (1897), W. N., 171; 77 L. T., 616.]

The above is an outline of the main provisions which must regulate contracts between the local authorities and undertakers. Apart from their power to take over the whole system, the municipality is empowered by the provisional order to exercise a somewhat strict supervision over the doings of the undertakers. The general nature of this supervision is to be found in the Electric Lighting (Clauses) Act, 1899, an abstract of which was published in the ELECTRICAL REVIEW for September 15th. It comprises a schedule which is in effect a reproduction of the form of provisional order so well known in connection with the Electric Lighting Acts, 1882 to 1888. It is important to observe that this Act does not apply to the County of London, except in so far as any of the provisions contained in the schedule are incorporated with any provisional order made by the Board of Trade under the Electric Lighting Acts extending to the County of London. It would be impossible, within the scope of the present article, to deal with the numerous points where the local authority is likely to come into contact with the undertakers. We have endeavoured to point out the legal incidents to the compulsory sale which undertakers may be compelled to make the local authority.

LONDON COUNTY COUNCIL.

THE Council on Tuesday postponed the consideration of a recommendation in favour of approval being given to the draft form of light railway order as circulated among the members with regard to the various light railway schemes already decided upon at a recent meeting.

LONDON UNITED TRAMWAYS.

The adjourned report of the Highways Committee, the consideration of which had been adjourned on two or three previous occasions, was again submitted in reference to the London United Tramways Act, 1899. It may be recollected that the Committee recommended the Council to approve plans forwarded by the company for the introduction of the overhead trolley system on the tramways in the Uxbridge Road between the Askew Arms public-house and the Uxbridge Road railway station, and in Uxbridge Road and Goldhawke Road between the railway station and Young's Corner, and for the adoption of the conduit system on the tramways between Young's Corner and Hammersmith Broadway, and thence along Beadon Road, Glanthorne Road, and Studland Road, and that part of The Grove between Beadon Road and King Street West.

To some surprise the recommendation was again deferred. It is thought that further negotiations are proceeding with the Hammersmith Vestry on the subject of extending the overhead system.

THE WESTMINSTER ELECTRIC TRAMWAY.

In a further report the Highways Committee reminded the Council of the recent decision to apply for Parliamentary powers to embank the Thames from Victoria Tower Gardens to Lambeth Bridge, and to widen Millbank Street to 70 feet. In connection with this scheme the Committee expressed the opinion that it was desirable to obtain powers to construct a tramway to be worked on an underground system, along Millbank Street on the completion of the widening of

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that thoroughfare. It was estimated that the tramway, which would comprise about 500 yards of double line, would cost about £6,000. The Committee recommended that (*a*) standing orders should be suspended, so as to allow the application to be made to Parliament in the next session, and (*b*) that the Parliamentary Committee should be instructed to include in the Tramways Bill a clause to empower the Council to construct the tramway.

Reporting upon the financial bearings of the proposal, the Finance Committee stated that it was evident the tramway could only be suggested as part of a much larger project, and that they had no information at present to guide them as to the extent of the scheme which, it was presumed, would ultimately be brought forward. It was impossible, the Committee concluded, for them to make any forecast of the financial results until further particulars were forthcoming in relation to the proposed line.

The Chairman of the Committee having moved the adoption of the first recommendation,

Mr. T. B. Westacott expressed the hope that the Council would not agree to the proposal to suspend standing orders. It was not a recommendation of the Highways Committee, but only of three of the members of the Committee, the others having received no notice that the matter was to be considered by the Committee. The question had never been placed on the agenda paper, and he asked the Council to reject the recommendation, more especially as neither the Improvements Committee nor the local authority had been consulted in regard to the matter.

Mr. Hayter said that after the statements of the previous speaker the Council should not agree to the suspension of standing orders. He then referred to the remarks made by the Finance Committee on the subject in order to show the indefiniteness of the proposal. The scheme was merely for a tramway from the House of Lords to Lambeth Bridge. It was, perhaps, only part of a larger project for tramways down the Grosvenor Road and along the Chelsea Embankment, but the Committee ought to prepare a complete scheme for the Council before proceeding with the recommendation.

Mr. J. W. Benn, chairman of the Committee, stated in reply to Mr. Westacott, that the Council would remember a question was put by Mr. Johnson to the Improvements Committee on October 24th, as to the desirability of a tramway being constructed along the widened Millbank Street. The matter was before the Highways Committee on two occasions, but he did not know whether Mr. Westacott was present. It was the privilege of the chairman to bring up in committee matters of emergency without their being placed upon the agenda paper, although he considered the member had had sufficient notice by Mr. Johnson's question. By adopting the proposal, the Council would only be continuing the policy pursued in connection with other schemes, as, for instance, the proposed tramway over Vauxhall Bridge, and he presumed also over the new Lambeth Bridge. He could not see any objection to the Council obtaining powers, but if they embarked upon the improvement scheme without the tramway, the Council would seriously handicap the development of tramways in London. Of course, the proposal was only part of a larger scheme for the south side of the metropolis.

On a division, 56 voted in favour of the recommendation and 28 against.

Lord Welby, chairman of the Council, said that the number in favour was not a sufficient majority to carry the motion, and he declared that the second recommendation would accordingly also fall to the ground.

The Council's Electric Traction Bill.

In compliance with standing orders, the consideration of the following report of the Highways Committee was adjourned until the next meeting:—

The Council has made application to the Board of Trade for a license under the London Tramways Act, 1888, for the use of electrical traction on the tramways between Westminster Bridge and Tooting. It has since been represented to us that it is doubtful whether, if this license were granted, the Council would have power, without further Parliamentary authority, to interfere with the public streets for the purposes of the necessary reconstruction of the tramways; and, as we attach great importance to this line and also the line from the junction at the "Horns" public house at Kennington to Blackfriars Bridge being reconstructed as a first experiment for electrical traction on the Council's tramways, we think it advisable that Parliamentary powers should be sought for the purpose in the Tramways Bill to be promoted by the Council next session. The line from Westminster to Tooting is about six miles in length, and the cost of reconstruction is estimated at about £191,400, while the length of the line between Blackfriars and Kennington is about two miles, and the estimated cost is £59,400, the estimate in each case including the cost of rolling stock and a proportion of the cost of mains, plant, and power house. Both of these lines are double throughout. We have, in accordance with the standing orders, informed the Finance Committee of our intention to submit this proposal to the Council; and we recommend:—(*a*) That the standing orders limiting the period for considering applications to Parliament be suspended, so far as may be necessary, to enable the Council to consider the following recommendation:—(*b*) That the Council do seek powers in the London County Tramways Bill, to be promoted in Parliament next session, for the reconstruction, for electrical traction, of the portions of the London County Council Tramways (*a*) between Westminster Bridge Road and Tooting, and (*b*) between Blackfriars Bridge and the tramways junction near the "Horns" public house at Kennington.

CORRESPONDENCE.

The Berrenberg Lamp.

I read with great interest in your current number a review of an article appearing in a contemporary anent the new factory of the Berrenberg Electric Lamp Company, Limited, at Southfields.

While fully agreeing with the writer that a 2½-watt lamp, having a life of 1,000 hours, is the lamp all consumers of current are praying for, I totally differ from his method of endeavouring to ridicule the claim of the Berrenberg lamp to give such results. He has evidently read the advertised claim of the lamp to save from 5s. to 15s. per lamp, according to cost of supply units. The advertisement is probably badly drawn and requires the additional words "per 1,000 hours burning" to complete its full sense, but this meaning is so apparent that I can scarcely conceive qualified engineers reading it otherwise.

The writer, however, has very foolishly walked into a simple trap, when he says "how can this amount be saved, when central station statistics show that the average 'annual' charge for current for one 8-C.P. lamp comes to only 8s?" Some lamps (such as I have seen in large pantechnicon warehouses) are not switched on once during the whole year, whereas the cost of many 16-C P. lamps will exceed £3 and £4 in one year. It is apparent, therefore, that station statistics of average lamp demand is a matter totally foreign to the question of lamp efficiency, and as your contributor proceeds to sum the matter up rather warmly for the poor lamp manufacturer, I think he will see an explanation of his mistake would only be scant courtesy.

For my part, comparing the claims made by this lamp of 2½ watts (presumably averaging this figure for the 1,000 hours), I consider that the fully 2 watts advantage claimed over all other lamps of long life I know of allows the makers in question to claim an even larger saving than they do, startling and almost incredible as the figures are.

Engineer.

[Our correspondent's enthusiastic support of the Berrenberg lamp—which we did not attack in any way—has caused him to jump to hasty conclusions. There was no ridicule in our note, nor did we dispute the efficiency definitely claimed for the lamp. But we took exception to the vague statements whose "meaning is so apparent," but which, like all half truths, are so misleading.

The person who is most interested in the cost of the energy absorbed by his lamps is not the qualified engineer, but the innocent consumer, who cannot discriminate between what is written and what is meant. The average annual charge per 8-C P. lamp is, as stated, 6s. or 7s. (not 8s.). Assuming that the Berrenberg lamp takes 2·5 watts per C P., as against the 4 watts per C.P. required by good lamps of other makes, the annual saving amounts to about 2s. per 8-C.P. lamp.

To justify the statements under discussion, we must take a lamp of double the candle-power and burning for double the time of the 8-C.P. lamp mentioned above—which bears out our prediction. Our correspondent's references to exceptional instances do not affect the issue. The statements were perfectly general in form, and must be applied to the average case.

We may point out, however, that a 16-C P. 60-watt lamp burning for 1,000 hours, at 3d. per unit, can only cost 15s.; even at 5d., an exorbitant charge for long-burning lamps, it cannot cost more than 25s. The £3 or £4 referred to by our correspondent, therefore, must be understood to imply three or four new lamps for renewals also. As for the "2 watts advantage claimed," we are pleased to know that this is the precise amount, as the makers did not tell us.—Eds. Elec. Rev.]

High and Low Speed Motors.

May I be allowed a few words in continuation of my letter of October 20th concerning high and slow speed motors? I observe that in your issue of November 3rd, one of your contributors does me the honour of differing (on page 708) from my statement as to the value of the slow speed motor referred to in my letter mentioned above.

Although I dissent from his views on many of the other points he mentions, these are, in some instances, matters which are open to argument; I imagined, however, that the current market value of any machine was a matter of actual fact, which could easily be verified.

However, as your contributor disagrees with this view, I shall have the greatest pleasure in affording him an opportunity of proving the value of his opinion by backing

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it, and I hope that you, Sir, will be kind enough to act as arbiter, and that the following proposal will meet the views of the writer of the article above referred to :—

I am willing to bet £10 even, that I can prove to your satisfaction that an old-established firm of English manufacturers of the highest standing, are prepared to supply slow speed motors, of the power and speed mentioned in your original article and in my previous letter, at a price not exceeding that mentioned by me. I may add that the firm referred to is not by any means a cheap one. To avoid opening your serious pages to the reproach of being a medium of gambling, I suggest that the winner can contribute to one of the admirable funds for the widows and orphans of soldiers, and I trust for the sake of charity, that your contributor's courage may be equal to his confidence, and that this opinion may have a better foundation than most of the others advanced in his article.

To turn to another matter; in your last number, on page 782, you take exception to the statement in Mr. Raworth's paper that it "might take 20 1-horse motors to do the work of one 10-horse motor driving the lot," assuming all the machines are at work simultaneously. Possibly Mr. Raworth himself may make plain this hard saying, but in case he does not, I venture to point out that there is at least one well-known case of frequent occurrence, in which the conditions he states apply, that is, when the power taken by the driven machines varies during the stroke; in such a case, each machine, if equipped with a separate motor, requires sufficient power to take it over the hard point of the stroke, while with one large motor driving a line shaft enough power for 20 per cent. or 25 per cent. of the whole number of machines on the hardest point need be allowed; the fly-wheel action of the whole system will help it over any abnormal instantaneous load. As regards the price of current at which electric driving can compete with gas or steam, this naturally varies in almost every case, even in the same trades, but it may be of interest to you to know that in one instance, at least, electricity at 8d. per unit has been found to be considerably cheaper than gas at 2s. 6d. per 1,000 cubic feet, the gas engine driving through shafting and belts, and the motors being attached direct to each machine.

The fact appears frequently to be lost sight of that the true comparison between separate motors and grouping, requires to be made on the basis of ascertaining not only whether separate motors are more economical, but also whether the saving they make will pay the capital charges on the extra outlay involved. That is a large subject, however, and needs an article to itself, written by one who knows his subject.

Lente.

Single-phase Motors.

In answer to Mr. Eborall's letter, which appeared in your issue of the 20th ult., I beg to state that my firm has for many years put on the market motors to give, if anything, better results as regards starting and guaranteed current consumption than those given in the description of the Heyland motors.

Coming now to Mr. Heyland's letter in your issue of the 27th ult., it has for many years been a well-known fact to me that, for producing a large starting torque, it is advantageous to give the starting winding less turns than the working winding, and we have made use of this wherever a great starting torque was required.

C. E. L. Brown.

Overhead Electric Tramway Equipment.

As a reader of this journal will you allow me to ask through its columns whether rail bonding, pole planting, overhead trolley wiring, and the work in fitting the overhead equipment is an art or needs any study.

The reason I am asking this question is, because some district surveyors in the town where I am doing the above work say that it needs no experience; that it is neither an art nor is it science. Having been on tramway work for over seven years, I shall be very pleased to hear some other persons' verdict.

I myself say that pole planting alone requires a man of experience. I also say that as simple as rail-bonding looks, that it is an art if a proper connection is to be made. Trusting you will kindly refer to this.

A Working Electrician.

[Of course experience is necessary, just the same as in the case of overhead telegraph wire construction.—Eds. Elec. Rev.]

Improved Trolley Poles.

The question that arose in my mind on first reading your notice of the above invention, was the method of successfully negotiating the section insulators, and I venture to think that the difficulties suggested both by "W. H. S." and "R. T. W.," are insignificant as compared with this latter.

H. C. B.

Foreign Competition.

As the question of foreign competition is now very much to the fore in this country, we think the following facts may have some interest for your readers.

In October, 1897, we, with other electrical cable makers, were invited by the Dublin United Tramways Company, Limited, to tender for the cables required in connection with the conversion of their tramways from horse to electric haulage.

The specification—written by the tramway company's consulting engineer, Mr. Parshall (an American)—was issued to us, providing, among other things, that the price quoted for the cables was to be inclusive of the drawing into the conduits in Dublin, and the jointing up and putting to work, and that delivery was to be made of the whole of the cables within nine months of the date of the order.

We tendered to the specification, in due course, offering to carry out the whole of the terms and conditions set forth in every particular, but received a notification from the secretary of the company on January 29th, 1898, to the effect that our tender had not been accepted.

So far, we had, of course, no ground for complaint, but we subsequently heard that the order had been placed with an American firm, the National Conduit and Cable Company, for paper-insulated cables, and as we held the patents for this class of material for this country, we entered an action for infringement as soon as the first cables were delivered.

This action has recently been tried, and has resulted in our favour. During the proceedings it was necessary for the tramway company to produce a copy of the contract they had made with the American firm, and it is particularly to this contract that we wish to draw attention.

We attach a copy of the contract herewith, and it will be noted that its conditions differ in many respects from those to which the English manufacturers were asked to quote.

Notably, the contract is made in America, and the tramway company took delivery of the cable in New York, this step being presumably an attempt to deprive the English manufacturer of the rights under his patent.

The tram company loaned to the National Conduit and Cable Company the services of their engineer (Mr. Parshall) to supervise the drawing in and jointing, so that this work, although carried out at the contractor's expense, has not been effected by him, as provided for in the original specification.

We understand that we were to provide over the lead sheathing of the cables a layer of compounded jute yarn, although for cables that are to be drawn into "ways," it is our practice to provide a plain lead covering only. We find that the American firm have provided plain lead-covered cables, thereby, of course, effecting a considerable saving in the cost.

We would then draw particular attention to the remarkable fact that blanks have been left in the contract both for the quantities of cable and the sizes, and prices at which they are to be supplied.

No time for delivery is stated, and, as a matter of fact, the American firm has largely exceeded the time allowed to the English manufacturers.

The guarantee clause expressly excludes electrolytic damage,

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although we were asked to include this possible cause of damage in our undertaking.

We are content to leave the matter to the judgment of the public.

The British Insulated Wire Company, Limited.
G. H. Nisbett.

November 14th, 1899.

[copy.]

This agreement made by and between the National Conduit and Cable Company, a corporation organised and existing under and by virtue of the laws of the State of New York, United States of America, with its principal business office in the City of New York, party of the first part, and the Dublin United Tramways Company, a corporation organised and existing under and by virtue of the laws of the United Kingdom of Great Britain and Ireland, and having its principal business office in the City of Dublin, Ireland, party of the second part.

Witnesseth:—That whereas the party of the first part is the manufacturer of and dealer in certain electrical conductors or cables known as "paper-covered cables," and whereas the party of the second part is a common carrier, operating and propelling its tramcars by means of electricity, and is desirous of purchasing said cables from said party of the first part for the purpose of transmitting electricity from the power station to said tramcars and otherwise.

Now, therefore, in consideration of the sum of $1, each to the other paid, the receipt whereof is hereby acknowledged, and of the covenants and promises hereinafter contained, the parties hereto covenant and agree as follows:—

The party of the first part agrees to sell to the party of the second part, and the party of the second part agrees to buy from the party of the first part feet, more or less, of the cable manufactured by the party of the first part, to be delivered to the party of the second part on board ship at the port of New York, said ship to be designated by the party of the first part. The size and price of the cable which the party of the first part agrees to sell to the party of the second part is as follows:—

The party of the second part agrees to pay for the said cable on the certificate of their consulting engineer, in New York funds, through Comptoir National d'Escompte de Paris, London, as follows:—

Fifty per cent. upon the arrival of the shipment in London, 40 per cent. when the circuit is jointed up in the subway, and the balance of 10 per cent. upon the completion and the acceptance of the cable in the subway.

It is further understood and agreed that the aforesaid cable shall be laid, installed, and connected up, under the direction of the engineer of the party of the second part, but at the cost and expense of the party of the first part.

It is further understood and agreed that the party of the first part shall furnish the party of the second part its guaranty and bond, guaranteeing the durability of the cables furnished by it as aforesaid, except as against the act of God, the public enemy, mechanical injury or electrolysis, for a period of ten (10) years from the date of acceptance, and that the said party of the first part shall also furnish its guaranty and bond for the purpose of indemnifying the party of the second part against damages incurred for infringement, because of the use of the cables purchased as aforesaid from the party of the first part; the party of the first part, however, to be notified by the party of the second part so soon as, and as often as, any action or proceeding is threatened involving the patentability of said cables.

In testimony whereof, the party of the first part has caused its corporate name to be hereunto signed by its and its corporate seal to be hereunto affixed with the attest of its on the day of March, 1898, and the party of the second part has hereunto caused its name to be signed by its president, and its corporate seal to be hereunto affixed, with the attest of its secretary, on the 11th day of March, 1898.

The Dublin United Tramways Company,
By Wm. Anderson,
Secretary and Manager.

Seal. Attest.
R. S. Tresilian, A. Secy.

The National Conduit and Cable Company,
By Edward S. Perot, President.

Seal. Attest.
Geo. J. Jackson, Secretary.
In the presence of Jas. H. Warner.

State of New York,
City and County of New York } Ss.

On this 11th day of March, 1898, before me, Henry B. Heylman, a Notary Public in and for the county of New York, appeared Edward S. Perot and George J. Jackson, to me known and known to me to be respectively, the president and secretary of the National Conduit and Cable Company, and who, being by me duly sworn, deposed and said that they were the president and secretary respectively, of the said the National Conduit and Cable Company, and had been duly authorised by the board of directors of said company to execute the foregoing instrument in the name of and for the aforesaid company, and acknowledged that they executed the within instrument and affixed the corporate seal thereto for the purposes and intents therein expressed.

Henry B. Heylman,
Notary Public (198),
N.Y. County.

Electricity Supply!

Engineers in the electrical business are wont to sniff disdainfully at any suggestion that the electric lighting industry is in its infancy, but the experience of the last few weeks is evidence that, at any rate, the company from which I obtain a fitful supply of current must be infantile—or, at least, puerile—to call itself a supply company when it provides little else but interruptions. The Blackheath and Greenwich District Electric Light Company not being yet ready to give current from its own station, are buying it from the London Electric Supply Company, and if the people in London are not getting a better supply than we do in this suburb, they have my sympathy. There have been four total extinctions in the last six days, one lasting for two hours, and during the greater part of the evening the pressure is just sufficient to make the lamps look like red-hot hairpins. Now, if this was 1889 instead of 1899, one would not think so much about it, or if the London Electric Supply Company would call its pressure what it is, instead of what it ought to be, I should know where I am; but one does not want, at this period of the nineteenth century, to go to the expense of having one's house fitted for the electric light and then find that the industry is so much "in its infancy" that it is necessary to watch its fitful struggles by the humble aid of the homely candle. Surely the supply company must have known that it had no current to spare before it undertook to supply this district.

A Believer in Candles.

Blackheath, *November 14th*, 1899.

Consulting Engineers and Contractors.

The question raised by your correspondents is by no means so simple as it appears. Every engineering manufacturer and contractor does a good deal of what is virtually consulting work. They advise their clients what is the best form of apparatus to use, what it will cost in work, &c., and often give detailed specifications of what they propose to supply.

Unfortunately this facility for obtaining information is very often badly abused, consumers often obtaining valuable information from sellers when they have not the slightest intention of placing the order with them.

Many firms also are in the habit of purchasing from one firm in a particular line, in whom they have confidence, and who are virtually their consultants for that particular branch.

In my own business I had a number of firms to whom I practically acted as consulting engineer. I kept them posted upon every new development in electricity, I advised them upon the best methods of carrying out any schemes they had in hand, and upon the suitability of different apparatus offered to them for their work. I received no consulting fee from them for this work, but I had what orders they had to give.

Apart from this also, the individual members of many contracting and manufacturing firms do a good deal of consulting work that is recognised and paid for as such, and which usually arises directly, or indirectly, from their business connection.

During nearly the whole of the 23 years that I was in business as a manufacturer and contractor, I had such a consulting practice running side by side with the ordinary business, and the consulting work nearly always came to me from clients with whom I was doing business regularly, in the ordinary way, and who had acquired confidence in my ability to advise them, or to report upon the matter in hand; or it came from recommendations by them.

A single instance will show the kind of work I mean.

A firm of dry dock owners, with whom I did business regularly, were repairing a petroleum ship in one of their docks when an explosion occurred on board, doing considerable damage.

The electric light was in use in the ship's hold, where the explosion took place, and I was called in to report: whether, if the cable supplying the lamps in the hold broke, a spark would pass to any part of the body of the ship? and if such a spark would ignite petroleum vapour if present? and I was required to attend the Board of Trade inquiry to give evidence if required.

Explosions of that kind, leading to similar commissions,

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do not often occur, but there are numbers of similar cases where firms require the advice of an expert, and a friend they are constantly doing business with, in whom they have confidence, is the readiest available.

There are limits, of course, to this kind of thing. A firm of engineers may advise a firm who are requiring, say, an electric light and power plant, and may afterwards be employed to carry out their own advice; but it would be very much out of place for a firm of engineers to advise a local authority and to act as consulting engineers for the authority, and to be the contractors for the work as well. I believe, however, there are cases of this.

When a member of a manufacturing or contracting firm acts as a consulting engineer, it often leads to strange and occasionally somewhat comical experiences.

When I have been employed to prepare a specification for some particular work, I have had mutilated portions of my own specification sent me for a long time after, as newly drawn specifications, on which I was to tender for some proposed new work.

On one occasion, too, I was required to prepare all figures showing exactly what I intended to supply, even to the size of the cables, and to work out the operating cost of the different possible methods.

When my tender was accepted, the plan I advised was copied into the consulting engineer's specification, together with the other figures I had supplied, and I was solemnly required to agree to them.

Whether a man who is purely a consultant is entitled to have apparatus for his own use at trade prices, because "he is in the trade," is rather a difficult question. Probably he can always obtain all he wants at trade price, or thereabouts, but, I should say, it is very doubtful as to his being entitled to it.

The phrase "in the trade" is a very elastic one. Is a consulting engineer, who is advising, say, a cotton spinner, as to an electric power plant he is putting down for his mill, "in the cotton trade," or where he is advising a brewer, is he entitled to his beer at trade prices?

I remember once a jeweller claiming to have some work done for him at trade prices, because he had once fixed an electric bell for himself, and therefore he was "in the trade."

Sydney F. Walker.

Barnsley Electric Tramway Schemes.

My attention has been drawn to a paragraph headed "Barnsley" under Electric Traction and Motive Power Notes on page 759 of your ELECTRICAL REVIEW for last week, and I regret that you have assumed, without having made the slightest inquiry on the subject, that the Barnsley Town Council are guilty of unfair dealing.

The fact is, that the Barnsley Town Council have never, at any time, made an arrangement with the British Electric Traction Company, but, on the contrary, have opposed their proceeding from the beginning.

Henry Horsfield,
Town Clerk.

Barnsley, *November 14th*, 1899.

[While we are pleased to insert this letter, we would point out to the writer that we said "It does not say much for the fair dealing of the Council *if*" such and such a thing has been done. As that certain thing has not been done (as we gather from the above letter), then the Council is not open to the charge. Furthermore, we would add that our remarks were, as then indicated, founded upon statements appearing in a Sheffield paper. If we have hurt the feelings of the Barnsley Town Council, we repent in dust and ashes as heartily as we believe that some day the travelling public there will do, *if* they have to change at the boundary line from municipal car to company car, instead of being able to take an unbroken journey over a continuous system introduced by the company mentioned.—EDS. ELEC. REV.]

Electrical Distribution of Motive Power.

With reference to your article in last week's number, your figures proving that sub-division is necessary to make electric driving pay are based on your only taking into consideration the amount of current used. If you had only brought in another factor, viz., cost, you could prove exactly the opposite. Take the case in this district, where running normal hours, 1 H.P. costs about £10 a year. In one shop we have a 4½-H.P. motor driving 10 lathes, two milling machines, one drill, one slotting machine, one screwing machine, and a pair of emery wheels. If each of these had had a separate motor the cost would have been over £500, whereas the actual outlay would be under £100, so that on a running bill of £45 you would have had to have saved £60 to allow for interest and depreciation on the extra cost of motors.

In the case above, the tools are running constantly in the ordinary term of machine shop practice, and are driven off one shaft, which is driven from the motor. This shaft always running will take about 1 H.P., and the motor will give about 86 per cent. efficiency. Small motors coupled direct to the tools, and with reduction gearing, would waste quite as much power as the shaft and single motor does.

In the case of machines each taking 1 H.P., and comparing 20 of these with a motor driving 20 of them, if they ran steadily at full load throughout the day, you would have the same difference in first outlay, but of course a much bigger running bill, £200, out of which to pay for interest and depreciation, but even in this case if the shaft is well run and not over long, it should not cost more than £10 or £15 a year to run it, and the lower efficiency of the 1-H.P. motors will counterbalance this amount.

In our opinion, no general rule can be given; each job ought to be taken on its merits, and besides allowing for which takes the least current, allowance must be made for which costs the least at the end of the year, which is a very different thing.

Rosling & Appleby.

November 14th, 1899.

A New Incandescent Lamp Factory.

Having read the article under the above heading in your paper of the 10th inst., referring to the Berrenberg Incandescent Lamp Factory, in which you take exception to certain statements respecting our lamps, appearing in the recent issue of a contemporary, we shall be glad if you will kindly allow us space to reply.

As far as the article deals with the Berrenberg metallic vacuum pumps, we think it requires no further explanation than to call the attention of the writer to a description which appeared in your paper on February 24th, 1896, Vol. 38, No. 948, embodying a report by Prof. Ayrton, F.R.S., on our metallic vacuum pumps, which Mr. Berrenberg has since so greatly improved that the result is still more remarkable, and he continues to make gratifying progress in this direction.

With regard, however, to the claims we make for our lamps, one fault urged against us appears to be that we have not dotted our i's or crossed our t's, as, in referring to the consumption of current, your contributor has interpreted our figures to mean the consumption of watts per lamp instead of watts per candle. Speaking about the heat, we would like your readers to judge for themselves by burning one of our lamps in water and taking the temperature, and then comparing it with that given off by another make under similar conditions. With regard to the saving effected by using our lamps, independent tests show in taking 16 C.P. 100-volt lamps lasting 1,000 hours, according to the watts per candle consumed, our lamps save from 5s. to 15s. per lamp, according to the price of the current used during that time. We do not speak of "annual saving," for the lamps may be burnt continuously, or, on the other hand, they may last several years before the 1,000 hours is reached.

Since Goebel made the first incandescent lamps in 1854 in New York, comparatively slight improvements have been effected in them. Mr. Berrenberg tested some of Goebel's lamps in Boston in 1891, which consumed 4·3 watts per candle, and many of the lamps in general use to-day cannot give a much better result. This is owing in a great measure to the ignorance or indifference on the part of the ordinary consumer as to the essentials of a good lamp, and, again, to the supply companies, whose chief object appears to be to sell as much current as possible. Without doubt the most economical lamp at present to use is one consuming from 1½ to 2 watts per candle, with a medium life of about 300 to 600 hours respectively, as the following figures will show.

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The current is calculated at 6d. per unit for better comparison with the prices actually paid, which can be adjusted accordingly:—

	s.	d.
16 c.p. 1½ watts for 1,000 hours = 24 units at 6d. =	12	0
3 lamps at 1s. 6d. ... ... =	4	6
	16	6
16 c.p. 2 watts for 1,000 hours = 32 units at 6d. =	16	0
1½ lamps at 1s. 6d. ... ... =	2	3
	18	3
16 c.p. 2½ watts for 1,000 hours = 40 units at 6d. =	20	0
1 lamp at 1s. 6d. ... ... =	1	6
	21	6

Mr. Berrenberg, having devoted years of labour to the subject, has, with the assistance of this company, succeeded in producing the above-mentioned lamps, which are far superior to any on the market, and we think that such efforts should receive due recognition at the hands of such journals as yours, instead of treating with ridicule our statements and referring to them in the following terms: "Such exaggerations recoil on the head of their perpetrator in the long run, and at the same time discredit the trade in general"—which last statement the writer thereof should bear in mind.

The Berrenberg Electric Lamp Syndicate, Limited.

[While our correspondents make clear their meaning, they do not refute our criticism of the loose wording of their announcements, which might just as easily have been accurately framed at first. Far from ridiculing them, we heartily welcome real efforts towards progress.—Eds. Elec. Rev.]

LEGAL.

The Electric Construction Company, Limited, v. The Imperial Tramways Company, Limited, The British Thomson Houston Company, Limited (Third Parties).

On Thursday, November 9th, the hearing was resumed in the Chancery Division of the High Court of Justice, before Mr. Justice Cozens-Hardy, of this action.

Mr. Astbury called, as a witness, Mr. John Imray, described as a civil engineer of large experience, who said he had considered the plaintiff's specification, and also the various specifications which had been referred to in the course of the trial, by way of anticipation. With regard to plaintiff's specification, witness said that if other forms of gearing, such as belts or friction clutches were used, there would be no necessity at all for springs. The mechanical object of springs was to take off shocks, and that was a matter well known in mechanics long before the date of plaintiff's invention.

What were the understood means of avoiding shock?—Usually buffers, strong things which would take off the blow. Springs were perfectly well known for that purpose.

In further examination, Mr. Imray said that, in his opinion, there was no difference, except in detail, between the way in which Reckenzaun supported his motor and that of the plaintiff, taking away the right-hand spring and leaving the left-hand spring, the two methods were precisely the same. With the exception of the spring attachment, he found all the elements of plaintiff's invention present in Finney's specification, and performing the same functions.

Mr. Imray was next questioned as to a picture plan of Sprague's invention as shown in the United States Official Gazette.

If anybody were told to make a motor as shown in the Gazette, and supply the commonest form of part to avoid vibration, what would he do?—He would put springs to where the motor is attached to the truck. It was a usual thing at that date to put springs to support the carriage.

Supposing the field magnet is hung from the car body itself, instead of being hung to the cross piece, what would be the effect of the springs of the car body upon the magnet, having regard to the fact that it was sleeved at the other end?—If you put the car body on springs there would be no need for springs to hang the car motor. Comparing Hermant's with the claim 3 of plaintiff's specification, witness considered the former was designed to solve the same problem as plaintiff's. The one essential of the plaintiff's, where he had tooth gearing, was that the two shafts, the armature shaft and the main driving shaft, must always be kept at a constant gearing distance, and that was provided for in Hermant's.

Cross-examined by Mr. Fletcher Moulton, Witness said he certainly did suggest that Reckenzaun's was a case of sleeving if you took out the springs.

I was speaking of it with springs, and I put it to you that no mechanician would ever describe that as sleeved.—He might not say "sleeved," he might say centred.

His Lordship: Centred or sleeved, do they mean the same thing?—It depends entirely on how the portions come into play.

Mr. Moulton: Sleeving is a mode of centring?—Yes.

The effect in producing swivelling is the same?—Yes.

In further cross-examination, Witness said there were no springs shown at all. As regards Sprague's (U.S.A. Official Gazette), supposing there was a rigid attachment to the car body by two links instead of springs at the other end and the car body rocked there would be a twisting action. Supposing they had springs from the other end and the car body was on springs, the movement of the car body rocking would compel the motor to go askew.

Pyott had no springs on his front or hind axle, but he put springs on his centre axle.

Re-examined by Mr. Cripps, witness said supposing you had a steam motor with a gearing apparatus, you must get the driving and driven wheels at constant distance, just the same as in an electromotor.

Mr. Wm. Worby Beaumont, M.I.C.E., &c., was next called for the defence. He said he had considered the problems in this case. With regard to the drawing in the Official Gazette, he agreed with Mr. Imray as to the indications of springs. He agreed that any engineer accustomed to that class of work would at once assume that there was something there of the nature of a buffer. Something of the sort was indicated in Adams's specification, and in the plan of Cryder. He agreed generally with the evidence of Mr. Imray as to the various other specifications.

Mr. Fletcher Moulton, in cross-examination: You have told his Lordship that Reckenzaun's is the same as the plaintiff's invention. Do you withdraw it?—No.

I do not know whether you were speaking of Reckenzaun's with or without springs?—I was speaking of it without springs.

Re-examined by Mr. Cripps, Witness deposed that he found in Reckenzaun's all the four elements, plus the spring, in the plaintiff's claim 1.

Mr. Astbury said that he had Prof. Silvanus Thompson present to give evidence if necessary, but he did not propose to call him or any other expert. The learned counsel then addressed his Lordship on the evidence which had been given, and submitted that the plaintiff's specification had been anticipated heaps of times.

Mr. Moulton, in reply, said he did not think that the construction of the plaintiff's claims would be difficult, if his Lordship would bear in mind one principle which had been laid down again and again in the judgment of the different courts, namely, that in interpreting the specification the claims were not to be interpreted as if they stood alone, but both for and against the patentee, his Lordship was bound to take into consideration the whole text of the specification in construing the claim.

His Lordship: I must construe the whole document, no doubt. I do not think that can be disputed.

Mr. Cripps said that he should not dispute that for a moment.

Mr. Moulton then referred in detail to the plaintiff's specification, and he said he paraphrased the claim in the following way—Handford said he hung the off end of his motor by springs from the truck, and he centred the other end on the driving axle. He then had springs connected with the truck, which would take off as much weight as the inventor chose by means of his adjustment. In the plaintiff's invention there were three elements. One end of the motor was suspended on springs and the other end centred and the weight was taken off by supporting springs. The inventor seemed to have attached some importance to his description of his special way of supporting the armature, but he (counsel) did not care about that, as he did not think it was material now. With regard to the alleged anticipation, the learned counsel submitted that he had called evidence of the very greatest value as to the position of this invention. In the first place, it proved that there was no common knowledge at the time which would lead people to do what the plaintiff's invention did. The evidence also proved that no less than five attempts had been made to mount an electric motor prior to the plaintiff's, but they all could be distinguished from that invention. His Lordship had to consider the special requisites of the electric motor as contrasted with the steam motor, and that would not allow any specification for a steam motor to be an anticipation of plaintiff's patent. Beyond that there was direct and uncontradicted evidence to show that nothing in those anticipations with regard to steam had become part of the knowledge of engineers. He submitted that the plaintiffs had proved the value of the patent.

Mr. Justice Cozens-Hardy said he would take time to consider his judgment, and asked to be furnished with copies of the shorthand notes which had been taken during the hearing.

Judgment.

Judgment was delivered on Tuesday, the 14th inst. His Lordship said:—

In this case, the plaintiffs sued as assignees of a patent for improvements in motors for electric railways, granted on August 10th, 1885, the alleged inventor being Mr. Sprague, an American. In the course of the present litigation the patent had expired, and the plaintiffs, therefore, had been obliged to limit their claim to one of damages. The defendants had clearly infringed this patent, assuming it to be valid, and the only issue really tried before him had been as to the validity of the patent. Defendants alleged want of novelty, and relied upon a large number of anticipations. The evidence of the scientific witnesses on both sides mainly dealt with the alleged anticipations. It was not required, except to a very slight extent, for the purpose of assisting him (the Judge) to construe the specifications, that he should go through them in detail. He apprehended that a specification ought to be regarded in the same manner as any other document which had to be interpreted by the Court. It must be looked at as a whole. The claims must not be looked at as if they stood alone. Strained and unnatural interpretation must be avoided. The true meaning and extent of the claims must be looked for without reference to the effect that

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this may have upon the validity of the patent. The patentee began his specification by describing the object of his invention, and he then proceeded to describe how that object was to be accomplished. His Lordship quoted passages on these heads from the specification, and said it seemed to him to show that heavy springs were prescribed when, and only when, there was a truck upon the car, and that where the car had no truck the yoke, or back-piece, might be hung from the car body itself, and that springs were not needed. He might add that the evidence satisfied him that what he took to be the view of the patentee was mechanically correct. The patentee then proceeded to describe other parts of the invention, and next indicated the mode by which the dead weight of the motor on the driving axle could be relieved. He (the Judge) thought that the plaintiffs' counsel were right in saying that that was an optional arrangement, and that it did not refer to springs attaching the yoke, or the back-piece, to the truck. These "supporting springs" might be used with a truck or without a truck. The patentee then pointed out that the mode of gearing by toothed wheels was not essential, and next referred in detail to the figures annexed to the specification, and he might observe that all the figures showed trucks, and that there was no figure of a car body without a truck. It was not necessary to read all that part of the specification, and he would pass on to the three claims, which required very careful consideration. The first claim was for "the motor of an electric railway car or carriage, having (*a*) its field magnet centred or sleeved upon a driving axle; (*b*) its armature supported directly upon the field magnet; (*c*) and having a shaft separate from the driving axle; and (*d*) communicating motion from the armature shaft to the driving axle, substantially as hereinbefore described." He was of opinion that that claim was for a motor having all the four elements, which he had called *a*, *b*, *c*, *d*, in combination, each of them being "substantially as hereinbefore described." It had no reference to a spring suspension. It applied to a case where a car body had no truck, and where springs were not described. It also applied to a case where there was a truck, but where belts were used, and where springs would not be needed. The second claim was verbally identical with the first claim, except that the optional supporting springs were added—"supported partly or wholly by springs from the car body, carriage body, or truck." It followed that, in his view, this had no reference to the spring suspension. With reference to the third claim, there, for the first time, was mention made of what he (the Judge) called "spring suspension." He was asked to hold that the last claim was practically identical with the first claim. He was unable to do so. It seemed to him to be an essentially different claim; it added something which was not found in the first claim, and which he believed was intentionally omitted from that claim. His Lordship concluded:—This being the construction which I place upon the specification, it was faintly, if at all argued, that the patent could be supported. The first claim, as I read it, was plainly not new, and the action, therefore, fails. Had I adopted the plaintiffs' contention that spring suspension is to be found in the first claim, it would have been necessary for me to consider in detail several of the alleged anticipations. But, in the view which I take, I think it would be a waste of time to do so. Suffice it to say, that my opinion is adverse to the plaintiffs on this point also. The action must be dismissed with costs.

Mr. Cripps, Q.C. (for defendants) asked for a certificate that the particulars which had been referred to, with the exclusion of Garland's, were reasonable.

His Lordship replied in the affirmative. The shorthand notes would show what the particulars were.

Mr. Gray (for plaintiffs) asked his Lordship not to grant so general a certificate, on the ground that several of the specifications put in by the other side only related to small parts.

His Lordship said he could not see his way to give any such direction. He went on to say, in answer to Mr. Cripps, that he did not mean to charge the plaintiffs with anything more than one set of costs. He had treated the defendants as only one defendant.

Mr. Gray said his clients might think it desirable to take the matter further, but they were not desirous of staying execution if an undertaking were furnished as to the return of costs. Mr. Gray said he understood that the defendant company was at present in liquidation (Counsel on the other side: Not yet), and he, therefore, asked for the usual undertaking from the solicitors.

His Lordship said he could not impose terms. He had dismissed the action with costs.

Mr. A. J. Walter, on behalf of the third parties to the action, the British Thomson-Houston Company, Limited, makers of the article in dispute, put in an application that they should be allowed their separate costs up to a certain stage in the proceedings, but eventually withdrew the application, and said that his clients would agree to his Lordship's ruling that there should be only one set of costs.

Heyl-Dia *v.* Edmunds and Others.

In the Chancery Division of the High Court of Justice on Saturday, November 11th, before Mr. Justice Kekewich, the hearing was concluded of an action brought by George Edwd. Heyl-Dia, an electrical engineer and chemist, carrying on business in Manchester, against the defendants, Henry Edmunds, of Victoria Street, Westminster, Jas. Edgar Baxter, of Highfield Leyland, rubber manufacturer, and M. G. B. Samuelson, managing director of Messrs. W. G. Glover & Co., of Salford. Plaintiff sought to obtain a declaration that he was entitled to the benefit of an invention and secret process for recovering from India-rubber waste a commercial India-rubber which was suitable for various purposes, and which he called "Heyloid." Plaintiff also sought an injunction to restrain the defendants from in any way disclosing particulars of his invention and secret process. Mr. Heyl-Dia also asked, alternatively, that it might be declared that he and the defendants, or some of them, were partners with regard to the invention and secret process; and, further, for a dissolution of partnership, with the usual inquiries and accounts. Defendants, by their statement of defence, admitted that plaintiff invented the secret process, but denied that he was the sole proprietor. It was said that the plaintiff had disclosed to all the defendants the mode of carrying out his invention, and the defendants affirmed that he was bound to do so under the terms of an agreement with them. For the purpose of testing the invention, the defendant, Baxter, had expended a large amount of money in the erection of works at Leyland. As to the defendant Samuelson, it was said that he had subsequently made an arrangement with the defendant Edmunds, whereby all his interest in the invention became Edmunds's property. As Baxter had spent a larger sum of money than was contemplated, a re-arrangement of the shares was effected under which Edmunds and Baxter would be each entitled to one-third. The three parties proceeded to form a company for the purpose of taking over and working the process. On July 12th, 1898, a company called the Caout-Chouc Company, was registered for that purpose. Shortly after registration, viz, on August 3rd, an agreement was made between Edmunds and Baxter and the plaintiff, but for the defence it was said that that had been rescinded, and defendants claimed that they, equally with the plaintiff, would be entitled to the use of the secret process and invention. The statement of defence further set out that the defendant Samuelson, did not now claim to be interested in the invention and secret process.

In the result, and after hearing evidence, his Lordship held that although there was no partnership between Baxter, Edmunds, and the plaintiff, Baxter and Edmunds were entitled to the benefit of the invention. If they were all co-owners, the plaintiff was entitled to one-third share under the new arrangement made between himself, Baxter, and Edmunds. Looking at the whole of the evidence, his Lordship thought plaintiff was entitled to no relief against the defendants, and there would simply be judgment for the defendants with costs.

Counsel for the defendants, on the suggestion of his Lordship, said they gave an undertaking not to disclose the secret process of manufacture of Heyloid, pending a possible appeal.

The British Insulated Wire Company *v.* The Dublin United Tramway Company and The National Conduit and Cable Company, of New York.

On 8th inst. this case was listed for hearing before the Vice-Chancellor, at Dublin. The action was one for damages for alleged infringement of a patent, and the only order which his Lordship was asked to make was one for an inquiry as to damages.

The Solicitor-General, Q.C., M.P., Mr. C. L. Matheson, Q.C., Mr. Blood, and Mr. Gerald Fitzgibbon (instructed by Messrs. D. & T. Fitzgerald) appeared for the plaintiffs; and the defendant companies were represented by Mr. Stephen Ronan, Q.C., Mr. J. Gordon, Q.C., and Mr. Fitzgerald Murphy (instructed by Messrs. Casey & Clay).

The Solicitor-General, in opening the case for the plaintiffs, said the writ was issued on September 10th, and originally claimed an injunction as to two patents, 11,894 of September 2nd, 1884, and No. 13,340, of October 19th, 1886. The latter patent had now dropped out of the case, and the Court was now solely concerned with patent No. 11,894. An injunction in the case would involve the taking up of all cables in the tramway system in Dublin, but as damages would meet the case, the plaintiffs only asked for an inquiry as to damages.

Mr. Ronan: Yes; out of mercy to us, the injunction is not asked for.

The Solicitor-General: Not to you, but partly out of mercy to the citizens of Dublin. The patent was a patent for an improvement in the insulation of electric conductors or cables. It consisted in applying to the electrified conductor some non-conducting material which is placed around it, and which protects the electrified cable from waste of electricity and from all surrounding substances.

Mr. Ronan, Q.C.: It is not necessary to go into all this. We admit the cable laid down is in substance made according to the principle of the plaintiffs' cable. If the Solicitor-General told your Lordship the patent expired on September 2nd last, before the writ was issued, it would have thrown a little more light on the matter.

The Solicitor-General: The infringement is admitted by affidavits, and it is quite obvious there must be an inquiry as to damages.

Mr. Ronan: There is some infringement, unquestionably.

Mr. Matheson: If you admit it now it is only a question of account.

The Solicitor-General said the invention consisted in the discovery that Manila paper—a pure vegetable paper—formed the best insulator.

Mr. Ronan, Q.C., said the patent was only a 14-year one, and they admitted using the invention.

Mr. Matheson, Q.C., said the plaintiffs had put in a tender for £30,092, and the tramway company had given the contract to the other defendants, so that a big amount was involved, and there should be an account.

The Solicitor-General said in any case he desired to state the plaintiffs' case. The British Insulated Company, who carried on business at Prescot, received a letter on October 18th, 1897, from the tramway company, asking them to tender for the piping and cables for the tram system of Dublin, the tenders to be lodged before November 1st. The date of sending in tenders was subsequently postponed to November 15th, and on the 13th plaintiffs sent in a tender, and the measure of damages would be the profit the plaintiffs would have made in the contract, because they were the only people in the United Kingdom empowered to legally sell that cable.

The Vice-Chancellor: Do you dispute that measure of damages, Mr. Ronan?

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Mr. Ronan, Q.C.: Entirely. I say the only damage they can recover in respect of the patent is for user, but they cannot recover for any act done outside the jurisdiction.

The Vice Chancellor: What do you mean by outside jurisdiction?

Mr. Ronan, Q.C.: For instance, there might be people making it in America. The point is, what acts have been done within the jurisdiction? I may tell you the patent expired on September 2nd, and we should have been at perfect liberty to send our goods into Ireland and the tramway company to take them on September 3rd, and the mistake we made is that we sent them a few weeks before, and for that mistake we must pay.

The Solicitor-General said the amount of the plaintiffs' tender was £30,092 12s. 10d., and afterwards they got information that cables were being delivered in Dublin, which were an infringement of their patent, and they sent a representative, Mr. Guiseppi, in August, 1898, to Dublin, and he saw the cables in the streets, and being delivered from the ships from America. He took samples, which showed the cables were identical with the plaintiffs' patent. The expiring years and months of a patent were most valuable, and had the plaintiffs got the contract a large profit would have been made. The statement of claim was delivered on September 9th, limited to the patent of 1884. It stated that the plaintiffs were the owners of the patent up to September 2nd, 1898, and that while the letters patent were good and valid the defendants infringed the patent. The American company occupied a similar position in America to the British Insulated Company here, and the tramway company preferred to get their goods from the American company. Down to September 2nd the plaintiffs were sole proprietors of the patent, and gave no license to anyone in the United Kingdom to sell their cables. The defendants deliberately took the risk, and now they had to face the music, and the only question was what were they to pay.

Mr. Tracey, secretary of the plaintiffs' company, was then examined, and stated that, had his company got the contract, they would have had a profit on the cables of £2,735.

Mr. Gordon, Q.C., said the damages would be limited to the amount of cable delivered up to September 2nd. It was a very small portion.

Evidence was also given as to the laying down of the American cables in Dublin.

Mr. Ronan, Q.C., in opening the case for the two defendant companies, said the patent of 1884 expired eight days before the commencement of the action, and therefore the action as far as it claimed an injunction to restrain the defendants was all nonsense. The result of the earlier proceedings was that the patent of 1886 was dropped altogether, and afterwards the injunction as to the patent of 1884 was also dropped. He submitted that the interlocutory motion should be refused with costs. The only question now was the amount of damages they should pay for the infringement of the patent of 1884, and what profit the plaintiffs would have made out of the cables supplied before September 2nd.

The arguments having been concluded,

The Vice-Chancellor said that the plaintiffs were not entitled to seek for an injunction, and he directed an inquiry as to damages, the inquiry to be limited to that portion of the cable received by the Tramway Company prior to September 2nd, plaintiffs to have general costs of the action, save the costs of the injunction, which were given to the defendants.—*Irish Times.*

In re The London Electrical Cab Company, Limited.

In the Chancery Division of the High Court of Justice on Saturday last, Mr. Justice Byrne had before him the matter of Bersey *v.* the London Electrical Cab Company, Limited, which was a motion on behalf of the plaintiff in a debenture holder's action to which no defence had been put in. Mr. Bersey, the plaintiff, it appeared was the holder of certain first mortgage debentures, which charged the whole undertaking of the defendant company, and the principal moneys became payable if a distress was put in, an execution levied, or if the company ceased to carry on business. The defendant company was said to have lost £11,000 in two years, and in consequence of it having ceased to carry on business, and a distress having been put in for rates, the debentures had fallen due. His Lordship made a declaration that the debentures formed a charge upon the undertaking of the company, and pronounced judgment in the ordinary form in a debenture holder's action, with liberty to apply in Chambers for a sale of the undertaking as a going concern.

Madras Electric Tramways Company, Limited.

On Wednesday, the 10th inst., in the Chancery Division of the High Court of Justice, the petition of the Electric Construction Company, Limited, for the winding up of the Madras Electric Tramways Company, Limited, was heard. Mr. Herbert Reed, Q.C., who appeared for the company, said that a fortnight ago he asked that the matter should stand over, but he felt that he could not now ask for further indulgence in that respect. There were a number of native shareholders, and there seemed to be some difficulty about the matter. Under those circumstances, counsel for the company asked for a compulsory order. His Lordship granted the compulsory order sought for.

In re Milver Portable Electric Battery Syndicate, Limited.

In the Chancery Division of the High Court of Justice on Wednesday, November 15th, Mr. Justice Wright, sitting as an additional judge for the transaction of company winding-up business, had before him the petition of G. Trenam for the winding up of the Milver Portable Electric Battery Syndicate, Limited. Mr. Claire said this was a winding-up petition by a creditor. There was some difficulty about it, as his Lordship would notice that the name of the company as it appeared in the *Gazette*, was that of the "Milner Portable Electrical Battery Syndicate, Limited," instead of "Milver, &c." In a Birmingham paper, however, the name of the company appeared correctly in the advertisement. The company had approached the petitioner with a view to paying him off, and counsel therefore hoped that the matter would stand over for a fortnight.

His Lordship acceded to counsel's request.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending Nov 15th, 1898		Week ending Nov. 14th, 1899.	
Alexandria	Value £120	Alexandria	Value £756
Amsterdam	210	Amsterdam	901
Boca	37	Antwerp. Elec. fuses	804
Boulogne	39	Bangkok. Teleg. mat.	95
Brisbane	40	Bergen. Teleg. cable.	10,675
Brussels	110	Boulogne	65
Calcutta	111	Brisbane	133
Canterbury	24	Buenos Ayres. Teleg. mat. ..	10
Cape Town	1,534	Calcutta	146
Christiania	15	Cape Town	468
Colombo	83	Christchurch	17
Copenhagen	70	Christiania. Teleg. wire ..	68
Demerara	25	Colombo	35
Durban	97	Durban	95
Flushing	10	Gibraltar	20
Fremantle	624	Gothenburg. Teleg. wire ..	13
Hamburg	120	Hamburg. Teleg. mat.	440
Hong Kong	1,757	Hong Kong	58
Las Palmas. Teleph. mat. ..	15	Kobe. Teleg. cable	145
Madeira	12	Launceston. Elec. motor ..	113
Melbourne	143	Lyttelton	24
Ostend	30	Madeira	13
Perth	38	Marseilles	69
Rio de Janeiro. Teleg. mat. ..	18	Melbourne	123
St. Petersburg	256	„ Teleg. wire ..	974
„ Teleg. mat. ..	180	Monte Video	100
Santander	20	Ostend	221
Santos	68	Perth	534
Sydney	2,461	Piraeus	15
Trinidad	26	Port Elizabeth	279
Wellington	361	Port Said	23
Yokohama	1,190	Santander	103
		St. Petersburg. Teleg. mat. .	33
		Shanghai	12
		Stockholm. Teleg. mat. ..	143
		Sydney	186
		Wellington	448
		„ Teleph. mat. ..	860
		Yokohama	1,096
		„ Teleg. mat. ..	244
		„ Telephones ..	960
Total ..	£9,874	Total ..	£20,404

Foreign Goods Transhipped.

Adelaide. Teleph. mat.	Value £111
Cape Town. Telephones ..	113
Total ..	£224

"All work and no play, &c."—London is by no means prepossessing in the late autumn or winter season, and the desire to avoid its dampness, dreariness and fogginess warrants no rebuke. The man whose very life is bound up in mere mundane matters may break his bonds asunder and escape for a few hours to spend a week-end far from the madding crowd. As a director of or shareholder in electricity supply concerns, he may glory in a really good dense and prolonged London fog, but as an ordinary individual he clamours for pure air. The combined influences of a mind at rest and of the breezes of fresh fields and pastures new, minus fog, revive his drooping spirits so that he returns to duty the better equipped for thorough hard work. The *South Coast Quarterly* for November carries one in thought to the neighbourhoods of Brighton, Tunbridge Wells, Arundel, and so on, and by the aid of neat little views places before us the leading attractions that these places offer for either brief or prolonged visits, at this period of the year. Some notes on the various associations of these picturesque and health-giving resorts are contributed in an entertaining manner by Joseph Hatton and other writers.

Appointment Vacant. — The East Indian Railway Company, 28—30, Nicholas Lane, E.C., is inviting applications for the post of electrician to advise on, and superintend, the erection and working of electrical plant for power and lighting in India. Age 28—35; salary, 800 rupees a month. Applications, with testimonials and medical certificate of fitness for service in India, to be addressed to the Secretary by November 22nd.

Auction Sale. — On Tuesday next, 21st inst., Messrs. Wheatley Kirk, Price & Co. will sell by public auction the contents of the Globe Works, Kirkstall Road, Leeds, by order of the trustee in *re* J. A. Edmondson, electrical engineer. The plant comprises an electrical installation for 10 arc and 20 incandescent lamps, several engines, motors, lathes, planing, boring and other machines. The new stock to be offered also comprises dynamos, motors, and stores, &c.

Bankruptcy Proceedings. — The first meeting of creditors in *re* E. M. Winter, electrical engineer, Amberley House, Norfolk Street, London, will be held on November 17th, and the public examination on December 19th, both at Bankruptcy Buildings, Carey Street, W.C.

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Books Received.—"Fire Tests with Partitions," by Messrs. D. Anderson & Sons, Limited, and Messrs. J. C. Broadbent and Co., Limited. London, 1899: British Fire Prevention Committee. 2s. 6d.

"Leçons sur l'Electricité, professé s a l'Institut Electrotechnique Montefiore annexé a l'Université de Liége," par Eric Gerard, Tome second; sixième édition. Paris: Gauthier-Villars et Fils, 1900. 12 fr.

Catalogues and Lists.—The Whitney Electrical Instrument Company, of America, sends us a proof sheet of its voltmeters, ammeters, and ohmmeters, portable and switchboard, for direct and alterrating current.

The British Thomson-Houston Company sends us one of its No 47 illustrated pamphlets of slow and moderate speed motors (C E type). The construction and various parts are explained, and illustrations showing the motors applied in printing work appear.

Messrs. Bradbury & Co., Limited, of Oldham, have issued an illustrated list of their Capstan lathes. Their new No. 6 Capstan lathe, has been designed specially for electrical engineers, for the rapid and cheap manufacture of incandescent lampholder parts. Electricians and manufacturers of lampholders have frequently expressed to them a desire for a lathe lighter in construction than the ordinary Capstan, and one which will take up to 1¼ inches in diameter through the spindle with automatic wire-feed and grip motion. It is considered that the machines used for this class of work are generally much heavier than is necessary and are not as convenient to operate, and it is claimed will not produce the work as rapidly as the No. 6 Capstan. To produce work from hollow castings, tubes, &c., it is necessary to have Bradbury's patent expanding chuck for holding same. When working from rods or solid castings an ordinary spring cone chuck is used; both are supplied with this lathe. Although the No. 6 lathe will take up to 1¼ inches through the automatic wire-feed and will produce an infinite variety of articles from brass, it will not do work from iron or steel larger than can be executed on their No. 5 Capstan, which only passes up to ⅞ inch through the wire-feed. It is essentially a brass-working machine.

Messrs. E. Goossens, Pope & Co., of Basinghall Street, E.C., are sending out circulars of their newest types in high voltage lamps. The obscuring of all lamps is effected by means of sand blast which does away with the discoloration found in many lamps frosted by chemical means.

A 16 pp. pamphlet has been issued by the Electrical Transmission Company, Limited, of Hammersmith, giving some general information and illustrations showing "progress in the electrical transmission of power." The matter is reprinted from an interestingly written article by Mr. W. F. Jones, A.M.I.E.E., M.I.Min.E., in a recent issue of the *Engineering Times*. The illustrations show a number of the applications of electric motors to factory driving, mining work, &c.

Charge of Stealing Electricity.—At West London, Mr. W. A. Webb applied on behalf of the Hammersmith Vestry for a summons against a person for stealing electricity. He stated that the complaint was that a connection was made at the side of the main wire belonging to the Vestry, with a fraudulent intention. A summons was granted.

Colliery Equipment. — The lighting of coal mines by means of the electric light is rapidly growing in favour in the North of England, and our Sunderland correspondent has just learned from Messrs. Reid, Forens & Co., of Sunderland and Newcastle, that they have several important works of that character in hand. The contracts include the supplying and fixing of two steam engines and two 220-volt, 100-ampere dynamos, complete with massive slate switchboard, and wiring for 200 lights for the Weardale Coal and Iron Company's Thornley Colliery; also one steam engine and dynamo for 220 volts, complete, for the Marquis of Londonderry's new Dawdon Colliery; also the supply and fixing of the necessary engines and dynamos, wiring, &c., for the South Moor Coal Company's several pits and villages, as well as the making and maintenance of the "Sussman" patent miner's lamp in use at the collieries. The firm have also just concluded the lighting of the colliery village of Deaf Hill, Durham. In addition to these important contracts, the firm named has had a lot of smaller work, one item being the lighting of the whole of the finished premises which have been erected in place of those destroyed by last year's fire at Sunderland.

Electrical Engineering in Italy.—A meeting has just been held at Padua to consider a scheme to utilise the water-power of the Piave and Cellina streams in the generation of electrical energy and the distribution of the same in Venice for lighting and power purposes. It was decided to proceed with a scheme, and a company is to be formed for the purpose.

For Sale.—From an advertisement in this issue it will be seen that the electrical plant, lease, &c., of the electrical engineering business now carried on by Messrs. Heath, Snowell & Co., Limited, Birmingham, (in liquidation) is offered for sale at £3,750 or valuation.

Messrs. Fuller, Horsey, Sons & Cassell will, on 30th inst., sell by auction engineers' tools and stock on the premises of the Maskelyne British Typewriter Company. See our advertisement pages for particulars.

Honour and Glory!—*Indian Engineering* says that the American contractors, "who supplied the Atbara Bridge, lose largely by the transaction. But the honour and glory count for a great deal!" There is no doubt that the affair has been a splendid advertisement for American contractors, but if it has served the purpose of arousing English firms to the importance of being better prepared to meet competition, it has not been altogether a disaster to English industry.

Intended Dividend.—The last day for receiving proofs of the intended dividend in *re* E. B. Pym, electrical engineer, Scarborough, is November 29th. The trustee is Mr. A. H. Wildy, Bankruptcy Buildings.

Liquidations, Dissolutions, &c.—Messrs. W. O. Rooper and A. G. Robins (W. O. Rooper & Robins, electrical engineers, Victoria Road, Stafford), have dissolved partnership. Mr. Rooper will attend to debts and will continue to trade at the same address.

A meeting of Berry's Electrical Company is to be held at the offices of Rowlands & Co., 41, Temple Row, Birmingham, on December 21st to hear an account of the winding up from the liquidator, Mr. A. E. Chatterley.

Mr. F. B. Nicholson informs us that the partnership existing between Mr. R. G. Tyler and himself has ceased to exist, and that he will in future carry on business at 53, Victoria Street, Westminster, in the name of Nicholson & Co. Mr. R. G. Tyler, we understand, has made arrangements to take into partnership Mr. W. Duncan, A.I.E.E. late chief of the electrical engineering staff of Messrs. Laing, Wharton and Down, Limited. The business of electrical and mechanical engineering and also that of Messrs Ernest Scott & Mountain, Limited, in London and district, will be continued at the same address, 20, New Bridge Street, E.C., by the new firm under the style of Tyler & Duncan. Special attention will be devoted to Messrs. Scott & Mountain's manufactures.

New Exhaust Pipe Head.—One of the most objectionable phenomena incidental to the use of an atmospheric exhaust pipe is the constant spraying with a mixture of oil and water, to which the surroundings are subjected. This may even lead, as in the case of the Westminster Electricity Supply Company, to legal proceedings for an abatement of the nuisance; it is not due to condensation of the exhaust steam itself, but to the moisture suspended in the steam, and is therefore capable of being avoided. A form of exhaust

head, recently described in the *American Electrician*, is made by the B. F. Sturtevant Company, Boston, and is intended to catch all suspended oil and water while permitting easy escape of the steam. The exhaust pipe is surmounted by a funnel, as seen in the figure, within which the pipe is divided; the two branches discharge the steam tangentially close to the outer walls, and give it a vigorous whirling motion. The entrained water and oil, thanks to their high specific gravity, which is 1,600 times greater than that of the steam, are thrown outwards, trickle down the sides of the funnel, and are led away from an outlet at the bottom, while the dry steam escapes freely through the central opening. These heads are made in sizes from 1 inch to 20 inches diameter.

Revolving Shade Lamp.—The Edison & Swan United Company has issued a leaflet describing the "Comet" revolving shade lamp, which consists of an enamelled or plated cylinder which revolves in a wire cradle, enabling the light to be thrown in any direction. It is well known that the impact of a direct ray of light upon the eye leads to injurious results, in consequence of the constant efforts of the muscles of accommodation of the eye to ward off harmful excess. The eye-shade, which serves as a reflector as well, may be moved by a touch to any desired angle, so that a desk, table, or other desired object alone may be illuminated, and all sharp shadows prevented. The standards are adjustable, are made in polished oak and also in metal. The cylinder or hood containing the lamp is white enamelled inside and green enamelled outside, but can be supplied nickel plated. The list illustrates the lamp adapted for desk, surgical, orchestral and other uses.

The Stanley Show. — Messrs. W. Canning & Co., of Birmingham, are again exhibiting their electro-plating plant and appliances at the Stanley Show at Stand 49, Machinery Section.

Trade Announcement.—Messrs. Oliver & Co., arc lamp manufacturers, announce that they have been obliged to take larger works owing to increased business. Their address is now Cambridge Place, Burrage Road, Woolwich. They have recently received an order from the Charing Cross and Strand Electricity Supply Company, Limited, for arc lamps and accessories required by the St. Martin's Vestry for lighting the Strand and Trafalgar Square, &c; They also have large orders in hand for the Great Northern Railway, Sir W. G. Armstrong, Whitworth & Co., Limited, of Manchester, and the Birmingham Carriage & Wagon Company (per Messrs. Ellis and Ward, Birmingham) &c.

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ELECTRIC LIGHTING NOTES.

Aycliffe.—The Darlington District Council has agreed to the erection of an overhead line along the side of the highway, to carry the electric current to the village of Aycliffe, over a distance of half a mile. The example of Aycliffe might well be followed by other villages.

Barnet.—The District Council has resolved to obtain a new provisional order covering the whole of the Council's district.

Barnsley.—An inquiry was held last week by Colonel W. Langton Cooke, M.I.C.E., an inspector of the Local Government Board, relative to an application of the Town Council to borrow £3,661 for the purpose of installing the electric light in various public buildings.

Berwick.—The Sanitary Authority, acting on Mr. Campbell Swinton's advice, has decided to support Edmundson's Electricity Supply Company, Limited, in their application for a provisional order.

Brecon.—According to the *South Wales Daily News*, Col. J. Morgan, J.P., Mayor of Brecon, has undertaken to defray the whole cost, estimated at £6,000, of establishing an electricity works in Brecon, and has instructed Mr. Bertram Thomas, of Manchester, to prepare a scheme. A provisional order is to be obtained at once.

Cleckheaton.—The District Council has decided to apply for a provisional order to supply electricity for public and private purposes within the district.

Clydach.—This rapidly rising town in the Swansea Valley showed itself in festive mood on Thursday evening last week, jubilant in the fact that it had shown the way in town-lighting matters to all rival towns—even Swansea itself. A public dinner was held in the Town Hall to inaugurate this lighting scheme, of which a short description may interest our readers. Some months ago the District Council let the contract for electric lighting of the streets to Messrs. John Player & Co., who had already a large power and lighting plant for the supply of their tinplate works and tinplate rolls foundry (from which some of the finest tinplate rolls to be had in this country are turned out). Mr. Player then selected the well-known firm of contractors, J. C. Howell, Limited, to prepare a scheme for him, and they, having gone carefully into the matter, found that two parts of the township—Clydach and Aber-Clydach—were admirably adapted to the ring main system, the generating works being quite at one end of the town, in Aber-Clydach, and the greatest number of lights at the farthest point from the generating house; the third circuit—to Buildings Village—is a straight run of 880 yards, and offered more obstacles to constant pressure than the other two circuits. In order to get the voltage correct, the feeders were run, the positive out to the far end, a distance of 1,000 yards, the negative feeding in at the near end, a distance of 120 yards. The voltage at Mr. Player's works is 220, and the pressure on the lighting system is 200 volts, a loss of 20 volts throughout the entire system. The two ring mains consist of No. 12 bare copper, one of these being 1,760 yards round, and the other 1,000. The smaller ring is for Aber-Clydach, and the centre of distribution is only 350 yards distant from the generating house; the mains for this circuit to the centre of distribution are a pair of No. 9 bare copper, the feeders from this centre to the ring main being three pairs of No. 10 bare copper. On this circuit the current is 11 amperes, and there are 17 lamp brackets. The larger ring main is for Clydach, and for this the centre of distribution is 900 yards distant from the generating house; the mains for this circuit to the centre of distribution are a pair of No. 4 bare copper, the feeders from the centre to the ring main being three pairs of No. 8 bare copper; the current on this circuit is 16 amperes, and there are 27 lamp brackets. On the Buildings circuit the current is 6 amperes, and there are 10 brackets. The brackets are placed upon the poles which carry the overhead wires, and are of a very handsome design, and absolutely waterproof. Two 16-c.p. lamps are enclosed in each globe, with one exception, where two 32-c.p. lamps are placed on a bracket outside the Town Hall. The lamps hang downwards from a specially made ball fitting, and the whole globe is covered by a large shade. The brackets are placed 14 feet 6 inches from the ground, and the lighting effect is all that could be desired. The means of bringing the wires down the pole is, we think, a novel one. Before the bracket is fixed on the pole, a hole is bored through the pole running downwards from the bracket end, and the back plate of the bracket is let into the pole entirely, so making a watertight joint. A ½-inch pipe is then carried up the pole, the lower end being bent upwards to suit the run of the hole, the top end of the pipe is bent round in an 8-inch sweep, which just clears the arm carrying the wires on the top of the pole. The insulated wires then leave the pipe through an insulating bush, and are tapped on to the bare mains, a loop being left in them. The lower end of the pipe is now driven into the hole bored through the pole, and the pipe is then stapled to the pole, this protecting the wires, and making as waterproof a job as is possible when connecting from overhead wires. The whole of the work was designed and carried out by Mr. W. M. Farniss, chief engineer to Messrs. J. C. Howell, Limited. The scheme is of interest as one to be commended to many other small townships, which might with advantage follow the example of Clydach, granted that other owners of large works are to be found possessed of the public spirit and progressive policy of Mr John Player, to whom Clydach is indebted for an up-to-date illuminant at a very moderate cost; the rate is only ½d. in the £, as the cost per annum for each two 16-c.p. lamps is £3 5s.

Colchester.—The Town Council has decided to apply to the Local Government Board for leave to borrow from the Public Works Loan Commissioners, at 2¾ per cent. interest, the £6,500 sanctioned for further purposes of electric lighting.

Dawlish.—The District Council decided last week to apply for a provisional order for establishing an electricity supply. Messrs. Taylor & Field, electrical engineers, reported that the cost of an installation, with a capacity of from 1,350 to 1,330 8-c.p. lamps would be £4,350, exclusive of the site.

A public meeting of the ratepayers held subsequently approved by a large majority the decision of the District Council.

Farnham.—The District Council has resolved that application be made to the Board of Trade for a provisional order enabling the Council to supply within the district electricity for all public or private purposes.

Grove Park.—The Greenwich Board of Guardians has decided to adopt electric lighting for the new workhouse at Grove Park.

Hampstead.—The receipts of the Vestry's electric lighting undertaking for the quarter ended at Michaelmas were £5,737 4s. 1d., as against £3,638 4s. 1d. for the corresponding quarter last year, showing an increase of 58 per cent. The net profit on the undertaking last year was 6 65 per cent.

Horsham.—The District Council has adopted the recommendation of the Electric Lighting Committee to proceed to exercise the powers conferred by their provisional order, and that Mr. Hawtayne be instructed to prepare detailed drawings and specifications in connection with his scheme to enable the Council to make application to the Local Government Board for the necessary borrowing powers for an installation of the electric light.

Heckmondwike.—Colonel W. R. Slack, R.E., one of the Local Government Board inspectors, held an inquiry on Thursday, respecting the Council's application for sanction to borrow £14,000 for electric lighting purposes.

Hull.—An accident in connection with the electricity mains occurred in Waterworks Street last week. A strong smell of burning rubber having been noticed, the electrical engineer had the pavement opened, when a dense yellow smoke escaped, followed by a loud report and a flame. The fire increased so much that the chemical engine from the fire station had to be summoned to extinguish the flames.

Ingleton.—We are informed that the electric lighting of Ingleton, West Riding, Yorks, for which the Board of Trade granted a license, has been entrusted to Messrs. Drake & Gorham. The turbines will be supplied by Messrs. Gilbert Gilkes & Co., the mains by the Callender Company, and the storage battery by the D.P. Battery Company, Limited.

Kendal.—The Corporation registers its intention in the *London Gazette* to apply for a provisional order in the usual way.

Witney.—Notice of the Witney Electric Supply Company's application for a provisional order is filed in the *London Gazette*.

Kirkby Lonsdale.—The proposal of the Kirkby Lonsdale District Council to purchase the electric lighting plant of Mr. Harris, Lunefield, for £2,200, has been abandoned as too expensive for the Westmorland town.

Leeds.—The City Council has resolved to extend and renew the mains, and to construct transformer sub-stations in the Chapeltown and Clarendon Road districts, and at the Town Hall, at an estimated cost of £30,896. During September there were 30 breakdowns in the rubber-insulated cables; these are to be withdrawn, to the value of £6,500, and replaced by paper-insulated cables.

Leek.—The District Council has instructed Messrs. Burstall & Monkhouse, Westminster, to visit Leek and make a preliminary report on the proposed electricity works, for a fee of 30 guineas.

Littlehampton.—The District Council has decided not to consent to the application of Messrs. Lees & Co. for a provisional order for the electric lighting of Littlehampton.

Liverpool.—Colonel C. H. Luard, R.E., an inspector of the Local Government Board, will to-day hold an inquiry into an application of the Liverpool City Council for sanction to borrow £300,000 for the purpose of electric lighting.

London, E.C.—The *Times* contains an abstract of the annual report of Mr. A. A. Voysey, the electrical engineer and inspector to the Corporation, in which he states that 46 instruments, mostly meters, had been submitted to him for testing. Of these 19·35 per cent. were slow, 25 8 were fast, and 54·85 were approximately correct. The mean percentage in the slow meters was 5·3, and in the fast 7 6. The testing fees received amounted to £31 7s. 6d. The Board of Trade had recently approved of the Aron meter for use on the City alternating current circuits, and the inspector anticipated that the usefulness of the electrical testing laboratory would be greatly increased and it ought to be self-supporting. During the year, in the main streets, 502 arc lamps had been in use. The number of lamp failures reported had been 646. The

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average time of extinction per lamp had been 220 minutes. Two hundred and forty-eight lamps had been late in starting—on an average 12 minutes. The penalties inflicted on the company for these failures had been £156. As to the side streets, the question of lighting had been delayed for another year in the endeavour to obtain a legal settlement of the differences between the Corporation and the company as to the meaning of the agreements for public lighting. There had been two interruptions in the private supply—one caused by the damage to a main by a pavement contractor. Serious defects in the pressure occurred on eight occasions and in circumstances which might not be repeated.

Long Eaton.—The District Council has resolved to obtain a provisional order for the supply of electricity in the district.

Malden and Coombe.—The District Council has been approached by the Kingston Corporation on the question of electricity supply, but has replied that it is not at present prepared to consider the matter.

Malton.—The District Council has consented to permit the Northern Counties Electric Supply Company to obtain a provisional order for the supply of electricity in the district. The company guarantees to light the streets at a cost 30 per cent. less than that now paid for gas. The initial outlay will be £10,000, which will be ultimately increased to £40,000. The Council will have the option of purchase after 10 years.

Newport.—The following appointments have been made:—Mains superintendent, Mr. A. J. Howard, of Tunbridge Wells; electrician, Mr. L. L. Foster, of Coventry.

Northfleet.—The District Council has rejected a proposal to apply for a provisional order for electric lighting.

Oldham.—The Corporation is applying to the Local Government Board for leave to borrow £36,000 for extensions of the electricity works and mains, according to Prof. Kennedy's recommendations.

Provisional Orders.—The *London Gazette* contains notice of the intention of the Elland, Exmouth, Cleethorpes-with-Thrunscoe, Sowerby Bridge, Gosport, and Alverstoke Local Councils for electric lighting provisional orders, also a notice by the Croydon Council of its intention to apply for powers to lease the tramways to the British Electric Traction Company.

Redditch.—The manager of the electric lighting works reports to the District Council that the scheme has paid its way in the first quarter of its working, and has left a balance in hand.

Redruth.—The Council has decided to support Edmundson's Electricity Supply Company, Limited, in their application to the Board of Trade for a provisional order, provided the clauses to be embodied in it are agreed to by the Council.

Rhyl.—As the result of a canvass made by the District Council it has been found that 19 out of every 20 tradesmen and 50 per cent. of private residents will take a supply of electricity.

Romford.—The District Council has decided to make application to the Board of Trade for a provisional order, empowering the Council to supply electricity in the district.

Russia.—La Compagnie Centrale d'Electricité de Moscou reports a profit of £9,306 for the past financial year, and is declaring a dividend of 5 per cent.

Sale.—The Board of Trade has agreed to postpone the question of the revocation of the lighting order of the District Council until June 30th, 1900.

Tiverton.—The Town Council, having been warned by the Board of Trade that its provisional order would shortly be revoked, has induced the Board to postpone its intention for a few months, and has obtained estimates of the cost of carrying out a scheme, as well as tenders from firms willing to take over the order.

Torquay.—The Electric Lighting Committee is willing to convert street gas lamps into electric lamps at a cost of £2 10s. a year. The Town Council has authorised the conversion of 160 lamps, and has placed the public lighting under the control of the above Committee.

Train Lighting.—The London and North-Western Railway Company have made arrangements to put on their line from Abergavenny to Merthyr 10 trains of new carriages, lighted by electricity, and fitted with special heating apparatus.

Walsall.—The Corporation has resolved to purchase an additional transformer at a cost of £558, and to put down a new sub-station, to cope with the increasing demand.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aston.—The District Council has decided to promote a Bill in the next session of Parliament to enable them to work the tramways in the district belonging to the Birmingham and Aston Tramways Company, Limited, and the City of Birmingham Tramways, Company, Limited, when such tramways shall be purchased by the Council.

Belfast.—Last week the Corporation held a special meeting, extending over two days, to consider the proposed acquisition of the street tramways and the operation thereof electrically. The resolutions to that end passed last April by the Council in committee were confirmed, after a long debate, in the course of which the advantages and economy of electric traction were discussed. A committee is to confer with the company as to terms. The town clerk is to give the necessary notices for the promotion of a Bill in the next session of Parliament.

Bournemouth.—A local paper says that the British Electric Traction Company are making another attempt to introduce tramways in Bournemouth. Foiled in their applications to the Light Railway Commissioners, they now propose applying for an Act of Parliament.

Cheltenham.—The Light Railway Commissioners have issued their order for the construction of an electric tramway from Cheltenham to Cleeve Hill. Simultaneously with this announcement, the statutory notice is published of Mr. Nevins's application to the Light Railway Commissioners for powers for the construction of a continuation line through the town in place of that section of the line quashed by the Commissioners early in the present year.

Colombo.—The Municipal Council has granted its electrical adviser, Mr. Thomas Cockerill, two months' leave from November 1st to January 1st, and has authorised him while on leave to prepare a report on the latest electric tramway practice in England and Scotland.

Devonport.—The construction of the system of electric tramways which is to be undertaken by the Devonport and District Tramways Company was formally begun on Tuesday last week. Mr. W. J. Waycott, chairman of the Corporation Tramways Committee, cut the first sod in presence of a numerous company, and subsequently the event was celebrated by a luncheon. Mr. J. S. Raworth, chairman of the Devonport and District Tramways Company, and director of the British Electric Traction Company, presided, and among others present were Mr. E. Garcke, director of the Devonport Company, and managing director of the British Electric Traction Company, Messrs. F. W. Chanter, director, and E. Hopwood, secretary of the Devonport Company, C. H. Gadsby and C. Chadwell, engineers for the company, and A. Foulks, contractor for the construction of the line. Mr. Garcke said the construction of the line would be pushed on as rapidly as possible. The company meant to go in for cheap fares and frequent service, and the line would be doubled where possible, so as to increase the efficiency of the service.

Dublin.—On 6th inst. an electric car collided with one of the Tramway Company's repairing cars. The trolley pole of the former was broken and the horse of the latter thrown. The service was suspended for a time.

One day last week an electric car ran off the line and blocked traffic for a considerable time.

On 9th inst. the electric tramcars began running to Drumcondra.

Electric Traction in Paris.—Electric traction is just now occupying a great deal of attention in Paris. In the first place it is being asked whether the great Metropolitan line, extending from the Vincennes Gate to the Maillot Gate, will be finished and in working order by next year. This line has a total underground length of 11,600 metres, and 23 stations. A tunnel of 10,200 metres has already been constructed, and 21 stations are finished. It is certain that the constructional operations will be finished by February, 1900. The Creusot establishments will at once proceed with the electrical installation. The principal station will be at Bercy; the work is already being commenced there. A series of subterranean lines is also to be formed at Paris for various tramways which are to extend from the suburbs to the heart of Paris. The work is being proceeded with, but nothing is finished as yet. The Electricity Company of the Sector of the Left Bank, which obtained the concession for two tramway lines from Boulogne to Vincennes, and from Montreuil to Boulogne, has just given up this concession to the Left Bank Electrical Tramways Company in consideration of an indemnity of 910,000 francs. The Compagnie Générale de Traction, of Paris, recently made an offer to the Compagnie Générale des Omnibus, to transform all their ordinary tramway lines, 17 in number, into electrical tramways, asking them to pay, until 1910, at which date the concession ends, a certain sum per car-kilometre, a sum that would be less than the cost in 1898 of their mechanical traction cars. Notwithstanding this offer, the Compagnie Générale des Omnibus has not yet come to any decision on the matter. Electric traction is at present, therefore, at a standstill in Paris.

France.—It is proposed to convert the steam tramways at St. Etienne into electric lines.

Glasgow.—After the Board of Trade inspection of the Govanhill electric tramways on Tuesday last week, the Tramways Committee formally opened the line for public service. The reconstruction of the permanent way from Glasgow Cross to Govanhill has been carried out partly by the staff of the tramways department and partly by the contractor, Mr. Daniel Murray. The rails used weigh about 100 lbs. per yard, and are in 60-feet lengths. Steel tie bars, 5 feet apart, are used to keep the rails in gauge. Under the track there is a 6-inch bed of Portland cement concrete. The copper bonding of the rails is done by the staff of the department. The rest of

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ducts through which the feeder cables and wires are drawn is in the centre of the track, usually termed the 4-foot way. The erection of the overhead equipment is in the hands of Messrs. Macartney, M'Elroy & Co. Except on the Albert Bridge, hardly any side poles have been used between Glasgow Cross and the head of Crown Street, the span wires being for the most part suspended by means of ornamental metal rosettes affixed to the buildings, in the same manner as in West Nile Street. This is considered a great improvement, and the intention is that the tramways department will carry out this plan in future when at all possible. The *Glasgow Herald* says that if the overhead construction throughout the city is no more obtrusive than it is in Crown Street, very few citizens will object to its appearance. Some time ago, the electric tramway from Springburn to Mitchell Street (2½ miles) was opened. On January 23rd last, the extension from Parliamentary Road to Glasgow Cross (¾ mile) was opened, and the Govanhill extension (about 1¾ miles) makes up the total length of electric tramways now opened to about 5 miles of double track. For some time the tramways department have been very busy building new electric cars at the Coplawhill car works. The number now in use is 47, and these have all been built by the department. The connection from Cathcart Road across to Coplawhill depôt being now electrically equipped, the department will find this connection with the car building and repairing shops of very great service, as hitherto the electric cars have had to be taken to and from the car works by horses.

The *Glasgow Evening News* says that an accident is reported to have occurred on the Springburn tramway route late on Saturday night, whereby three men were injured. It is stated that in Castle Street a telephone wire broke and fell across the electric trolley wire. The telephone wire thus became charged with electricity, and, while squirming about the street, it is said to have encircled two men, throwing them to the ground. A labourer rushed to the assistance of the two men, and by catching hold of the wire, is said to have received a shock. When interviewed, the tramway officials stated that they had a report of a telephone wire having broken and come in contact with the trolley wires, but they were not aware that anyone had been injured.

Holland.—It is reported that Messrs. Siemens & Halske, of Berlin, have secured a contract to construct an electric railway between Rotterdam, the Hague, and Scheveningen.

Houghton-le-Spring.—Last week an extraordinary special meeting was held to receive a deputation from the Electrical Tramways Company, Sunderland, represented by Mr. F. J. Trewhitt, and Mr. D. Balfour, jun., O.E., Houghton-le-Spring, who submitted plans as to the proposed operations in laying down an overhead electric tramway system for Houghton-le-Spring district, and requesting the Council to give the promoters their support in applying to the Local Government Board for necessary powers for a lease of 42 years. The Council decided to support the proposal.

Ilfracombe.—At last week's Council meeting a letter was read from the British Electric Traction Company as to the proposal to run electric trams from the Pier to the railway station. Mr. W. Pile said they were not in a position to deal with the matter, seeing they had made such little progress with the electric lighting of the town. The clerk was instructed to write the company accordingly.

Kinver.—An order has been made by the Light Railway Commissioners, and confirmed by the Board of Trade, authorising the construction of light railways, on a gauge of 3 feet 6 inches, from Stourbridge to Kinver, in the counties of Worcester and Stafford, by the British Electric Traction Company, Limited. Three years is fixed as the period within which the works are to be completed, but this term may be extended. Provision is also made for widening certain roads and bridges by the company during the construction of the lines.

The lines authorised are:—No. 1, 2 miles 4 furlongs 4·5 chains, commencing in Amblecote, opposite Fish Inn, at Coalbourne brook, passing along High Street, Woolaston, until it unites with the Bridgnorth Road, and thence proceeding along the latter road towards Enville, and terminating in the parish of Kinver, opposite the Stewponey and Foley Arms Hotel; No. 1a, 1·5 chains, commencing by a junction with No. 1 at its commencement and terminating by a junction with the existing tramway opposite the corner of Collis Street, Coalbourne brook; No. 1b, 1·25 chains, commencing by a junction with No. 1 at its commencement and terminating by a junction with the existing tramway at a point 40 yards to the south-east of the termination of No. 1a; and No. 2, 1 mile 4 furlongs 8·5 chains, commencing by a junction with the termination of Railway No. 1 and terminating in the parish of Kinver on the western side of the road leading from Kinver Bridge to High Street at a point 75 yards to the southward of the canal lock.

Lancaster.—On Thursday last week the Council held a special meeting, at which it was resolved to promote a Bill empowering them to acquire the undertaking of the Lancaster and District Tramways Company, Limited, to construct certain additional lines, to widen certain streets, &c. The full amount required for the scheme was stated by the Mayor as £70,000. The tramway construction would be carried out by degrees. There would be 10 miles altogether. It is proposed to adopt the overhead trolley system.

At the present time there is a four-mile horse tramway between Lancaster and Morecambe. An effort has been made by the Lancaster and Morecambe Councils to buy up the tramway, but the company have declined negotiations at present. However, a clause will be inserted in a Bill, which the Corporation will submit to Parliament next session, to allow the purchase. Meanwhile the Corporation have drawn up a scheme mentioned above.

Liverpool.—Last week an influential deputation of representatives of railway, waterway, and carting companies waited upon the Lord Mayor to protest against the introduction of electric tramways in certain busy streets, as they might hamper the trade of the port, and materially increase the risk of accident. The Lord Mayor said a good case had been made out, and it would receive every consideration.

Manchester.—On 10th inst. Sir F. Marindin and Mr. A. P. Trotter held an inquiry, at Manchester, on behalf of the Local Government Board, respecting the application of the Corporation to borrow £800,000 for tramway purposes. The chairman of the Tramways Committee of the City Council stated that one portion of the tramways system would be worked by Salford, another by Oldham, and another by Ashton-under-Lyne. The central portion, which would be under the control of Manchester, included the districts of Middleton, Failsworth, Droylesden, Audenshaw, Gorton, Denton, Levenshulme, and Heaton Norris and Stockport. They were also in negotiation with Withington, Moss Side, and Stretford. The amount of the money mentioned was not all that would be required, but included the cost of the reconstruction of the whole of the present track within the city boundary, the electrical equipment of the whole of the city track with the outside districts already entered into agreement with, the provision of 600 cars, the estimates for one car-shed to accommodate 252 cars, and the preliminary expenses already incurred. The track mileage, including recent extensions, was about 150 miles, of which nearly 100 miles were owned by the Manchester and local authorities.

Mr. C. H. Wordingham, city electrical engineer to the Corporation of Manchester, said that the overhead trolley system was the most suitable, and two systems were proposed to be used, one being the span wire construction with centre running trolley, and the other being the side running trolley, which was the best in appearance. The choice would depend upon the width of the street or the importance of a good appearance. The poles would be of equal strength, so that there would be no difficulty in altering from one system to another at very slight expense in case of necessity. It would be impracticable to construct any underground system for the reason of interference with the traffic, and the prohibitive cost, which would be out of proportion to the advantages to be gained. The streets of Manchester were undermined very largely by pipes and cellars, which often reached to the kerb stones of the footpaths, and therefore it would be difficult to fix poles in the most suitable places. On this account it was necessary to make a good allowance for contingencies. At the central station the current was at present distributed for lighting purposes, but there would be sufficient power for traction over a surrounding area of half a mile where the traffic was particularly heavy. It was proposed to erect a large station at Stuart Street, where power would be generated and transmitted to sub-stations both for lighting and traction. It was intended to place the sub-stations as nearly as possible a distance of a mile from each other. Witness gave his estimate for his portion of the work for the lines which would be worked by Manchester independent of the lines which would be worked by other authorities in conjunction with the Manchester system. The overhead equipment for 68 miles in the city and 17 miles in the outside districts at £1,300 a mile would cost £110,500, and £16,575 for contingencies would raise the total to £127,075. For the bonding of the rails he presented an estimate, with contingencies, of £22,925, bringing the total with the cost of the overhead equipment to £150,000.

Mr. Ernest J. Scown, permanent way engineer of the Tramways Department, stated that the amount estimated for the reconstruction of 68 miles of single track of the existing permanent way to make it suitable for electric traction would cost £250,000.

Mr. John Gibbons, architect, submitted the plans of proposed car shed in Queen's Road, which with the purchase of the land is to cost £90,000.

This concluded the inquiry.

On 7th inst. a meeting of owners and ratepayers consented to the promotion of the Manchester Corporation Tramways Act, 1900.

Manchester Underground Railway Scheme.—We gather from an article in the *Manchester Courier* that a movement is on foot for the construction of an electric underground railway (to cost £1,200,000) by inner and outer services, bringing into connection the various railway systems. It is stated that a Manchester firm of solicitors is engaged in completing the preliminary arrangements, and it is expected that ere long the plans will be deposited in Parliament. According to the plans, the permanent way will be contained in two iron or concrete tubes, at a depth of from 50 to 60 feet below the surface. The carriages are after the pattern of those on the Douglas to Laxey line, and charging stations are to be erected on convenient sites.

Mumbles.—It is stated that the British Electric Traction Company intend adding to the attractions of the Mumbles by erecting a winter garden at the shore end of the Mumbles Pier, which is now their property. If this report be correct, the company is to be congratulated upon its emulation of a kind of enterprise which has contributed so largely to the success of some electrical lines in America.

Preston.—In accordance with the recommendations of Messrs. Lacey, Clirehugh & Sillar, the Council have decided upon a 4-feet gauge for the proposed electric tramways, and have resolved to promote a Bill next session for the purpose of obtaining the necessary powers to construct and run tramways both in Preston and the neighbouring districts of Fulwood and Walton-le-Dale.

(*Continued on page* 807.)

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ELECTRIC CRANES.

The rapidly extending use of electrical transmission of power in workshops has necessarily included the application of this agent to the driving of cranes, both movable and stationary. But even where no other machines are electrically operated, the advantages of electricity for crane driving, as compared with the old square shafts, rope drive, &c., are so marked, that in many instances it has been found good policy to employ it solely for this purpose. We commence this week a series of views of cranes of both types which have actually been erected, showing the directions along which modern designs tend to proceed.

Fig. 1.

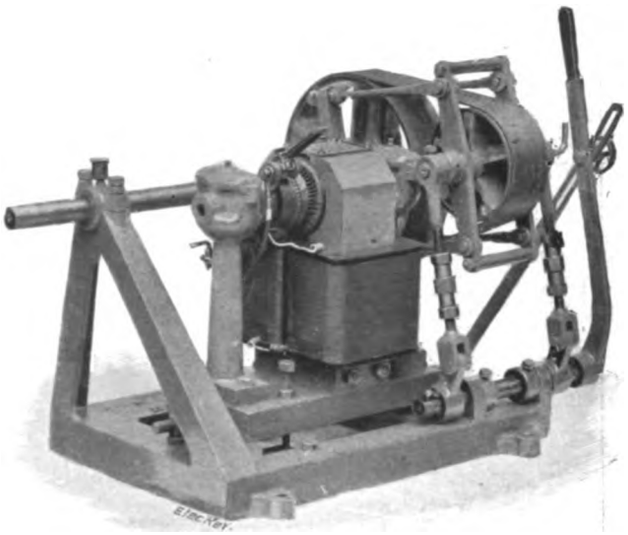
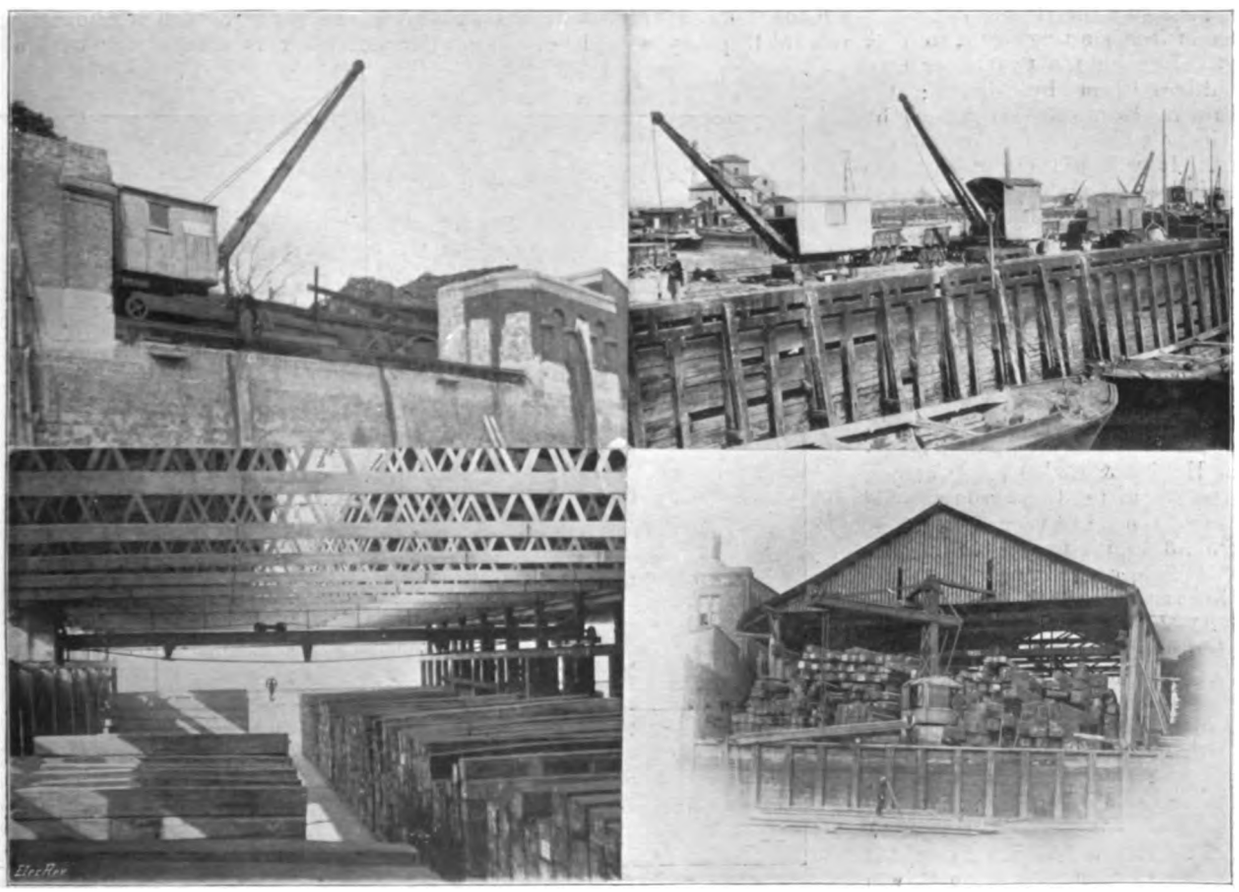


Fig. 2.

A.



B.

C. Fig 3. D.

The high rotative speed at which electro-motors of small power must run in order to secure high efficiency with small initial cost, necessitates the interposition of a train of reduction gear between the motor and the main shaft, while the construction of the motor and its mode of working render a smooth and gradual start desirable. These requirements are met in various ways. The method employed by Messrs. Wimshurst, Hollick & Co., Limited, is illustrated in fig. 1, which shows the essential features of the system; the driven shaft is provided with a large "flat" faced pulley belted to a similar but smaller pulley, the latter being carried on a frame which swings on the main shaft. The tension of the belt can be adjusted by means of nuts on the side rods of the frame. The

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armature shaft carries a small pulley made of compressed paper, the diameter of which is slightly greater than the least distance between the iron pulleys, and the motor itself is supported on a rocking base. When the motor has been

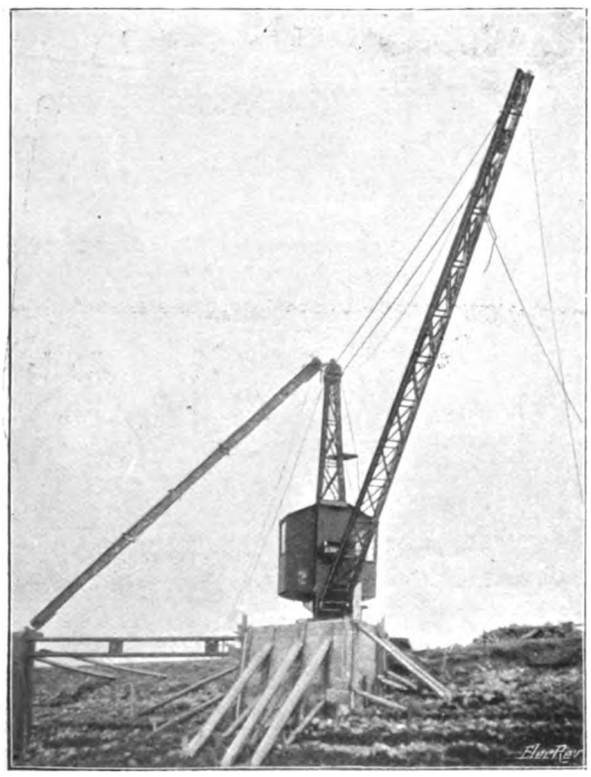

Fig. 4.

started up by means of an ordinary starting resistance switch, the swinging frame is gradually brought down by means of the starting lever, so that the small pulley is wedged between the two larger ones and drives them by friction; the pressure on both sides is equalised by the slight rocking movement of the motor. It will be noticed that the motor is brought up to speed first, and may be kept running all the while the machine is in operation, without affecting the stopping, starting, &c., of the latter. A shunt motor must, of course, be used for this purpose. In case of jamming of the load, or an overload, the gear slips and prevents injury. Fig. 2 shows another view of the same gear, applied to a similar purpose. This gear is used on all Messrs. Wimshurst, Hollick & Co.'s electric cranes, and appears to fulfil the requirements mentioned above to a very high degree.

In fig. 3 we illustrate a few applications of these cranes. One which was installed at a coal wharf on the Thames in 1894, and is capable of lifting 25 cwt. 100 feet per minute, is shown in fig. 3A. The motor in this case took 2 amperes at 203 volts, running light; when lifting the full load at a speed of 80 feet per minute, the current was 21 amperes; for slewing with the load, 14 amperes was required; and for slewing while lifting the full load, 27 amperes. The current never exceeded 29 amperes, though the motor was capable of carrying 75 amperes intermittently. Fig. 3B. is a view of the jetty at Dagenham Dock, in Essex, on which are two electric cranes, employed in unloading barges at the rate of 1,000 tons each per week. The larger of these lifts 30 cwt. at 90 feet per minute, with a radius of action of 22 feet. Fig 3C shows an overhead traveller, of the fixed jenny type, in shed No. 4 of the West India Dock, where similar cranes have been at work since 1893; there are now 22 of these in use, with spans of 40 to 65 feet, lifting 6 tons at 15 feet, or 2 tons at 45 feet per minute, travelling longitudinally at 150 feet, and transversely at 65 feet per minute. These cranes require a maximum of 8½ H.P. when lifting the full load, and therefore have an overall efficiency of nearly 72 per cent. For travelling with full load about 3 H.P. is required. Fig. 3D is a view of a stationary jib crane, specially designed to utilise as much space as possible for stacking timber at a sawmill. The jib is horizontal, and is carried on a steel post pivoted at top and bottom; a bogie runs along the jib to carry the load at a radius variable from 5 to 20 feet. Three electric travellers are installed within the timber sheds. One of their greatest recommendations for such situations is the low insurance premium compared with that which would be demanded if steam cranes were in use. These cranes, and a timber stacking crane, are supplied with power by a dynamo of 24 E.H.P., which is driven from the main shafting; although the power required to drive the cranes would be over 30 H.P. if they were all working at once, it is found that the dynamo is of ample capacity to cope with the maximum demand met with in practice.

Fig. 4 represents a tall derrick crane capable of lifting a load of 2 tons at 50 feet per minute, 4 tons at 25 feet, or 8 tons with a return block. The jib works over a circle of 24 feet radius. Figs. 5 and 6 show an end view of the crane seen in fig. 3C, and front view of a crane of the travelling jenny type, also at the West India Dock.

All the above cranes are operated by means of the Hollick gear, some of them having been at work for as long as six years; although the arrangement may not at first sight strike one as likely to please the "engineering eye," the fact remains that it has given excellent results in practice, as regards both efficiency and maintenance.

Another form of gearing which has been extensively applied is that of Messrs. Carrick & Ritchie; in this case bevel friction wheels are employed, and it is noteworthy that here also compressed paper is adopted for the rubbing

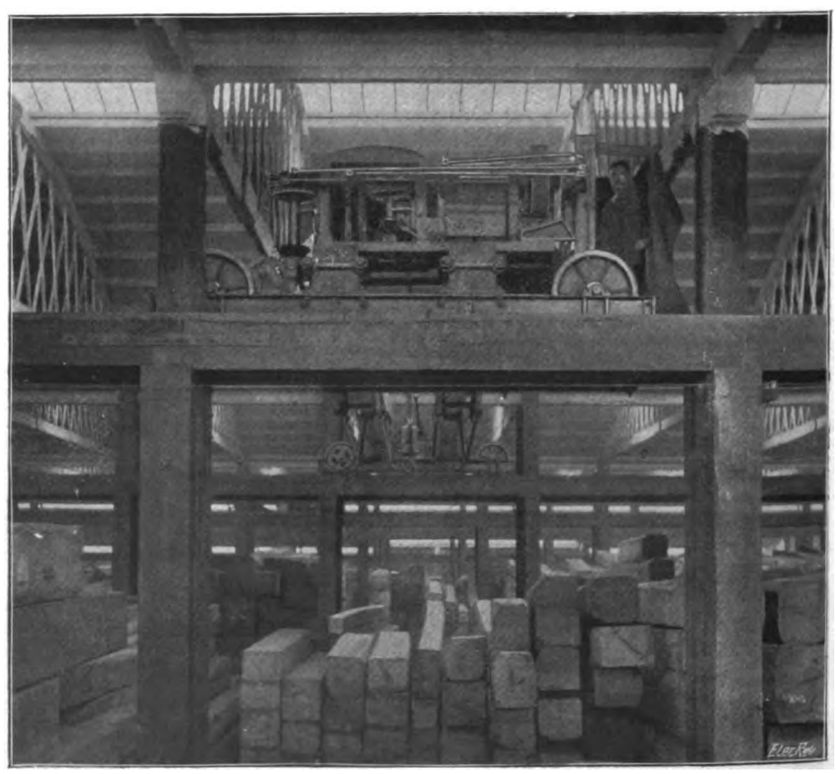

Fig. 5.

surfaces. It is stated that a perfect grip is obtained with this material, and that it gives complete satisfaction in every way. Fig. 10 shows the method of applying the gear to a single motor crane; a clutch driven by a feather slides

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upon the motor shaft between two loose friction cones, either of which can be put in gear by sliding the clutch towards it. The cones are in contact with a bevel wheel of larger diameter, which is driven in either direction according to the position of the clutch. Fig. 7 shows the gearing of a derrick crane of fixed radius; made by Messrs. Carrick and Ritchie. Double helical gear is used for the first speed reduction, followed by plain toothed gear. The details explain themselves.

An overhead travelling crane, capable of lifting two tons is seen in fig. 8; all the gear is at one end, and the load is carried by a jenny running across the beams, and pulled to and fro by means of pitch chains. It will be noticed that most of the bearings are split, so that any shaft can be removed without dismantling the crane; this applies also to the rail wheel axles. The use of solid bearings — a very objectionable feature, often met with in cheap cranes — is thus avoided. Several of these cranes are at work and giving every satisfaction.

Fig. 9 shows an

Fig. 6.

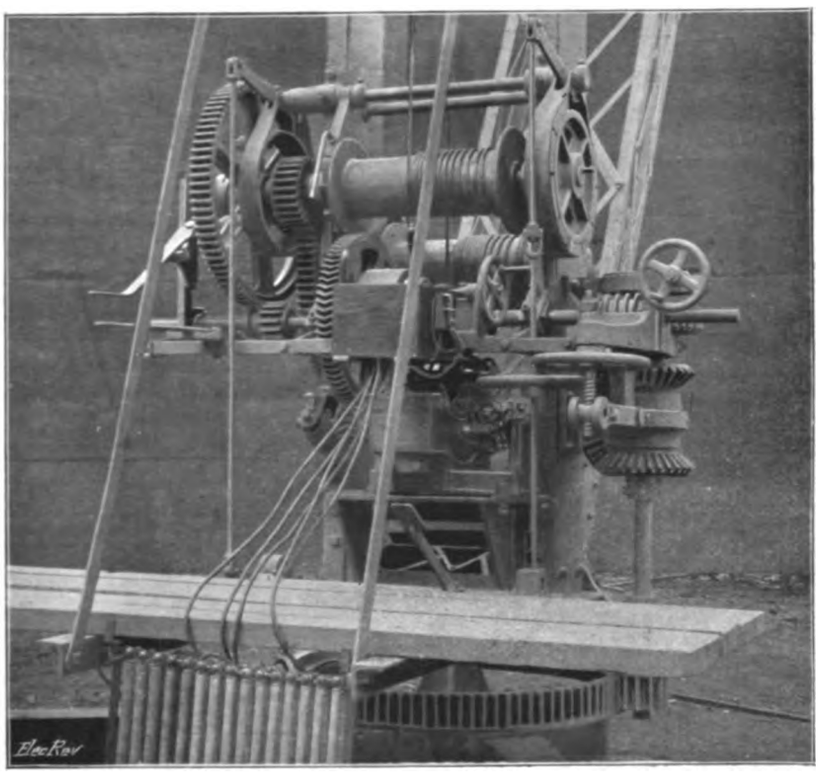

Fig. 7.

electric derrick of the most recent type, fitted with a "Lundell" motor; the cabin, which is rendered necessary by the very exposed situation in which the crane is at work, is partly removed to exhibit the gearing. The load is raised at a speed of 60 feet per minute, which is an unusually high rate for a derrick crane. In this case double reduction toothed gear is used for lifting, and worm gear for swinging.

A very neat little travelling crane for light loads is illustrated in fig. 10; this is mounted on a bogie, and is provided with travelling, slewing and lifting gear worked by one motor of Messrs. Thos. Parker's make. This crane was designed for lifting loads of 5 cwt. from a barge at a speed of 30 feet per minute, and carrying them along the wharf. Here the speed reduction is effected by means of worm gear running in oil. Wire rope is used for the lifting tackle, in accordance with Messrs. Carrick and Ritchie's usual custom, though chains are sometimes fitted for special purposes. It is stated that wire rope is quicker and

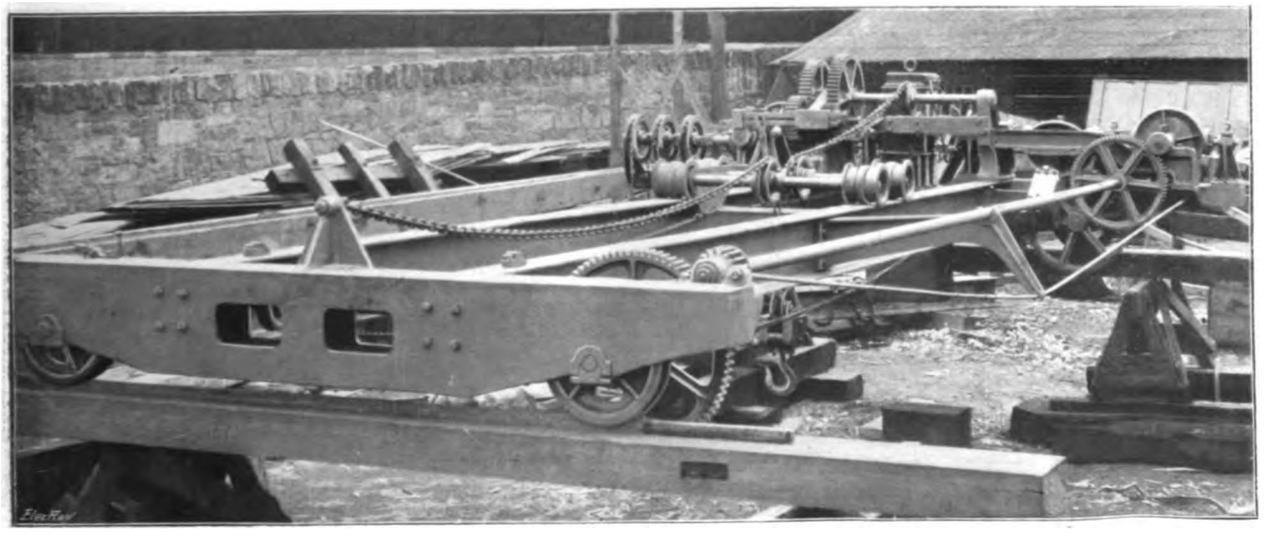

Fig. 8.

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smoother in action than chains; it is invariably used in ordinary workshop practice. The control of the crane is very simple; it is easily worked by a boy.

So far we have been concerned with cranes in which all the motions are operated by means of a single motor; this is usually kept running all the time the crane is at work. The use of a separate motor for each motion is, however, to be preferred, on the grounds both of simplicity of gear and of economy in operation. When this system is adopted, it is better to use series motors, which have the advantages of

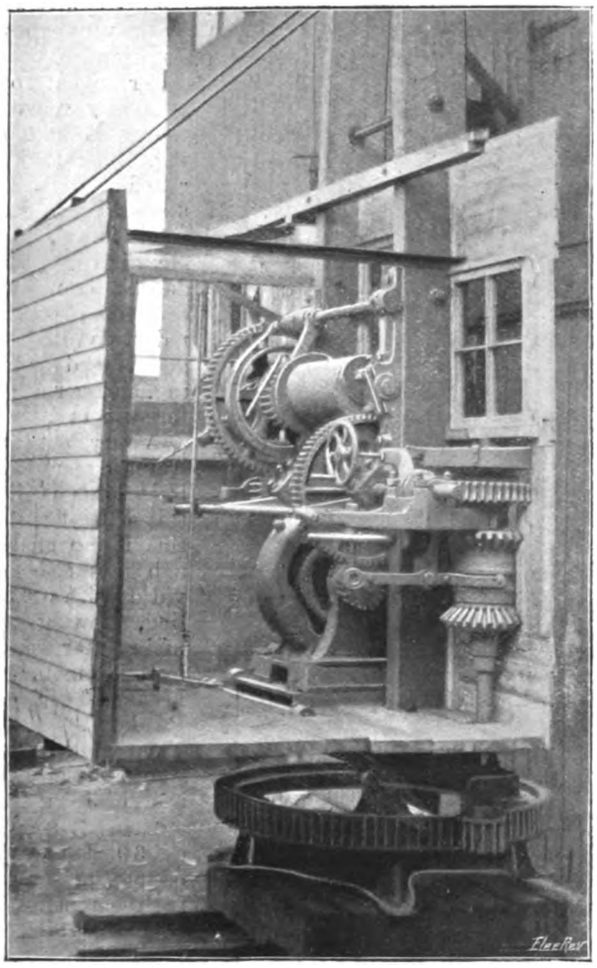

Fig. 9.

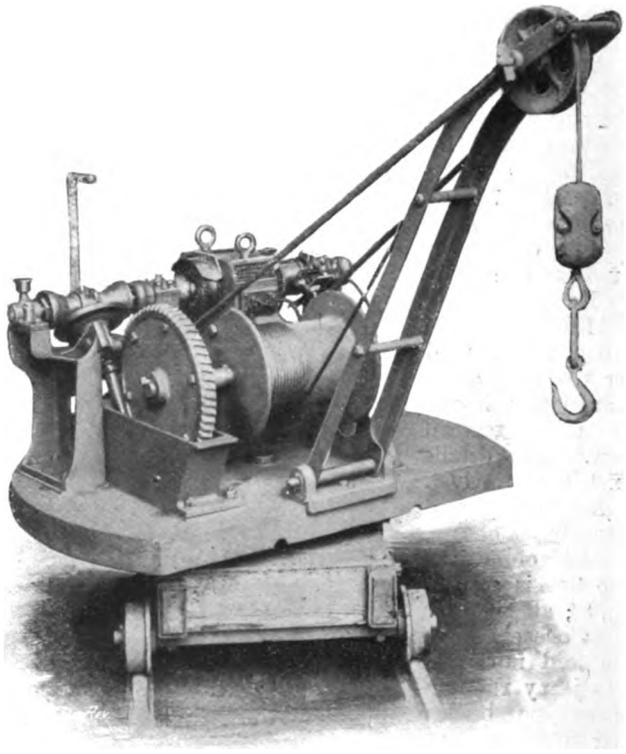

Fig. 10.

large initial torque and automatic adjustment of speed to load over a wide range; so that when light loads are being handled the speed is high, while heavy loads are dealt with at a suitably low speed.

An overhead traveller for lifting 10 tons, fitted with three

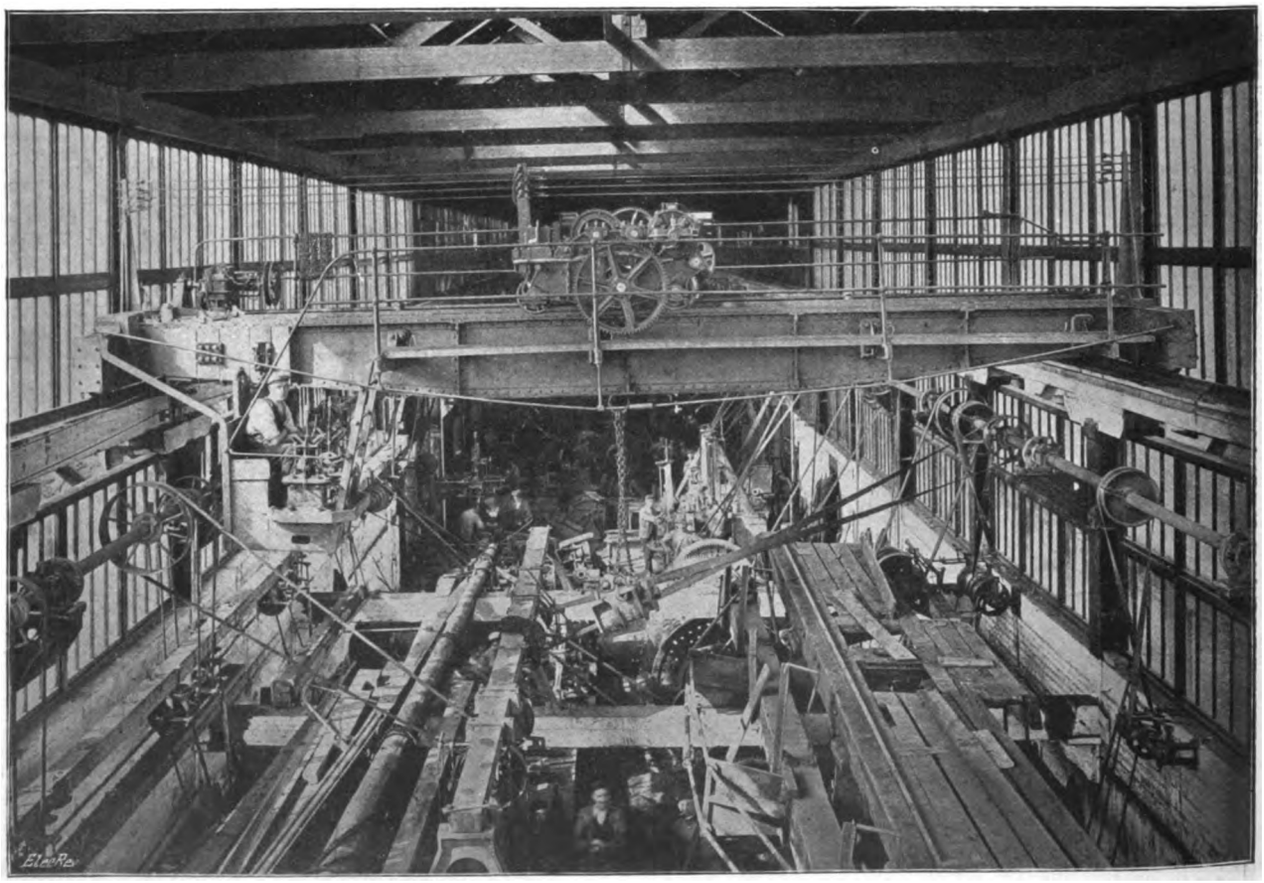

Fig 11.

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motors made by Messrs. Scott & Mountain, Limited, is illustrated in fig. 11, as erected in the shops of the latter company by Messrs. Carrick & Ritchie. Similar cranes are made for 3 to 15 tons; they are built almost entirely of steel, and the first motion pinions and wheels are either of steel or gun-metal. All the shafts are fitted with covers to facilitate their removal and the renewal of the bearings. Platforms are fitted on each side, and hand gear is provided for use when electric power is not available, as, for instance, on holidays. The load is lifted by a steel wire rope and return block, the latter having a swivel hook in ball bearings. An automatic brake is fitted, and is controlled by the working current, so that directly the lifting motor is put in gear the brake is released, and *vice versâ*. The motors are controlled by means of liquid resistances fixed in the cage, where the attendant is stationed. The four wires conveying the current to the lifting and cross-traversing motors are seen in the figure, with the tubular sliding shoes by means of which the connection is made.

(*To be continued.*)

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page* 802.)

Newport.—The County Council last week discussed the clauses for its Bill to be promoted in the next Parliamentary session asking for powers to use the overhead electric trolley system for the tramways. The work is estimated to cost about £120,000. The joint committee decided to obtain the energy from the present electric light works, but the expert who was called in reported that the present works could not be used for the dual purpose of supplying current for lighting and traction, and he recommended a site in Corporation Road. This site was, however, opposed by Lord Tredegar, and the Crindau site substituted.

Plymouth.—Mr. J. H. Rider, the electrical engineer to the Corporation of Plymouth, has prepared a report on the extension of plant necessary for supplying current to the Compton section of the tramways which it is proposed to equip for electric traction. The present tramway plant consists of two 100-KW. steam generators, one being a spare, and a battery of accumulators. The battery is used in conjunction with the plant in the day, and can in the evening, if necessary, take the whole of the six cars now running on the Prince Rock section. When the proposed extension is made, there will be 16 or 18 cars running. To provide power for these, Mr. Rider proposes to put down in the present buildings a generator for 450—500 KW, driven by a steam engine of 700 H.P., and also two additional Lancashire boilers, as well as a battery of accumulators at a sub-station near the tram route. The total cost of this extension is estimated at £20,000. The additional plant would more than double the possible output of the works, and enable them to add immediately some £4,000 per annum to the revenue, while the additional charges, including sinking fund and interest on the outlay, would not exceed £3,148 per annum. The Electric Lighting Committee have decided to invite tenders for the plant, and to apply for authority to borrow money. The Town Council has endorsed the decision.

Royton.—After considering correspondence from the Rochdale Corporation, the Royton District Council has decided to inform the Corporation of its intention to acquire the existing tramways, and alter or reconstruct them as may be necessary to make the gauge conformable with the Oldham and Rochdale lines.

St. Helens.—The directors of the St. Helens and District Tramways Company on 8th inst. inspected the Peasley Cross electrical section, which is ready for the Board of Trade inspection and sanction. Great difficulty has been experienced in rendering this section workable on account of the railway bridge crossing Peasley Cross Lane being so low that the electric trolley could not possibly be worked under it. For some years a controversy has existed between the Corporation and the London and North-Western Railway Company as to who is responsible for restoring the bridge to its proper height. The bridge and road at this point have sunk two or three feet on account of colliery working. Pending the settlement of this point, a Liverpool paper says that the tramway manager, Mr. Cuttler, has had the standard on which the trolley is carried reduced in height, so that the large bogey car used for the directors' inspection was able to pass safely under the bridge. It is not yet clear whether the Board of Trade will be able to sanction the carrying of passengers on the top deck of the car on account of the danger from this bridge being so much below the standard height.

Springhead.—The District Council has decided to grant an interview to the directors of the United Kingdom Light Railway and Electric Tramway Company with reference to the proposed scheme for the district. The Saddleworth Council is also granting an interview.

Tunstall.—The Urban District Council on 8th inst. decided to make application to the Board of Trade for a provisional order authorising them to supply electricity for public and private purposes within the district of Tunstall, and also in the parishes of Golden Hill and Chell. In October the clerk received a letter from the engineer of the Potteries Electric Traction Company stating that on the following Saturday the company would begin to run cars every half-hour from Tunstall Town Hall to the northern boundary of the town. Two days later he received another letter to the effect that owing to unforeseen circumstances they were compelled to postpone the opening of the line to Golden Hill. Since then he had not heard anything. The surveyor said that the Board of Trade had stepped in and prevented them from running. Mr. J. N. Peake said there was no doubt the company was playing the fool with the Council. He moved that the company be not allowed to run cars into Tunstall until they were prepared to open the line to the northern boundary. Mr. Peake's resolution was carried.

Walthamstow.—The District Council has decided that electricity should be the motive power of the new tramways, and that six lines should be constructed through the principal thoroughfares.

Wolverhampton.—At last week's Council meeting, Alderman C. T. Mander moved the adoption of a special report of the Tramways Committee, relative to the proposal by a syndicate to lay down an experimental line of surface contact tramway on the Wednesfield Road for the purpose of testing. An abstract of the report appeared in last week's ELECTRICAL REVIEW. Alderman Mander explained that the syndicate had proposed to lay a tramline in a field in Wolverhampton in order to experiment. He brought the matter before his committee, and they thought that a tramway in a field would not be as fair a test of wear and tear as would be obtained if the line were laid on a public road. As the result of a consideration with Mr. Thomas Parker, the representative of the syndicate, who had the system in hand, the committee suggested the laying of a line on the Wednesfield Road. The town would be put to no additional expense. If the committee did not like the system, the line would simply be left for some other method of traction. Alderman Marston said he totally objected to the committee's proposal. He objected to any part of their streets being handed over to a syndicate for experimental purposes. He added that the system of traction mentioned had not been successful anywhere. Alderman W. H. Jones agreed with Alderman Marston, and said that in the trolley system they had a thoroughly economical and successful system, while the conduit and street systems had been failures. Councillor Greensill said that the present was the time to test the system. It was not the syndicate, but the committee, who wished the experiment to take place in the street. As several members of the Council said that the committee's report should be presented at another meeting of the Council, Alderman Mander intimated he was willing to consent to it going back to the committee for reconsideration, and this was agreed to.

TELEGRAPH AND TELEPHONE NOTES.

African Trans-Continental Telegraphs.—The *Times* Berlin correspondent says that an agreement under the dates March 15th and October 28th, 1899, has been concluded between the German Government and the African Trans-Continental Telegraph Company, according to which the company receives permission to carry through German East Africa the African North-to-South Telegraph line designed to connect Cape Town with Cairo. The chief provisions of the treaty are to the following effect:—

1. The construction of the telegraph line will be carried out by the company at its own cost and must be completed within five years.
2. The company has to erect at its own cost, between the two stations nearest Rhodesia on the South and nearest British East Africa on the North, a telegraph wire intended for the service of German East Africa. The cost of maintaining this wire shall be borne by the company.
3. The German Government reserves the exclusive right of establishing and working telegraph stations in German East Africa, and of introducing for such stations the tariffs for German East African messages.
4. The German Government has secured the control of the line with its territory by the reservation of perfect liberty to connect the wires with an apparatus (*Durch beliebige Einleitung der Drähte*) at any point between the two stations mentioned in Article 2 of this agreement.

Furthermore the company has to pay a tariff of 10 centimes per word to the German Government.

(The two last-mentioned conditions, which are very onerous for the company, may, according to the agreement, be dropped in exchange for the concession by the company of advantages of equal value in some other sphere.)

5. On the expiration of 40 years after the completion of the telegraph line through German East Africa the German Government has the right to take over the German East African section of the line without payment. The cost of maintenance will then fall upon the Government. The company will, however, have to pay the Government a yearly transit charge amounting to the whole of the annual cost of administration, provided always that this payment shall not exceed the amount of one half-penny per word.
6. The company is bound to transmit over its lines at its general tariff charges all telegrams received by it for and from German East Africa; and the company has further declared its willingness to accord, in favour of all telegrams transmitted to or from German East Africa, any reductions of tariff which it may accord to third parties.
7. Detailed provisions have been incorporated in the agreement with a view to safeguarding German sovereign rights and the jurisdiction of the Governor of German East Africa with reference to the company and those in its employment. For one thing, the Governor can at his own discretion grant the employés and workmen of the company a military escort, the expense of which shall be borne by the company in so far as it does not exceed £1,000.
8. All differences arising out of the interpretation of the treaty shall be settled by a Court of Arbitration. In the first instance one of the two arbitrators shall be chosen by each of the two parties. In the case of non-agreement on the part of the arbitrators a third arbitrator (umpire?) may be appointed by the President of the German Imperial Court of Justice on the application of both the parties.

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American Pacific Cable.—The *Morning Post* correspondent at Washington says that the report of the committee appointed to investigate the advisability of a Pacific cable has been handed to the President. It urges that the cable should be begun as soon as the necessary preliminaries can be attended to. The route laid down in the report runs from San Francisco to Hawaii, thence to Wake Island and Guam, and from there to Manila. It is suggested that the cable be afterwards run to Yokohama. The report will be submitted to Congress, and will, it is believed, be fully approved.

A Damaged Cable.—The *Edinburgh Evening Dispatch* says that for some days past operations, when weather permitted, have been carried on in connection with the repair to the Forth cable between Granton and Burntisland. This cable was damaged during one of the recent gales by a ship's anchor fouling it. In consequence of the cable-laying steamer *Monarch* undergoing a refit, the large steam tug *Empress of India* is temporarily fitted up with the necessary appliances on board, and under the superintendence of officers from the *Monarch* the work is being carried on.

German Cable Steamer.—On Wednesday, 8th inst., was launched at Messrs. David J. Dunlop & Co.'s shipbuilding yard, Inch Works, Port Glasgow, the c.s. *von Podbielski*. The event is chiefly of interest owing to the fact that she is the first cable steamer built for Germany, being named after the present chief of the German Postal Administration. The *von Podbielski* has been built for meeting the requirements of a modern cable repairing steamer more than as a cable-laying steamer; and with a good speed, twin screws, a light draught and the latest designed cable machinery, she should in every way prove satisfactory. From a shipbuilding point of view, she is built to meet all the requirements of the highest class of the Germanischer Lloyd. The following are the chief measurements:—Length between perpendiculars, 255 feet; breadth (moulded), 35 feet; draught (loaded), 16 feet 6 inches. The two sets of engines will give her a speed of 13 knots when loaded, and it is thought that she will be the fastest cable steamer afloat. The steamer is fitted with a paying-out machine aft and a new design of picking-up machine forward, built of steel, with two drums and two separate sets of engines, and can pick up under a strain of 25 tons. The ship is flush decked, is fitted throughout with electric light, has a powerful search-light and all the latest improvements. Her owners are the Norddeutsche Seekabelwerke Aktiengesellschaft in Cologne, who have a factory in course of construction at Nordenham, near the mouth of the Weser, the technical control of which will be in the hands of the well-known firm of Felten & Guilleaume, Karlswerk, Mülheim-am-Rhein. She will be principally engaged in the repairing and laying of the German Government cables in the North Sea, Baltic and Channel.

Hull Telephones.—At the last City Council meeting it was resolved to appoint a special committee to report upon the desirability of establishing a municipal telephone service for Hull and district. Mr. Brown stated that the Hull Chamber of Trades had already secured the names of about 1,100 subscribers of £5 5s. each for such a system.

International Telephone Communication. — The Communal Council of Zurich has offered an annual guarantee of £420 to the Ticino Cantonal authorities in respect of the projected international telephone line between Lugano and Zurich.

The Mutual Telephone Scheme.—The Altrincham, Sale, and Stretford Urban District Councils have approved of an application of the Mutual Telephone Company, Limited, for a license enabling the said company to establish a telephone system in their respective districts, and have undertaken to afford reasonable facilities for the carrying out of the provisions of such license, including underground way leases. At the Stretford meeting, an application of the National Telephone Company to construct an underground cable along Chester Road from the city boundary to Old Trafford Bar was again adjourned.

News from the Seat of War.—In consequence of the "interruption" to the Mozambique-Delagoa Bay cable, which occurred on the 31st ult., we have to rely for news from Natal on the line which runs along the West Coast of Africa, and thence reaches the front by landline. The *Globe* has the following rhyming reference to the inconvenience thus caused:—

Alas! 'tis in vain that we scan
The sheets of the "Latest Edition";
For news of a man in the rear or the van
Is always delayed in transmission.

Oh! how can the man in the street
Discover the present position
Of the fighting *élite* in the army and fleet
When the news is delayed in transmission?

Some eventide posters will show
That the Boers have been sent to perdition.
Was it yesterday? No. It occurred at Glencoe.
And was somehow delayed in transmission.

So, postal authorities, use,
If it's possible, more expedition.
We give you your dues, but news is not news
When it's always delayed in transmission.

A Simple Method of Re-establishing Telegraphic Communication over Short Distances.—Dr. Oliver Lodge writes to the *Times* as follows under the above heading:—"It is rash unasked to offer suggestions to practical telegraphists such as, no doubt, exist inside and in the vicinity of Ladysmith, but perhaps it might be worth while by cable to request them to try to communicate by the following method: Lay a wire across Ladysmith, or other invested station, east and west, and earth the two ends thoroughly, so as to get as long a base as possible. Insert in this wire a powerful battery, or a dynamo, and a signalling key (sharper signals can be got by breaking the current under alcohol or between the poles of a strong magnet); insert also, by an alternative switch, a pair of low resistance telephones, and a condenser to keep out steady earth currents. Then let another party, south of the above district and as near as is consistent with military exigencies, lay or utilise another east and west wire, of greater length than the other, and likewise thoroughly well earthed at each end in damp soil, employing salt if necessary, or, still better, utilising a river; and let them likewise insert a pair of telephones (with a condenser) to receive signals, and a dynamo or battery with a signalling key to send them. It matters little where the outside actual station is, but its two 'earths' should be as near and as much one on each side of the invested station as is practicable. Unless the soil is hopelessly dry for all accessible depths, slow signalling by this method of earth-tapping can certainly be achieved, provided strong enough currents are used, even without the use of special apparatus; the short and the long signals of the Morse code being marked by the beginning and end of the current, or by the interval between two successive reversals, and being readable by an operator skilled in the use of the 'sounder.' Earth current disturbances will be heard, but can usually be recognised and disregarded. An alternating dynamo would be preferable to a continuous current dynamo if it were of high frequency, and sometimes the harmonics of an ordinary alternator are sufficiently strong for the purpose; or a revolving commutator can be made to carve an ordinary battery current into rapid intermittencies, producing a hum in the distant telephone, as in the arrangement applied under the direction of Sir W. Preece in the sea near Cardiff. A great number of refinements could be applied if there were plenty of time, but my object is to point out that a slow kind of telegraphy can almost certainly be re-established, if it be considered worth while, with apparatus probably already on the spot. (The possible use of the line of rails as a semi-connector, or earth substitute, should not be overlooked.) To avoid difficulties about 'calling,' or asking for a change from 'send' to 'receive,' it is natural to suggest that each station should 'receive' for every alternate hour, and then the skilled operator rests. The 'sending' demands much less skill than the 'receiving.' A telephone held to the sender's ear, and connected, if necessary, to a couple of iron pegs in the earth in his immediate vicinity, or to a yard of wire running parallel to his line wire, will tell him if he is sending signals in an intelligible manner or not."

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies:—		
Jamaica-Colon	June 30, 1899 ...	...
Trinidad-Demerara (1871 original)	Oct. 20, 1899 }	Nov. 9, 1899.
Do. do. (1891 duplicate)	Oct. 6, 1899 }	one cable restored.
South African:—		
Lourenco Marques-Mozambique ...	Oct. 31, 1899	...Nov. 15, 1899 (?)
Zanzibar-Mombasa	Oct. 27, 1899 ...	...
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Havre-Waterville	Oct. 25, 1899 ...	...
Latakia-Cyprus	June 20, 1899 ...	...
Landlines.		
West Indies:—		
Cuban Government lines	Oct. 30, 1899 ...	...
Communication with Aquin and Les Cayes, Haiti	Nov. 10, 1899 ...	Nov. 10, 1899
Line to Port de Paix, Haiti ...	Nov. 10, 1899 ...	Nov. 11, 1899
Communication with Jeremie and Port de Paix	Nov. 14, 1899 ...	...
South African:—		
Communication with Mafeking ...	Oct. 13, 1899 ...	...
Communication with all offices beyond the Orange River ...	Oct. 18, 1899 ...	...
Communication beyond Burghersdorp, Cape of Good Hope, and Estcourt, Natal	Nov. 7, 1899 ...	...
Colombian Government lines to Bogota	Oct. 31, 1899 ...	...
Communication with interior of Colombia, excepting Amalfi, Ambalema, Buga, Cartago, Ibague, Manizales, Medellin, Palmire, Pasto, Popoyans, Reinedos, Sonson, and Santo Domingo... ...	Nov. 6, 1899 ...	...

The Telegraph Wire Export Trade.—Not for a long time has the export trade in this country in telegraph wire and apparatus connected therewith been so active as during the past month. The returns just issued show that the value of such shipments during October amounted to no less than £369,243, as compared with only £44,512 in the preceding month, and £89,313 in October last year. The briskness during the month just ended has wrought a considerable change in the figures for the year's shipments to date. At the end of September the total was £116,071 behind that for the same period of 1898. At the end of October this decline had been changed to an increase of £163,859, the value of the exports during the 10 months ending with October being no less than £1,100,580, as against only £936,721 in the corresponding period of 1898.

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Telegraph Cables in the Spanish-American War.—Sir Edward Sassoon has written to the *Times* as follows with reference to some remarks made by the Marquis of Tweeddale at last week's meeting of the Eastern Extension Telegraph Company:—

I am very loth to encroach upon your space, but the persistence with which Lord Tweeddale adheres to his statement that the Cuban telegraph cables were not interfered with during the Spanish-American war ought not to be allowed to pass without remark. I therefore crave your indulgence to make a few short quotations from Lieut Cameron McR. Winslow's "Cable cutting at Cienfuegos" (May 11th, 1898), in the *Century Magazine* of March last. Regarding one cable the writer says:—

"At this point the *Nashville's* launch stopped and began to cut the cable. Axes and cold chisels were tried, but the hack-saw, a small hand saw about 9 inches in length used for cutting metals, was found to be the most effective. With this saw, by frequently changing the men, the cable was cut through in from 20 minutes to half-an-hour."

And, again—

"And it was again cut, this time by men in the *Marblehead's* boat, the end being left in 13 fathoms of water. The piece taken out was about 150 feet in length."

Concerning the second cable, the narrative states that

"This cable was lifted and handled just as the first one had been, the *Marblehead's* launch cutting the inshore end and the *Nashville's* launch underrunning it to the westward and making the offshore cut. Out of this cable a piece about 100 feet in length was taken and coiled down in the *Marblehead's* boat."

These quotations are to the point and require no comment.

The Marquis of Tweeddale replies to this letter in yesterday's *Times* to the effect that he never made that statement ascribed to him by Sir Edward.

The Value of Submarine Cables.—The *Daily News* Paris correspondent says:—"After the Germans, the French, instructed by the experience of this war, are anxious to have cables of their own. The existence of a British cable monopoly has brought England one incidental advantage. It is able at present to control more or less the cables from South Africa. But if foreign Governments combine to break down the British cable monopoly nobody will rejoice more than the British public, who will benefit more from cable extension than any other country. For the French will never be able to lay cables across the oceans without heavy bonuses from their Government. The Conseil Supérieur of the French settlements of Indo-China decided yesterday, we learn by a message from Tonkin, to lay a cable from Saigon to Port Arthur, to connect with the Siberian overland wire, the cost of the new cable being borne entirely by the Colony. This extension, I may point out, must lead to competitive routes between Europe and Burma, Singapore, and Manila. There is a group of Deputies who are charged to advise the Government and Chamber on trade questions abroad. They are known as the Conseillers du Commerce Extérieur. Associated with them are the heads of the great trading-houses, and persons in the Consular and Colonial services. This group has just held a meeting. The chairman, Deputy Henrique, has called the attention of members to the question of submarine cables, which are mostly in English or American hands. The meeting decided unanimously to make urgent representations to Government on the subject."

Wireless Telegraphy and the War.—It is stated by the *Times* that on arriving at the front shortly Captain Kennedy, R.E., will proceed to open up communications between various camps by means of the Marconi wireless telegraphy. The Royal Engineer authorities are confident that it will be possible to establish efficient connections from 200 to 300 miles in extent.

CONTRACTS OPEN AND CLOSED.

OPEN.

Accrington.—November 18th. The Corporation wants tenders for cables, wires, street boxes, and connections for electric lighting. See "Official Notices" November 3rd.

Battersea.—December 4th. The Vestry wants tenders for arc lamps and posts. See "Official Notices" this week.

Bray.—November 20th. The Council wants tenders for jet condensing plant for electricity works. See "Official Notices" November 3rd.

Bury-St.-Edmunds.—November 22nd. The Town Council invites tenders for electric light fittings for certain public buildings. Specifications, &c., at the Borough Surveyor's office, Town Hall.

Darwen.—November 27th. The Corporation wants tenders for one Lancashire boiler and accessories, one tramway switchboard. See "Official Notices" November 10th.

Denmark.—December 28th. The Corporation of Aarhus is inviting tenders for the water-tube boiler plant, steam dynamos and switchboard, accumulators for electricity works. From our "Official Notices," November 3rd, further particulars may be obtained.

Dublin.—November 20th. The Board of Public Works is inviting tenders for the hire of plant, &c., required for the electric lighting of the State apartments, Dublin Castle, during the next Castle season. Specifications, H. Williams, secretary, Public Works office, Dublin.

Essex.—November 27th. The Governors of Felsted School, Essex, are inviting tenders for boiler, two 27-KW. steam dynamos, condenser, pipework, accumulators, cables, and switchboard for electric lighting. See "Official Notices" October 27th.

Glasgow.—November 20th. The Electricity Department wants offers for 10 miles of 2-inch cast-iron pipes. See "Official Notices" October 13th.

Greenock.—November 23rd. The Police Board is inviting offers for leasing the tramways within the burgh, and converting them into electric trolley lines. See "Official Notices" November 10th.

Hackney.—December 12th. The Vestry Electric Lighting Committee is inviting tenders for refuse destructors to deal with the whole of the refuse of the parish. Specification, &c., may be obtained at the offices of Mr. Robert Hammond, M.Inst.C.E.

Harrow.—December 4th. The Electric Light and Power Company wants tenders for a 150 KW. steam dynamo and switchboard extension. See "Official Notices" this week.

Hammersmith.—November 22nd. Tenders are wanted for wiring the stables depôt for the Vestry. See "Official Notices" this week.

Islington.—November 22nd. The Vestry wants tenders for condensing plant for the electricity works. See "Official Notices" November 3rd.

Lambeth.—December 6th. The Vestry is prepared to receive tenders for 25 arc lamps and posts. For particulars, see "Official Notices" November 10th.

Manchester.—December 2nd. The Tramways Committee wants tenders for 5,000 tons of steel girder rails and 250 tons of steel fish-plates. See "Official Notices" to-day.

Middlesbrough.—November 22nd. The Electric Lighting Committee wants tenders for condensing plant and pipe-work for the electricity works. See "Official Notices" October 20th.

Mistretta (Sicily).—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Palermo, stating that tenders are invited by the Municipality of Mistretta, not later than December 31st next, for the establishment of a service of electric lighting in that town. Such particulars as have been received may be examined on personal application at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 5 p.m.

Newcastle-on-Tyne.—November 30th. The Tramways Committee wants tenders for two 1,000-H.P. steam dynamos for electric tramway works. See "Official Notices" October 27th.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

Portsmouth.—November 17th. The Council invites tenders for the supply of 40, 60, or 80 electric tramcars. See our "Official Notices" November 3rd.

Portugal.—November 22nd. Tenders are being invited, until 22nd inst., by the Royal Company of Portuguese Railways, for the supply of 8 tons of galvanised iron telegraph wire. Tenders to be sent to La Compagnie Royale des Chemins de Fer Portugais, Santa Apolonia. Particulars may be obtained from the offices of the company, 28, Rue de Chateaudun, Paris.

Plymouth.—December 8th. The Corporation wants tenders for tramcars, trucks, motors, trolley arms, &c. See "Official Notices" to-day.

Spain.—November 23rd. Tenders are being invited until November 23rd by the municipal authorities of Chiclana de la Frontera (Cadiz province) for the concession for the electric lighting of the town during a period of five years. Tenders are to be sent to Le Secretariat del Ayuntamienti de Chiclana de la Frontera (Cadiz), whence particulars may be obtained.

Swansea.—November 20th. The Corporation wants tenders for five Lancashire boilers with jet condensing plant, feed pumps, economiser, piping, &c., for electricity works. See "Official Notices" November 3rd.

CLOSED.

Aldershot.—Messrs. Parsons & Co. have obtained the order for the generating machinery for Aldershot Camp. The plant will consist of three turbo-generators of 250 KW. each, and one turbo-generator of 100 KW.

Asylum Lighting.—We understand from the *Contract Journal* that the following contracts have been given out for the Winwick Asylum, near Warrington. Contract No. 1:—Generating plant, including three sets of condensing engines or turbines, with directly-coupled dynamos, each of 100 KW. output at 220 volts; booster set, motors, surface condensers, cooling tower, steam and exhaust pipes, &c., C. A. Parsons & Co. Contract No. 2:—Switchboard, Edison & Swan Company; storage battery, Hart Accumulator Company.

Islington.—The Tudor Company has received the contract for a battery of 1,000 ampere-hour's capacity from the Vestry at £679. An exchange gives the list of other tenderers as follows:—

E.P.S. Company	£664
Pritchetts & Gold	642
Hart Accumulator Company	640
Chloride Electrical Storage Syndicate	640
Tudor Company (alternative)	610
W. C. Horne & Sons, Limited (Pollak)	572

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Oldham.—The Council has given a contract to Messrs. J. Spencer, Limited, for the supply of tramway poles, amounting to £18,500, and also one to Messrs. Askham Bros. & Wilson, Limited, for steel points and crossings at £8,500.

Paisley.—The Town Council has agreed to purchase from Messrs. Babcock & Wilcox, Limited, three water-tube boilers, to be delivered respectively on 31st inst. and 10th and 23rd prox., and erected, including brick work, for the sum of £1,635. The Council has also accepted the offer of Messrs. T. and T. Vicars, engineers, Earlestown, for patent mechanical stokers with shafting for extension of the electric lighting plant at £430, the price quoted in May, 1897 (notwithstanding advance in cost of material and workmanship in the interim).

Rotherham.—The Council has accepted the following tenders in connection with the electric lighting scheme:—Boilers, Tetlow Bros., Hollinwood, £1,240; engines, dynamos, &c., W. H. Allen, Son & Co., £7,702; battery, D P. Battery Company, £755 10s; switchboard, &c., James White & Co., Glasgow, £1,290 18s. 9d.; mains, Callender's Cable and Construction Company, London, £4,092 12s. 11d.; and the town clerk has been instructed to apply to the Local Government Board for borrowing powers.

Sheffield.—The *Contract Journal* says that the following tenders for electric lighting machinery have been accepted by the Town Council:—Tetlow Bros. (boilers), £1,240; W. H. Allen, Son & Co. (engines and dynamos), £7,702; D.P. Battery Company (battery), £755 10s.; J. White & Co. (switchboard, &c.), £1,290 18s. 9d.; Callender Cable Company (mains—solid system), £4,092 12s. 11d.

Wigan.—We understand that Messrs. W. T. Glover & Co. have secured the contract for electric light cables for the Wigan Corporation at £13,932; the boiler contract is in the hands of Messrs. Babcock & Wilcox at £4,500; that for steam dynamos, &c., is with the General Electric Company, Limited, at £9,187, whilst Messrs. Doulton will supply conduits at the cost of £2,725.

FORTHCOMING EVENTS.

Saturday, November 18th.—At 3 30 p.m. The Institution of Junior Engineers. Visit to the City and South London Railway Works, Stockwell.

Tuesday, November 21st.—At 8 p.m. The Institution of Civil Engineers. For further discussion: "The Waterloo and City Railway," by H. H. Dalrymple-Hay, M.I.C.E.; "The Electrical Equipment of the Waterloo and City Railway," by Bernard M. Jenkin, Assoc.M.Inst.C.E.

Thursday, November 23rd.—At 8 p.m. The Institution of Electrical Engineers. Meeting at the Institution of Civil Engineers, 25, Great George Street, Westminster, S.W. "The Cost of Steam Raising," by John Holliday, Assoc.M.Inst.C.E.; "Influence of Cheap Fuels on the Cost of Electrical Energy," by R. E. Crompton, Past President.

Friday, November 24th.—Institution of Mechanical Engineers. Lord Chas. Beresford, C.B., M.P., on "Openings for Mechanical Engineers in China." President, Sir W. H. White.
At 8 p.m. Electro-Harmonic Concert, Café Monico, Regent Street, W.

Tuesday, November 28th.—Manchester Society of Junior Electrical Engineers. Meeting at Deansgate Hotel, Manchester. Paper by Mr. J. H. Henderson on "Aluminium, Its Treatment and Use, as Applied to Electrical Engineering."

Wednesday, December 6th.—Institution of Electrical Engineers' annual dinner, Grand Hall, Hotel Cecil.

NOTES.

Royal Institution.—The annual course of Christmas lectures (six) specially adapted for young people will this year be delivered by Mr. Charles Vernon Boys, F.R.S. The subject will be "Fluids in Motion and at Rest." The first lecture will take place on Thursday, December 28th, the others being delivered on December 30th, and on January 2nd, 4th, 6th, and 9th, 1900.

The Medical Battery Company.—There is a notice in last Friday's *London Gazette* that this company, of 489, Oxford Street, W., resolved on 7th inst. to wind up voluntarily, it having been proved that the company cannot, by reason of its liabilities, continue its business. Mr. L. F. Aspinall, of 57, Elgin Crescent, North Kensington, W., has been appointed liquidator. The notice is signed "C. B. Harness, chairman."

Central Station Breakdowns.—After commenting editorially upon "a regular epidemic of interruption of electric lighting service in Great Britain during the present autumn," the text of its comment being the recent breakdown at the Hastings station, the *Electrical World* and *Engineer* says:—"We believe we are safe in saying that an interruption in electric lighting service is very rare in America, and almost unheard of in our larger cities. What the fundamental cause of this difference may be it is difficult to say. Possibly it lies in the greater latitude which appears to be allowed central station engineers in Great Britain with respect to the introduction of their own ideas in the way of changes from standard practice. In this country security of service is the prime consideration, and the engineer, with the fear of the hard-hearted Board of Directors ever before him, hesitates long before becoming responsible for anything involving untried elements."

The Babcock Superheater.—We have received from the Babcock & Wilcox Co. their catalogue of accessories, in which we find a description of the superheater we recently described, and the arrangement for flooding the pipes when not in actual use is illustrated. By this system of working, a superheater ought to have a very considerable durability. It appears that the usual provision of the Babcock & Wilcox Co. is a superheat of 100° to 150° F., with which an economy of 10 to 15 per cent. is regularly to be obtained. Care must, of course, be taken to drain the superheater after flooding, for which purpose it might not be amiss to interlock the main steam outlet valve with the superheater in order to prevent the former being opened when the superheater is full of water. We have already pointed out that the economy due to superheat is almost entirely due to its action in countervailing the effects of the cylinder metal. Our correspondent of November 3rd, Mr. Tatlow, complains that we should have assumed the theoretical saving of superheat on the basis of the application of heat at maximum temperature—an impossibility, of course, in practice. The formula quoted implies the use of feed water heated to the temperature of ebullition, and is, of course, not applicable to the constantly varying conditions of practice. We do not know that the theoretical formula is ever used in estimating economies in practice, but simply the method used by Mr. Tatlow of comparing the actual heat quantities as given in any steam table. Looked at from this point of view, the smallness of the amount of added heat in superheated steam is better perceived; but here again the effect is seen to be as much below as the ideal formula shows it to be in excess of actual results, which confirms the practical man's claim that superheating must be looked on entirely from the practical point of view, and will then be seen to depend very much for its effects on too little-considered items, such as clearance surface and the quality of such surfaces.

The Zeeman Effect.—In an extract from correspondence between Sir Norman Lockyer and Prof. Preston, printed in *Nature* in the issue of November 2nd, the latter defends his priority to Prof. Cornu in the discovery of the quadrupling of the spectral lines in a strong magnetic field. Prof. Preston published descriptions and photographs of triplets and quartets in a paper read before the Royal Dublin Society, December 22nd, 1897. Prof. Cornu announced his discovery of them in the *Comptes Rendus* in the course of 1898. Prof. Preston has since shown that in a stronger field the quartet is resolved into a sextet by the splitting of the outer lines.

The Electro-Harmonic Society.—The "ladies' night" concert of this society takes place next Friday evening in the International Hall of the Café Monico. The programme is a light one, and should prove enjoyable. Miss Olive Kennett and Mr. Charles Fry, whose Shakespearian recitals at St. George's Hall are so well known, will give dramatic sketches, while Mr. Fredk. Upton, of "sensational novel" fame, and Mr. Chas. Frood, will supply the humorous element. The remainder of the programme consists of ballads and instrumental pieces.

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The O'Keenan Electricity Meter—Mr. O'Keenan has just presented to the Société des Electriciens a new electricity meter of his own invention. This meter consists in principle of a little electro-motor, which is connected as a shunt to a fixed resistance. The electromotive force generated by the motor, and consequently its angular speed, is proportional to the difference of potential between the terminals of the fixed resistance. Therefore the angular speed, or the indications of the meter, are proportional to the strength of the current to be measured; it is thus an ampere-hour meter. The apparatus consists of a fixed cylinder of soft iron; round this are arranged, concentrically, the two-pole pieces of a permanent magnet, which form the magnetic field. Within the annular *entrefer* revolves an armature, consisting of a support bearing bobbins, the wires of which are connected with a collector, on which rub two brushes conveying the current. The support is not conductive, therefore there is no fear of Foucault currents. Arrangements are made to overcome all passive resistances by means of a constant current sent into the armature. A watt-hour meter has also been designed. The magnetic field is produced by a permanent magnet, and an electro-magnet placed opposite. The electro-magnet is not saturated, and is excited by a shunt across the terminals of the total difference of potential. The two magnetic fluxes produced are in the same sense; by giving them the same value, we obtain a counter electromotive force proportional to the flux which diminishes as the difference of potential increases. We thus get a watt-hour meter which is exact as long as the variations of the difference of potential are slight. Special arrangements have also been made to make the apparatus work with alternating currents. The apparatus is quite air-tight, and is therefore protected from any dust which might soil the collector. The current in the armature is extremely small, and the fall of potential is very slight. No sparks are produced on the collector. The apparatus is independent of variations of temperature, and the armature moves in a very powerful field, and is entirely withdrawn from the influences of outer fields. These meters are graduated to indicate hecto-watt-hours under a certain determined difference of potential. These instruments have already been tried for some time, and have given very satisfactory results. They are constructed by the company that makes the Thomson meters.

Electric Leakage and Government Observatories.—At the Board of Trade on Wednesday, Sir Courtenay Boyle presided over a conference of representatives of electric railway and electric tramway enterprises on the one hand, and representatives of the Government interested in the Greenwich and Kew Observatories on the other. The *Times* says that the object of the conference was to ascertain the best means of dealing with the alleged interference with the delicate instruments in the observatories by the leakage which it is assumed will follow from the introduction of large systems of electric traction. After Sir Courtenay Boyle had opened the proceedings, interesting speeches were delivered by Prof. Rucker and the Astronomer Royal, who alleged that there must be magnetic disturbance; and by Sir Douglas Fox, Major Cardew, and others who would not admit that any interference with observatory instruments had at present been proved. As a result, a committee was appointed "to investigate the amount of magnetic disturbance produced in the neighbourhood of electric tramways and railways constructed and worked under the Board of Trade regulations; and to report as early as possible." The committee consists of Profs. Rucker, Ayrton, and Perry, representing the laboratories; Prof. Kennedy, Mr. H. F. Parshall, Major Cardew, and Mr. Brousson, for the electric traction companies; and Mr. A. P. Trotter for the Board of Trade.

Army Reserve Men.—We are pleased to note that the directors of Callender's Cable and Construction Company are allowing their Army Reserve men who have been called out on service, half pay, the money being paid regularly to their families. The employés have appointed a committee to make weekly collections for supplementing the amounts voted by the directors. Any surplus that there may be after the actual wants have been met, is to be reserved to meet the needs of any family whose head may meet with accident or death, or for the Mansion House Fund.

50-ton Overhead Traveller.—A 50-ton overhead traveller, made for the boiler shop of Messrs. Hick, Hargreaves & Co., is described in the *Engineering Times*. To cover a span of 50 feet, it occupies a head room between gantry rail and nearest roof tie of 9 feet 6 inches. The girders are double web section, built of plate and angles with 6 feet × 3 inches × ½ inch T stiffeners, the plates being $\frac{5}{16}$ thick and 5 feet central depth. The longitudinal speed is 200 feet per minute, and the cross traverse 100 feet per minute. There are two lifting barrels, one for 50 tons at $1\frac{3}{4}$ feet per minute, and for 25 tons at $3\frac{1}{2}$ feet per minute, the other for loads of 7 and $3\frac{1}{2}$ tons at 12 and 24 feet speed of lift respectively. The barrels are right and left grooved, and steel wire rope is used for the lift, which is 25 feet high. The hooks are fitted with ball bearing heads, and quick running gears are cut. The total weight of the crane is 95 tons when fully loaded. The electrical equipment contains three series wound motors with each its independent resistance, and Vaughan & Foster's patent reversing switch. These motors run as follows:—Hoisting motor, 300 revolutions per minute; cross traverse motor, 300 revolutions per minute; longitudinal motor, 600 revolutions per minute—slow speeds, which involve expensive and large motors, but eliminate the high gear speeds otherwise necessary, and with greater ease of stopping and reversing, presenting, it is claimed, advantages worth the price. The switches are of the liquid resistance type, placed in the operating cage. The brake is magnetic, and automatically applied and released as current is switched on and off the motors. If current fails, the brake acts at once, and sustains the load; but how this is done is not explained. Current is collected for the crane from two bare copper wires, stretched along the gantry girder, by sliders fixed to the operator's cage. Even in busy shops cranes rarely work more than 10 to 20 per cent. of the working hours. During the intervals there is no power consumed, and this renders an electric crane so much more economical than one with a flying rope, or a constantly revolving longitudinal shaft. Considerable numbers of electric cranes are being made by Messrs. Vaughan for large engineering workshops, including one of 125 tons for the Openshaw Works of Armstrong, Whitworth and Co., and nine light cranes for Hadfield's Steel Foundry Company, of Sheffield. Seven electric cranes have recently been completed for H.M. dockyard at Portsmouth.

Personal.—Mr. Robert Blackmore, superintendent engineer with the National Electric Supply Company, Limited, and late on staff of the St. James's and Pall Mall Electric Light Company, has been appointed city electrical engineer of Wakefield.

Mr. Geo. Taunton has been appointed secretary of the Consolidated Telephone Construction and Manufacturing Company in place of Mr. Charles Curtoys, who, we understand, has resigned through ill-health.

Mr. A. J. Lawson has resigned his position as engineer and manager to the County of London and Brush Provincial Electric Lighting Company, the Richmond (Surrey) Electric Light and Power Company, and the Scottish House-to-House Company (Coatbridge).

The Royal Society.—Among the papers read yesterday afternoon were the following:—

"Note on the E.M.F. of the Organ Shock, and on the Electrical Resistance of the Organ in *Malapterurus electricus*," by Prof. F. Gotch, F.R.S., and G. J. Burch.

"On the Least Potential Difference required to produce Discharge through various Gases," by Hon. R. J. Strutt.

"An Experimental Research on some Standards of Light," by J. E. Petavel.

Motor Car Meet.—The fourth annual meet of the Motor Car Club took place at the Hotel Métropole on Monday morning, and was followed by a run to Brighton. The great majority of the cars taking part were propelled by oil; "electricity, indeed," says the *Times*, "was just represented, and only a single steam vehicle—a lorry apparently bearing a heavy load of electrical plant—exhibited itself in Whitehall Place before the start." As is usual with these Brighton trips, some of the cars went a-missing on the road.

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Electric Power Transmission in Sweden.—*Engineering* says that the large Ljungan waterfall at Olby, Sweden, is about to be utilised for industrial purposes. A company was formed some time ago, with a capital of 2,000,000 kroner, which bought the waterfall and the adjoining land, and in the beginning of last year the work was commenced. A canal was constructed to lead the river round the waterfall, above which a dam was built. The canal is about 2,700 feet long, and consists of three sections: the influx canal, 2,000 feet long; the passage from this down to and through the turbine house, about 170 feet long; and the exit canal, some 500 feet long. The influx canal, again, consists of three portions, of which the lower part, 500 feet long, is built of stone, being rather more than 30 feet broad and deep. About 15,000 cubic metres of stone have been required for the building of this canal, and the making of the upper end of the canal has entailed the removal of 30,000 cubic metres of earth. Also the building of the turbine house has necessitated extensive removals of earth (10,000 cubic metres), and it stands on a concrete foundation of 2,500 cubic metres. The building is about 130 feet long, and the inside height is over 60 feet. The water is led from the canal into the turbine house through five pipes of 6 feet diameter, and two of about 8 feet diameter. In addition to these there are several reserve pipes, which can be taken into use without much additional cost, should the erection of new industrial establishments make them desirable. The dynamos will be direct coupled to the turbines, and the electric power will be conveyed direct from there to the workshops. The water-power, which can be made available without interfering with that part of the stream which must be left intact, amounts to some 12,000 H P. About half of this power will be required for the two large factories, Olby Electro-Chemical Company and Olby Calcium Carbide Company. The latter is situated on the east, and the buildings of the former on the west, side of the canal. The Olby Electro-Chemical Company will manufacture chloride of potash according to a new process.

Correction.—Mr. A. Nichols Moore notifies us that he has not been appointed engineer-in-*chief* of the Blackpool and Fleetwood Tramroad Company, but engineer-in-*charge*.

Stegmann v. O'Connor (Appeal).—In the Appeal Court yesterday, the appeal of plaintiff in the action of Stegmann *v.* O'Connor, from a judgment given by the Divisional Court in February last, was heard. Judgment was reserved. A report of the case will be given next week.

The Climax Water-tube Boiler.—With reference to the article on the "Climax" water-tube boiler appearing in our issue of the 10th, Messrs. B. R. Rowland & Co., Limited, draw our attention to the fact that the question of burning bituminous fuel has been already provided for by means of specially designed fire-bricks arranged with air ducts to ensure perfect combustion.

Appointments Vacant.—The Radcliffe District Council wants an electrical engineer. See "Official Notices" to-day.

An assistant is wanted in the electrical engineering department at the City and Guilds College, Exhibition Road, at £100 a year. See "Official Notices" this week.

Lecture.—Under the auspices of the Sheffield Society of Engineers and Metallurgists, an interesting lecture was delivered on 13th inst. at the Technical Department of the University College by Prof. Ripper, M.I.C.E. The subject was "The Progress of Steam Engineering, as Influenced by Electrical Developments."

Marriage.—On 4th inst. Mr. R. G. Botting, managing director of the Aberdeen Electrical Engineering Company, Schoolhill, was married to Annie, eldest daughter of Mr. Andrew Stott, Douglas Hotel, at the Gilcomston Parish Church, Aberdeen.

Electrolytic Lamps.—According to the *American Electrician*, a patent recently issued to W. E. Irish describes a modification of the ordinary arc lamp, by means of which a rod or tube of some material which, when heated, conducts the current and emits light at a high efficiency, is substituted for the arc between two carbons, the arc serving as a means of heating this material and thereby starting the lamp. In one arrangement, the arc is surrounded by a sleeve of normally non-conducting oxide, of a rare earth, which is heated by the arc until it becomes a conductor; the arc then may be extinguished, leaving the sleeve incandescent. The idea is not without importance; if it is found that electrolytic bodies cost less for maintenance and electricity supply than arc lamps, we have here a ready means of converting the latter.

Monozite Sand.—We should be glad to receive any information from our readers regarding the use which is made of this material for electrical purposes.

NEW COMPANIES REGISTERED.

Watts, Rumford & Co., Limited (64,111).—This company was registered on November 8th, with a capital of £5,000 in £1 shares, to adopt an agreement with Charles Watts, and to carry on the business of electrical, heating, and general engineers, smiths, bellhangers, ironmongers, hardwaremen, coppersmiths, tool makers, boiler makers, iron and brass founders, suppliers of electric light and power, &c. The first subscribers (each with one share) are:—John Marales, jun., North View, South Shields, shipowner; Jamieson Robertson, 44, Norcott Road, Stoke Newington, N., shipowner; George W. Rumford, 18, Scafield Terrace, South Shields, engineer; John B. Rumford, 18, Scafield Terrace, South Shields, electrical engineer; Ralph W. Graham, 26, King Street, South Shields, solicitor; Ernest B. Biglan, 71, Frederick Street, South Shields, secretary; and Charles Watts, 33, Charlotte Street, South Shields, electrical engineer. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; qualification, £100; remuneration as fixed by the company. Registered office, Edinburgh Buildings, 34, King Street, South Shields, Durham.

Monobloc Accumulator Syndicate, Limited (64,142).—This company was registered on November 10th, with a capital of £20,000 in £1 shares, to adopt an agreement with Gustave Leve for the acquisition of certain inventions, to carry on the business of an electric traction and light company, to construct and maintain cables, wires, lines, accumulators and works, and to supply electricity for all purposes. The first subscribers (each with one share) are:—C. Wanklyn, Belgravia Mansions, S.W., gentleman; J. M. Gorham, 66, Victoria Street, S.W., engineer; J. F. Albright, 66, Victoria Street, S.W., engineer; B. M. Drake, 66, Victoria Street, S.W., engineer; G. Leve, 1, Lawn Road, Hampstead, gentleman; F. Belcher, 43, Ellora Road, Streatham, S.W., clerk; and A. Eaney, 25, Rosel Road, Clapham, S.W., clerk. The number of directors is not to less than two nor more than four; the first are C. Wanklyn, B. M. Drake, J. W. Gorham, and J. F. Albright; remuneration, £50 per annum, and 7½ per cent. of the net profits, divisible. Registered office, 66, Victoria Street, S.W.

Loughborough and District Electric Traction Syndicate, Limited (64,124).—This company was registered on November 9th, with a capital of £1,000 in £10 shares, to construct, equip, and work by electrical or other mechanical or animal power any tramways and light railways at Loughborough, Leicestershire, and elsewhere. The first subscribers (each with one share) are:—R. P. Sellon, Queen Anne's Mansions, S.W., electrical engineer; B. Broadhurst, Jesmond, Wolverton Avenue, Norbiton, secretary; N. S. Russell, Old Rectory, Loughton, Essex, civil engineer; R. A. Dawburn, "Wierton," Sideup, Kent, engineer; E. H. Tyler, 15, Kirkstall Road, Streatham Hill, S.W., engineer; W. E. Lane, 14, Durley Road, Stamford Hill, N., secretary; and J. McLachlan, 33, Agamemnon Road, West Hampstead, N.W., assistant secretary. The number of directors is not to be less than three nor more than five; the first are to be appointed by the subscribers; qualification, £100.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Chloride Electrical Storage Syndicate, Limited (35,389).—This company's annual return was filed on October 19th, when 80,000 "A" preference, 30,000 "B" preference, 100,000 "C" preference, and 12,500 founders' shares were taken up out of a capital of £262,500 in 80,000 "A" preference, 30,000 "B" preference, 140,000 "C" preference, and 12,500 founders' shares, all of £1 each. £1 has been called up on each of 65,000 "A" preference shares, and £65,000 has been received. £157,000 is considered paid on 15,500 "A" preference, 30,000 "B" preference, and 100,000 "C" preference and 12,500 founders' shares.

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CITY NOTES.

Bolton Corporation Electricity Accounts.
Public lighting and private supply.

The electric lighting undertaking of the Bolton Corporation is one of the progressive undertakings that naturally seem to have location in the Lancashire and Yorkshire district. Originally designed by Mr. J. H. Rider, who left to get out the scheme for Plymouth, the business has been ably developed by Mr. Arthur Ellis, who had charge previously of the Southport works. One of the most interesting points in the general survey of the position of the undertaking is the comparatively small capital expenditure, while the works' costs are at the same time commendably low.

GENERAL STATEMENT.

	1897.	1898.	Increase.
Total capital expenditure ...	£57,038	£67,253	£10,215
Number of units sold	341,888	416,635	74,747
Number of lamps connected ...	32,000	43,740	11,740
Gross revenue	£6,693	£7,942	£1 249
Gross profit	£3,771	£4,536	£765
Average price per unit sold ...	4·01d.	4·02d.	·01d.

A useful feature of the accounts as printed, which might advantageously be imitated elsewhere, is the setting out on a side column of the figures for the previous year, so that a comparison between the current and last year's can be readily made. One misses, however, a detailed capital statement of expenditure, and some particulars which are usually given in the last table of the Board of Trade form. On the other hand, some useful statistics are published regarding the units generated and sold from the opening of the works, the length of mains, number and size of transformers, and appropriation of gross profits.

From the revenue statement it will be seen that there has been a slight increase in the receipts per unit sold, but this is more than counter-balanced by a drop in the returns due to sales of fittings, &c.

REVENUE STATEMENT.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current ..	£5,720	4·01d.	£6,987	4·02d.	·01d.
Meter rents	157	·11d.	219	·12d.	·01d.
Supply of fittings ..	816	·57d.	736	·43d.	—·14d.
Sundry	...	...	...	...	...
Gross revenue	£6 693	4 69d.	£7,942	4 57d.	—·12d.

The following figures give the detailed particulars of units generated, &c. :—

	Units generated.	Private.	Public.	Total.	Unaccounted for.	Per cent.
1897 ...	486,836	331,382	10,506	341,888	131,914	27 0
1898 ...	560,375	406,306	10,329	416,635	132,500	23 6

The total length of mains laid amounts to 50,870 yards, supplying 559 consumers, with an average of 78 8-c.p. lamps each. This figure has remained remarkably constant since the beginning of the undertaking. The transformers in use vary in size from under 1 KW. to over 20 KW. :—

Less than 2 KW.	3 to 7 KW.	10 to 15 KW.	20-21 KW.
201	75	14	19.

The large proportion of small transformers must tell against economy, and the results are, therefore, exceedingly good, bearing this in mind. We believe that Bolton is one of the places where a conversion from alternating to continuous supply for the centre of the town is in contemplation.

COST OF PRODUCTION.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal	£691	·49d.	£838	·48d.	—·01d.
Oil, waste, water, and engine room stores.	330	·23d.	347	·20d.	— 03d.
Salaries and wages incurred in generation and distribution.	999	·70d.	1,086	·63d.	—·07d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	90	·06d.	169	·11d.	+ 05d.
Works' cost	£2,110	1 48d.	£2,460	1·42d.	— 06d.
Rent, rates and taxes ..	223	·16d.	249	·14d.	— 02d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	372	·26d.	400	·23d.	—·03d.
General establishment charges, stationery and printing, law charges and insurance	·205	·14d.	231	·13d.	— 01d.
Other expenses	12	·01d.	66	·04d.	+ 03 l.
Total costs ...	£2,922	2 05d.	£3,406	1·96d.	—·09d.

In the costs increases are shown on repairs—still a most moderate item—and in "other expenses," but a total reduction of nearly one-tenth of a penny is effected, leaving the "total costs" at less than 2d. In 1896 a net loss of £270 resulted, which was charged to the rates. In 1897 this was turned into a net profit of £918, and in 1898 no less than £1,205 was left after paying all charges, as shown below:—

PROFIT STATEMENT.

	1897.	1898.
Interest on loans	£1,443	£1,599
Sinking fund for repayments	1,410	1,732
Net profit carried to reserve fund	918	1 205
Net profit carried to credit of rates	...	1,000
Gross profit	£3,771	£4,536

West India and Panama Telegraph Company, Limited.

The half-yearly meeting of this company was held on Wednesday at Winchester House, Mr. W. S. Andrews presiding.

The CHAIRMAN said that, as he led them to expect at the last meeting, there had been a considerable falling off in the receipts as compared with the period of the American-Spanish war. The increase shown at that meeting was earned owing to the war, and, as he then said, it was impossible to forecast what the future traffic would be after the war was ended. He also then regretted that notwithstanding the large reduction made in the tariff more than 12 months ago, there was not only no increase in the number of words exchanged with the British Islands, but an actual decrease. He could understand the decrease in money, but a decrease in the number of words exchanged, in the face of the large reduction, was another thing. Of course, it pointed to stagnant commercial relations. The report showed that events had not belied their anticipations. Not only had they got down to the commercial foundation, but that foundation had itself sunk down a little. After reminding them that they could expect no progress until the commercial state of the West Indies improved, he proceeded to refer to figures. The total for the half-year was £30,929, as against £39,612 for the period ended June, 1898—decrease, £8,683. In this £500 was included, owing to the Jamaica subsidy not having quite ceased in the half-year with which they were comparing, and which, therefore, would appear to show a further reduction, and certain rebates allowed to the company were also lowered in the half-year. Turning to the expenses, there was a small decrease of £212, notwithstanding the sum voted to the directors. Expenses of ships and cables were rather less. A pretty expensive renewal in the St. Lucia-St. Vincent section was charged to reserve. The result of all this was, that they were able to recommend the usual dividends on the first and second preference, and 6d. on the ordinary shares, carrying forward £379. They all wished that this were more, but under the difficult and discouraging circumstances they had had to contend with, that was the utmost they could accomplish. It became necessary for important reasons in connection with the altered nature of things in the West Indies to reduce the international tariff to and from Porto Rico on February 15th last. Fortunately, that reduction had resulted in an increase—a turn in the tide in the number of words sent—last half-year, and this had been mainly confined to Porto Rico, which the reduction affected. That island was now working under American rule, and the increase in the number of words exchanged with it was a decidedly encouraging feature. But notwithstanding the increased words, the revenue was still left lower than it was before the reduction, but it did point to an augmentation of the business which was what they had to depend upon. He was sorry to say that the ill fortune of the West Indies which had been so persistent, had pursued them in the period under review, for the islands were again visited with a disastrous hurricane. That mainly affected Montserrat, Porto Rico, and other islands. The company voted £120 for the relief of the consequent distress. Sir Cuthbert Quilter and Sir Neville Lubbock visited the West Indies and made recommendations to the Government. The West Indian Committee had shown themselves to be alive to the crisis, and the Colonial Bank had drawn attention to certain reciprocity arrangements between the islands and America, which it was believed would tend to very considerable improvement. That was really the crux of the position. Their revenues could not improve until the trade and commerce of the islands became more active. The Cuba Company's action against this company was not on for hearing, and it was not likely to be for a considerable period. The directors felt that the only thing was to try and keep things together, not to lose ground, but to keep pegging away, doing their best under the circumstances. Those circumstances might improve through reciprocity arrangements, and American, commercial, and other management in Porto Rico beginning to tell. He did not know if they might eventually get a little assistance elsewhere; that was a card that they had not played, because the opportunity had not arisen. He moved the adoption of the report and the declaration of dividends.

Mr. HOLMES seconded.

Several shareholders offered very lengthy criticisms of the action of the board in matters connected with the balance-sheet. A large ordinary shareholder (1,000 £10 shares), who described the under-

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taking as a miserably wretched one, hanging on year by year like a man with a morbid disease, protested against the ordinary shareholders, whose dividend was only 6*d.* per share, being made to pay for sums subscribed to the distress funds. The preference shareholders ought to bear it. These subscriptions should be voluntary from shareholders personally. He thought the time was coming for winding up. Another shareholder thought that the £80,000 5 per cent. debentures should be redeemed, and an issue at a lower rate of interest made. Objection was raised to the interest on investments being placed to reserve account instead of going to the credit of the revenue account, while the interest paid for borrowed money was debited to revenue.

The various criticisms having been replied to, the report and accounts were unanimously adopted.

Prospectus.

YESTERDAY afternoon the list of applications closed in an issue of £150,000 4½ per cent. first mortgage debenture stock of the Castner-Kellner Alkali Company, Limited. The subscribed capital of the company is £300,000 in ordinary shares. The issue is made at 102 per cent., and the stock will be secured by a specific first mortgage to the trustees for the debenture stockholders of the whole of the freehold land, works, and buildings of the company, and by a first floating charge on all the other property and assets, present and future of the company. The issue is for paying off debenture loans carrying a higher rate of interest, and meeting other liabilities incurred in the completion of the works.

Stock Exchange Notices.—The Stock Exchange Committee have ordered the undermentioned securities to be quoted in the Official List:—Aluminium Company, Limited—further issue of 5,000 shares of £1 each, fully paid, Nos. 60,001 to 65,000. City and South London Railway Company—£150,000 5 per cent. preference stock (1891), £200,000 5 per cent. preference stock (1896), and a further issue of £225,000 consolidated ordinary stock, in lieu of preference and ordinary shares respectively, now quoted.

The Brazilian Submarine Telegraph Company, Limited.—An extraordinary general meeting of this company was held at Winchester House on Friday last. Mr. W. Andrews presided. He moved the confirmation of the resolutions which were passed at a meeting on October 25th. The resolutions were confirmed. The name of the company will henceforth be "The Western Telegraph Company, Limited."

The Western and Brazilian Telegraph Company, Limited.—On Friday last an extraordinary general meeting of this company was held at Winchester House, when the resolutions passed at an extraordinary general meeting on October 24th, 1899, were confirmed as special resolutions. Mr. W. S. Andrews presided.

Telegraph Manufacturing Company.—The directors announce an interim dividend on the ordinary shares at the rate of 6 per cent. per annum, free of income-tax, for the half-year ended September 30th last, payable 1st prox. The transfer books of the ordinary shares will be closed from 16th to 30th, inclusive.

Brush Electrical Engineering Company.—The letters of allotment in perpetual second debenture stock have been posted.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending November 11th, 1899, were £182 11s. 4d.; November 11th, 1898, £229 17s. 9d.; aggregate for half-year to date, £19,243 15s. 11d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending November 10th, 1899, were £2,997 19s. 6d.; corresponding period, 1898, £2,607 16s. 0d.; increase, £390 3s. 6d.

The Cape Electric Tramways.—The receipts for October were:—Cape Town, £11,602; Port Elizabeth, £4,547.

The City and South London Railway Company.—The receipts for the week ending November 12th, 1899, were £1,082; November 13th, 1898, £1,056; increase £26. Total receipts for half-year, 1899, £19,406; total receipts corresponding period, 1898, £19,359; increase, £47. Miles open, 8¼.

The Dover Corporation Electric Tramways.—The receipts for the week ending November 11th, 1899, were £171 14s. 1d.; November 12th, 1898, £161 18s. 4d.; increase, £9 15s. 9d. Total receipts to date, 1899, £8,990 11s. 11d.; corresponding period 1898, £7,502 8s. 10d.; increase, £1,488 8s. 1d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,633, 1898, 4,806. Number of cars, 1899, 11; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, November 10th, 1899, were as follows:—D. U. T. Co., horse cars, £263 10s. 9d.; ditto, electric cars, £2,732 6s. 0d.; D. S. D. Co., electric cars, £710 17s. 8d.; total, £3,705 14s. 0d.; corresponding week last year—D. U. T. Co., horse cars, £2,286 6s. 5d.; ditto, electric cars, £352 2s. 10d.; D. S. D. Co., electric cars, £791 4s. 6d.; total, £3,429 13s. 9d.; increase, £276 0s. 3d. Aggregate to date, £81,979 16s. 10d.; aggregate to date last year, £78,903 13s. 6d.; increase to date, £3,076 3s. 4d. Worked:—The mileage open is 39 miles electrically, 5 miles by horses, as against 18 miles electrically, and 29 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending November 12th, 1899, were £581; November 16th, 1898, £234; Car miles run, 11,947; 1898, 3,604. Number of cars, 1899, 28; 1898, 10. Total receipts to date, from April 1st, 1899, £19,474; 1898, from June 27th, 1898, £5,109. Miles of track open, 12; 1898, 8¼.

The Liverpool Overhead Railway Company.—The receipts for the week ending November 12th, 1899, amounted to £1,684; corresponding week last year, £1,436; increase, £248.

The South Staffordshire Tramways Company.—The receipts for week ending November 10th, 1899, were £739 19s. 5d.; November 11th, 1898, £660 15s. 5d.; aggregate receipts for 45 weeks £30,095 7s. 2d.; 1898, £28,547 11s. 11d.

STOCKS AND SHARES.

Wednesday Evening.

WHILE business continues fairly active in the market for electrical supply shares, there is no special feature claiming particular attention. Investment orders still show themselves shy of coming into the Stock Exchange, and the cloud of dear money hangs gloomily on the horizon. Most activity is noticeable in the shares of the metropolitan companies. City of Londons, after their rise, have been sold, and consequently lost half the 10s. which they added to their price last week. Charing Cross, on the other hand, are improving, the old shares having risen to 10½ and the Preference to 6½. The latest issue are dealt in at about 10. Nothing fresh can be gleaned as to the company's exploitation of the City.

Pronounced dulness is the order of the day in London Electric Supply and South Londons. Both are pressed for sale, and the market does not want to buy either. Pressed for a reason as to why the shares should be so weak, the dealers are at a loss for an answer, and can only explain it by referring to the absence of buyers. It will be remembered that South Londons were affected in the same droopy way in the early summer, but appeared to get over their fit of depression, it was evidently for a time only.

Hampstead Electrics are once more being vigorously hawked for sale by the same firm of outside brokers upon whose attentions in this way we have previously animadverted. The persistent energies of the people in question call for another strong recommendation that the shares should be let severely alone. The price at which they are being offered may seem a tempting one to the guileless mind of an investor unfortunate enough to have already got some shares at par, but, as we have previously remarked, there are no buyers at all for these precious investments in the Stock Exchange, although there are plenty of only too willing sellers.

In the telegraph department the most striking feature is a rise of 10 in Commercial Cable stock, bringing it to 195. This, however, has caused less remark than a change of 2 per cent. in Easterns would do, so narrow is the market on this side of the water. The Anglo-American Companies, it is understood, are doing exceedingly well, and Anglo descriptions monopolise a good deal of the miscellaneous market's attention. The Deferred stock is recovering some of its old vivacity, and is confidently expected to reach 20 before the anxiously awaited dividend is out. For ourselves, we consider that the "B" stock has just as much chance, if not more, of rising to 120, at which the return is exactly 5 per cent. on the money.

Neither of the Eastern stocks shows much variation. Considering how rapid has been the rise in Eastern Ordinary, after its heavy fall, there is naturally a lull in the market, pending further developments with the coming Pacific cable. Had it not been for the threatened competitor, there is little doubt but that the company would be able to declare an enhanced dividend for the stockholders, for both this and the "China" company have profited largely by the Transvaal hostilities. Bearing in view the unsettled outlook ahead, both as regards the competition and scaling down of rates, we shall be surprised if either Board launches out into increased dividends for a year or two, at any rate.

Great Northern Telegraph (Copenhagen) shares are being quietly picked up, and vague reports circulate as to the excellent business which the company is doing, but no definite information is obtainable in the market.

What little interest is usually displayed over traction issues has quite fallen asleep this week. A well-known jobber in British Electrics said he never remembered such a quiet time in the shares. They are not offered, neither are they bid for. It would seem to require a miracle to make the prices move in one direction or the other. Other electric traction concerns are slightly easier. Anglo-Argentines can be bought at a shade under the middle price of 4. Buenos Ayres and Belgrano are 5⅜, and Calcutta trams marked 8⅜ on Tuesday. Blackpool and Fleetwood exhibit no change at 20, and Barcelona Tramway shares are a good market in the neighbourhood of 13. New General Tractions are lifeless; the price is 4 middle.

Writing on Wednesday night, as we have to do, it is, of course, impossible to say what effect will be produced upon the market by the important meeting of the Marylebone Vestry that will be held on Thursday. Dr. Fletcher Little is in the field with an ambitious proposal that the London County Council should take over the whole of the Metropolitan Electric Company's undertaking, including the generating station at Willesden, and sub-let various portions of it to the municipal bodies whom the purchase would mostly concern. This would, indeed, be what is familiarly termed a "large order," but, although it is hardly likely that the scheme will be passed in its entirety, it is quite possible that some modified form of it will be submitted in due course to the County Council. All this should help the market in Metropolitans pretty considerably, and holders would be well advised not to part with their shares for the present.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Nov. 8th.	Closing Quotation, Nov. 15th.	Business done during week ended Nov. 15th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	...	...
905,580£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	65 — 68	65 — 69	68	66¾
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	116½—117½	117 —118	118	116¾
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	17 — 17½	17½— 18	18	17 1/16
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15½	15⅝	15½
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	180 —190	190 —200	195	...
1,998,898£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	103 —105	103 —105	104½	...
224,350	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9⅝	9⅛
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20 xd	19 — 20	...	...
12,261	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
20,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½ %	3½ %	12 — 12½	12 — 12½	12¼	12⅛
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101 —104	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½ %	7 %	7 %	157 —162	157 —162	160	159
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	99 —102	99 —102	99½	...
39,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,498,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	117 —122 xd	117 —122	118¼	...
250,009	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	15½— 16	15½— 16	15 15/16	15½
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	118 —123	118 —123	...	...
95,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
360,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—6,000	25	4 %	...	...	101—104% xd	101 —104%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5½ %	11½— 11⅝	11½— 11⅝	11⅝	11½
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15½— 16	15½— 16	15 15/16	15 1/16
180,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	30 — 31	30 — 32	30⅞	...
39,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52 xd	48 — 52	51	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	⅛— ¼	⅛— ¼	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	⅝— 1	⅝— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	5 — 5¼	5 — 5¼	5¼	5⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5⅜	5¼— 5⅜	5 1/16	5 3/16
1,229,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —103	100 —103	101¼	100¼
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅝— 1	⅝— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,339	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
8,361	Submarine Cables Trust	Cert.	...	...	...	129 —134	129 —134	...	...
98,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5¼	4⅜— 5¼	...	...
151,728£	Do. do. 5 % Debs.	Stock	...	..	...	105 —108	105 —108	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	%	...	99 —103	99 —103	100	...
80,008	West Coast of America, Nos. 1—80,000 and 53,001—53,008	2½	...	...	...	⅛— 1	⅛— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	103 —105	103 —105	...	...
359,531	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
98,331	West India and Panama Telegraph	10	1 %	3%	...	1½— 1⅝	1½— 1⅝	1⅝	...
84,568	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10⅝	10½— 10⅝	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	9 — 10	9 — 10	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,200	100	5 %	5 %	...	105 —108	105 —108	...	...
168,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7⅛— 8⅛	7⅛— 8⅛	8 3/16	...
13,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	9½— 10⅛	10 — 11	10⅛	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	6 — 6½	5⅝— 6¼	6 1/16	6
84,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	8 — 9	8 — 9	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	111 —113	111 —113	113	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11½— 12⅛	11½— 12	11 13/16	11⅝
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 14	13 — 14	13⅛	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10 — 11	10½— 11⅛	11	10 15/16
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
200,000	Do. 4½% Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	111 —114	111 — 114	112½	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5⅛	5 — 5⅛	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3⅞— 4	3⅞— 3⅞	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 6⅝	6½— 6⅝	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	105½	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	15 — 16	15⅝	15 7/16
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14 — 15	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½— 16½	15½— 16½	...	...
81,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	15½— 16½	15½— 16½	16⅛	16 1/16
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3⅞— 4	3⅞— 4	3 13/16	3 13/16
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½—15½	14½— 15½	15½	14⅞

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Nov. 8th.	Closing Quotation Nov. 15th.	Business done during week ended Nov. 15th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2⅜— 3¼	2⅜— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
80,000	British Electric Traction	10	...	...	6 %	16½— 17½	16½— 17½	17	...
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13½— 14	13½— 14	14	13⅝
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	127½	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11 — 12	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6⅝	6½— 6⅝	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅞— 2⅛	1⅞— 2⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2¼— 2½	2¼— 2½	2 7/16	2 5/16
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —115	110 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13 — 14	13 — 14	13½	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	113 —116	113 —116	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10½— 10⅝	10½— 10⅝	10⅝	...
178,303	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,033	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5¼	4⅜— 5¼	5¼	5
71,447	Do. do. Def. do.	5	...	...	...	5 — 5⅛	5 — 5⅛	...	...
630,000£	City and South London Railway	Stock	1 1/16 %	1⅞ %	2⅛ %	63 — 66	63 — 66	64	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6½— 6⅝	6½— 6⅝	...	...
82,098	Crompton & Co., Nos. 1 to 82,098	3	...	...	...	3¾— 4	3¾— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛ %	6 %	6 %	2 — 2½	2 — 2½	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛ %	6 %	6 %	4 — 5	4 — 5	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2 — 2½	2 — 2½	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3⅛	3 — 3⅛	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	104 —107	104 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅛— ⅛	¼ — ⅛	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21⅛	21¼
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	102⅛	101¼
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3¼ %	3¼ %	9¼— 9½	9 — 9¼	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13⅜— 13⅝	13¼— 13⅜	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	37½	37
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9¼— 9⅝	9¼— 9⅝	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	101 —104	...	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.

Brompton and Kensington, 4½% Debentures of £100, 105—108.

National Electric Free Wiring, 10s. paid, ¼—⅜.

Smithfield Market Electric, 1—3.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6%, £5 (fully paid), 7¼—7⅜. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.

*T. Parker, £10 (fully paid), 18⅜.

* From Birmingham Share List.

Bank rate of discount 5 per cent. (October 5th, 1899).

MARKET QUOTATIONS, Wednesday, November 15th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a " Nitric .. .. .. per cwt.	22/-	22/-	..
a " Oxalic .. .. .. per cwt.	82/-	82/-	..
a " Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) .. per ton	£29	£29	..
a " " .. .. per ton	£27	£27	..
a Bleaching powder .. .. per ton	£6 10	£6 1	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a " (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25 10	£26	10s. dec.
a Lead, Nitrate .. .. .. per ton	£25	£25	..
a " White Sugar .. .. per ton	£31	£31	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3½d.	3½d.	..
a " Caustic (75/80 %) .. per ton	£24	£24	..
a " Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a " Recovered .. .. per ton	£5 10	£5 10	..
a " Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a " Crystals .. .. .. per ton	£8	£8	..
a " Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£224	£224	..
b " Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8½d.	..
c " Tube (brazed) .. .. per lb.	10d.	10¼d.	¼d. dec.
" Wire, basis .. .. per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f " Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£86	£86	£1 dec.
g " Wire (basis price) .. per lb.	10¾d.	10¾d.	..
g " Sheet .. .. .. per ton	£86	£86	£1 dec.
g " Rod .. .. .. per ton	£86	£86	£1 dec.
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	7/-	7/-	..
h India-rubber, Para fine .. per lb.	4/4 to 4/6	4/8 to 4/5½	½d. to 1d. inc.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i " Pig (Cleveland warrants) per ton	70/7½	69/10½d.	9d. inc.
i " Forgings, according to size per ton	From £11	From £11	..
i " Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8 .. per ton	£14 5	£14 5	..
g Lead, English Ingot .. .. per ton	£17 12 6	£17 12 6	..
g " " Sheet .. .. per ton	£18 16	£18 16	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bott'e	£9 7½6	£9 5	2/6 inc.
d Mica (in original cases), small per lb.	2d. to 8d.	2d. to 8d.	..
d " " medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d " " large per lb.	3/6 to 7/6	3/6 to 7/6	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p " rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd str't p & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 11	£3 11	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	to £40	From £15,	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	nominal	£143	..
g " foil .. .. per lb.	1/6	1/6	..
n " wire Nos. 1 to 16 .. .. per lb.	1/11	1/11	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb	7¾d.	7¾d.	..
j " Best Flax, 6 lea. .. per lb.	5d.	5d.	..
j " Hemp, 3 ply 10 lbs. .. per lb.	8¾d.	8¾d.	..
j " " Russian, 10 lbs. per lb	4½d.	4½d.	..
j " Jute, 180 lbs. rove .. per ton	£14	£14	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t	£26	£26	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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VELVRIL: A NEW SUBSTITUTE FOR INDIA-RUBBER AND GUTTA-PERCHA.

The rapidly extending use of paper insulation for underground cables of all types is causing the question of rubber supply and price to become of less importance to cable manufacturers, but rubber is still used in large quantities for deep-sea cable insulation, and, therefore, the discovery and manufacture of an artificial substitute for it cannot be without interest for a large proportion of the electrical engineering profession.

On Monday evening, November 6th, Mr. Walter F. Reid, F.I.C., read a paper before the London Section of the Society of Chemical Industry, in which he described the manufacture and uses of a new rubber substitute, called "Velvril." Alluding to the possibility of the demand for rubber exceeding the supply of the natural product, Mr. Reid stated that the consumption is now estimated to be 60,000 tons per annum. The exports from Para show the greatest increase, the total shipped from this port in 1898 having been 25,000 tons, an advance of 3,000 tons upon the total for 1897. The Singapore variety of natural rubber shows, however, no such advance, and in 1898 the exports from this port only amounted to 2,600 tons. As this is the material most suitable for cable insulation, and as the last cable laid to New York required over 500 tons, or one-fifth the annual output for insulation, the situation of the cable manufacturer with regard to the supply of natural rubber is seen to be somewhat anomalous.

The new substitute for rubber is a mixture of nitrated linseed, or castor oil, with nitro-cellulose. The nitrated oil is prepared first, and is then mixed with the nitro-cellulose. A homogeneous mass is obtained, the elastic and other properties of which can be greatly varied by alterations in the proportions of the two constituents. The proportions which yield a product most closely resembling Para rubber are two pints nitrated oil and one pint nitro-cellulose. Castor oil yields better results than linseed oil. The elasticity of the product is 25 per cent. Its durability is greater than that of rubber, a sample of the product, after three years' exposure to all the vicissitudes of the English climate in the author's garden, having shown but slight marks of deterioration. The product can be moulded under heat and pressure, or it can be worked by dissolving in any suitable solvent, and then evaporating the solvent. When used for coating cables, the artificial product may either be applied in the form of a thick paste, the solvent being allowed to evaporate after each coating, or the solid product may be applied directly with the aid of heat and a pressure of 15 tons per square inch. The author considers that the latter method gives the best results.

Velvril may also be applied as a tape-wrapping of thin sheet, in the same manner that rubber is applied in the present method of cable manufacture.

Velvril is superior to vulcanised rubber, in that it is without action on copper. The author showed samples of copper wire coated in the manner described—with velvril—but he did not give any insulation tests of the new material, and in response to inquiries, stated that further experiments upon this use of velvril were in progress. The greater portion of his paper was devoted to the other applications of velvril, a mere enumeration of these showing the wide possibilities of the new substitute for rubber, *if* the price at which these manufactures can be sold will permit them to enter into keen competition with those produced from other materials by the older method of manufacture. As Mr. Reid studiously avoided the subject of *cost* in his paper, one may be excused for remaining somewhat sceptical on this point until further information is forthcoming.

The applications of velvril discussed by Mr. Reid were as follows:

Machine belting, portmanteaus, camping-out sheets, loin cloths for horses, balloon materials, hose and tubing, carding wire foundations for spinning rollers, floor coverings, paints, enamelled leather, and fishing lines.

As the production of this new material has already entered upon the manufacturing stage, Mr. Reid was able to exhibit samples of its application to all the uses named above, and he also informed his audience that these were but *a selection* of the products turned out by the velvril factory at Streatham Common, S.W.

In the discussion which followed the reading of the paper, considerable attention was directed to the question of the explosibility of the artificial material, and of its readiness to become ignited, but Mr. Reid assured the inquirers that "velvril" was non-explosive, and not more inflammable than other organic products. A rubber manufacturer present tried to obtain definite information as to the cost per pound of "velvril," but Mr. Reid refused to be drawn upon this point—perhaps wisely.

The full report of the paper and the discussion will appear in the November issue of the *Journal of the Society of Chemical Industry.*

FUEL CONSUMPTION OF ELECTRIC TRACTION ENGINES.

The *Street Railway Review* publishes in its special issue a paper on the fuel consumption shown by a number of tests made by Prof. Carpenter with a view to pointing out the effect of condensing, &c., on economical performance. The number of tests embodied is 35. No duty is more variable than that called for from traction engines on street railway work. Simple non-condensing engines show an economy but little less than that usually secured from this class on ordinary and more steady work, or about 34·3 lbs. of steam per H.P.-hour, and 4·63 lbs. of coal, the best result on a steady load being that corresponding to about ¼ cut-off, and being 27 lbs. of steam per I.H.P.-hour, any other load, greater or smaller, increasing the consumption. An interesting and instructive curve shows how the increase of steam varies with the load. The total steam per hour increases faster than the increase of load, the curve of steam per I.H.P.-hour showing slightly over 27 lbs. at 120 H.P., and 30 lbs. at 150 H.P., 44 lbs. at 160 H.P., and 64·3 lbs. at 40 H.P., the total steam increasing faster than the increase of load. The total results of all tests show a steam consumption for this class of engine only 25 per cent. higher than when working under most favourable conditions. The curves given were obtained from tests of a straight line engine, 14 inches × 14 inches × 210 revolutions per minute. The straight line engine of Prof. John Sweet is perhaps the best finished of any horizontal engine made. In respect of finish and also of design it is a remarkable example of careful design and scientific construction.

The average of all simple non-condensing engines with slide valves shows 35·1 lbs. of steam per H.P.-hour, or, neglecting one engine which was in bad order, 34·3. The average power developed was 54·2 per cent. of the rated capacity, and the steam pressures 90 to 120 lbs. The figures are useful in other ways as showing the load factor and pointing to the necessity of keeping engines of moderate cylinder dimensions so as to be of economical size over the greatest amount of work.

The same class of engine, but with Corliss gear, showed an average steam consumption of 28·3 lbs. per I.H.P.-hour and a load factor 50·3 of rated capacity, but only three engines come into this list. Non-condensing compound engines were four in number and did not show much improvement upon the first class, the average of the two best being 32·28 lbs. of steam and the load factor 51 to 62·7 per cent. The engines were from 400 to 1,250 H.P. capacity. While the simple engine therefore is only 25 per cent. below its best performance on steady load, the compound falls 40 per cent. below its economical performance, and is therefore but little superior to the simple engine for traction work.

As soon as condensing is applied a great difference is seen. Compound condensing engines show an average steam consumption of 23·96 lbs. or, if extremes be eliminated, of 24·26, with load factors 32 to 47 per cent. The average of the middle four is only 22·7 lbs., a figure which may be taken as most probably correct for this class of engine.

TABLE I.

Class of engine.	Boiler H.P. per engine H.P.	Cost per H.P. shillings. Engine.	Boiler.	Pumps and heaters.	Piping, &c.	Total per I.H.P.	Cost of 500-H.P. plant.
NON-CONDENSING—							
1. Simple slide ...	1·135	32 0	54 4	8 0	10·0	114 4	£2,860
2. Simple Corliss ...	·933	48 0	44 8	8 0	20 0	120 8	3,020
3. Compound slide...	1 000	44 0	48 0	11 6	20 0	120 0	3,000
CONDENSING—							
4. Compound slide...	·75	44 0	36 0	16 0	24·0	120 0	3,000
5. Compound Corliss	·602	64 00	29·0	16 0	24 0	133 0	3,325

As most makers will guarantee such engines to run on 18 lbs. of steam under steady load, and many such engines have worked with as little as 15 lbs., it appears that the loss due to variable load is 30 to 40 per cent. One of the engines in this list actually did show as little as 16·7 lbs. These engines had simple slide valves. With Corliss or similar gear the steam consumption only averages 18·8 lbs. On steady load such engines can be expected to run on 15 lbs. per I.H.P.-hour, showing a loss of about 20 per cent. due to irregular load. The load factor varied from 27·7 to 72 per cent., and it is observed that the evaporation per pound of coal is better than in the lower class of engines—evidence clearly of a generally better class of station and superior men and probably of better fuel.

Omitting one test not on all fours with the other seven, the average steam is 18·25, and the coal 2·36 lbs. per I.H.P.-hour.

Assuming a boiler horse-power to mean 30·4 lbs. of steam, the author has given a table showing the cost of 500 H.P. of plant for the different classes of engines reviewed. (See Table I.) If the author's premises are right, it appears of very little use employing anything less economical than compound slide valve engines, the enhanced cost of which is balanced by the smaller boiler power required. It will be observed that boilers are considered to be worth 48s. per H.P. when erected. This would bring the cost of a large Lancashire boiler evaporating 8,100 lbs. per hour to about £650, a figure which is at least £100 or £150 below the cost of a high class boiler of that type placed on its seat and bricked in. For capitalising values coal is assumed at 8s. per ton of 2,000 lbs., and the day is taken at 18 hours. To the fuel cost per H.P.-year are added fixed charges, &c., equal to 8 per cent. of the cost of the plant. On this basis the total cost per H.P.-year for the five classes given in Table I. works out as follows for the 18 hours' day:—

TABLE II.

Class.	Shillings.	Class.	Shillings.
1. Average ...	130·84	4. Average ...	95 04
1. Best	129·96	4. Best	72·64
2. Average ...	100 32	5. Average ...	72·48
2. Best	88·80	5. Best	57 84
3. Average ...	118·16		

The facts appear, from these figures, that no station can afford to purchase and work simple non-condensing engines of any type, as

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compared with the compound condensing engine, and that the best types of this latter class give better financial results than any other class; so much so, indeed, that no other inferior class can even be considered for power house work, though why the author should consider low speed of rotation to be also essential is not very clear.

PHYSICAL SOCIETY.

Ordinary Meeting held in the Physical Laboratory of the Central Technical College (by invitation of Prof. Ayrton), November 10th, 1899.

Prof. Lodge, F.R.S., President in the chair.

Mr. F. S. Spiers read a paper on "Contact Electricity."

The object of the paper was to determine, in a more satisfactory manner than has hitherto been attempted, the part played by the medium in the potential difference which arises when two dissimilar metals are put in contact. The first experiments were made with a piece of apparatus used by Profs. Ayrton and Perry about 20 years ago. This apparatus, in which the metals in contact are capable of a rotation of 180° about a vertical axis, and are placed between two vertical inductors connected to a quadrant electrometer, was afterwards considerably improved, and the compensation arrangement of Lord Kelvin was introduced, so as to measure the potential differences by a null method. The metals first used were platinum and zinc, but on account of the low melting point of the latter metal, it was replaced by aluminium. In order to try and remove the air sheets which cling to the surfaces of the metals, the tube was repeatedly heated and exhausted. The potential difference between the plates was found to gradually fall as this was done. It was proved that this was due to the oxidation of the aluminium, for on cleaning its surface, the original effect was again obtained. Attempts were then made to remove the oxygen by displacing it with hydrogen, but after four washings with pure dry gas, and at low pressures, there was still enough oxygen left to completely oxidise the aluminium. The oxide of aluminium is not decomposed by hydrogen at a bright red heat. It was therefore decided to substitute iron, and burn out the oxygen with hydrogen, by encasing the lower part of the apparatus in a copper tube, and heating to bright redness with a blowpipe flame. By this means the value of the Volta effect between iron and platinum, in an atmosphere of hydrogen, was found to be 0·6 of a volt, the platinum being positive to the iron. This result is different both in magnitude and sign to that obtained when air is the medium.

The Chairman said he had given the subject of contact electricity some attention during the last 15 years, and the author had performed a valuable series of experiments which he should have liked to have seen done several years ago. He had always felt that a vacuum would never get rid of the condensed air films. The burning out process used had provided the most reliable results upon the subject.

Dr. Lehfeldt pointed out that the action of hydrogen upon ferric oxide was a limited one, and that it was impossible to bring about complete deoxidation in that manner. At a dull red heat, the ratio between the water vapour and oxygen present is about 20 to 1.

Prof. Perry expressed his interest in the experiments, but said that they had not affected his opinion upon the nature of the Volta effect.

Prof. Armstrong said he was not wholly satisfied with the results, although a substantial approach to a solution had been made. The author had fully realised the difficulties of the experiments, but he had treated the matter as a surface gas effect, and had not guarded against moisture. Gases must be both dirty and moist before chemical action can take place, and we cannot expect to arrive at a solution of the problem until we have removed not only oxygen but dirt and moisture. It is impossible to completely exhaust the apparatus, and a number of molecules must always be left which is more than necessary to produce the Volta effect. Moisture can never be got rid of by exhaustion. The method of Dewar in using liquid oxygen or liquid hydrogen would get rid of gases and water vapour, and in this manner it would be possible to perform experiments which could be regarded as final. If the effect disappeared at low temperatures it might be urged that the temperature was too low for it to be produced. The author must have been dealing with combination effects, for it had been proved that hydrogen alloyed both with platinum and iron at a dull red heat.

Mr. Cooper said he would like to see the experiments repeated after precautions had been taken to remove nitrogen from the apparatus.

Prof. S. P. Thompson said he had recently taken part in a discussion upon the subject with some earnest followers of the old contact theory. They uphold that the property of metals which determines the potential difference when two are put in contact is as fixed and definite as other physical properties, such as density, and that the potential difference observed in air is approximately the same as the true potential difference. It has been agreed to call the former the apparent potential difference. Prof. Thompson said that the real Volta effect was near to the effect observed in air. In circuits formed of metals, there are other electromotive forces of the order of a millionth of a volt. The chemical electromotive forces in a circuit are of the order of a volt. The value of the Volta effect derived from thermo-dynamical considerations concerning the Peltier effect is much smaller than observed chemical potential differences. If, however, we take into account not only the Peltier effect, but also the Thomson effect, we will have other terms entering into the equations which may tend to give a value more nearly equal to a volt. Prof. Thompson said that, in observing chemical E.M.Fs., the Peltier effects did not come into the question, because of their smallness compared with the value of the chemical effect.

Prof. Perry pointed out that the Peltier effect was not distinct from the Volta effect, but was simply the differential coefficient of it.

The Chairman said that, if a circuit containing Peltier effects were treated thermo-dynamically, as if it were a reversible heat engine, we could arrive at an equation connecting the value of the Peltier effects with the rate of change of the whole electromotive force in the circuit with temperature. The electromotive force which changed was not necessarily the Volta effect.

Prof. Perry said he thought it was.

Prof. Ayrton suggested that advance might be made in the theoretical side of the question if the chairman were to put in writing his objections to the statement that the E.M.F. concerned was the true Volta effect. The extent of the Peltier effect proves the variation of the Volta effect with temperature, but because it is small it does not necessarily follow that the Volta effect is small. Where the Volta effect is a maximum or a minimum the Peltier effect vanishes. The experimental work of the paper didn't go far enough to convince him of the nature of contact electricity. Before we can hope to prove anything with respect to the two theories, we must be able to get a cyclic change of events. That is to say, we must be able to change our surfaces and media in a perfectly definite manner so as to be able at any time to return to the particular state from which we started.

Prof. Everett said that as the variation in the potential difference between two metals in a medium was probably due to slow chemical action which caused the metals to become less and less susceptible, he should expect that changing backwards and forwards from one medium to another would give to the potential difference an oscillatory variation gradually becoming smaller and smaller.

The Chairman said he would like to see experiments showing a cyclic effect similar to that mentioned by Prof. Ayrton. The difficulty in these experiments is to avoid chemical action. Chemical action is not necessary to get the Volta effect. The effect would be greatest in dry gas. Moisture tends to reduce the effect, and that is why its presence is unimportant.

Prof. Callendar expressed his interest in the surface character of the effect and its independence of the manner in which the plates were touched.

Dr. Stansfield suggested gold as a suitable metal to be experimented on because of its non-oxidisability.

Mr. Spiers, in replying, referred to Dr. Lehfeldt's assertion that the whole of the oxygen cannot be removed by hydrogen. In his experiments, however, there was very little ferric oxide and a large quantity of hydrogen, and although it was possible that all the oxide was not reduced, still a large portion of it was. The experiments were to be carried on, and attempts would be made to get a cyclic effect.

A paper on "The Heat of Formation of Alloys" was postponed until the next meeting.

THE ELECTRIC v. THE STEAM TORPEDO BOAT.

When all the world is watching with interest the application of the steam turbine principle to torpedo boats and similar vessels, it is interesting to find someone who will come forward and champion the claims of a vessel which is to be propelled entirely by electrical means. Mr. Charles T. Childs, in a recent issue of the American *Marine Engineering*, has brought forward a bold proposal for utilising electricity for torpedo boats. He approaches the subject from quite a different point of view to that held by naval experts in this country. The naval authorities of Great Britain, in their designs of a torpedo boat, have in view the necessity of making it a sea-going vessel, which can be relied upon to act in conjunction with a fleet, or may be expected to act quite well singly. We believe, also, that the work of a torpedo boat is occasionally diversified by using it as a despatch boat, or fulfilling some of the multifarious duties which occasionally fall to the lot of the smaller vessels of the Navy. But it will be seen how widely different are the opinions of Mr. Childs, when he states that it may be laid down as an axiom, that a boat built for torpedo service has to be so specialised as to be unfit for any other duty. He also adds that the sea-going cruising torpedo boat is a sort of anomalous contrivance, developed out of the struggle for high speed, and is not, properly speaking, a torpedo boat at all. It is hardly necessary, however, to go very deeply into the reasons for and against the use of torpedo boats for various purposes; but it may be observed that the different requirements of various nations can alone decide the type of boat. There is little doubt that Mr. Childs brings some damaging conclusions against the steam-driven torpedo vessel; everyone will admit that one of the essentials of an efficient torpedo boat is that it should be, as nearly as possible, invisible, and no one would seriously doubt that the risk of discovery is much greater if a torpedo boat is emitting smoke; more, the smoke-stack itself will be a more or less conspicuous object. At the same time, we do not think that even a steam-driven torpedo boat will very frequently show flame under forced draught. To quote Mr. Childs's own language: "A steam torpedo attack may be converted into a sort of merry torchlight procession, considerably more dangerous to the attacking party than to the attacked."

No doubt a night attack by torpedo boats is very likely to be discovered by the vagaries that might arise in steam-driven vessels, but we seriously doubt whether the engines that are placed on torpedo

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boats are quite so noisy as Mr. Childs would have us believe, though we are quite prepared to admit that a trifling incident would render the attack nugatory. Obviously these criticisms of steam torpedo boats are leading up to a suggestion of some other means of propulsion, and the sum total of Mr. Childs's contention is, that steam should be replaced by accumulators, and he makes out a distinctly good case for the electric boat as against steam. If the torpedo boat can rely upon its accumulators, it ought to prove an efficient aid, especially in repelling attacks; at the same time, the chief objections that arise in one's mind are, that an electric torpedo boat has a limited range of action, and it would be unable to travel far from land, or it must always remain under the convoy of a larger vessel, from which it can obtain its necessary supply of electrical energy; in short, it would lose much of the individualistic action which one associates so highly with torpedo vessels. Apart from these objections, there must be a good deal to render an electric torpedo boat a serviceable craft. It would be distinctly less likely than a steam vessel to give warning of its approach, and it could be, doubtless, operated by a smaller crew than is necessary in a steam vessel. Putting his theory into practical shape, however, Mr. Childs takes the case of a boat 40 feet long, having a beam of 4 feet, and a draught of 5 feet; this will displace, when light, 100 tons, and carry, normally, 30 tons of coal. If 45 tons is allowed for the weight (hull, ammunition, crew, stores, &c), there is left 95 tons, or 213,000 lbs. for electrical equipments. To attain a speed of 22 knots, about 1,500 H P. will be required. As the torpedo boat goes at full speed only at the instant of attack, the motors installed should be such as to work most economically at lower speeds. They should weigh as little as possible, and should be worked up to their utmost possible output for the rush of attack. Four motors, each developing 400 H P., could be reduced in weight to 6,500 lbs. each, or 26,000 lbs. for the four; this would leave 187,000 lbs. for battery, circuits, controllers, &c. Allowing 12,000 lbs. for the latter, and 175,000 lbs. for the battery, the question is, says Mr. Childs, what performance could be expected? According to practical tests, based mainly upon the workings of French accumulator vehicles, 175,000 lbs. of accumulators would maintain at the screw 140 H.P. for 24 hours, 300 H P. for 10 hours, 520 H P. for 5 hours, and 2,000 H P. for 1 hour, a power that would give a rush speed of 25 knots. With regard to the crew necessary to operate such a boat, it is assumed that a steam vessel of similar size would carry two officers and 18 men. The electric boat would want enough men to launch the torpedoes and one officer and five men, at the outside. It is assumed by the writer that the cost of such a boat would be about the same as steam, and it is urged that such a vessel would answer all the requirements, and would have sufficient range at low speeds. With an adequate number of circuits and controlling arrangements in different parts of the vessel (both of which arrangements Mr. Childs suggests) there would be obviously some difficulty in disabling a vessel, in the same sense as a well-directed shot would end the career of a vessel propelled by steam. These are conspicuous among many other advantages that would be possessed by an electric torpedo boat, and though one cannot share entirely the enthusiastic views of Mr. Childs, there is no reason to doubt that an electric boat would have a distinct sphere of action; but as we have pointed out, it would rely to a greater extent upon keeping up its lines of communication, either with a vessel or the shore—a course which is not absolutely necessary with a steam vessel. Not for a moment, however, do we suppose that the electric torpedo is likely to supplant the steam-propelled vessel to any considerable extent: it could be nothing more than supplementary. In spite of our desire to see a wider application of electrical machinery, we do not think that Mr. Childs is quite fair to steamboats; because, of the many torpedo boats we have seen, we have been struck with the almost entire absence of noise from the engines, and the absence of smoke, and at night we have been unable to detect, at a few yards distance, the presence of a torpedo boat, save for the swishing of the water. A properly managed steam boat ought to be almost as indistinguishable at operating distance as an electrical one would be.

Moreover, it should not be forgotten that there is a widely accepted theory among naval men that if a torpedo boat managed to plant its torpedo, it would have answered its function, and both officers and crew would accept their extermination as part of the bargain.

THE ARCHBUTT-DEELEY WATER-SOFTENING PROCESS.

We have received from Messrs. Mather & Platt their descriptive pamphlet of the Archbutt-Deeley system of water softening.

The principal constituents of hard water are the carbonates of lime and magnesia, and the sulphate of lime. The latter salt is less easily reduced by heat than is the carbonate, but when it is precipitated, it forms a very hard and tenacious scale, and it can be dealt with by dosing the water with carbonate of soda. The result of the mixture is the formation of carbonate of lime and sulphate of soda. This latter salt is exceedingly soluble, and remains inert in the water, the only danger to be guarded against being the concentration which would occur if a boiler were worked too long without partial blowing out, or entire emptying. The carbonate of lime is insoluble, and will precipitate in the feed tank if a reasonable time be allowed. Bicarbonate of lime is a salt that is not apparently known in the dry state. It probably occurs in solution in water. We say probably, because though it is usual to say that carbonate of lime is only freely soluble in water when there is an excess of carbonic acid gas present, it has been found that the amount of carbonic acid gas in the chemical equivalent of the lime salt, and this is a very powerful argument for the contention that the salt is really bicarbonate. By adding caustic lime or caustic soda to a bicarbonate solution, the extra molecule of carbonic acid is absorbed, and a double amount of insoluble lime carbonate is thrown down by the use of lime. With caustic soda the resulting monocarbonate of soda remains in solution.

It is probable that a lime carbonate water may be softened even by the use of carbonate of soda, for soda is known to exist even dry as a bicarbonate, and possibly it can also exist in solution as bicarbonate. This probably explains why ordinary crystal soda (a hydrated carbonate) will soften a lime carbonate water. But soda is expensive, and carbonate waters, whether containing lime or magnesia, are far more cheaply softened by caustic lime. Moreover, all the lime practically deposits, whereas all the soda remains in solution, and may concentrate to danger point by long evaporation in the boiler.

The caustic lime process of water softening is exceedingly pretty. It is known as Clarke's process, from its inventor, Dr. Clarke, and it is at the base of all water-softening systems. It is sometimes found that when waters have been softened they are very apt to throw down a peculiar deposit in the feed pipes to a boiler. To prevent this, the Archbutt-Deeley process includes a re-carbonating process, by which the softened water is re-impregnated with carbonic acid gas obtained by forcing into it air passed through a small closed coke furnace.

This recarbonates the small excess of alkaline lime remaining in the water and reconverts it to bicarbonate, enabling it to traverse feed pipes without depositing.

There are two tests for softened water. First, if insufficient lime has been added, the addition of nitrate of silver to some of the clear softened water will produce a milky whiteness. If too much lime has been added, there is produced a dark brown discoloration. The correct amount of caustic lime is proved to have been used when a very faint straw yellow colour is produced by the silver solution. If too pale—hardly perceptible—a little more lime is needed, and should be added to the next tank full treated. If too dark, the quantity of lime must be diminished.

Precipitation of the sediment formed by the lime is accelerated if a little of the previously formed deposit is left in the tank and stirred well up with each charge of fresh water. The larger crystals of the old deposit serve as nuclei round which the newly separated molecules of lime carbonate may aggregate. After softening, and when recarbonating is necessary, the sufficiency of the recarbonating is tested by means of a solution of phenol-phthalein. This solution is turned pink by water containing free alkali, but when carbonated sufficiently the water is acid, and the pink colour is no longer formed. The same substance may be used as a test in place of the nitrate of silver. If sufficient lime has been added, a faint pink colour is produced by the phenol-phthalein solution. Too deep a pink indicates, of course, an excess of lime.

It is usual to boil the quicklime in a small tank of water by means of steam. Waters containing organic matter require the addition of a small quantity of alumino ferric to assist precipitation. This coagulates and precipitates albuminoid matter.

It is claimed that by softening water in considerable quantity at once by means of an alternation of large tanks, the results obtained can be made more reliable than by any continuous process. As many as 30,000 gallons of water are treated by the intermittent tank process at the Midland Railway works at Derby. The water comes from the Derwent, which flows for a considerable part of its course through a district of almost pure carbonate of lime, and receives tributaries, such as the Wye and its feeders, which are almost entirely limestone rivers. Of the total area of 300,000 acres drained by the Derwent, 63,000 are limestone areas and 6,000 are limestone shales.

With so many hard waters the process of softening is so cheap and simple that it is very much a matter of surprise that more is not done in this way.

It is estimated that allowing 20 minutes to fill a tank and 20 minutes to empty it into the reserve, with 90 minutes for treatment and settlement, a supply of 1,000 gallons per hour can be softened by means of one tank 8 feet cube if the water can be run into it at the rate of 120 gallons per minute. Similarly for 4,000 gallons per hour a couple of tanks 12 feet square and 10 feet deep will serve with a supply capable of being run in at 360 gallons per minute.

Purely carbonate or temporarily hard water may cost as little as one-fifth of a penny per 1,000 gallons in chemicals, while some of the worst waters, heavily charged with lime sulphate, may cost as much as 4d. But even this is better than paying 8d. per 1,000 gallons for the mains water, which is itself, probably, in need of treatment.

The above estimates of cost are based on a price of 20s. per ton for quicklime, and £4 per ton for 58 per cent. alkali, or alkali which contains 58 per cent. of NaO in 100 parts, by weight, this being the trade method of evaluating various forms of alkali manufactured.

"TESTED LAMPS."

Some interesting particulars of the results of tests made by the "Tested Lamp" Company, on the life of various types of incandescent lamp, were recently published in one of our contemporaries. Unfortunately, though not unreasonably, the names of the makers are not stated. One English-made 16-C.P. 200-volt lamp starts at 19 C.P., goes up to 20, then rapidly falls to 9, while the power absorbed rises

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from 3·0 to 6·5 watts per C.P. in 432 hours. This lamp is *not* recommended! Another English lamp, which bears a high reputation for long life, is also condemned, the C.P. varying from 12 C.P. to 14, and falling to 9·6, while the power rises from 4·5 to 6·6 watts per C.P. in 336 hours. The best 200-volt lamp tested, also an English one, *fell* rapidly from 20 to 15·8 C.P., at which figure it remained constant for 500 hours; the power varied inversely, from 3·2 to 3·75 watts per C.P. This is a capital result. An American lamp rose from 20 to 21·6 C.P., and gradually fell to 15·6; the power rose from 3·2 to 3·9 watts per C.P. in about 600 hours. Of 100-volt lamps tested, one by the maker of the best lamp mentioned above shows a slight rise to 16·8 and a gradual fall to 13·9 C.P. in 576 hours, with a power consumption of 3·5 to 4·2 watts per C.P. in the same time; a lamp by another maker rose from 17·4 to 18·3 C.P., and fell to 13·5, the power varying from 3·25 to 4·15 watts per C.P. in 600 hours. By integrating the curves it was found that, at 5d. per unit, the American lamp gave 100 C.P. hours for an average cost of 1·7d., while the best English lamp worked out at 1·88d. The two 100-volt lamps gave approximately the same values as the above.

It is interesting to note that in every case the rapid initial change in C.P., whether a rise or a fall, took place during the first 48 hours.

The last lamp mentioned gave on the whole the best electrical results, but was mechanically defective.

THE TUNBRIDGE WELLS OF THE FUTURE.

The residents of this charming inland watering place are in a state of agitation, for is there not a movement on foot to detract from the beauty of the roads by hideous trams on the electric overhead system, to vitiate the pure air of Heaven by nauseous gases emanating from a refuse destructor, and to aid and abet the spread of unparliamentary language by the temper-spoiling adoption of a municipal telephone exchange. Shade of Beau Nash! One can almost imagine that *Arbiter Elegantiarum*, of Tunbridge Wells, writhing in his grave at the very thoughts of the innovations which were proposed on the occasion of Sir William Preece's visit to the electric lighting works, to which we briefly referred in our last issue.

The introduction of "the light of the future" was disturbing enough to the remains of the man who insisted upon early hours, but as for what is to come—well, let the modern reader look back upon the characteristic and interesting life of those who foregathered in the Pantiles in the middle of the eighteenth century, and a sigh of regret will involuntarily escape him at the prosy tale we are about to unfold at the end of the nineteenth.

Badinage apart, it is not long since we had the pleasure of referring to a racy address, given to the Congress of the Sanitary Institute by its president, Sir W. H. Preece, in which he, in the character of a modern Moses, warmly advocated the use of refuse destructors. He dwelt upon them as was appropriate, more from the sanitary than the engineering aspect; but we were pleased to observe that this distinguished engineer is now urging the adoption of a destructor at Tunbridge Wells in combination with an electric light station.

In a place so dependent upon the favour of visitors, and naturally so attractive, it is certainly advisable that no sanitary precaution should be wanting, and we should expect the refuse to be especially rich in cinders, and consequently in steam-raising capacity, in a purely residential district like Tunbridge Wells.

A well-considered scheme should result in considerable fuel economy in the electricity station, while the capital expenditure and the cost of labour per ton of refuse burned, need not be any higher than if the destructor (which may be considered a sanitary necessity) were a separate institution. Some saving may even be effected in the cost of management by putting both installations under one chief.

We do not apprehend that any such egregious mistake is likely to be made as that which has occurred at Shoreditch, where the profits of the undertaking are being swallowed up by a most extravagant arrangement of labour-saving machinery, enormous in first cost, absorbing a very large proportion of the current generated, and so utterly ineffective for its purpose that the cost for labour is considerably higher than that of any other destructor within our knowledge.

The recently published accounts, and the comments thereon in our own columns and those of our contemporaries, will not have escaped notice; but we hope presently to undertake a further analysis of the working costs of this installation, which, as we have pointed out from the commencement, has tended only to the disappointment of those who were erroneously led to expect in the Shoreditch plant something like a revolution in steam raising for the generation of electricity.

In the course of his speech proposing the health of Sir W. H. Preece, Mr. Elvy Robb, the chairman of the Electric Lighting Committee, referred to the municipal electric lighting scheme devised by Sir William some five years ago. Since they had done him the honour to make him chairman of the Lighting Committee it had been the more brought home to him what an important undertaking the ratepayers possessed, and how essential it was in their interest that it should be further developed and not checked. The undertaking, which they began five years ago not without hesitation, could to-day be sold at a very enhanced price if the town contemplated such a foolish step. At Eastbourne the ratepayers allowed a company to do what they ought to have done themselves, and to-day they were buying back the undertaking at a premium, and were paying £80,000 for what was not such a successful undertaking as had cost the ratepayers of Tunbridge Wells only £40,000. He had no doubt a company could be floated on the results of the five years' working in Tunbridge Wells to buy the local undertaking at a profit to the ratepayers of anything between £24,000 and £40,000. Not only had the ratepayers a valuable property, but a handsome return was being made to them. It was therefore a matter for regret that such an undertaking should meet with so much opposition. He gave their opponents every credit for honesty of purpose; he felt additional regret that some of them were gentlemen they were accustomed to regard as among the ablest men on the Council, and he would venture to make that the opportunity to tender the olive branch, in the hope that an end might be put to what had been termed an hereditary feud between gas and electric light. Let them work together in the interests of the ratepayers, instead of in opposition—an opposition which he gave every credit to as being simply intended for honest criticism. Now it had been demonstrated that there was room for both illuminants, and that, moreover, there was really a large demand for the electric light in the town, let them make the electrical supply a still bigger success, because by doing so they must be promoting the welfare of the town. He suggested that now a large sum of the ratepayers' money had been expended, it was too late to discuss the principle of electric lighting, and that all criticism should be solely directed to making the electric lighting a still greater success in the interests of the ratepayers. Their united efforts would be needed to come to a right decision on two questions which were about to occupy the Council, viz., telephony and tramways. He reminded them that the Corporation had no past traditions to go upon. They could only follow the example of other towns which had been successful, and now they found to what extent the burgesses appreciated the great advantages of the electric light, they would with confidence give their attention to other enterprises for the good of the town.

Sir William Preece tendered his hearty congratulations on the remarkable growth and success of their undertaking. He remembered when he first came down there the Council wanted a very small scheme—smaller, in fact, than they really could have—and what had been the result? The growth was so rapid that more than one enlargement was necessary, and in the short space of five years they had 30,000 lamps where only 1,500 were contemplated at the start, and in another year the gross profit alone would repay the original outlay that they were content to start with. Their local undertaking was, however, one of the most remarkable examples of the growth of the electric light, and also of the excellent management of their works. If they looked at the tabulated statements which the technical journals published, they would find that Tunbridge Wells, although not a large town, occupied a position very near the top in the return the ratepayers were making on their capital. The fact that Tunbridge Wells occupied such an unique position was really due to the irrepressible energy and the admirable commercial spirit of their engineer, Mr. Boot, with whose recommendation he was thankful to have had a little to do. Local governing bodies used to be content to make roads, but now they were recognising that tramways were merely advanced forms of roads. As towns grew, and new districts were opened out, it was necessary that a means of reaching the trading or commercial centres of a town without undue loss of time should be provided. Therefore electric tramways, as the best means of transit, were being laid down in every direction. In Tunbridge Wells he believed the housing of the working classes was a prominent question. How did other towns get rid of over-crowded areas? The population was carried out of the crowded centre to the open country and the pure air for themselves and children. Land was cheaper, and cottages and gardens could be provided more cheaply at the end of a tramline. The duty of a town council to improve the public health therefore embraced the application of electricity in this direction. But all classes used tramways, and apart from this, there was the indirect benefit that they made the electrical undertaking profit during the part of the day when their station was being run at a loss. It would also reduce the cost of production, which would put them in a still better position to supply the town, because the working expenses would be covered by a larger return, and their profit would not all have to be made in a few hours of the evening. He urged that the local authority, and not a private company, should construct tramways, especially where they had been wise enough to own the electrical undertaking, because they effected the double object of providing rapid and easy locomotion, and reduced the cost of producing electrical energy at the works. The great desirability of reducing the unprofitable hours of working would also be assisted by a large extension of the street lighting, and he trusted Tunbridge Wells would have the benefit of a large extension in this direction. A third means of reducing the cost of generation was by the provision of a destructor. This was also desirable from the sanitary point of view, as they completely destroyed a danger to health, while providing fuel for the electric light works. The dust destructor had now been brought to great perfection, and they could benefit by the experience of other towns. A destructor should certainly be in connection with their electric light works. Five years ago they questioned him on the point, and he suggested they should wait for the results of other towns' experiments, which they now had. The Town Council, by promoting its electrical undertaking, could at the same time promote the public health as well as effect a great financial economy. He was glad to hear that these questions were going to have their serious consideration. He had much pleasure in proposing continued success to their already very successful electrical undertaking.

Alderman Finch, as one of the oldest members of the Committee, and Mr. Ashby Wood, as the original chairman of the Committee, responded.

Mr. H. L. P. Boot also briefly replied.

The Council on 9th inst. met to consider various matters, among them being a proposal for an application to be made to the Light

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Railway Commissioners for an order to construct electric tramways within the borough. Mr. Councillor Robb moved an amendment to this proposition, that the matter be referred to the Lighting Committee, who would have the advantage of Mr. Boot's services, which would enable them to fully discuss the matter. This was ultimately carried.

From the preceding remarks, it will be evident that the Council contemplates moving very shortly in the matter of municipal telephones, but before taking any actual steps, it might be as well for them to peruse an article on the subject on page 1054, of the ELECTRICAL REVIEW, for June 30th, 1899.

THE BOARD OF TRADE REPORT ON THE DUBLIN TRAMWAY ACCIDENTS.

THE following is a copy of Mr. A. P. Trotter's report to the Railway Department of the Board of Trade:—

8, Richmond Terrace, Whitehall,
October 2nd, 1899.

Sir,—I have the honour to report, for the information of the Board of Trade, that in compliance with the instructions contained in your minute of August 25th, 1899, R. 10,879, I have held an inquiry with reference to certain accidents which have occurred in the working of the electric tramways of the Dublin United Tramways Company.

The inquiry was opened at the Four Courts, Dublin, at 10 a.m., on September 28th, notice having been given to the under secretary, the town clerk, and the secretary of the Dublin United Tramways Company.

Messrs. John Gordon, Q.C., and Mr. J. Fitzgerald Murphy (instructed by Messrs. Casey & Clay) appeared for the Dublin United Tramways Company.

Mr. Henry Bonass, law agent, appeared for the Dublin Corporation. There were also present Mr. Henry Campbell, town clerk, and Mr. Spencer Harty, city engineer.

Mr. Gordon, Q.C., offered on behalf of the tramway company to give every facility for the investigation of the matters, and to produce officers and employés if required.

I stated that the Board of Trade had instructed me to inquire into four accidents which occurred on June 20th, July 30th, July 31st, and August 6th.

EVIDENCE.

Accident of June 20th.

Mr. TOWLE, resident engineer of the Dublin United Tramways, said that when car No. 5 was going up Grafton Street the trolley left the wire, and the trolley head caught in the span wire. The standard which carried the trolley pole was pulled over, the cast-iron base being broken on the roof of the car. The trolley head was of an old type—part of the original Southern Tramways equipment. He could not tell why the trolley left the wire; this was an accident which often happened. The span wires did not break. The standard did not come bodily from the roof of the car, but the casting was broken, and showed no flaw. A trolley head similar to the one which caused the accident was produced, and the witness explained how it might catch on a wire, either by the screws which projected from it, or by the opening between the trolley wheel and the socket. When it was firmly caught something had to go, and as the wires held the standard was broken. A passenger named Ennis was struck, and received injuries by the trolley pole falling on him.

Mr. GORDON, Q.C., said that these old trolley heads which were mainly the cause of this accident, were now superseded. The new pattern had no projecting parts.

Mr. TOWLE produced one of the new heads, and explained that it was held to the pole by friction with a wedge and screws. If it became caught it would pull off, and would be prevented from falling by a chain inside the socket. These were being fitted at the rate of about 25 per week. When the new heads were substituted, accidents like the one they were investigating would be practically impossible. Some of the cast-iron bases were broken on the old Dublin Southern Tramways in 1896, but since then this was the only breakage of the kind which had occurred. All the standards were now bolted to the cars right through the roof.

Accident of July 30th.

Mr. GORDON, Q.C., said that this accident occurred in Amiens Street by a passenger pulling a cord. The bridge at which the accident happened was rather low. The wires had been erected in accordance with the wishes of the Corporation, but since the accident span wires had been done away with, and brackets substituted. The city engineer now approved of the reconstruction. The accident was one which the company could hardly avoid. It was almost impossible to prevent a passenger doing something that might be wrong, though he did not think it was wrong. The trolley rope having been pulled, and the trolley having come off, span wires were broken, the trolley wire sagged, and the next car tried to rush through, and broke more of the wires, causing a more alarming state of affairs than existed before.

Persons on the first car who complained of being injured were taken to the hospital, where they remained for some days and were discharged. They were all more frightened than hurt. Any claims that were made were settled by the company. They were all examined by the company's doctor.

Counsel also referred to the obligation to use guard wires, and said that the tramway company were anxious to insulate them. When they came in contact with the trolley wire one or both were burned. The telegraph wires were underground, and most of the telephone wires were going underground. No passengers on the second car were hurt, but bystanders were alarmed at the flashes.

Dr. CHANCE, questioned as to the nature of the injuries, said that he believed that there were some slight burns, but that on September 1st (the following day) when he examined them they were healed. He thought the injuries were chiefly psychical. One of the persons was a car driver who was not on the tramway at all. He drove some of the other persons to the hospital, and then went back for another fare, and later in the day returned to the hospital, stating that he had received a shock, and asked for compensation.

Mr. PARSHALL, questioned as to his knowledge of any other instance in which a passenger mistook a trolley rope for a bell rope, said that this was the first time he had heard of it being done. It was unprecedented to the extent of his knowledge. His experience dated from the beginning of the industry of electric traction. Questioned as to what precautions he thought it would be necessary to take to avoid repetition of such an accident, he replied that this was so exceptional that it was hard to say; but that if the trolley were so designed that it would not catch, and if a stop were placed at the base of the trolley arm, it might be prevented. But if it went up only 3 inches, and the head were of a bad design, an accident might happen. The slack of the trolley cord might be taken up, and it might be fastened to a ring at the foot of the trolley pole. Questioned as to the practice of "nursing" the trolley round corners and under points by the conductors, he thought they did as much harm as good, and he would prefer that they should leave them alone.

Mr. GORDON, Q.C., offered to get copies of the depositions taken at the police court inquiry, but was told that these were not needed, the technical part of the matter being very clear.

Mr. TOWLE said that in this accident the trolley wire was not broken at all; all the "pull off" wires were broken by the second car, and short bracket arms had been put up.

Mr. PARSHALL said that at a sudden curve it was necessary to have "pull-off" wires, and that they used many "long ears."

Mr. HARTY, city engineer, alluded to accidents due to the use of high speeds, but as the question of speed did not enter into the accidents which were the subject of the present inquiry, the matter was dropped.

Accident of July 31st.

Mr. TOWLE said that the trolley came off at the diagonal crossing piece at the corner of Gardiner Street and Talbot Street. No one was injured. That type of trolley head had been discarded. The trolley head flew up and caught in a guard wire and broke it. This wire came into contact with the trolley wire, and the "short circuit" melted both wires, which fell into the street, causing alarm. The end of the trolley wire which fell was a "short end," that is, it ended at a section insulator, and was therefore "dead" when it fell.

Mr. PARSHALL, questioned as to the gauge of the guard wire, said that it was, in accordance with the Board of Trade regulations, equivalent to No. 8. Asked whether the guard wires were so thoroughly "earthed" as to "blow" the fuse in the feeder box when the "short circuit" occurred, he replied that no fuses were provided in these boxes. The present system of tramways was divided into 13 sections, and automatic circuit openers at the works were set to open at 300 amperes. He considered that fuses in feeder boxes would "blow" under ordinary working conditions. He thought that half-a-dozen cars might start simultaneously on a half-mile section, and this would "blow" any fuse that could be usefully placed in a feeder box. He admitted that such a coincidence was unlikely, but it is the unlikely which happens.

Accident of August 6th.

Mr. TOWLE said that in this case one of the new trolley heads caught in a "frog" at College Green, was pulled off the trolley pole, and fell on the conductor, inflicting a slight injury. It had not occurred to them then to use a chain. He thought that this chain would prevent such an accident in future. The stops mentioned by Mr. Parshall to prevent the arm going too high were being put on.

Mr. GORDON, Q.C., said that, owing to the oscillations of the car, it would be difficult to regulate this height, but it certainly would clear the guard wires.

CONCLUSION.

The four accidents which form the subject of this inquiry were due to the rising of the trolley head above its ordinary position. In two cases (July 30th and 31st) the trolley head wrecked the overhead wires; in one case (June 20th) the overhead wires were so strong, that the cast-iron standard on which the trolley pole is hinged was broken, and in the last (August 6th) the trolley head, intentionally made detachable, came off. In the first and the last of these accidents one person was injured by the fall of parts of the trolley; in the accident of July 30th six passengers compained of injuries from electric shocks, and in the remaining accident no one was injured.

Breaking of Trolley Standard.

It appears that accidents similar to that of June 20th happened somewhat frequently on the old Southern Tramway system. Those standards were merely fastened to the roof by coach screws. That construction was undoubtedly defective, but it has been abandoned and does not affect the present case. The detachable trolley head appears to be well suited to prevent the recurrence of such an accident.

Wires Wrecked by Trolley.

The expression "trolley" is rather indefinite, and includes the pole or arm, the trolley head at the end of this pole, and the wheel which forms part of this head. Trolleys leave or "jump" the trolley wire from many different causes. These causes may be minimised, but

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can hardly be removed altogether. It is important, therefore, to prevent such an occurrence from doing injury. So well known is this kind of accident that it is put forward by some tramway engineers as a reason for not using guard wires, but this objection may be at once removed by preventing the trolley head rising more than a short distance above the trolley wire.

The Use of a Stop on the Trolley Pole.

The height of the trolley wire above the rails necessarily varies a little, and the maximum height must be considered, with allowance for "pitching" or oscillation of the car. A limit should then be fixed—in some cases this is 6 inches, and in one town it is said to be 3 inches. The limit, in the case centre running trolleys, as in the ordinary American style, can be easily arranged by putting a spring hook on to the end of the trolley rope, and a ring on the car, doing away with a yard or two of slack, which the conductors at present tie up anyhow.

Having regard to the extraordinary accident of July 30th, when the trolley rope was mistaken for a bell rope, this ring might be fixed on the edge of the canopy over the end platform. In the case of the "Dickinson" or swivel trolley heads, the slack on the trolley rope cannot be used to fix this limit, and an adjustable screw stop may be placed, and is now commonly placed, on the lower end of the trolley pole, as in the "Dawson" pattern.

Where the "Dickinson" system is used to a limited extent, the trolley wire being nowhere more than 5 or perhaps 6 feet from a perpendicular to the centre of the track, the trolley rope may be employed in the ordinary way, but it would be better to secure it to the foot of the trolley pole by a hook and ring. Where the swivel system is employed to a greater extent, with an 8 or 10-foot reach, trolley ropes are likely to cause accidents, and must be secured carefully, or dispensed with altogether, a bamboo with a hook being used instead.

I do not consider that the Tramway Company was to blame, in the first instance, for the accident of July 30th. In the wide experience of Mr. Parshall no similar accident had been heard of. The trolley is generally pressed upwards by powerful springs, with a pressure of about 25 lbs., and in this case, the line being low on account of the bridge, the force applied to the supposed bell-pull must have been between 30 and 40 lbs.

It is much better to use arm construction than span wires where the line is brought down low to go under a bridge, because if the trolley leaves the wire when the wire is low, the blows on the span wires would be much more severe. In such a place guard wires, if any, should be kept at the usual height, to clear the trolley head. This change has been made at Amiens Street.

An Improved Trolley Head.

The difficulty of preventing trolleys from leaving the wire, and the accidents due to this cause, have received attention from tramway engineers, but without much success. Horizontal sliding collectors are used on some tramways instead of trolleys, but that system appears to be more suited for continuous suburban lines than for intricate thoroughfares as those in Dublin.

One of the principal objects of the "Dickinson" trolley system is to enable short bracket arms to be used instead of span wires, and to dispense almost entirely with "pull-off" wires; but, owing to peculiar local conditions, the Tramway Company have been compelled to use both span wires and swivel trolley heads. The pattern of head used until lately, while not more likely to leave the wire than the centre-running trolley, was more likely to catch and to tear down the overhead wires. Mr. Towle has endeavoured to produce a trolley head which, while containing some features calculated to prevent "jumping," aims chiefly at avoiding the damage which the older pattern did to the overhead wires. The novel form and detachability promise to be valuable improvements.

Brackets v. Span Wires.

The centre-pole arrangement with brackets on each side for carrying the trolley wire, excellently adapted for tramways in wide streets, is used to a limited extent in Dublin; but it is said to be unsuitable on account of the unsystematic driving of cars, wagons, &c. Some of the brackets used in Dublin are of great length—several exceed 20 feet. Improvements in the swivel trolley head, or greater confidence in its use, should enable much shorter brackets to be employed. It appears that the choice of the bracket or of the span-wire system rests more with the Corporation than with the discretion of the tramway engineers.

Electric Shocks on Tramways.

Without wishing to make light of the effect of electric shocks of 500 volts, or to underrate the importance of securing the confidence as well as the safety of the public, it should be observed that the electrical pressure of 500 volts has been deliberately chosen because the results of shocks due to light or brief contact with a charged wire are not serious. The employés on tramway works often receive them, generally through carelessness.

The injury produced by such a shock may generally be estimated by the resulting burns; shocks due to higher pressures are accompanied by injuries to the nervous system. A passenger on an electric tramway should not be in more danger of receiving an electric shock than a passenger on a railway is in danger of being scalded.

RECOMMENDATIONS.

Guard Wires.

Guard wires are at present a necessary evil. They should be so well connected to earth, by connecting the poles to the rails, that any serious rush of electric current will melt fuses in the feeder boxes. If the traffic on any section is so irregular as to be likely to cause a heavy demand for current, the length of that section should be reduced so that the maximum working current can be carried by a fuse of practical dimensions, and one which will melt in case of a "short circuit." An automatic circuit opener is always placed on each feeder circuit, at the main switchboard at the works. These frequently open when a temporary demand for current largely exceeds the normal current. The switchboard attendant cautiously closes the circuit opener, which sometimes opens again. It would be well if matters could be so arranged that, in the event of a "dead short circuit," after two or three attempts to close the circuit opener, the attendant should be able "blow" a section fuse in a feeder box, by holding up the circuit opener. In the very rare event of a short circuit on a feeder, the circuit opener on the generator would open. The tramway engineers should be allowed free discretion by the Dublin Corporation as to the best mode of "feeding" the half-mile or quarter-mile sections of the trolley wire, and the placing of the switches.

I am not prepared to recommend the general use of wooden strips instead of guard wires. I consider that the adoption of the system of guard wires carried on the telegraph or telephone poles, in common use on the Continent, is very desirable. This has been tried at Blackburn.

I attach more importance to the substitution of this system of guard wires for the present one, than to any other improvement in electric tramways for the safety of the public, but this is a matter which must be arranged between the tramway engineers and the telegraph and telephone authorities, the Board of Trade having no powers in the matter.

The Prevention of these Accidents.

The use of brackets instead of span wires would prevent such accidents as those of June 20th and July 30th.

The use of a stop to prevent the trolley head, after leaving the wire, from touching the guard wires, or the abolition of guard wires of this kind, will prevent such an accident as that of July 31st.

The new form of trolley head will prevent such accidents as those of June 20th and August 6th.

I have the honour to be, Sir,

Your obedient Servant,

ALEXANDER P. TROTTER.

The Assistant Secretary,
Railway Department, Board of Trade.

ELECTRIC MOTORS ON U.S. SHIPS.

THE annual report of Rear-Admiral Melville, engineer-in-chief of the U.S. Navy, deals at considerable length with the question of electrically-driven auxiliaries, and reviews the long discussion on this important subject. Upon the whole, he thinks the opportunities for electric power on ship-board, in spite of its many advantages, are limited by insuperable conditions. The *Electrical World and Engineer* quotes the Admiral's statements as follows:—

"For some time past—in fact, ever since the successful use of electric motors for general power purposes on shore—the Bureau has been carefully investigating their adaptability to the driving of the numerous auxiliary engines on board ship, and in view of the conclusion that the electric drive of the auxiliaries would not, under existing conditions, be so satisfactory and economical, on the whole, as the steam drive, believes it would be of interest to state the reasons for this conclusion.

"This is the more appropriate, because in some quarters the fact that electric motors are extensively used on shore has led to the belief that they would be equally successful on board ship. The Bureau has planned to use electric motors exclusively in its new plant at the Brooklyn Navy Yard, and it will be readily appreciated, therefore, that their non-use on board ship is for very good reasons.

"The advantages claimed for electric motors over small steam engines on board ship may be classed as greater ease of operation, avoidance of heat, which accompanies the use of steam pipes in living places, and much greater economy. Against these, however, are to be put the much greater weight of the necessary electric outfit, the greater delicacy of the type of electric motors ordinarily used, the lack of ready adaptability to the various conditions of service, a general denial of the claims for economy as ordinarily presented, and the increase in the amount of space required below the protective deck for the installation of the necessary dynamo rooms, this space being necessarily taken from coal bunkers.

"On board ship, where excess of weight is so carefully guarded against, it would certainly be very unwise to adopt a change of motive power involving a great increase in weight, unless the advantages gained are very material. It

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must always be remembered that, speaking generally, on board ship the use of an electric motor involves a total weight for the motive power at least three times that of the motor itself, because there is always the generator and its driving engine, besides the motors supplied by them; or, in other words, the electric drive of an auxiliary will weigh at least three times as much as the steam drive, assuming the motor to weigh no more than the engine it displaces, although usually it does weigh more. The answer which would be made to this is, of course, very familiar to anybody who has studied the problem, viz., that the auxiliaries are not all in use at one time, and that therefore the generator capacity required is considerably less than the total motor capacity. This is another case where a statement which may be true elsewhere is not true for the circumstances on board ship. Our naval machinery has to be designed so that in time of action everything can be ready for use, and, as a matter of fact, a very little study of the question will show that it not only may, but almost certainly would, happen that every auxiliary on the ship, except the capstan engine and some of the boat winches, would be used simultaneously.

"I wish to emphasise the point that the objection to using electric motors for driving the auxiliaries on board ship is not an objection to the use of electric motors *per se*, but to installing them in a location for which they are not adapted, and where their good features cannot be utilised. What has led to the wide use of electric motors on shore is not only the absence of heat, cleanliness and ease of installation and operation, but above all, the simplicity of the transmission of power from a central station to a distance. Now the great majority of the auxiliaries on board ship are so near the boilers that less piping is involved in a direct steam drive than in an electric drive from dynamos necessarily at some distance from the boilers.

"The ease of transmitting power to a distance over a wire, as compared with great lengths of steam piping, gives the electric drive a very attractive side, even for distances no greater than the maximum ones on board ship, so that we should naturally expect to find electrically-driven capstans and steering engines. These two auxiliaries are not under this Bureau, but are the ones requiring long and objectionable steam pipes through the living spaces. Here, however, another point has been made by some who are very anxious to use motors elsewhere, viz.: That for the service in these cases, motors are not sufficiently reliable. Naturally a system involving four parts, each liable to break down, is more delicate than one involving but two of these parts. With a steam drive there are the boilers and the steam engine driving the auxiliaries. In the electric drive we have the boilers, the steam engines, and also the electric generators and motors. It is merely a detail whether the steam engines operate the auxiliaries directly or whether a smaller number of them, having a greater power in each engine, operate electric dynamos. Personally I should think, however, that if motors are considered sufficiently reliable to drive feed pumps and air pumps on shipboard, for which they are not well adapted, they would be reliable for these other two cases noted, which they fit so well otherwise. The absurdity of an electric drive of auxiliary machinery on board ship situated closer to the main engines than the engines driving the dynamos, becomes all the more apparent when contrasted with the steam drive for auxiliaries situated in the very extreme ends of the ship.

"On the battleship *Alabama* the space required for electric motors, where used, is approximately the same as that required for steam engines to do the same work. The space required for the wiring, &c., is less than that necessary for steam piping, had that been used. The space required for the generating sets is 10,140 cubic feet. The capacity of these generating sets is 256 KW. total. If all the auxiliary machinery on board this ship were operated by electricity, and if the space required for the electric generators were increased in the ratio of the increase of necessary capacity in the generating room, the space that would be required in the generating rooms would be 50,700 cubic feet for a capacity of 1,280 KW. Consequent upon the extension of the use of electricity would be an increase in the total weight of the machinery equal to from 150 to 250 tons as a minimum. This loss in weight is as much as the gain following the use of water-tube boilers. The increased space occupied by the larger generating rooms would accommodate 900 tons of coal, or 3,600 H P. could be added to the power of the propelling engines, giving the ship, in the first instance, 45 per cent. greater coal endurance, or in the second instance, 1·5 knots increase in speed.

"The operation of electrical machinery is purely mechanical. That this may be done efficiently requires good mechanical ability at the generating engines. Electric difficulties and casualties are almost always questions of mechanical engineering. I know that it would conduce to the efficiency of the service, to the feasibility of a more extended use of electricity, and to an increase in the life of electrical apparatus if the electric generating plant were placed in charge of this Bureau. I therefore recommend that this change be authorised."

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

21,614. "Improvements in suspension insulators for the trolley wires of electric tramways and the like." A. Wiseman. Dated October 30th.

21,630. "An electrical appliance for working points to tram and railway lines." G. Chappell, jun., and H. Chappell. Dated October 30th.

21,634. "Improvements in incandescent electric lamps." M. R. Heide. Dated October 30th.

21,637. "Electrodes for arc lamps." H. Belmer. Dated October 30th. (Complete.)

21,640. "Improvements in wireless telegraphy." W. Booth and J. Scheil. Dated October 30th.

21,643. "Improvements in electric cut-outs." J. Peschek and N. Edwards. Dated October 30th.

21,649. "Improvements in systems of control for electrically propelled vehicles and trains." The British Thomson-Houston Company, Limited. (W. B. Potter and F. E. Case, United States.) Dated October 30th. (Complete.)

21,651. "Improvements in electric railways and in controlling devices therefor." The British Thomson-Houston Company, Limited. (W. B. Potter, United States.) Dated October 30th. (Complete.)

21,652. "Improvements in methods of, and means for, synchronising electric motors." The British Thomson-Houston Company, Limited. (F. E. Case, United States.) Dated October 30th. (Complete.)

21,653. "Improvements in regulating electric motors." The British Thomson-Houston Company, Limited. (F. E. Case, United States.) Dated October 30th. (Complete.)

21,654. "Improvements in electric brakes and methods of operating the same." The British Thomson-Houston Company, Limited. (F. E. Case, United States.) Dated October 30th. (Complete.)

21,655. "Improvements in systems of controlling electric motors." The British Thomson-Houston Company, Limited. (A. S. Garfield, France.) Dated October 30th. (Complete.)

21,656. "Improvements in systems of control for electrically propelled trains." The British Thomson-Houston Company, Limited. (E. A. Sperry, United States.) Dated October 30th. (Complete.)

21,657. "Improvements in electric train control systems." The British Thomson-Houston Company, Limited. (C. E. Barry, United States.) Dated October 30th. (Complete.)

21,658. "Improvements in signal systems for electric railways." The British Thomson-Houston Company, Limited. (S. B. Stewart, United States.) Dated October 30th. (Complete.)

21,659. "Improvements in circuit breakers for alternating electric currents." The British Thomson-Houston Company, Limited. (T. J. Johnstone, United States.) Dated October 30th. (Complete.)

21,660. "Improvements in electric circuit breakers." The British Thomson-Houston Company, Limited. (H. W. Buck, United States.) Dated October 30th. (Complete.)

21,661. "Improvements in circuit breakers or switches of high potential electric circuits." The British Thomson-Houston Company, Limited. (E. M. Hewlett, United States.) Dated October 30th. (Complete.)

21,662. "Improvements in electric arc lamps." The British Thomson-Houston Company, Limited. (G. E. Stevens, United States.) Dated October 30th. (Complete.)

21,663. "Improvements in electric arc lamps." The British Thomson-Houston Company, Limited. (R. Fleming, United States.) Dated October 30th. (Complete.)

21,664. "Improvements in electric arc lamps." The British Thomson-Houston Company, Limited. (C. E. Harthan and G. E. Stevens, United States.) Dated October 30th. (Complete.)

21,665. "Improvements in electric arc lamps." The British Thomson-Houston Company, Limited. (R. Fleming, United States.) Dated October 30th. (Complete.)

21,666. "Improvements in automatic cut-out for rotary electrical converters." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated October 30th. (Complete.)

21,667. "Improvements in systems of electrical distribution." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated October 30th. (Complete.)

21,668. "Improvements in alternating electric current system." The British Thomson-Houston Company, Limited. (W. H. Pratt, United States.) Dated October 30th. (Complete.)

21,669. "Improvements in electric meters." The British Thomson-Houston Company, Limited. (E. Thomson, United States.) Dated October 30th. (Complete.)

21,670. "Improvements in alternating electric current transformers." The British Thomson-Houston Company, Limited. (A. R. Everest, United States.) Dated October 30th. (Complete.)

21,681. "Improvements in or relating to electric batteries." A. J. Boult. (E. Perrot, France.) Dated October 30th.

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21,720. "Improvements in and relating to switches for electric light." T. Bell and S. Simpson Berry. Dated October 31st.

21,730. "Improved starting and reversing switch for electric motors." J. R. Lockie. Dated October 31st.

21,742. "Improvements in electric railway rail bonds." T. J. McTighe. Dated October 31st. (Date applied for under Patents, &c., Act, 1883, Section 103, May 24th, 1899, being date of application in United States.) (Complete.)

21,748. "Improvements in or relating to electric lamps for carriages and like vehicles." T. W. H. Biddle and F. D. Gray. Dated October 31st.

21,778. "Improvements in electrically controlled elevators or lifts." H. Rowntree. Dated October 31st. (Complete.)

21,780. "Improvements in electric relays" H. H. Lake. (W. G. Nixon, United States.) Dated October 31st. (Complete.)

21,785. "Improvements in telephonic repeaters or relays and c rcuits connected therewith and therefor." C. Adams-Randall. Dated October 31st.

21,796. "Improvements in electricity meters." W. M. Mordey and G. C. Fricker. Dated October 31st.

21,807. "Improvements in electric massage instruments." L. Casper and A. H. Pierce. Dated October 31st. (Complete.)

21,810. "Improvements in electrical measuring instruments." H. P. Davis and F. Conrad. (Date applied for under Patents, &c., Act, 1883, Sec. 103, April 1st, being date of application in United States.) Dated October 31st.

21,844. "Improvements in portable telephone apparatus." H. C. L. Holden. Dated November 1st.

21,862. "Improvements in bracket for incandescent electric lamps and the like." R. Bayer. (Colsman & Co., Germany.) Dated November 1st.

21,877. "Improvements in or connected with electric arc lighting." A. Vosmaer. Dated November 1st.

21,881. "Improvements in electric incandescence lamps." H. H. Lake. (La Societe de Commentary-Fourchambault et Decazeville, France.) Dated November 1st.

21,882. "Improvements in means or apparatus for use at the crossing points of electric traction trolley wires." S. S. Grant. Dated November 1st.

21,886. "Improvements in connecting plugs for electrical switchboards." A. T. T. Thomson and P. Warnford-Davis. Dated November 1st. (Complete.)

21,893. "Improvements relating to electric railways." R. Belfield. Dated November 1st.

21,907. "New or improved filaments for incandescence electric lamps and processes for manufacturing such filaments." C. A. Lee. Dated November 2nd.

21,922. "Improvements in and relating to valves for electric action for organs." S. Richardson. Dated November 2nd.

21,960. "Improvements in electric traction." W. A. Burns. Dated November 2nd.

21,966. "Improvements in and relating to the manufacture and repair of incandescent lamps." F. Fanta. Dated November 2nd.

21,968. "Improvements in arc lamps and roller-clutch mechanism for feeding and controlling the electrodes therein." H. H. Leigh. (T. E. Drohan, United States.) Dated November 2nd. (Complete.)

21,990. "Improvements in and connected with cord-grips for electrical apparatus." H. Oppenheimer. (Actiengesellschaft Mix & Genest, Germany.) Dated November 3rd.

22,008. "A new or improved method and means of recording or indicating the amount of electric current or energy in a circuit." F. M. Staunton. Dated November 3rd.

22,016. "Improvements in electrical switches for telephonic systems and other purposes." M. Byng and A. G. Bell. Dated November 3rd. (Complete.)

22,020. "Improvements in or relating to telegraphy without the use of continuous wires." W. P. Thompson. (F. Braun, Germany.) Dated November 3rd.

22,028. "Improvements in or connected with electrodes for electrolysers." R. Eycken, C. Leroy, and R. Moritz. Dated November 3rd. (Date applied for under Patents, &c., Act, Sec. 103, May 3rd, 1899, being date of application in France.) Dated November 3rd. (Complete.)

22,039. "Improvements in means for collecting electricity from the overhead conductors of electric tramways." B. T. Emett. Dated November 3rd.

22,081. "Improvements in and connected with micro-telephones." S. Schiff. Dated November 4th. (Complete.)

22,088. "Improvements in incandescent electric lamps." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated November 4th. (Complete.)

22,091. "Improvements relating to electric lamps." W. Felsch. Dated November 4th.

22,092. "The electric candle shade adaptor." W. E. Sotheby. Dated November 4th.

22,100. "Improvements in and relating to electric lamps." C. Kellner. Dated November 4th.

22,102. "Improvements in or relating to electric cables." J. Y. Buchanan. Dated November 4th.

22,107. "Improvements in electric alarm water columns." M. L. Bush and C. F. Swain. Dated November 4th. (Date applied for under Patents, &c., Act, 1883, Section 103, April 8th, 1899, being date of application in United States.) (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

3,210. "Improvements in electrical measuring instruments." A. C. Heap. Dated February 8th, 1898. Relates to current and energy meters. An electro-dynamometer for measuring current has fixed and movable coils connected together in series or parallel, and through additional non-inductive resistance with the ends of a main resi-tance, carrying the continuous or alternating current to be measured. The resistances are made non-inductive, and of material having a low temperature resistance coefficient. The main resistance may be changed, to enable one dynamometer to be used for large or small currents. The current coils of wattmeters may be connected similarly, the pressure coil being connected in series with a high resistance, which may also be changed. The pressure coil of such an instrument may be connected by a switch in two ways, to measure either current or power. 5 c aims.

3,365. "Improvements in telephone systems." D. Sinclair and W. Aitken. Dated February 10th, 1898. Relates to an exchange worked on the central battery system in which the energy of the battery is only operative from the time a subscriber calls to the operator's reply and from the clearing out signal to the disconnection of the plugs. The exchange battery is earthed at its centre, and is connected at one end to the subscriber's indicators and to the clearing-out indicator, the other pole of the battery being connected to the middle point of a differentially-wound relay. The free ends of the indicator are connected to the inner points of the jacks, which are normally contacted by springs; the insertion of a plug breaks this contact. The line springs are shown bridged by a resistance the centre point of which is connected to springs. The subscriber's bell is in a bridge across the lines and the centre point is connected to the armature of electro-magnet. The armature of the electro-magnet is operated by the subscriber in sending a call. The operator's relay is provided with four pairs of contacts of which normally connect the sections of the plugs together. The outer contacts of first and second pairs are connected to a generator and make and break. The outer contact of pair is connected to earth, and the outer contact of the third pair is connected to one coil of the relay. In a modified arrangement, the relay is omitted, the generator being connected to the operator's calling key. The inner contacts and springs are also omitted in the jacks, an electro-magnetic switch being connected to the sockets to make and break the circuit between the resistance and the indicator. The magnet may be operated by a push instead of the telephone lever. In the case of single-board exchanges, the indicator is connected by inner springs across the two line contact-springs. 8 claims.

3,431. "Improvements in anodes for electrolytic operations." H. E. Beach. Dated February 11th, 1898. Anodes, for use in electrolytic operations, are formed somewhat like a fork or comb, that is, with a crossbar from which a number of rods depend or radiate. These rods may also be of any section, but they all taper to a point at the bottom. The provisional specification further states that plate electrodes may be made wedge-shaped, the thick part being at the top. 2 claims.

3,507. "Improvements in electric motors." Eversheds & Vignoles, Limited, and S. Evershed. Dated February 11th, 1898. Motor meters having vertical spindles, supported magnetically as described in Specification No. 9,127, 1897, are provided with nearly closed iron circuits for this purpose. These may serve also as brake magnets. The spindle is supported by a permanent or electro-magnet, and is centered by a long pivot working in and on two jewels. The magnet is surrounded by an iron cylinder having a round hole containing an iron disc carried by the spindle. With this arrangement the spindle may be supported clear of the end bearing. In a modification, the disc is larger and extends below or above the perforated disc forming the bottom of the cylinder. In a further modification, the disc has a vertical cylindrical rim situated below a similar cylindrical part on the bottom. In another modification, a cylindrical part on the bottom surrounds the spindle, which carries no additional iron part. The cylinder may be replaced by three or more symmetrically arranged steel rods connected to top and bottom discs. 2 claims.

3,555. "A combined switch and controller for electro-motors." C. P. Elieson and W. S. Naylor. Dated February 12th, 1898. Switches for controlling electric motors are provided with means (shown in plan) for quickly opening the circuits at any time, and for indicating when the switch arms are making proper contacts. A vertical shaft provided with a handle, has a square part engaging arms, which may be turned over stationary contacts to connect the motor field and armature either in series or parallel with part or the whole of a battery. The shaft is also movable vertically, and carries bars which normally connect contacts in the motor circuit, but can be pushed down to break contact. Turning of the bars is prevented by a fork engaging a guide, The switch arms are connected with a segment, notches in which receive a spring pressed pin when the arms are in proper engagement with the contacts. In any other position the pin is held out by the segment and places a spring in contact with a screw in the circuit of a bell or other indicator. 4 claims.

3,563. "Improvements in or relating to electric arc lamps." F. Brown. Dated February 12th, 1898. Arc lamps are provided with airtight casings and globes, for use in air containing combustible gas or dust, and with cut-outs arranged to disconnect the lamps if the globes are broken so that enclosed liquid or compressed gas escapes. In one arrangement, air is compressed into the casing and globe through a non-return valve, and raises a piston against a contact spring by which the lamp circuit is completed. In a modification, two concentric globes are used, and air is compressed through a valve into the space between them, which communicates with a cylinder containing a piston operating a switch-lever. In another arrangement, a liquid is circulated through pipes and between two concentric globes, the inner of which floats in the liquid and carries metal pieces to close the circuit through pieces fixed on the lamp casing; the inner globe is kept in position by guides. 5 claims.

3,660. "Improvements in apparatus for making and breaking electric circuits at predetermined times." H. O. Swoboda. Dated February 15th, 1898. Relates to switches for making and breaking the circuit at pre-determined times. Two adjustable contact arms are mounted on a spindle driven by a clockwork or other suitable motor. They engage with spring contacts and send a momentary current through one or other of the electro-magnets, the armatures of which are carried by a swinging pivoted frame. A weighted extension of the frame passes through a slot in the cross-piece of the double-pole switch and throws it into or out of contact with the spring, according to which of the magnets is energised. In order that the contact with the springs may be only momentary, the arms are fitted with insulating pieces. 4 claims.

3,650. "Improvements in holders for electric glow lamps." W. Geipel, F. M. T. Lange, and W. R. R. Saltrick. Dated February 16th, 1898. Relates to ho ders for incandescent lamps. A cylindrical insulator is made with too deep cavities to receive plunger carriers. Each plunger carrier is constructed with an inclined hole, into which the supply wire is passed through a tapered hole in the insulator. The wire is secured by a screw, placed so as to be accessible over the edge of the insulator, which may be recessed for the purpose, if necessary. The tapering of the hole permits the end of the insulating covering on the wire to be placed within it. 3 claims.

4,455. "Improvements in or connected with electric railways of the sectional conductor type." F. C. Esmond. Dated February 22nd, 1898. Relates to electric railways and tramways on a road contact or sectional conductor system with electro-magnetic switches provided with leakage arrangements. The switches are excited by a shunt current from the studs through the fine wire coil to earth or return, thereby lifting the armature which completes the circuit from the main conductor to the stud through a holding-up coil and a coil. The latter breaks the earth connection for the shunt circuit. To ensure the release of the switch when the vehicle passes from over it, a leakage plate surrounds, but is insulated from, the stud and is connected to a coil on the switch magnet wound so as to oppose the effect of the other coils. This plate may be touched by an additional brush on the collector. The exciting and holding up coils surround a common movable core which is thereby lifted into contact with the exposed stud and the contacts connected to the main. These contacts and the magnets are separated by an insulating partition in the switch box. The cap or a projection on it is sufficiently magnetised when the current pa ses through the holding up coil to lift an armature which breaks the shunt circuit. To supply current for the switches, if the main supply fails, a motor generator on the vehicle, worked by the line current, charges a storage battery and this works the generator to supply a local current when required. 5 claims.

4,540. "Apparatus for electrically controlling the hoisting mechanism of elevators or other type of machinery." H. H. Leigh. (F. J. Sprague, United States.) Dated February 23rd, 1898. Relates to an electrical system for controlling and regulating a lift or other motor directly from a switch in the cage. The following objects are effected:—The motor, which is shunt wound, having been started, an intermediate speed is obtained by cutting out resistances in the armature circuit simultaneously with an increase of the resistance in a shunt circuit of the armature which is ultimately opened. Full speed can then be obtained by decreasng the field strength of the motor. A too rapid change in the strength of the current in the main motor is prevented by the introduction of a throttle which acts preferably by regulating the strength of a current passing to a pilot motor employed to automatically operate the controlling apparatus. The main motor is also fitted with an electric brake, which, whilst the motor is slowing down after the circuit has been opened, is held off by a current generated by the motor itself. A diagram is given showing the arrangement of the circuits in the case of the application of the system to a shunt-wound motor, the arrangement being such that the current can be sent through the armature in either direction, while the current through the field magnets passes in one direction only. The controlling apparatus is operated by a pilot motor, the circuit of which is automatically interrupted as soon as the controlling apparatus has been brought into a predetermined position. Upon the opening of the circuit at the cage switch or elsewhere, or upon failure of the current, the controlling apparatus is returned automatically to its initial position independently of the position of the operator's switch. The hoisting machinery forming the subject matter of Specification No. 80,923, A.D. 1897, is described but not claimed in the present specification. 5 claims.

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THE

ELECTRICAL REVIEW.

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THE

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1900

Edition

NOW IN PREPARATION.

H. ALABASTER, GATEHOUSE & CO.,

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PROGRESS IN ELECTRICAL ENGINEERING.

THE presidential address with which Prof. Thompson opened the session of the Institution of Electrical Engineers, while not distinguished by any feature of striking novelty, had for keynote the word "Progress!" It must be admitted that no idea could be suggested that would be more appropriate to the conditions at this time prevailing in the electrical and allied industries than that of progress; the developments which we see taking place in every direction speak for themselves of the extraordinary rate at which electrical science is advancing, and of the prosperity of the industry.

The President's reference to telegraphy was confined to means of increasing the speed of transmission, with especial regard to submarine cable working. In this connection the Professor wonders why his suggestion, that inductive leaks of high resistance should be applied to the cable at intervals, has never been put into practice; as a matter of fact the experiment *has* been tried, not once but very many times, with innumerable combinations of inductive leaks, and the result in every case has been that either no advantage at all has been obtained, or else the working speed has been decreased. There are plenty of artificial cables on which the President could experiment if he were desirous of doing so.

Telephones are put in the corner in disgrace. Electrolytic lamps are touched on with a suggestion of "Why ever didn't we think of it before?"

The excessive cost of wiring buildings is considered to be, perhaps, the most serious obstacle to the spread of electric lighting, and the remedy is said to lie in the use of metallic conduits, and single instead of double insulation. We have heard this before, but are not yet convinced. While we accept steel conduits, or iron gas barrel, properly installed, as the best protection for the conductors, whether singly or doubly insulated, we cannot agree that this offers any prospect of combining cheapness with its other good qualities. The solution must be found, we believe, either in a concentric system, with earthed outer, or in a lead-covered twin-wire system, both of which are already in the field. We attach little importance to the fears so often expressed that such systems will suffer from mechanical damage, or to the craving evinced by some to pull the wires out of their ducts at unstated intervals; with the general adoption of higher voltages the drop of pressure in the wiring has been made of secondary consequence, the smallest size of wire to be used being determined more by mechanical than by electrical considerations, while the risk of fire due to mechanical injury to either of the types of wire referred to is absolutely trifling compared with the dangers of paraffin lamps and exposed gas burners.

The deep impression left by the Swiss re-union upon the President was plainly manifest in his treatment of the distribution of electricity from generating stations to con-

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sumers. Holding before us the examples of the Kander Works and the lighting of Milan, the Professor pointed out the vast superiority of alternating currents, especially those of the three-phase variety, for transmission over great distances. We are persuaded that the one great fundamental reason for the use of high pressure alternating currents is the fact that alternators do not require commutators. "There's the rub!"—in more senses than one. It is an incontestable fact that, with equal maximum pressures, a given power can be transmitted by direct current with less copper than by any system of alternating currents that can be devised. Unfortunately, it is not practically possible—at present—to generate direct current at pressures above 4,000 or 5,000 volts; but who shall say what the future may bring forth?

As regards the use of three-phase currents for general supply at moderate pressures, we cannot follow the President. The statement that the direct current three-wire system merely substitutes three wires for four is most unfair, seeing that at the same time the sectional area of two of these is halved, and that of the third is usually reduced to one-fourth, other things being equal. In fact, instead of 16 : 12, the ratio in which the weight of copper is reduced is 16 : 5. To call the three-phase four-wire system the logical extension of Dr. Hopkinson's idea is also unjustifiable; more copper is required on this system than on the direct current three-wire system, *cæteris paribus*. It is noteworthy that wherever both power and light are to be supplied by the Swiss generating stations, they are as far as possible kept separate, and very often direct current is used for lighting, three-phase for power, in the same area. This is because of the effect of starting induction motors upon the power factor of the system, causing excessive variation of the voltage at the lamps if all are fed in common. In other cases, the lighting circuits are supplied by single-phase currents taken from *one* circuit only of the three-phase generators. It must be borne in mind, too, that on the Continent much greater variation in the lighting pressure is patiently endured by the consumers than an English *clientèle* would put up with.

The President, moreover, remarked that a direct current will not drive a motor. It is true that the current in any armature conductor alternates in direction; but it is continuous with regard to the adjacent pole piece. Supply the slip rings of a rotary converter with three-phase currents; it will not start if the pole pieces are laminated, but must be mechanically brought up to speed.

As for the fire risk, while it may be true that a grindstone is more dangerous than an induction motor, it is also true if for the induction motor we substitute a direct current motor of decent design. The fact that grindstones are not boxed in while motors are, is merely an illustration of the parable of the gnat and the camel, with application to the insurance companies.

The remarkable experiment described by Prof. Thompson on the parallel running of alternators may have a bearing on the practical working of generating machinery, but in what respect is not so clear as we could wish. Under the conditions described no light is thrown on the question whether, if the excited machine had been supplied with driving power, the other would have been damaged. As it was, the "unexcited" alternator was not only called upon to do the work of both, but, in addition, had to drive the idle machine. If both had originally been fully loaded, the former would have been overloaded by more than 100 per cent., with a consequent C^2R loss 300 per cent. greater than the normal—a condition under which it would soon come to grief, if the engine could drive it. We should be glad to know the effect of the *amortisseur* upon the characteristics of the alternator when running on an inductive load. We know that it would to some extent reduce the efficiency, but this drawback may, perhaps, be counterbalanced by greater gains in other respects.

Dealing with electric traction, Prof. Thompson naturally favoured surface contacts, and considered it an advantage that our cities are not disfigured by networks of overhead trolley lines. Apparently our large cities do not value this advantage, for Liverpool, Manchester and Glasgow are disfiguring themselves as quickly as they can get the materials to do it.

We really do not see the grave objections to the overhead trolley system, even in busy cities. *No* tramway, of whatever description, can be permitted in the busiest thoroughfares, such as the Strand or Cheapside; nor do we see that the overhead equipment interferes with traffic any more than the conduit or surface contacts. It is the *cars* that get in the way.

The President turns to Switzerland rather than to America for guidance as to the future development of electric railways. But why must we go abroad for guidance? Did not Great Britain lead the world in every department of our profession? and may she not do so still? Electric railways had their first beginning in this country, and were a practical success here before they had been even attempted elsewhere. It is unfair to draw a sharp contrast between the pioneer City and South London Railway and the brand new Burgdorf-Thun railway; but even if we compare these, we only find one radical difference—one is worked by direct current, the other on the three-phase system, and both are successful.

Let us be ready to adopt three-phase working if experience shows the need; but let us rely also on ourselves, without, however, rejecting experience gained abroad.

We cordially endorse Prof. Thompson's remark that unless the experiments now in progress at Earl's Court include a decisive comparison of the direct and alternating current systems, the expenditure is wasted; for of the practical ability of direct currents to work the traffic there is no room for question.

So many subjects were dealt with in the address that we must pass over many of them in silence. An interesting reference to the financial condition of the industry revealed the fact that no less a sum than £105,997,716 is invested in it at this time. The value of *Science Abstracts* as a means of disseminating knowledge among the members, and keeping them abreast of progress, was emphasised, and the address concluded with an appeal to the members, in support of a circular recently issued, to hasten forward the erection of a suitable and long-desired building for the housing of the Institution.

Physical Society Dinner.—A dinner given by the Physical Society was held one evening last week in the Victoria Hall of the Hotel Cecil. The president of the Society, Prof. O. J. Lodge, took the chair, and the guests included a large number of prominent members of contemporary scientific societies.

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THE SUPPLY OF ELECTRIC ENERGY FOR TRACTION PURPOSES.

By PHILIP DAWSON.

The question of the best method of generating electrical energy for traction purposes is at present a most important one in Great Britain. There are probably few countries which present a larger field in this direction. Five years ago there were practically no electric roads of any very great importance. At the present moment we have some 400 miles of route on which some 2,000 electric tramway motor cars circulate. This, not including the cost of expropriation, Parliamentary, and other such charges, represents an actual capital expenditure of from £5,000,000 to £6,000,000 sterling.

Besides the lines mentioned, and which are already in operation, there are at least other 400 miles of route under construction, representing another five to six millions of money.

It is not probable or desirable that electric roads should be as recklessly built in the United Kingdom as has been the case in the United States. There, with some 60,000,000 of inhabitants, there exist, roughly, 30,000 miles of electric surface roads and 100,000 motor cars. Owing to our stringent laws and regulations, and to the solidity with which we always construct, roads in many cases would not pay in this country which would be very lucrative either in America or on the Continent.

It is not over-estimating to state that within the next five years we shall construct at least another 2,000 miles of electric tramways. This would only represent twice the mileage of tramways possessed by Greater New York, a city which is still inferior to Greater London in population and area. We can thus count on an additional expenditure of probably another £35,000,000 over and above the £10,000,000 or £12,000,000 already spent. The total expenditure within the next few years will probably therefore not be much under £50,000,000.

Leaving for a moment on one side the question of tramways, and looking at railways, there is, I believe, a future for the application of electric traction in this field as yet but little dreamed of and far surpassing the possibilities in any other country. The reasons for this are simple: we have large cities and we centralise the business. We have innumerable steam railways running into the hearts of our large industrial towns, bringing in millions of people daily. Land is very valuable and there are natural conditions which generally make it impossible for the railway companies to increase the number of their lines. Traffic is already so dense, that in most cases the railway companies are running as many trains on their city and suburban lines, as they safely can by steam. The use of electric traction would, owing to the rapid acceleration obtainable with electric motors, enable the railways to greatly increase the average speed of their trains, and therefore to augment the number of trains by 50 per cent, if not to double it.

In London alone we have, counting all the railways including the Metropolitan and District, probably at least 1,000 miles of track which might advantageously be equipped electrically. The same, although not on such a large scale, holds good of our other large commercial centres such as Liverpool, Manchester, Birmingham, Sheffield, Glasgow, &c. In these towns there would altogether probably be at least another 1,000 miles to be equipped. It is probable that the railway companies will soon realise the necessity of introducing electric traction, and, indeed, several of our large railway companies are already studying the subject. The introduction of electric traction on railways, owing to the greater speed and hence greater power required and more intense service, will probably not cost much under £10,000 a mile. We may probably, therefore, look forward within the next few years to an expenditure by our railway companies of not far short of £30,000,000; this, added to the £50,000,000 which by that time will have been expended in electric tramways and light railways means a total expenditure, in the next few years, for electric traction alone, of about £80,000,000.

The annual average number of car miles run per mile of route is probably not much under 150,000 and may, in many cases, reach 200,000. Including the railways which will be equipped, it is probably safe to estimate on the latter figure.

Supposing, therefore, that tramways, light railways, and railways included, we shall, in the next few years, have some *5,000 miles* of line, we get an average total annual car mileage of over *1,000,000,000 car miles run per annum*. Taking the total working expenses at, say, *fourpence-halfpenny per car mile*, we get a total annual expenditure of, roughly, *£20,000,000*. The cost of power varies approximately between 10 and 40 per cent. of the total working expenses as set forth above. The total annual expenses for the "Supply of Electric Energy for Traction Purposes" may therefore be expected to reach within the next few years from *£2,000,000* to *£8,000,000*.

This preamble will serve to show what an important question it is not only to get an absolutely certain and continuous supply of energy, but also to attempt in every possible way to reduce the cost of supplying the same.

It is evident that different cases will require different treatment. We will, therefore, briefly consider the cases which will generally present themselves, and then attempt to indicate the line of thought which might be pursued in solving the problem of cheap and certain supply.

We may practically divide the systems to be supplied as follows:—

Tramways.	Tramways in densely populated cities.
	Tramways in smaller towns.
	Light railways connecting populous industrial centres.
	Light railways connecting country towns and pleasure resorts.
Railways.	Metropolitan and suburban railways.
	Link between centre of city and railway terminus.
	Long distance railways.
	Light railways connecting rural districts to main line.

The system to be supplied, however, does not dictate the design of the generating station and supply system. The conditions which govern this may practically be summarised as follows:—

Big town, large population and heavy traffic lines.	End of longest line not more than four miles from supply station.
	Impossible to locate economically station near centre of system.
	Station centrally located with exception of one or two long outlying districts.
Small town, lighter traffic.	Station in centre of lines, no very long line.
	Station in centre of lines with one or two longer branches.

In the above sub-division it has been supposed that a given location of power house is not imposed.

Before proceeding any further it may be well to point out some of the radical differences between lighting and traction. A traction station as a rule runs at least 22 out of the 24 hours, the load factor is therefore much greater than in a lighting station. The average output is, as a rule, also much larger. For example, where are there lighting stations to be found which can be compared to the 96th Street power house of the Metropolitan Street Railway, of New York, which contains *eleven* 3,500-KW. direct connected generators? Or to the New Manhattan New York Elevated Railway power house, now under construction, which will contain ten 6,000-KW direct connected generators, or the New York Third Avenue line now under construction, in which there will be 10 direct connected 3,000 KW. units?

In traction work owing to holidays and special circumstances, such as races or games, unexpected overloads are always possible and must be coped with. The load must necessarily be a very fluctuating one, the average being probably in large stations about 75 per cent. of the maximum ordinary load.

Where continuous current machines are used the voltage must be fairly constant, and the maximum variation of speed of the engine must be small so as to allow compound wound dynamos to run economically and satisfactorily in parallel.

Where three-phase generators are used the variation of angular velocity must be very small, a maximum variation of about $\frac{1}{4}$th per cent. of angular velocity during one revolution being all that is permissible.

The special conditions which maintain are therefore, amongst others, practically continuous running, and probable and possible very heavy and unforeseen overloads. A far shorter time is available for overhauling the machinery, and as it is not economical to have very much spare power the

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machinery should be of such type as to run with very little care, supervision or chance of accident. In a traction station the efficiency of the generating plant is a far greater factor than in lighting, owing to the practically continuous load. Time and labour-saving apparatus find therefore a far better application than would otherwise be the case, and larger capital expenditure is justified. Furthermore, economical engines both as regards steam consumption, repairs, maintenance, and depreciation, become necessary.

Plants originally designed and well adapted for lighting are more than useless, and the combination of a traction station with such is fatal. On the other hand, combining lighting with a traction station may, in many instances, prove exceedingly successful.

Considering the sub-division of possible plants which has been made, the following systems may, in each case, be considered:—There can be no iron bound rules, and in each particular instance the relation of power producing expenses, total working expenses, capital expenditure, interest and sinking fund on same must always be most carefully considered before deciding on the system to be adopted.

In choosing the location of a power station, it should be, of course, as nearly situated to the centre of distribution of the whole system as economically possible. The ground on which it is located should be easily accessible by rail and water, so as to get fuel easily and cheaply. Good feed and condensing water should be obtainable, and the ground should be such as not to cause very heavy expense in sinking the foundations of the various buildings.

Where the station is fairly central and the lines do not go much beyond three or four miles from the power house, continuous current generators, with possibly boosters to supply the distant and hard worked lines, may advantageously be used. Even where the station is centrally located, when the traffic is very dense and the total power required exceeds from 4,000 to 5,000 KW, three-phase generators with sub-stations and rotary converters may become advisable. Where three-phase plant is used, with few exceptions, no continuous current generators should be used, but all continuous current should be supplied by rotary converters even in the station itself, as the reaction of continuous current generators through the line on to the rotary converters makes governing difficult.

Where the station is centrally situated, but with one or two lines going out a long way, continuous current generators may be used, one or more polyphase generators, preferably driven by continuous current motors in the main station, sending high tension current to rotary converters in sub-stations near the extremities of the outlying lines.

In a small system when the station is centrally located, gas engines driven by water-gas made on the premises, and in parallel with accumulators, may, in many instances, prove most effective, especially where coal is expensive. It is the cost of the coal which will indicate whether in such a case gas or steam engines are the most advantageous. A gas plant will probably cost about 25 per cent. more than a steam plant, but the coal consumption and labour required with gas are less than with steam, and it will be the entire producing expenses required by steam as compared to the sinking fund and interest on the greater capital expenditure required by a gas plant, which will guide in coming to a decision.

Where a small plant cannot be located centrally, a subsidiary battery of accumulators and a booster located in the battery sub-station may prove of the greatest value.

In choosing the number of units for a traction plant, they should be as small as possible in regard to economical working. Thus, for example, in a station requiring a maximum power of 200 I.H.P., we might have two units of 200 I.H.P. each, whereas in a station requiring a maximum I.H.P. of 90,000, we would have 10 units of 10,000 I.H.P. each. Thus in the first instance a reserve of 100 per cent. would be necessary, whilst about 10 per cent. would be sufficient in the last case.

Continental and American experience of traction work has led to the nearly universal adoption of large slow speed engines. In England it seems as if this lead were now being followed, although with us owing to the special conditions that obtain in marine work, such excellent high speed engines have been devised that in many instances similar engines have been successfully used for traction purposes. At the same time marine conditions where the space is limited, and where it is advantageous to have the smallest and lightest and yet powerful engine, are totally different to those which maintain in traction work. In that case space and weight do not matter, the chief point is to have a simple, economical, and abnormally vigorous engine; refinements which are, therefore, most important in marine practice are entirely out of place in a traction plant.

There are, of course, cases such as the City & Waterloo, where space is limited, and in such cases marine experience is naturally of the greatest utility.

There is a great difference between over 8 lbs. of coal burned per Board of Trade unit generated at the switchboard and 3 lbs. of coal practically of the same calorific value. This difference in coal consumption alone, assuming the mileage referred to previously, would amount to about 3,000,000 tons of coal per annum, an amount which would correspond to approximately one-and-a-half millions of our money. The above corresponds to the difference between some high-speed marine and Corliss type engines.

In passing, the difference between European and American practice may briefly be noted. In the former it is nearly always usual to use three or more bearings, whereas in America two bearings are nearly universally used, the armature and shaft being either pressed on, one beside the other, or forming one, a bearing being located at either end of the shaft.

Attention may be called to the fact that this was the alternative offered to the Glasgow Corporation by the American engine builders who tendered.

It is hoped that the above few remarks may be of value to those interested in traction work. It is certainly desirable that our engineers should carefully digest what has been done elsewhere, and not under-estimate their competitors. This once done let us go ahead on our own lines and we are sure to be right. Lines built as carefully and solidly as those in the United Kingdom are not to be found the world over.

SOME NOTES ON ROTARY CONVERTERS, WITH SPECIAL REFERENCE TO THE EXTENSION PLANT OF THE CHICAGO EDISON COMPANY.

By A. C. EBORALL.

ASSUMING it to be advisable to distribute and use continuous current for all such purposes as power, traction, and lighting,—an idea which appears to have taken strong hold in this country amongst the majority of those responsible for laying out large schemes and plants—and as, on the score of economy, it is necessary for all large or extended areas to be fed with high tension polyphase current, means have had to be found whereby this polyphase current can be converted (in suitable sub-stations) into direct current for feeding the networks. There are two ways of doing this, one of which has been very extensively used. The first is by means of motor-generators, the second, by means of rotary converters.

Although it is certainly true that the latter type of machine forms, in many cases, the best connecting link between the polyphase and direct current circuits, yet it certainly appears to the writer that the claims of the motor-generator in this connection have been hitherto somewhat overlooked, and that there is an undesirable tendency in this country to copy rather too closely the American importation and practice, and to lay down rotary converter plants for every case arising. A brief consideration of this matter may perhaps prove of interest here, and possibly lead to a profitable discussion in future columns of the ELECTRICAL REVIEW.

A.—*Motor Generators.*—In this case, the conversion of the high pressure polyphase current into low pressure direct current is made directly, there being no intermediate apparatus. Each set will consist of an asynchronous polyphase motor direct-coupled with an ordinary direct current generator, the two machines being preferably upon the same bedplate. The two or three-phase motor, as the case may be, runs practically synchronously at no load, the speed falling not more than 3 per cent. at full load, and 5

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per cent. at 50 per cent. overload. The set can be economically started from either side, with the greatest celerity and ease, even by a quite unskilled attendant. If it is required to start up from the polyphase side, which would invariably be the case, all that has to be done is to throw over the high-tension switches, and gradually move the handle of the rotor resistance round until the latter is short-circuited. The current taken at starting would never exceed 50 per cent. of the full load current, as the combined sets would naturally start up without load. On the other hand, should it be desirable to start up from the direct current side—a case that could only occur should the rotor resistance of the asynchronous motor break down,* all that has to be done is to run up the set from the generator end, using the latter as a direct current motor, and to switch the polyphase motor in as soon as approximately normal speed is attained. Synchronising is, of course, quite unnecessary, and the polyphase motor can be switched in without affecting the network, and, indeed, without taking appreciable current, even if the speed is 10 per cent. above or below the normal.

As the motors are asynchronous, any number of sets, of any size, can be run in parallel without the slightest interchange of current, and without hunting. There is no excitation to be adjusted, apart from that of the direct current generators (not even here if the generators are compounded), and the running of the sets is absolutely independent of the quality of the engines. Once the motors have been switched in, they can be left to themselves, as no adjustments are necessary with varying load.

The switchboard necessary for controlling motor-generator sets is a very simple affair. For each set there are only required high-tension switches and fuses, low tension switches and fuses, one alternating current amperemeter, one direct current amperemeter, one direct current voltmeter, one starting resistance, and one field regulator and switch. Of course, there would be an alternating current voltmeter on one pair of the polyphase bus bars, and wattmeters or watt-hour meters can be added at discretion. The advantages of simplicity of switchboard and gear cannot be over-estimated for sub-station work.

With regard to the important points of efficiency and power factor, with motor-generator sets above 100 KW. output (which alone the writer has in his mind), the efficiency would not be less than 90 per cent. above three-quarter load, and the efficiency curve is quite flat between this and a 25 per cent. overload. Again, the power factor would not be less than 90 per cent. at three-quarter load, increasing to 92 per cent. with greater loads. It should always be borne in mind, that the design of motor-generators is much more flexible than is the design of rotary converters, this being a point that will be again referred to later on. A suitable speed for the sets being settled upon, this fixes the number of motor field poles, but the number of these poles does not materially affect the quality of the design of large induction motors. On the other hand, the direct current machine is designed absolutely independently of the motor, and will have the number of poles giving the best result from the commutation point of view. Also the line pressure is quite independent of the direct current pressure, and does not form a fixed proportion of it. The latter can be varied in the simplest possible manner, either by a compound winding, or by means of a regulator in the shunt circuit of the generator. Again, any of the direct current machines forming the generator parts can be connected together for feeding three-wire networks, for instance, without influencing the motor parts in any way.

The overload capacity of a motor-generator set is determined by the sparking limit of the direct current generator, that is to say, the set would have an overload capacity of not less than 25 per cent. The output of the motor depends practically upon the heating limit, which would be very high on account of the nearly fireproof construction, and, as a matter of fact, all well designed polyphase motors will carry a 75 per cent. overload for say, one hour, without damaging themselves. On the other hand, the heating limit of the generator will occur at a greater load than its sparking limit, on account of the low full load temperature rises invariably specified in England. An important point in connection with motor-generators, and due to the nature of the motors, is that a momentary short-circuit will not cause the motors to pull up, as is frequently the case with synchronous machinery; and moreover, should the motor tend to pull up from any cause, it will do so unwillingly, and should the cause be removed before the speed has dropped below about half synchronism, it will "pick up" and run up to normal speed again. Again, should one phase of the transmission line to the sub-station breakdown, or one phase of the generators in the power house, the motor-generators will in all cases continue running as single-phasers, and will develop, when running under these conditions, about two-thirds of their normal output as polyphase sets. This is also true of synchronous machinery, but not to such a great extent.

On account of the simpler character of the machinery, the much smaller amount of auxiliary apparatus, and the greater familiarity of the machinery and its adjustments to the attendant in the sub-station, the risk of breakdown is less with motor-generators than with rotaries, and moreover, in the former case, should such a thing occur, the fault is more easily found and put right, and the attendant is more likely to know what to do.

Finally, with regard to the cost of the sub-station plant, and the cost of maintenance and attendance; almost invariably, the cost of the motor-generator and switch gear will be approximately equal to the cost of rotary converters, switch gear, and the necessary step-down transformers, and in some cases it will be found to work out a trifle less. The cost of maintenance will be about the same in each case, but the attendance required by the machinery is in general less with motor-generators, and also a highly trained and experienced attendant is unnecessary. So that, bearing the first two considerations in mind, motor-generators come out better than rotary converters on the following points:—

Summary I.

1. There is no intermediate apparatus between the motor and the line, as the former is connected directly to the line conductors.
2. The sets can be started equally well from either end with the greatest ease, by unskilled labour if necessary, by means of the simplest possible arrangements, the starting current being inconsiderable in either case.
3. Perfect parallel running without synchronising. Moreover, it is independent of the suitability of the generator engines, nature of line, adjustment of excitation, &c.
4. Switch gear and board of the simplest possible character.
5. Flexibility of design of the plant. The best proportions can be used with motor and generator, the direct current voltage is independent of that of the line voltage, and can be varied by very simple means, by compounding, or otherwise.
6. Greater reliability when working.
7. Familiar character of the machinery and its management to the attendants.
8. The direct current side of each set being independent of the polyphase side, connections or alterations made to this side do not affect the other, and cannot possibly short-circuit the transmission lines, however much the various direct current machines or their circuits are inter-connected.
9. Less attendance is required in the sub-station, which will cost less on this account, and also because it need not be of a high order of experience.

B. *Rotary Converters.*—As the coils on the armature of a rotary converter are connected up to form a single winding, from which tappings are made to the slip rings and commutator bars, and as, with the usual windings in use, the direct current pressure has a greater value than that between the slip-rings, the ratio of the two pressures being constant for a given winding, it follows that in every case the rotary has to be connected *indirectly* with the line conductors, that is, step-down transformers have to be interposed between them and the slip rings. Each converter set will, therefore, consist essentially of the rotary converter and a step-down polyphase transformer of equal output to it, and the rotaries will always run synchronously with the generators in the power station.

Rotary converters are invariably arranged to start up from

* Even in this case, the set could easily be started from the polyphase side, by simply short-circuiting the brushes on the rings, and then switching in, but under these circumstances the starting current might be very large.

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the direct current side, as, unless special provision is made for it as described below, starting from the polyphase side is thoroughly unsatisfactory. Using the former method of starting, the operation is as follows:—The compound winding (if any) on the fields having been cut out, the machine is run up to full speed as a shunt wound direct current motor. It now has to be synchronised with the line current, this being done in the usual manner by means of pilot lamps, &c., and the rotary can then be switched in. The starting resistance having been cut out, the direct current side can be connected to the direct current bus bars, and the field excitation varied in order to obtain the best effect, the value of field current allowed depending upon the conditions of working, and having no effect upon the direct current pressure. The current taken by the direct current side to start under these conditions does not exceed 50 per cent. of the full load current.

As indicated above, it is possible, but not desirable, to start rotary converters from the polyphase side. As in order to obtain satisfactory parallel running, short-circuited "damping coils" have to be wound on the pole-pieces, it is clear that it should be possible to run up the machine as a polyphase induction motor, by simply switching the slip-rings on to the low pressure polyphase bus bars fed by the step-down transformers. Under these circumstances, the polyphase currents circulating in the armature produce a very irregular revolving field, which induces currents in the damping coils, causing the machine to run up to a synchronous speed. But although the machine runs up to speed practically unloaded, the amount of starting current taken cannot be kept down, as owing to the tendency of the armature field to cog into that produced by the short-circuited coils on the poles, the torque produced with a reasonable value of current per phase is not sufficient to get the machine up to the normal speed. Consequently, the current consumption when starting under these conditions is frequently as much as four or five times the normal full load current. If the rotary is not provided with damping coils, it is still possible to start it in this way, if the pole-pieces are solid, by reason of the eddy currents induced in them, but the starting current taken in such a case is so great that it is practically impossible to employ the method commercially. It must be remembered that the large currents drawn from the lines when starting up rotary converters as induction motors, are currents of very low power factor, and may disturb the pressure regulation of the whole system, on account of the large drops they produce in the generators and transmission lines.

(To be continued.)

THE HARGREAVES-BIRD ELECTROLYTIC ALKALI PROCESS.

By JOHN B. C. KERSHAW, F.I.C.

The small works of the General Electrolytic Parent Company, at Farnworth, near Widnes, which on Monday last were inspected by representatives of the technical press as a preliminary to the public issue of the prospectus of the larger company, have twice been visited by the writer, and the following notes are based upon the observations made during those two visits, and upon the facts and figures contained in the various reports recently received from the officials of the company. It is seldom that a new chemical process is subjected to such a thorough trial as that undergone by the Hargreaves-Bird electrolytic alkali process. It is now nearly four years since Mr. James Hargreaves first described his new electrolytic cell to the members of the London Section of the Society of Chemical Industry,* and presented figures and estimates based upon 59 days' actual operations of the full-sized experimental cell at Farnworth. Since that date, almost continuous work with one large-sized cell has been carried on in these works, and many improvements in details of the cell and process are said to have been effected.

In these modern days ill-advised haste is the rule in the development of most industrial processes. Press representatives are invited to inspect working models in place of the real thing. Lack of reliable estimates is supposed by the promoters to be counterbalanced in some occult fashion by the unlimited supply of champagne and other more solid refreshments; and since the conditions for this latter supply are more easily satisfied in large cities, the show is transferred to one of the reception rooms of a modern hotel. It is therefore refreshing in these days to come across such an instance of leisurely development as that seen in the history of the Hargreaves-Bird process, and to be invited to inspect the apparatus at work, not under impossible conditions in an ante-room of a swagger hotel, as an appendage to a *recherché* luncheon, but under normal working conditions at the works of the company in South Lancashire.

This electrolytic process for the production of alkali and of chlorine compounds, and the special form of cell in which the electrolysis of the sodium chloride solution is carried out, have already been described in these columns.*

The writer has also described the works at Farnworth and the results of certain tests made by him upon samples taken from the electrolytic cell upon the occasion of his visits in November, 1897, and January, 1898, in the paper named below.† For the convenience of readers who are unacquainted with the special features of the Hargreaves-Bird electrolytic cell, it may be stated that it consists of a central anode chamber, flanked on either side by cathode chambers, which contain steam and carbonic acid gas, in place of the usual salt solution. The separating walls of these three divisions of the cell are formed by combined diaphragm-cathodes. These are impermeable to the salt solution contained in the anode chamber, but allow the electric current to pass and to carry with it the electrically-charged atoms, *i.e.*, the "*ions*," of sodium. On arriving at the outer surface of the diaphragm cathode, these sodium "*ions*" discharge their electricity, react with the steam and carbonic acid gas, and produce hydrogen and a solution of sodium carbonate.

Photographs of the cell and of the diaphragm-cathode were reproduced in the issue of the Electrical Review already named.

Turning now to a consideration of the various reports which have been made upon this process, those of Prof. Ramsay and of Messrs. Cross and Bevan contain figures which demand special attention.

Mr. A. E. Fletcher and Messrs. A. Norman Tate & Co. have also reported upon the chemical aspects of the process; while reports from Mr. J. Fletcher Moulton and Mr. G. G. M. Hardingham deal with the question of patent validity.

From Prof. Ramsay's first report, dated March 14th, 1898, the following two extracts are taken:—

1. "Careful experiments, made by me on the spot, have shown that 97·28 per cent. of the electric power is utilised in producing carbonate of soda and chlorine. I regard this as a most astonishing result."

The word "power" is used here by Prof. Ramsay incorrectly. The power efficiency of the process is most certainly not 97 per cent.

2. "It is intended, I am informed, to erect 250 cells, of which the output would be 9,488 tons a year of soda ash (if all the soda were sold in that form; of course an equivalent amount of caustic might be made), and 17,250 tons of bleach, assuming all the chlorine to be used without waste; if the usual loss of 5 per cent. is deducted, the yield would be 16,400 tons. At the present prices of bleach and soda ash the sale of these products would bring in £124,700; and the cost of the current required for their manufacture would be £33,000; leaving a margin of £91,700 to cover the cost of the other processes of manufacture, and to divide as profits.

"My experience is not sufficient to enable me to state the cost of the other processes necessary; but I think that I should leave a large margin, if I were to assume that half the margin, or £46,000, would be amply sufficient."

Messrs. Cross and Bevan follow in Prof. Ramsay's footsteps, as the two following extracts from their report dated March 22nd, 1898, show:—

1. "The theoretical yield of pure soda ash from a current

* *Journal Society Chemical Industry*, December, 1895.

* Electrical Review, August 5th, 1898.
† *Electrician*, February 18th, 1898.

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of 2,294 amperes for one hour is 9·976 lbs.; the amount actually yielded during our inspection was at the rate of 9·705 lbs. From these figures we obtain the remarkable electrical efficiency of 97·28 per cent. By far the most important item in the cost of production is that of electrical power.

2. "Each cell takes a current of 2,294 amperes. The mean pressure at the dynamo when we investigated the process was 4·71 volts. At the cell it was only 3·94 volts, but even taking the higher figure, which might be considerably reduced with a large installation, we find that each cell requires 14·4835 E.H.P. At ¼d. this amounts to a total cost for power of £33,040 14s. 3d. for 250 cells per annum.

"The difference between this sum and £124,279 15s. leaves a very large margin for other charges."

The writer desires to point out that these chemists have apparently based their calculations and estimates upon observations made when the cell was working at its maximum efficiency. The efficiency of the Hargreaves-Bird cell depends upon the efficiency of the diaphragm, and, according to the inventor's statements, the normal life of each is 30 days. Commencing with a high impermeability to the passage of the salt solution, and also with a comparatively high electrical resistance, both of these characteristics slowly diminish from day to day, until a point of time arrives when the amount of salt passing through the diaphragm necessitates its removal, and substitution by a new one.

The tests made by the writer in 1897-98, and the figures supplied by the General Electrolytic Parent Company for the actual work of the cell, during two runs in September, October, and November, 1897, support this view.

These are as follows:—

Tests of Cathode Liquor.

E.M.F. at cell.	Mean sp. gr. cold.	Mean %, Na_2CO_3	Mean %, Na Cl.	Age of diaphragm.
...	1 125	10·90	·94	40 days.
5·4 volts.	1 094	10·44	·10	1½ days.

Details of Two Runs of the Cell in 1897.

Period of run.	Mean current. amperes.	Mean E.M.F. volts.	Salt decomposed per 24 hrs. lbs.	% Efficiency. Current.	Energy.
Sept. 15th—Oct. 11th.	2 031·5	4·2	217	92·7	50·05
Oct. 12th—Nov. 2nd.	2,089	4·24	218	90·4	48·99

These figures show that estimates of the yield of this cell, based upon a current efficiency of 97 per cent., are misleading, and that such estimates ought to have been based upon the average work of the cell during a period of 30 days, or whatever other time period may have been decided upon as the normal life of the diaphragms. If this course had been taken, the efficiency of 97·28 per cent., which figures so conspicuously in each of these reports, would have been clearly indicated as a *maximum* efficiency, and the reports would not have been open to the charge of misrepresentation which may at present be brought against them. The average *current efficiency* of the Hargreaves-Bird cell is, as a matter of fact, about 91 per cent., and the *energy efficiency* about 49·5 per cent.

The two reports would also have been more satisfactory if the probable costs of raw materials, labour, diaphragms, management, &c., had been more fully dealt with. The costs of obtaining soda ash or cryst. soda from solutions of the carbonate are fully known to chemical experts, as are likewise the costs of bleach and chlorate production. Prof. Ramsay and Messrs. Cross and Bevan, could with a little inquiry have obtained information on these points, which would have enabled them to fill up very considerable gaps in their reports.

A third point upon which these chemical experts ought to have reported, is that relating to the influence of magnesium and iron salts in the brine upon the electrolytic procedure. It has been understood that the presence of these impurities has caused the chemists at the Castner-Kellner works at Weston Point considerable trouble, and that some method of purifying the brine before it enters the cells, has had to be adopted in order to overcome the difficulty. Will this purification also be necessary at Middlewich with the Hargreaves-Bird process?

In making these remarks upon the reports of Prof. Ramsay and Messrs. Cross and Bevan, the writer has no desire to withdraw any of his earlier opinions with respect to the Hargreaves-Bird process. He still considers it to be one of the most promising of the processes for the electrolytic production of soda and bleach which have received industrial trials, and if the capitalisation of the new company be not excessive, and the management be good and efficient, he has little doubt that a financial success will be attained.

But "good wine needs no bush," and simply because the process is a satisfactory one, there was the less need for the chemical experts to base their reports upon misleading figures, or to drag into prominence a current efficiency which will not be attained under actual conditions of work.

INSTITUTION OF ELECTRICAL ENGINEERS.

INAUGURAL ADDRESS

By Prof. Silvanus P. Thompson, D.Sc., F.R.S., President.

(*Delivered Thursday, November 16th.*)

The Institution of Electrical Engineers represents not only a great and growing industry, but also an important scientific profession. Any man, therefore, who finds himself placed by the will of his fellow members in the position of president of such an Institution, may well ask himself, on entering upon his term of office as head of the profession, what are the interests of the Institution, what the most pressing needs for its development, and how he can best serve those interests or aid in that development.

In these days the advancement of science depends largely upon the mutual co-operation of scientific workers and of the societies founded for the diffusion and co-ordination of knowledge. The progress of electrical engineering, both in its industrial and its professional aspects, depends likewise in no small degree upon the combination of electrical engineers of all classes in active union. Rightly conducted, the influence of such an Institution as ours, both within and without its borders, is very great. If we speak in the name of the united profession, with the weight of the whole industry to emphasise our views, we command the respect not only of all other professional bodies, not only of other industries akin to ours, but of public bodies, central as well as local. We can influence even the administrative departments of the Government itself when considering any regulation or proposed legislation touching electrical questions.

Further, our discussions in this room have a most direct influence not only on the development of electrical practice, but on that of electrical science. To find an instance, I need hardly go further than the presidential address of Prof. Hughes in 1886, which set the electrical world discussing the effects of self-induction. The number of scientific papers read before this and other bodies during the succeeding two or three years upon the measurement of self and mutual induction is directly attributable to the effect of that remarkable address. In the electrical world, however, there are many other influences at work. Great as may be the influence of scientific societies, of the open discussion of scientific and technical problems, there are others equally potent. The prices of the materials used in our industry—iron, steel, copper, gutta-percha, India-rubber, mica—the cost of coal, the cost of water-power, the cost of transport by land and sea, the cost of labour, the technical skill and training of our designers and manufacturers relatively to those of our foreign competitors—all have the most direct influence in determining the development of the industry in one direction or another. At a time of disquietude in international politics, many of these factors in the problem may far outweigh the direct influence of our Institution. All of them will have an influence direct or indirect on us. For we flourish in proportion as the electrical industry flourishes; and as the empire flourishes, so will our Institution share in the general weal. Yet amid this complicated state of the conditions which determine the future of the electrical industry, our Institution can render real and lasting service, if by directing attention to the things which make for progress, if only by pointing out the path along which technical advances are being made or are to be made, it can assist the manufacturer, the designer, the contractor, the consulting engineer, and the capitalist, and ultimately the authorities of local and central government. There is no question but that at the present time money is being spent in this country, in many directions not to the best advantage, on electrical schemes which are ill-advised or antiquated, or too petty; that machinery is being constructed on wrong lines, to be discarded a few years hence long before its natural term of life is reached; that electrical appliances, because not made to the standards recommended by experience, are made in smaller quantities at a time, and therefore at greater expense than need be. Our Institution, by the recommendations of its Standardising Committee, has tried to prevent at least some of this waste, and it might do much more without imposing any harmful restrictions upon the freedom of a single individual. If it can point out the trend of opinion, the ameliorations resulting from experience in all parts of the world; if it can help to diffuse amongst its mem-

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bership generally a knowledge of these things, and of the latest discoveries and inventions, the benefit it will confer, not only on its members, but on the industry at large, will be no small one.

I therefore propose to direct your attention to some of the tendencies which manifest themselves at present in the electrical world; some of them doubtless transitory, but others indicating changes of a permanent kind.

In telegraphy, the oldest branch of our profession, there is not much room to chronicle change. Nevertheless there is an obvious tendency to increased use of automatic methods of sending. Slowly, but surely, the use of the automatic transmitter is extending in cable service, whilst on the Continent and in America the advantages of the Wheatstone automatic are being gradually recognised as the increase of matter to be transmitted over existing landlines causes a demand for accelerated methods. It may be here recalled that the very first paper read before this Institution on March 13th, 1872, when it commenced operations as the Society of Telegraph Engineers, was on the topic of "Automatic Transmission." The use of alternating currents of a fairly high frequency is also receiving attention. Prof. Rowland has invented a multiplex typewriter working with alternate currents. The substitution of delicate optical receivers, working by photography for the purpose of enabling more rapid signals to be received, for the relays and recorders previously used, opens out a further field. Just as the limit at which the hand can send is surpassed by the automatic sender, so the speed at which the eye can read the visible motion is surpassed by that of the photographic receiver. In this connection the recent suggestions on the one hand of Squier and Crehore, and on the other of Pollak and Virág, demand careful attention. The experiments of the latter between Buda-Pesth and Berlin appear to have come as a surprise to many Continental electricians not previously conversant with the Wheatstone automatic transmitter; while the success that they have obtained in sending words at the rate of 1,300 to 1,500 words per minute over a landline of 475 miles long once more raises the familiar question whether a mile or two of subterranean cable inserted in the line would not have effectually barred the transmission and reduced it to ordinary rates. We need not believe all the nonsense telegraphed by special correspondents to the daily press from Vienna, that home of scientific canards. But Pollak and Virág's results are of more substance than the imaginary achievements of Jan Szczepanik. It is interesting to note that in their experiments success was largely due to the use at each end of the line of an inductive shunt—a device advocated so strongly for cables by our late past president, Mr. Willoughby Smith.

When we turn to the question whether such rapid methods of signalling will prove of any use on subterranean or submarine cables we are still confronted by the old difficulty that no improvements whatever in apparatus at the ends of the cable will get rid of the sluggishness inherent in the cable itself, if constructed upon the traditional patterns. The suggestion which I advocated in 1893 of accelerating the speed of signalling by attacking the problem in the middle instead of tinkering at the ends has not yet borne fruit. My suggestion to construct cables with a series of self-inductive artificial leaks of high resistance distributed all along its length to combat its distributive capacity appears to be too radical to be acceptable to the cable authorities. But it is self-evident that whatever good an inductive shunt (or artificial "leak") at the end of a cable will do in getting rid of the static charges, an inductive shunt (or artificial inductive "leak") at the middle will do just twice as much. Why, then, should the suggestion to utilise this known property at one or more points along the length of the cable not be put to an experimental trial?

Of the tendencies in the telephonic world I forbear to speak. Great Britain has little reason to be proud of her record—past and present—in that line. She allowed the microphone, freely given to the world by its too generous inventor, to be exploited as a monopoly by others.

The competition of electricity with gas as a means of illumination has been rendered very severe by the improvements introduced during recent years in incandescent gas lighting. The discovery of the properties of the rare earths in giving an augmented illumination—the result of a purely scientific research—was the foundation of the invention of the Welsbach mantle. It is singular that the very same properties were not turned to account in electric illumination before the invention by Nernst of the lamp which bears his name; a lamp for the commercial introduction of which electrical engineers are still waiting expectantly. Meantime a far more important factor in the economic struggle remains in a possible reduction of the high prime cost of electric wiring of buildings. Could electric house wiring be carried out as simply and as cheaply as the putting in of gas pipes an enormous advance might be confidently expected. But so long as our station engineers and our fire insurance inspectors insist on having both wires fully insulated, and do not allow an uninsulated or a semi-insulated return conductor, so long will this advance be delayed. With the introduction of armoured conduits for interior wiring, surely the prejudice which requires a double insulation will disappear.

In the public distribution of electric energy for lighting and power the necessities of economic working are effecting a slow but sure revolution. The methods that were in vogue at the date when the Electric Lighting Act of 1888 made electric distribution in this country commercially possible are being superseded. Larger generating units are being used in our stations. Larger areas of supply and fewer generating centres in an area are a necessity of the time. From the row of little bipolar dynamos, each with its own small high-speed engine—a sight so familiar in the older lighting stations of this country—we are gradually passing to the use of large multipolar machines coupled to larger and more economical steam engines. Ten years ago a distribution at six miles from the generating station was looked upon askance by many electrical engineers. To-day it is recognised that the secret of economical work is to generate on the large scale—"in bulk" as the phrase goes—and to distribute over large areas at an appropriately high voltage. Whether the prime source of power be hydraulic or thermal, the problems of economic distribution are essentially identical. Two of the most recent examples—both of water-power stations—must suffice. At the Kanderwerke at Spiez a pressure of 4,000 volts suffices for the distribution of current for lighting and power within a radius of six miles; but for the 30-mile distribution from the same station to supply the city of Berne and the Burgdorf-Thun railway, a 16,000-volt pressure is adopted. The city of Milan, which is lit by power from the hydraulic station at Paderno, 24 miles distant, receives its currents at 13,500 volts. When electric energy is thus generated and distributed on the larger scale, the time-honoured methods suitable for parochial areas must give way to newer ones of greater economy. Continuous current generators and motors are unsuitable for operation in such wise at economical voltages. The great superiority of alternating currents asserts itself here uncontested. And with the greater economy of copper that is afforded—in the transmission at a given superior limit of voltage—by the use of three-phase currents, commercial considerations of the most elementary order decree that the fittest shall survive. It was, doubtless, in its time a great advance when the late Dr. Hopkinson in this country, and independently Mr. Edison in America, introduced the "three-wire" system, in which by the employment of a central or neutral wire three copper conductors were made to suffice where four conductors had previously been needed. The obvious economy of using *one* neutral wire instead of *two* separate return conductors was sufficient to secure its rapid adoption. But with the introduction of the three-phase distribution we may now have three wires doing the work of six, each wire, when the circuits are equally loaded, serving as a return for the currents of the other two. In cases where, as in three-phase lighting, the three lines are not equally loaded, we may by adopting a Y-grouping with a neutral wire leading back to the common junction have *one* neutral wire serving in the place of *three* separate return conductors, thus carrying forward Dr. Hopkinson's idea to its logical extension. Experience in Heilbronn, in Strassburg, in Lyon, and a score of other places, proves that the fear formerly expressed as to difficulties in balancing the circuits is unfounded. In the light of such experience it is not premature to say that the use of the three-wire system with continuous currents is obsolete. Obsolete it is not, however, in the sense of being disused. Obsolete it is in the sense that a better and more economical method is known and is already largely in use. Of all the new lighting stations now under construction in middle Europe, quite two-thirds are designed for three-phase work. Even in Berlin, where the admirably engineered group of lighting stations on the continuous-current plan has been eminently successful, financially and technically, all extensions are being made on the three-phase plan; and in a few years the whole will probably have been converted to alternating currents.

While the continuous current is, of course, the only species admissible for electrolytic work with all its rapidly growing applications in the chemical industries, the superiority of alternating currents for motive power and for all long-distance work is every day becoming apparent. Only a very short time ago it was the fashion to decry alternating currents on the alleged ground that alternating current motors were not self-starting. That reflection might have had some weight 10 years ago. But the simple truth is that continuous currents will not work motors at all except toys of the old Barlow wheel type. Let him who doubts this statement ask himself what is the purpose of that costly organ, the commutator, which is an integral part of every so-called continuous current motor. The sole function of a commutator is to commute a continuous current into an alternating one, or *vice versâ*. If a continuous current will drive a motor, why go to the expense of putting into any motor a commutator to commute that current into an alternating one inside the machine? Moreover, the unnecessary commutator—for it is unnecessary if the currents are supplied to begin with as alternating currents—introduces the risks attendant upon the use of "brushes"—risks which have led the insurance companies to prescribe that all motors with commutators should be put in fireproof enclosures. Let it be once realised that the commutator is an unnecessary excrescence due to the supply of a particular kind of current which won't work a motor until commuted, and that, with the supply of the proper kind of current, no commutator is needed, and before long we shall see these restrictions withdrawn. A common grindstone is a thousand times more likely than a well-constructed modern commutatorless motor to cause an outbreak of fire. Yet no one prescribes fireproof enclosures around grindstones in any ordinary factory.

Another tendency of the times is the simplification of the switchboard, its construction of fireproof materials throughout, and with more room both before and behind for the good arrangement of gear and connections, and the avoidance of an unnecessary multiplication of fuses. The avoidance of step-up transformers by direct generation at high voltage is in itself an obvious step toward simplification.

In the working of alternate-current generating stations, where parallel running of a number of generators is a necessity, the station engineer has always had before him the fear of a serious breakdown should anything happen to one of the generators. If the field magnet of any one generator loses its magnetism through any failure of the exciting current, then all the other generators instantly pour an immense current through its armature, with dire disaster not only to it but to the station as a whole. All manner of devices have been designed to combat this dread eventuality. Fuses and safety-devices of every description, including automatic disconnecting gear warranted only to operate for currents in opposition of phase, are found not always to do their duty. Much discussion has arisen as to whether the excitation of alternators in parallel ought to be an excitation in

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parallel, or whether each alternator ought to be provided with a separate exciter on its own shaft. Even excitation in duplicate from two independent sources has been tried. It is satisfactory to note that a means has been discovered which will entirely remove this source of anxiety, and render such accidents impossible in the future. Let me here narrate a test described in a recent number of the *Bulletin de la Societe Internationale des Electriciens* (December, 1898, p. 498) upon two alternators of 250 kw. each, direct-driven at 67 revolutions per minute by two horizontal compound engines, the alternators being constructed by the well-known house of Farcot. Both alternators were separately excited, and were synchronised together and put in parallel in the usual manner. While thus running the excitation was suddenly cut off from the field magnets of one alternator, and then the steam was cut off from the engine of the other alternator, which remained excited. Both machines continued to turn, the unexcited alternator continuing the supply, furnishing current for the lighting circuit and also supplying enough current to continue to drive at nearly normal speed the other machine and its engine. This extraordinary test, repeated many times, took place in the lighting station of the town of St. Ouen. The explanation lies in the construction of the alternators. Their revolving field magnets are furnished on the plan suggested by Mons. Leblanc, with the device termed by him an *amortisseur*, which is nothing else than a simple and substantial squirrel cage of copper embedded in the pole pieces of the field magnets, each pole being perforated with six slots to receive six stout copper rods, the whole of which are short-circuited together by two external rings of copper. We are all familiar with the device of the embedded squirrel-cage construction introduced by Dobrowolsky and Brown nearly ten years ago into the so-called *rotors* of poly-phase motors. In these motors the squirrel-cage structure revolves at a slightly lower speed than that of the revolving magnetic field; and it has long been known that if the same structure is mechanically caused to revolve at a speed slightly above synchronism, the machine becomes a generator, taking power to drive it. In brief, the induced eddy currents in the copper structure, when revolved above or below synchronism, magnetise it and make it act as a field magnet. Leblanc, adapting this device to the actual field magnets of alternators, has not only simplified the operation of synchronising, but has given to the alternator the new and remarkable property that, on the failure of the excitation from the ordinary source, the automatic action of the eddy currents comes into play, and thereby entirely prevents the disastrous reactions which have been so much dreaded by station engineers. I regard this invention as one of the most important of recent years. It has been applied also to the 600 kw. alternators in the sector of the Champs Elysées in Paris.

(*To be continued.*)

THE COST OF STEAM RAISING.

By John Holliday, A.M.I.C.E.

(*Paper read November 23rd, 1899.*)

In the earlier days of the steam engine it was customary to measure the efficiency of the steam plant by the amount of work done by a given weight of coal, and this was expressed by giving the weight of coal consumed per horse-power per hour, allowance sometimes being made for the quality of the coal used. At that time, when a single boiler or range of boilers supplied steam to but one, or at most a pair of engines, and the boiler was laid down at the same time as, and as integral portion of, a new steam engine plant, and was, more often than not, supplied by the maker of the engine as part of his contract, this method of estimating was not so wholly misleading as it is in the present day, when a single boiler or range of boilers often not only supplies a large main engine, but also many auxiliary or independent ones, and also serves many other purposes. The practice has therefore arisen of expressing the efficiency of an engine by stating the quantity of steam it uses per horse-power per hour, thus eliminating entirely all questions of the quality of the fuel, the efficiency of the boiler for transmitting the heat of that fuel to the water, and of the furnace and stoker, whether human or mechanical, in evolving from the fuel all the heat it contains. In this way the performance of a good engine is not marred by an indifferent duty obtained from the boiler, from any cause whatsoever. We have therefore on record the results of many engine trials, given in figures which take no account of the performances of the boiler by which the steam they used was supplied, and we have also many recorded tests of steam boilers determined quite apart from any question of power involving the employment of a steam engine. Again, we have many instances given of the cost of steam power, the best of which are summed up by Prof. Unwin in Chapter III. of his work on the "Development and Transmission of Power;" but in all these cases, in order to arrive at the cost of the steam-power, it has been, of course, necessary to include the working and cost of both engine and boiler; and whilst a steam engine cannot perform any useful work when dissociated from the steam boiler, the boiler can, and often does, perform many useful functions other than the production of power by means of a steam engine, and it is to the cost of producing steam, quite apart from the question of power, that attention is directed in this paper. A ton of coal may cost, say, 8s. when delivered on the stokehold floor, and we may, in a general way, consider steam delivered from the boiler into the steam main as the manufactured article of which the coal is the chief but not the only raw material used in the process of manufacture; the question then becomes what is the increased value of this ton of coal when delivered in the form of steam into the steam mains? The other items which, with the cost of fuel, go to make up the total cost of steam produced, are working expenses, maintenance of boiler and plant, capital charges, rents, rates, taxes, &c. In almost all cases the cost of the fuel is by far the greatest part of the whole cost, and it can only be in the centre of the coalfields, or some other equally favoured spot, where it is probable that the cost of the fuel will be anything less than 50 per cent. of the total cost, exception being, of course, made to those cases in which waste materials, by-products, or refuse, which might otherwise have to be removed at some expense, are used as fuels for steam raising. This being the case, the cost of fuel required to convert a given quantity of water at a given temperature into steam at a certain pressure, gives a fairly relative idea of the cost of raising steam in districts where similar conditions and prices of fuels obtain. Mr. Bryan Donkin, M.Inst.C.E., has largely

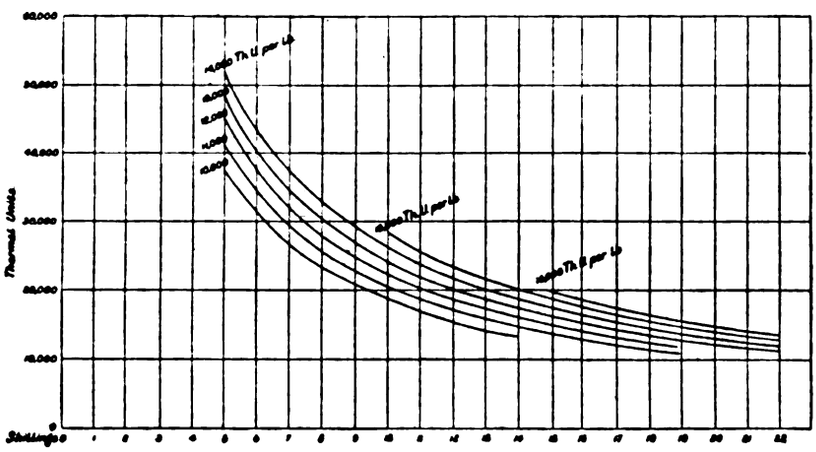

Diagram 1.

used, as a basis of comparison, the cost of fuel required to evaporate 1,000 gallons, the water being at a temperature of 60° F., and the steam evaporated at 60 lbs. per square inch above the atmosphere, or else the temperature of the water is taken at 212° F., and evaporation at atmospheric pressure, or, in other words, evaporation is from and at 212° F.; in any case a reduction to a common basis is easy when the conditions are known.

The following formula gives a ready means of obtaining the cost of fuel to evaporate 1,000 gallons of water when the price of the fuel and the quantity of water evaporated per pound of fuel are known.

Let C = cost of evaporating 1,000 gallons in shillings.
" P = price of coal per ton in shillings.
" W = pounds of water evaporated per pound of coal.

$$\text{Then } C = \frac{P}{W} \times \frac{10,000}{2,240}$$

$$\frac{P}{W} \times 4{\cdot}464.$$

This is a useful figure, especially for comparison of boilers working in the same district, where the prices of various descriptions of coals may be taken to vary with the amount of heat that they will evolve, because it takes into account the efficiency of the boiler and furnace and also that of the stoker, whether human or mechanical; but, at the same time, the limits within which comparisons may be made on this basis are narrow, as the figure would always show a very large advantage in favour of the use of poor quality and low price fuels, which a closer examination into the whole of the cost of steam raising might cause almost, if not entirely, to disappear. There will, however, be less likelihood of giving rise to misapprehensions if it be always borne in mind that this figure gives, not the cost of evaporating 1,000 gallons, but only the cost of the fuel required to evaporate 1,000 gallons of water.

Mr. Bryan Donkin, M.Inst.C.E., has published figures from some tests he carried out with different kinds of fuel in the same boiler, the conditions in all cases being the same; the results are comparable on the basis of the cost of fuel required to evaporate 1,000 gallons.

Kind of fuel.	Cost of fuel per ton.	Water evaporated per lb. of fuel.	Cost of fuel per 1,000 gallons evaporated.
	s. d.	lbs.	s. d.
A.—Dust coke ...	5 0	6 0	3 8
B.—Dust Welsh coal	10 0	8 0	5 3
C.—Large Welsh coal	22 0	9 0	10 11

These figures go far to show the economy to be obtained by using inferior fuels, which, as a rule, are far cheaper on the basis of calorific power than higher-class fuels. No better example of this could be given than the comparison of experiments B and C in the table given

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TABLE II.—FORCED DRAUGHT BOILERS. NOS. 1, 2, AND 3.

Boiler.		Fuel.					Water.				Cost of fuel.	Working expenses.																	
Date.	Time.	Breeze.	Large coke.	Total.	Average price per ton.		Refuse.	Evaporated.	Used by fan engine.	Net evaporation.	Evaporated per hour per boiler.		Wages of stokers and cleaners.			Fuel weighing and distribution.			Removal of refuse.			Water.			Light.			Stores.			Total.		
1895.	Boiler hours.	Tons.	Tons.	Tons.	s.	d.	Tons.	Gallons.	Gallons.	Gallons.	Gallons	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Jan.	1,867	515	...	515	3	6	122	715,850	46,675	669,175	358	90	2	6	23	6	11	2	4	5	12	4	0	11	18	7	2	7	0	1	5	9	53	6	8
Feb.	1,615	390	...	390	3	6	93	542,100	40,375	501,725	311	58	16	0	25	19	0	1	11	4	9	6	0	9	0	6	2	10	0	0	18	3	49	5	3
Mar.	1,265	289	...	289	3	6	140	401,710	31 625	370,085	293	50	11	6	28	17	3	1	4	5	14	0	0	6	13	11	1	0	4	1	7	4	53	3	3
April	1,866	443	..	443	3	6	102	615,770	46 650	569,120	305	77	10	6	24	14	0	2	12	3	10	4	0	10	5	3	1	11	0	1	0	4	50	6	10
May	1,927	433	19	452	3	9	102	640,174	48 174	592,000	307	84	16	0	24	1	0	2	10	3	10	4	0	10	13	5	0	15	4	1	14	6	49	18	6
June	1,315	292	...	292	3	6	95	405,880	32 875	373,005	284	51	2	0	25	1	4	0	19	9	9	10	0	6	15	3	0	13	0	1	5	9	44	5	1
July	1,855	361	99	460	4	9½	95	701,374	46,374	655 000	353	110	4	0	15	12	5	2	10	11	9	10	0	11	13	10	1	3	0	1	6	1	41	16	3
Aug.	1,994	344	138	482	5	2½	96	756,365	49,850	706,518	354	125	15	0	17	16	9	2	9	11	9	12	0	12	12	2	1	2	6	0	11	4	44	4	8
Sept.	1,903	280	140	420	5	6	85	671,440	47,575	623,865	328	115	10	0	20	4	9	1	4	10	8	10	0	11	3	10	1	2	8	0	18	11	43	5	0
Oct.	1,814	236	176	412	6	0¾	79	682,856	45,350	637,506	351	124	18	0	21	19	2	2	3	3	7	18	0	11	7	7	1	1	4	2	3	4	46	12	8
Nov.	1,538	291	12	303	3	9	92	433,030	33,450	399,580	299	84	3	6	25	4	5	1	4	7	9	4	0	7	4	4	1	5	4	3	10	11	44	2	8
Dec.	1,840	442	...	442	3	6	102	614,330	46,000	568 330	309	77	17	0	24	10	6	2	12	3	10	4	0	10	4	8	1	15	4	0	6	8	49	13	5
Avgs. and totals	20,599	4,316	584	4,900	4	3½	1,203	7,180,932	514,973	6,665,959	323	1,051	6	0	277	7	6	23	8	2	120	6	0	119	13	6	16	6	10	16	9	2	573	11	2

TABLE III.—NATURAL DRAUGHT BOILERS. NOS. 4, 5, 6, 7, 8, AND 9.

Boiler.		Fuel.					Water.			Cost of fuel.	Working expenses.																		
Date.	Time.	Welsh.	Scotch.	Total.	Average price per ton.		Refuse.	Evaporated.	Evaporated per pound of fuel.	Evaporated per hour per boiler.		Wages of stokers and cleaners.			Fuel weighing and distribution.			Removal of refuse.			Water			Light.			Stores.			Total.		
1895.	Boiler hours.	Tons.	Tons	Tons.	s.	d.	Tons	Gallons.	Pounds	Gallons		£	s.	d.	£	s.	d.	£	s.	d.	£	s	d.	£	s.	d.	£	s.	d.	£	s.	d.
Jan.	2,351	487	...	487	14	6	47	893,320	8·18	380	353	1	6	23	8	2	2	2	(	4	14	0	14	17	6	2	19	0	0	14	3	48	14	11
Feb.	2,234	408	...	408	4	6	48	819,592	8 97	367	295	16	0	26	13	0	1	12	9	4	16	0	13	13	0	3	9	0	0	13	3	50	17	0
March	2,944	536	...	536	14	6	70	1,103,084	9·18	375	388	12	0	23	17	5	2	5	4	7	0	0	18	7	8	3	11	0	2	1	4	57	2	9
April	2,296	436	...	436	14	6	49	869,596	9 11	387	316	2	0	29	19	4	2	11	6	4	18	0	14	16	6	1	18	8	0	15	1	54	19	1
May	3,034	525	...	525	14	6	54	1,098,106	9·34	362	382	12	6	16	19	4	2	18	3	5	8	0	18	6	0	1	3	6	1	13	7	46	8	10
June	3,005	492	..	492	14	6	52	1,084,922	9 84	361	356	14	0	14	16	11	1	13	4	5	4	0	18	1	7	1	10	0	1	15	1	43	0	11
July	3,135	526	86	612	14	3½	72	1,381,211	10·07	440	437	13	0	25	3	2	3	7	8	7	4	0	23	0	5	1	15	2	1	9	5	61	19	10
Aug.	3,282	587	...	587	14	6	72	1,343,916	10 22	409	425	11	6	32	4	6	3	0	9	7	4	0	22	7	11	1	17	0	0	7	8	67	1	10
Sept.	3,399	609	...	609	14	6	73	1,345,900	9·86	396	441	10	6	22	2	5	1	15	11	7	6	0	22	8	7	2	0	4	1	0	2	56	13	5
Oct.	3,409	619	...	619	14	6	71	1,360,745	9 81	399	448	11	6	31	11	0	3	5	0	7	2	0	22	13	6	2	0	0	2	17	8	69	9	2
Nov.	3,266	440	70	510	14	3½	71	1,232,619	10 80	377	364	17	0	16	8	6	8	6	1	7	2	0	20	10	10	2	11	4	3	6	7	58	5	4
Dec.	2,702	332	156	488	14	0½	66	1,035,130	9 47	383	342	18	0	25	8	9	6	0	9	6	12	0	17	5	0	2	12	0	0	2	1	58	0	7
Avgs. and totals	35,057	5,997	312	6,309	14	5½	715	13,594,141	9·62	388	4,553	19	6	289	12	6	38	19	4	74	10	0	226	8	6	27	7	2	16	16	2	372	13	8

above, where we see that a difference of 120 per cent. in the price of the fuel gives an increased efficiency of but 5·5 per cent. at an increase in cost of 108 per cent. Should it be possible in practice to transfer the total heat of a fuel to the water contained in the boiler in the furnace of which the fuel is burned, or even a fixed and definite portion of the total heat, then the true value of that fuel for the purpose of steam raising would depend directly on the calorific power, and it would be possible, the price of the fuel and its calorific value being known, to foretell the amount of useful heat that would be secured by the combustion of one pennyworth of the fuel in question.

A table showing the number of thermal units in one pennyworth of fuel of various qualities and prices was given by Mr. R. E. B. Crompton, Past-President, in his paper on the "Cost of Electrical Energy" read before this Institution in April, 1894, which is, by permission, reproduced in Table I.*

Some figures from this table will be found set out in Diagram I. These, like the preceding table, show the enormous advantage promised by the use of low quality and low priced fuels, but, as there never was a gain without some loss, we may briefly inquire what the possible losses and disadvantages of cheap fuels are—and they are many.

In the first place, in order to get the same amount of heat with a low quality fuel as with a higher quality under similar conditions, more fuel must be burned in the same time; then, if the boilers and furnaces are already working up to their full power, either more boilers and furnaces must be put down, or the present furnaces must be enlarged, entailing an expenditure of capital, the interest of which must be set against the extra economy obtained; or else the fires must be worked harder, perhaps by the use of forced draught causing the furnace gases to leave at a higher temperature, and thus carry to waste a larger proportion of the heat in the fuel than formerly. The mere fact of more fuel having to be fired into the furnaces every hour will entail more work on the stoker, for which extra wages will have to be paid either to the same or to additional men. The extra amount of fuel used will cause the fire doors to be opened, in the case of hand-fired furnaces, more frequently or for longer periods both for firing and for cleaning fires, whilst the extra amount of refuse taken from the furnaces will carry to waste a correspondingly larger amount of heat, and, what is of more importance, will often cost a great deal more in removal, particularly in busy manufacturing centres. Extra storage and space for fuel may have to be provided, and the wear and tear of the furnaces increased according to the extra amount of fuel used, and not according to the amount of steam produced. Low quality fuels, too, as a rule, require a stronger draught to burn them to the best advantage than better qualities; this may necessitate an expenditure for more chimney power in the case of natural draught, and larger fans and engines, of course using more steam to drive them in the case of forced draughts. In substituting inferior for better-class fuels we may expect a reduction in the cost of the fuel, depending on the differences in the ratio of calorific value to price of the two fuels, and an increase in working expenses, &c., depending on the increased amount of fuel used.

It may not be out of place to give here a word of warning to those who are invited by the manufacturers of special furnaces to enter into contracts with them, in virtue of which the manufacturer of the patent furnace shall take as his remuneration for fixing the furnace, free of charge or at cost price, a definite proportion of the ascertained saving in the fuel bill from the time the new appliance was put in, as compared with a previous period; such an arrangement may seem very fair and reasonable; but if the reduction of the fuel bills is accomplished by the use of inferior fuel, there must inevitably be increased incidental expenses, the whole burden of which will fall on the steam user, and from which the furnace manufacturer will be entirely free. Still more to be deprecated is any arrangement based on a comparison of the amount and cost of fuel consumed on two trials, one made before the introduction of the special appliance, and the other after it, for in addition to other disadvantages to the steam user, it is reasonable to assume that the furnace manufacturer will take pains to secure those conditions under which his furnace works best, whilst a furnace about to be discarded is scarcely likely to be either in the best possible order, or worked to the best advantage; indeed, it is safe to say that the vaunted superiority of many a special appliance over the ordinary furnace, whatever that may be, is attributable mainly, if not solely, to the better conditions obtained for it, and the greater skill with which it was worked, and with a reversal of these conditions, the result may have been reversed also.

It sometimes happens that a single range of boilers has to supply steam to a number of more or less different and independent concerns, each of which has to bear its own share of the expenses of producing the steam it uses, so that it becomes necessary to determine the total cost of the steam produced and divide that sum amongst the different

* Table I. is not reprinted here, as it will be found in ELECTRICAL REVIEW, April 27th, 1894, page 499, in Mr. Crompton's paper.

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concerns as nearly as possible according to their respective consumptions. This has been the case with a range of boilers in which the author has been directly interested for the last six years; failing to find any records of determinations of the proportion which the fuel bill bore to the total cost of the steam delivered into the steam main, he has collected the data on which the following statements of costs have been made out.

The plant consists of nine Lancashire boilers in the main boiler house, and four spare boilers in another house, connected to the same system of steam mains, but the latter used only as spare to the nine boilers in the larger house. The nine Lancashire boilers are of various makes and ages, none of them being modern, and vary in size from 6 feet 6 inches to 7 feet in diameter, and from 28 to 30 feet in length. They are arranged in two groups, Nos. 1, 2, and 3, being fitted with Perret's water-cased grates for burning inferior fuels and delivering their products of combustion into a separate main flue and chimney from the other six, which are fitted with ordinary bars and hand fired, Martin's balanced doors being used in the 12 furnaces of these six boilers. The boilers are all loaded to 60 lbs. pressure per square inch, and feed water is delivered to the Lancashire boilers from a common feed main through three steam heaters, which, being

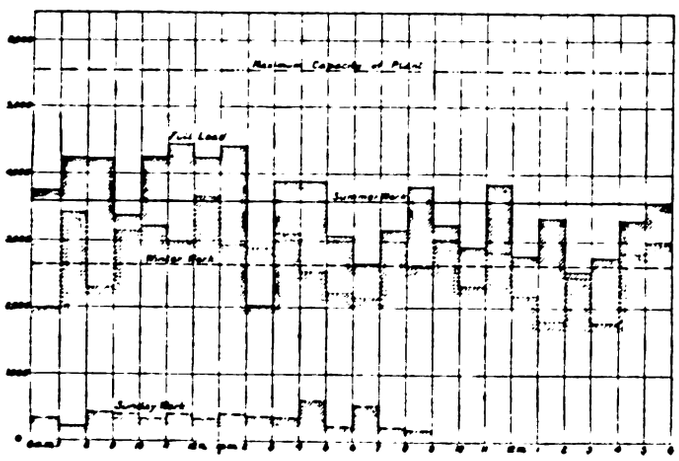

Diagram 2.

supplied with steam up to 12 lbs. per square inch above the atmosphere, heat the feed water to an average of 220° F. after it passes the feed pump on its way to the boilers. The demand for steam is fairly constant during the 24 hours (see Diagram No. II.), so that it is not necessary to bank up any of the fires during any portion of the day or week, except between 6 o'clock a.m. and 6 o'clock p.m. on Sundays, when two boilers only are kept under very easy steam.

In working these boilers it has all along been recognised that steam was produced much more cheaply by the forced draught than by the natural draught furnaces, consequently they were always worked up to their full power, and as the minimum demand for steam almost exceeded, except on Sundays, the amount they, by themselves, were capable of producing, they were seldom even damped down, and therefore worked under conditions extraordinarily favourable to economy; whilst the natural draught furnaces, having to make up the difference between the demand for steam and that produced by the forced draught furnaces, being fitted for that purpose with an automatic damper, were constantly varying between partial and full load, so that losses by unconsumed gases and radiation were abnormally great. This fact must be kept in mind, and allowed for, in comparing the results obtained in the two systems, and it will be seen that the six boilers fitted with natural draught furnaces gave much better results when doing the largest amount of work.

During seven months of the year seven boilers working together are able to supply the demand for steam, but during the later summer and autumn months the requirement is much greater, and nine boilers have to be worked heavily, and sometimes even more, which fact justifies the existence of the four reserve boilers which might otherwise constitute an extravagantly large spare plant.

The fuel generally used for the boilers with Perret furnaces is breeze, which is delivered in front of the boilers at the price of 3s. 6d. per ton. This fuel contains a large amount of incombustible material from 21 to 25 per cent.; the amount burnt is about 15 tons in 24 hours, or 1,400 lbs. per hour, or 18 lbs. per hour per square foot of grate surface, the total area of the six furnaces being 78 square feet, and evaporate from 5·5 to 6 lbs. of water per pound of fuel; taking this at 5·8, the cost of fuel to evaporate 1,000 gallons is, by the formula given above:—

$$C = \frac{P}{W} \times 4\,464$$

$$= \frac{3\,5}{5{\cdot}8} \times 4\,464$$

$$= 2\,69 \text{ shillings} = 2\text{s. } 8\tfrac{1}{4}\text{d.}$$

The quantity of water evaporated is about 3,400 lbs. per hour per boiler, equivalent to 170 H.P. at 20 lbs. of steam per horse-power per hour, a low result which eventually makes itself felt as one of the drawbacks to the use of inferior fuels. There being a plentiful supply of this breeze, it has been used almost invariably during the period of these observations for these three boilers, other fuels being tried at various times, but none were found able to compete with it. The air pressure used for the Perret furnaces averaged about 1·1 inches of water column as measured under the fire bars, and was produced by a 36-inch fan driven by a belt from a special engine, the steam for which was taken from the boiler, and its amount is included in the figures given above, but for which due allowance is made in the proper place, both for the cost of the steam used and the interest on the capital sunk in the fan engine and other special appliances.

(To be continued.)

LONDON COUNTY COUNCIL.

The Council, at the meeting on Tuesday, resolved to lend £50,000 to the Hackney Vestry for electric lighting purposes at 3½ per cent., no repayment of principal to be made during the first three years, but the whole sum to be repaid in the remaining 39 years out of the 42 years. It was also decided to advance £3,110 to the Poplar District Board for the purchase of site for an electric light station.

It was decided, at the request of the chairman of the Highways Committee, to again postpone for a fortnight the report dealing with the United Tramways Company, in order to allow the Hammersmith Vestry to place their views before the Council.

Electric Tramways.

The adjourned report of the Highways Committee was again submitted recommending the Council to seek powers in the London County Tramways Bill for sanction to reconstruct for electric traction the tramways between Westminster Bridge and Tooting, and between Blackfriars Bridge and the "Horns" public house at Kennington.

A report was submitted by the Finance Committee dealing with the financial bearings of the proposal of the Highways Committee to obtain powers in a Bill to authorise the use of electric traction on the Westminster Bridge-Tooting tramways, and on the lines between Blackfriars Bridge and Kennington Park. The committee stated:—

It has been assumed in previous calculations as to the financial aspects of tramway and light railway schemes that the traffic receipts will amount to at least as much as the present average receipts per mile run for the system of horse tramways, viz., 10¼d. per mile, and that the expenses of working by electric traction will be 6d. per mile. These figures show an estimated profit on working of 4¼d. per mile run, and the average profit on working the present tramways is about 2d. per mile run, so that the estimated saving in working expenses as a result of adopting electric traction is 2¼d. per mile run. The number of miles run over the lines which it is proposed to convert is stated by the tramways manager to be upwards of 2,070,000 per annum. The mileage at 2¼d. per mile equals about £21,500, and this figure, therefore, is the extra profit which the Council may look for as a result of the conversion. Out of this will have to be paid the charge for interest on and repayment of the capital cost of conversion, which is estimated at £271,200 (including equipment). From this, however, may be deducted the estimated value of old materials arising from the dismantling of the existing lines, £15,750, leaving a net capital outlay of £255,450. From inquiries which we have caused to be made as to what has been done in other towns where powers have been obtained for the conversion of horse to electrical traction, we think the Council would probably be able to obtain the consent of the Treasury to the whole cost of conversion being charged to capital account and being spread over the Council's short period term of 25 years. We have promised the chairman of the Highways Committee to consider whether repayment can be spread over 30 years. Assuming the period of 25 years for the repayment of the total outlay, and taking the rate of interest at 8 per cent., the annual charge for debt would be £17,882, leaving a margin of extra profit as a result of the conversion of £3,618 a year. This would gradually increase as the debt is paid off.

The Chairman of the Highways Committee having moved the adoption of the recommendation,

Colonel Ford said there was a very strong feeling in the South of London that the experiment proposed should not be carried out in one of the busiest parts of London, and he appealed to the chairman as to whether there was not some less frequented spot where the trials could be made. As an amendment the speaker proposed that the application to Parliament should be subject to the consent of the local authorities being obtained to the experiment being made, but there was no seconder.

Mr. Gilbert, in reference to the proposed Blackfriars section, asked the chairman of the Committee whether it would not be possible to extend the line from the "Horns" public house to the junction of the cable tramways in Brixton Road. If the electric line were not extended in that manner, great public inconvenience would be caused, since it would be necessary to work the 200 yards of track between the "Horns" and Brixton Road by means of horse traction.

Mr. J. W. Benn, in reply, stated that the difficulty suggested by the hon. member would be overcome by the general powers being sought by the Council in the ensuing session in order to transform the whole of the undertaking to electric traction.

The recommendation on being put to the meeting was then adopted.

Light Electric Railways.

In a further adjourned report the Highways Committee recommended the Council to approve the draft of the Deptford, Shooter's Hill, and Woolwich light railways order, and to authorise the Committee to settle the orders in substantially the same form with regard to the proposed light railways (1) between Clapham and Kingston Road; (2) New Cross and Eltham; and (3) in Archway Road, Highgate.

Mr. Melville Beachcroft expressed the opinion that whether the application was successful or not there should be no mistake about the form of the order. The specimen order prepared by the solicitor and the draft order had contained a clause which would have enabled the Council on the completion of the lines to have leased them to a company, if it was considered desirable to do so. Unfortunately, these were narrow-minded members on the Committee who

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thought there would be danger in introducing a clause of that nature into the order in question. The decision of the Committee to override the advice of the solicitor was only carried by a narrow vote, and the result was that the order did not contain the particular clause. He thought every right-minded councillor would agree that whether it was the intention of the Council to lease the lines or not it was advisable that the clause should be embodied in the order. The Highways Committee had resolved to recommend the clause in the case of the Archway Road, Highgate, line, and it ought to be included in other schemes. As an amendment, the speaker proposed that a clause should be inserted in the order giving the Council power, similar to that contained in the Tramways Act, of leasing the lines at any time found to be desirable.

Dr. LONGSTAFF, in seconding the amendment, said that the modest proposal should commend itself to everyone.

The CHAIRMAN OF THE COMMITTEE stated that the question had been carefully reviewed, and that the Committee had come to the conclusion that it was better to go before the Commissioners as a municipality desiring the powers and desiring to work the railways. Some of them were of opinion that the Council would stand a better chance of obtaining the orders in that manner than by appearing before the Light Railway Commissioners with another form of order. The Committee had also arrived at the conclusion that the leasing of tramways had been weighed in the balance and found wanting.

Mr. T. B. WESTACOTT mentioned that not a single light railway order had been granted which did not contain the clause providing for the leasing of the railways.

After further discussion, a division was taken on the amendment. There were 41 in favour and 65 against. The amendment was, therefore, rejected, and the recommendation of the Committee was then adopted.

ASYLUM LIGHTING.

The Asylums Committee stated that in course of time there would be several asylums on the Horton estate, comprising 1,060 acres, and that they were of opinion, instead of each institution having its own separate plant for the supply of the electric light and water, that it would be more economical to erect a central station for those purposes. Three schemes had already been under consideration, but the Committee were not prepared to recommend the adoption of any one of them. The engineer was engaged in drawing up another scheme, which, it was hoped, would be submitted to the Council by the beginning of next year. The Committee accordingly recommended the Council to approve the principle of a central station for the supply of water and electricity, and to authorise them to bring up a scheme for that purpose.

MARCONI TELEGRAPHY.

THE improvements which Mr. Marconi has made in his system of wireless telegraphy, appear to be rapidly increasing its efficiency and extending its range. One of its recent achievements is graphically described by Major Flood Page in the *Times* of the 18th inst. Before Mr. Marconi left New York he cabled to the office of his company in London that he would speak to the Needles (where there is a Marconi installation) from the steamship *St. Paul*, on her arrival in English waters. The telegraphists were in attendance at the Needles station for some hours before the vessel was expected, and in due time their anxiety was relieved by the ringing of the bell. "Is that you, *St. Paul?*" "Yes." "Where are you?" "Sixty-six nautical miles away." The exchange of telegraphic messages was continued while the vessel passed along. Messages were sent by passengers to be forwarded to many parts of England and France, and the latest war news was communicated to the ship where it was published, in the *Transatlantic Times*, which was printed by the ship's compositor, and sold at a dollar a copy, for the benefit of the Seamen's Fund.

That vessels within 70 or 80 miles of land, can communicate with the shore by wireless telegraphy with the greatest ease and certainty, has now been established by Mr. Marconi, and in this field alone there is likely to be considerable employment for the Marconi apparatus. But what is still more urgently wanted is some means of enabling vessels to ascertain the direction in which the etheric waves come from, say, a lighthouse or another vessel. By this means a vessel in a fog might ascertain its position and avoid collisions and shipwreck. According to the *New York Herald*, of October 10th, Mr. Marconi appears to have already attained some success in this direction by the use of deflectors. Mr. Marconi is represented as saying "In the very near future I will have ready what is known as a deflector. By means of the deflector, ships will be able to make their way through fog and storm to safety. In England, lighthouses are already using wireless telegraphy. My plan is to have all ships equipped with signalling machines and deflectors. It will then be possible to send the signalling currents all in one direction, instead of broadcast as is now done. The deflectors will be revolved about the mast, and as the currents reach the point from which they are sent to the receiver, an indicator will ring, and the pilot may steer his vessel along a safe course, being guided by signals from the shore."

We have for some time heard a good deal about these deflectors. In only one instance have we any record of their having been successfully used. When Mr. Marconi undertook to report the yacht races for the *New York Herald*, he conceived it possible that the spirit of journalistic rivalry might lead to an attempt to interfere with the communication which it was his aim to establish. Some attempt appears actually to have been made either to tap the Marconi waves or to create an etheric disturbance which would obliterate the Marconi messages. This is said to have been defeated by Mr. Marconi "by an ingenious arrangement" — probably some arrangement of deflectors.

Theory hitherto has condemned the successful use of metal plates, either as deflectors or reflectors, and there is at present little faith among the experts in this idea. Mr. Marconi has already, however, accomplished so much, often in defiance of theoretical predictions, that he may yet succeed in directing his waves in a definite direction, or in ascertaining the direction from which they come, to the receiving station.

The naval authorities of the United States Government, after witnessing a demonstration by Mr. Marconi between the cruiser *New York* and the battleship *Massachusetts*, have become convinced that the system can be utilised with immense advantage in naval warfare. It is intended to introduce the system into the United States Navy, and it is proposed, in the first place, to establish it between Key West and Cuba.

At the request of the War Office six of Mr. Marconi's assistants have started for Cape Town, whence they will go to Durban to assist Sir Redvers Buller. The plant is similar to that tested so successfully in the last naval manœuvres. The plant might be of immense value in military operations after it has been thoroughly tested and adapted for this use, but it is not likely that the present apparatus will stand the knocking about that it will be subjected to in the field. The beleagured garrisons in South Africa are apparently not supplied with Marconi plant. The system of telegraphy by earth currents, suggested by Dr. Lodge in the *Times*, might be of use in an emergency, and certainly deserves the attention of military telegraphists.

A TENDER POINT.

ON the question of inviting tenders for electrical plant, it is now a frequent practice with corporations to postpone their decision to the last moment; indeed, although the matter is often under consideration for years before any definite steps are taken, months only are granted to the contractor to complete, in many cases, heavy contracts, as councillors, in their desire to see the installation for which they have had part in voting the credit, completed during their own term of office, leave too little time for the manufacturer to make and erect the plant. Of course, it would be possible for the manufacturer to make the plant in advance as stock, provided that some standards were agreed upon by consulting engineers, but in the present state of the profession, this appears to be too much to expect. Assistance to manufacturers would, however, be given if more time were allowed for the preparation of tenders, and if facilities were afforded for the getting out of estimates. In the present state of affairs the time is often limited to a week or ten days, and only rarely is a month allowed, although it is evident that if the plant is of any importance, and any drawings are required, one month is certainly not too much. Again, it is the practice of some of our consulting electricians, when the tender is divided into sections, to include in the dynamo section so many accessories of which the electrical contractor is not a maker, that a great deal of work is entailed on him in the obtaining of tenders from sub-contractors; indeed, it is not uncommon that in this section

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the value of the electrical work is much less than half the total of the tender. The reason that the electrical contractor has to do this work is that if he refuses another will accept, whereas the engine makers, who occupy a more independent position, decline entirely to tender under such conditions.

If the consulting engineer is not himself prepared to take the trouble to split up the tender form into more sections, at least he may aid by asking for less detailed information with regard to accessories, and by stating in round figures the allowance that should be made for these extras, leaving the settlement of detail until he is brought face to face with the successful tenderer. Of course it is obvious that if he can get contractors to tender for the whole of the machinery section, it saves the consultant much time; but if he passes what is, after all, his own work on to other shoulders, he should give more time for carrying it out. Another difficulty of less importance is, that generally only one ordinary copy of the specification is handed to the tendering firm, and it is necessary to prepare copies so that tenders may be invited from possible sub-contractors; this means a loss of two or three days, as often the specification is a document of 80 or 100 pages. Would it be too much to ask the consulting engineers to adopt some plan that would obviate this loss of time? In a recent tender the plan adopted by the War Office, due, we believe, to Capt. Baylay, R.E., seems a good one, and met the before-mentioned points; the specification was provided in the ordinary way, and, as far as possible, the sections were so divided, that each section could be dealt with completely by one contractor; thus it became unnecessary to type the copy for sub-contractors, and as the various schedules of prices and particulars were printed in copying ink on a sheet with perforations for ready detachment, it was only necessary to detach the schedules and tender form, and after press copying, forward them, retaining the specification, and, of course, the press copy. The War Office thus had all the particulars it required, and the contractor all that he wanted, without loss of time and unnecessary expense.

It may be considered that any such plan is a detail of little importance, but it must be borne in mind that it is only by attention to such detail, in many cases occupying 20 per cent. of the time allowed, that we can hope to get work planned and executed in the short time available.

CORRESPONDENCE.

The Board of Trade and Electric Tramways.

Your article, "The Board of Trade and Electric Tramways," is indeed interesting, and having had most of these difficulties to contend with as resident and consulting engineer to the Madras Electric Tramways, I trust you will see your way to publish the following:—

Trolley poles at present are not by any means perfect, and the various tramway engineers have yet to find out some of their little peculiarities, such as tearing down pole arms, overhead wires, guards, pullovers, span wires, &c., and as many of the designers and engineers have had no previous practical experience in traction work, one must expect accidents.

I will leave the trolley pole alone in this letter, but will endeavour to treat same at some future date. I am led to understand from your article that with the "Dickinson" system, span and pullover wires are not used;* this, of course, is a slip on your part, as these are essential on curves, at which points a trolley is most inclined to leave the overhead wire, and from my experience it is advisable to have all pullovers and cross-wires insulated at both ends, and not earthed as suggested by Mr. Trotter.† I can endorse all Mr. Trotter says regarding centre poles; not only are they a nuisance to drivers of vehicles and traffic in general, but a source of great danger to passengers who will alight when the car is travelling, and invariably run foul of the centre pole. Of course, this could be avoided, assuming you have width of street for two vehicles to pass each other on both sides of track, and 4 feet clearance from car to centre pole. The in-and-out motion of traffic is very much to be avoided.

* We did not say so.

† Mr. Trotter referred to the *guard* wires.—Eds. Elec. Rev.

I am glad to see you have drawn attention to the long arm brackets, which are unsightly, distinctly weak, and dangerous.

I am sorry that I cannot fall in with your idea that 500 volts are dangerous. I have seen many cases in which a cable has dropped upon a group of Madras natives, with their scanty wearing apparel and bare feet, with no more serious result than a bit of a fright; in fact, it acted rather as a tonic.

Guard wires of various kinds are, no doubt, a necessary evil, and having carried out a great many experiments in conjunction with the Madras Government telegraph engineers, I am inclined to think it possible to design guard wires to avoid almost all risk of contact; at the same time, this can be done with greater efficiency, and be much more sightly, by the telegraph or telephone companies, at the tramway company's expense, binding off their line wire, and running a larger gauge over the track, as required by all railway companies, in crossing their lines. A light fuse could be inserted joining up span wire to line wire, insuring in case of accident no damage to telephone or telegraph instruments. Under the span wires, from an arm extending some little distance further out, could be run two light guard wires, parallel to the span line wires, with bridge pieces of the same section of wire, running at right angles about every 6 feet. By such an arrangement I have found from practical tests that it is almost impossible for a telegraph or telephone wire to drop to earth, as these wires are out of the line of sight, it is by far the most satisfactory plan.

I beg to differ with you in your answer to "Working Electrician," and contend that experience in engineering is not essential in the erection of traction plant. All that is necessary is, that you have served a pupilage of three years, minus black time—counting number of hours worked would be almost a total of 12 or 18 months at most, at the end of which the said pupil of wide and varied experience requests his firm to pay him in accordance with his abilities. They make him a large and handsome offer of a salary of from £20 to £40 per year, which, in many cases, he cannot think of accepting, as it is so charitable of his late employer to so accurately appraise his real value. A few months after he is again to the front, having a relation or friend in one of the municipal corporations, he is installed as resident electrical engineer, and at once prepares electric light and traction schemes, and endeavours with the help of the said Corporation or committee (who, as we all know, are born electrical engineers) to carry out these schemes.

Then the faults crop up, and the poor ratepayers have to pay, pay, pay, for this absent-minded beggar, who, of course, blames his contractors, and is ably supported by the rest of the born engineers. I hear on good authority that in the near future they intend making electrical engineers, in which case you will, no doubt, use all the influence of your valuable paper in the furtherance of such an excellent scheme.

F. S. Hanning.

Arithmetic of Electrical Measurements.

I have had the Electrical Review for the past 15 years, and saw the review of the seventh edition of my little book on "Electrical Measurements" in the issue of October 27th, p. 668.

As a general rule I never reply to reviewers—like Madame Correlli, I ignore them—I should not do so now had not the publisher called my attention to the par., and that since then I have received a cutting anonymously.

The first 13 lines simply express the opinion of *one* individual—your reviewer.

The fact that the seventh edition is now being issued, and that also that the book has been translated into German and commands a large sale in Germany, are proofs that I also have an opinion, and that my opinion as to what is necessary for "young students in electrical measurements" is not only respected, but, moreover, valued.

Your reviewer says, "Minotto is as usual spelt wrongly Menotti." If it be usual to spell it Menotti, whence his authority for "Minotto?"

Again, "He would not be sorry to see a text-book issued which ignored the existence of primary cells altogether."

F

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This is a desideratum only to be accomplished when there is no demand for them, and when such huge establishments as the Post Office Telegraph Department and the telegraph and telephone companies throughout the world cease to use them.

The misprint + for × on p. 52 had already been noticed, but as you yourselves, on p. 671 of this same issue, October 27th, 1899, "*regret unfortunate slips*," so do I, and the misprint will be corrected in any future issues.

Your reviewer would do well to study the synonyms and idioms of our English language before again indulging in the strain of sarcasm underlying his allusion to my expression "constant variation."

Had he consulted Webster's, Walker's, or Worcester's dictionary, had he studied the utterances of our greatest orators, he should have known that this phrase, though apparently paradoxical, is perfectly consistent, and quite allowable in the sense in which I have used it.

But it is a great pity he concluded by showing a want of knowledge of electrical terms in common use, by sneeringly remarking that on p. 110 I mention "conductivity resistance," *whatever that may be*.

I may be considered an ignoramus for using such a term, but I can assure your reviewer he can place Lord Kelvin, Sir W. H. Preece, and Mr. H. R. Kempe in the same category. They, in common with several well-known electricians, repeatedly use the term.

I have neither time nor desire to enter on any controversy respecting such trivialities, but having been the editor of a journal for some years, I certainly should advise you, in future, to criticise the criticisms of your satirical critic.

If the ELECTRICAL REVIEW is to maintain its previous high reputation, it will be well to note that such expressions as I quote will not tend to do it—p. 683. Prof. C. A. Carus-Wilson writes:—"In your criticisms of my letter *you ridicule Mr.* Barlow, &c."

In your current issue, p. 792, you have to explain to a correspondent, "*There was no ridicule in our note*," &c. P. 795, "*If we have hurt the feelings* of the Barnsley Town Council," &c. Again, p. 796, "*Far from ridiculing* them (the Berrenberg Syndicate)," &c. Three semi-apologies in one issue show something must be amiss at your head-quarters.

Wm. R. P. Hobbs.

H.M.S. *Vernon, November 22nd*, 1899.

[We must congratulate Mr. Hobbs upon his relations with Lord Kelvin, Sir W. H. Preece, Mr. H. R. Kempe, and "Madame" Corelli (with one *r*); we await their comments. We point out misprints whenever we come across them, merely for the assistance of the author in issuing his next edition, and of the readers of the present one. The spelling of Minotto we had many years ago on the authority of the engineer of the Italian Telegraph Administration. Mr. Hobbs has apparently misread "conductor resistance," a common and correct expression, as "conductivity resistance," an absurd contradiction in terms, and we may say that Mr. Kempe has now abandoned "conductivity resistance" for "conductor resistance." We entirely deny Mr. Hobbs's assertion that the three quotations at the end of his letter were semi-apologetic, although we are always prepared to make reparation if we are in the wrong. Finally, we prefer to think that if anything is amiss, it is in the "head" quarters of our irate correspondent himself.—EDS. ELEC. REV.]

Signalling Without Contact.

In your current issue is a letter, signed "C. M. J.," which demands a reply from me. The letter bristles with questions, answers to which will emphasise some of the strong points of my system; but it will be evident that a gentleman who demands "a nearer approach to absolute certainty than may be attained by fallible humanity" will not be easy to satisfy.

"C. M. J." commences the attack by stating that when a driver in a fog passes "fixed signals *which cannot be seen*" (the italics are mine), he "assumes" they are "at danger"; it would be interesting to hear by what sense he discovers or assumes that they are *there*. Moreover, if a driver knows by inspiration when he is passing an invisible signal post, and assumes the signal to be at danger until he makes out a fogger with a green lamp or flag, of what earthly use are the detonators?

As to Sir George Findlay having "written in the highest praise of the results attained," the question is: What bearing has this on the discussion of a new apparatus? Plenty has been said, and justly said, in the highest praise of the old millwrights' work with hand tools, but that is no reason for discarding modern machine tools.

"C. M. J." suggests the use of an invariable danger signal except when an "all right" signal has to be given. This can easily be arranged if desired, and, as I say in my paper, the form of signals is a subject for discussion. To me it seems that the idea of running with your signal on is quite wrong: the indicator on an engine necessarily gives, not the signal you are coming to, but the signal last taken, and under which you are running. Possibly, in order to show still more clearly that this is what is being done, it might be well to construct the indicator to show a back instead of a front view of the two semaphores.

The "danger signal and an all right signal in quick succession" as proposed by me form practically *one* signal to be read after the arm is stationary, a short ring on the bell having called attention to the receipt of a fresh signal. It is difficult to see where the confusion comes in.

"C. M. J." asks, in regard to the danger signal, "Can no circumstances be conceived in which his danger signal would not be invariable?" When "C. M. J." has arranged that under no conceivable circumstances can a rail, a tyre, an axle, a detonator, or a letter-writer fail, I shall be happy to discuss the question of absolute perfection in signalling on the engine also.

As to whether detonators or relays are the more liable to failure, that is a matter that can only be determined by a large experience of both. If "C. M. J." had had my experience he would have more faith in the armature relays than he appears to have.

The permanent road magnets undoubtedly do retain their magnetism for a very long time—how long I cannot say. If it should prove necessary, they can very easily be remagnetised at long intervals *in situ* by passing over them a suitable electro-magnet hung from a trolley pushed along the line.

I fully admit that simplicity is, to some extent, a matter of opinion, and I must leave each individual to form his own. I may, however, point out that in the discussion of my paper, Mr. W. A. Price, M.A., who has had wide practical experience with electrical apparatus, described the parts of mine as being "extremely simple." Mr. Swinburne has said of my system "It is in the very nature of things much simpler and cheaper than the present semaphore system." I certainly attach more importance to the deliberately expressed opinions of such men as Mr. Price and Mr. Swinburne than to the lucubrations of an anonymous correspondent.

"C. M. J.'s" statements that my apparatus "would practically convert the cab of the engine into a signal box," and that "the driver of an express train would require a man to attend to the signalling apparatus" are not worth controverting; but it may interest "C. M. J." to hear that the fitting of the apparatus on the Great Northern engine was carried out at high pressure, under my direction, entirely by engine-fitters who had not had the slightest experience of electrical work, and without our even having a magnet wherewith to test things as we went on. This work was done at Doncaster, and when the engine came up to London the signals were duly taken at fast speed.

"C. M. J." next tries to frighten us with the number of signals to be taken by a train travelling at 60 miles an hour over a line with four block stations to the mile. Well, the idea, certainly, is alarming; though why it will be harder to take in 30 signal indications in a minute given exactly where you expect them on the engine than looked out for on the roadside is not explained. Will "C. M. J." kindly say where, with four stations to the mile, trains are to be seen travelling at 60 miles an hour? The show would draw good gate money.

That, "with the road blocked ahead, the driver, when inside the distant, but before reaching the warning magnets, would have his *home* "semaphore showing off, and," not "inviting him to run on," but giving him permission to move on, is true; it is also true that the distant signal would be *on* and telling him to slow down.

Next, as to failure of road numbers. It is no more possible to give the wrong number than to pull down the wrong roadside semaphore, the switches being interlocked

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with the point levers; failure to give a road number would, *ipso facto*, show that something was wrong. If the signalman tries to run the express up to a bay platform, the driver will be made aware of the fact while a thousand yards away.

For single lines worked by signals it would probably be best to use only electro-magnets on the road. The danger magnets on each side of the line, however, might be connected in separate circuits with separate batteries.

Finally, I think it is better to try and avert danger than to maintain a nursery for the cultivation of "the sense of alertness to danger." By-the-bye, is this the sense which enables a driver to "assume" that he is passing an invisible signal at danger?

If "C. M. J." will be good enough to communicate with me I shall have much pleasure in showing him some apparatus connected up with batteries, so that he may see how really simple and compact the whole thing is.

W. S. Boult.

32, Victoria Street, S.W.
November 16th, 1899.

Contact Electricity.

May I make a few comments on the remarks you made in your generous editorial on the paper on "Contact Electricity," which I read before the Physical Society, and which was reported in your last issue?

You stated that I was dealing with differences as small as $\frac{1}{50}$th of a volt, and that in my experiments there were many conditions that might account for a stray $\frac{1}{10}$th of a volt. Very true; but as I entirely ignored such small differences in drawing conclusions from my results, the criticism is irrelevant. The changes to which I attached importance were from 1·02 volts to 0·28 volt, from 0·98 volt to 0·09 volt, from 0·37 volt to −0·60 volt, and so on.

You referred to errors caused by the electrification of the glass tube. Such disturbances are easily recognised, and, it is needless to add, were carefully eliminated.

Thermal differences, of course, did not come in to any appreciable extent, as all measurements were made when the apparatus was quite cold.

Frederick S. Spiers.

Consulting Engineers and Contractors.

It was not our intention to enter further into the discussion of the question of "Consulting Engineers and Contractors." Having put our question and obtained our answer, we were quite content to leave the matter in other, and more interested, hands; but your correspondent, Mr. Sydney F. Walker, raises an entirely new issue. The sort of consulting engineer which we thought the contractor had a genuine complaint against was the man who, posing as a consulting engineer pure and simple, was, at the same time, quite willing to act as a contractor if he could get a supply house to give him trade terms. The gentleman Mr. Walker has in his mind is, on the contrary, one who states boldly, "I am a contractor, but my experience is such that I am as capable (often more so) as any man to give my customers advice." He does not interfere with anybody, because he does not usually advise outside his own connection. This man, we have no hesitation in saying, is fully entitled to receive trade terms. True, his customers occasionally treat him in the mean manner Mr. Walker draws attention to. They get all they can out of him free, and then use their stolen knowledge to hawk their installation round the whole trade in search of someone who, not having spent time and trouble in preparing a workable scheme, is quite able to undersell him by a small percentage. But as a rule we do not think that this is so, and more often the work is placed in his hands without further question. There is, however, a worse form of enemy to the straightforward contractor, viz.:—the man who, being actually a contractor himself, poses as a consulting engineer, draws up a cast-iron specification insisting on dynamo "A," engine "B," wire "C," and lamps "D," on which he has special terms, being employed, and then tenders for the work himself, and, of course, is able to underbid everybody. Such a man is beneath contempt, we know, but, at the same time, is far too common, and should be discouraged, not to say gibbeted, wherever possible. However, this is entirely a matter for the trade, and in their hands we are content to leave it now we have set the ball rolling. One word only we should like to add. Owing to your anonymous correspondent, of the 10th current, not appearing in the "Correspondence" page, we had overlooked his contribution to the discussion, but now note that he refers to us as "a firm of contractors." This is just what we say we are not. We are a supply house wholly, and it was in the interest of the contractor that we first entered the field, and drew attention to the grievance which we thought our customer (the contractor) had.

For the Stewart Electrical Syndicate, Limited.
Douglas C. Bath, *Managing Director.*

November 21st, 1899.

I think the question raised by Messrs. The Stewart Electrical Syndicate is one which seriously affects the electrical trade.

In addition to the type of consulting engineer brought to notice in their letter, contractors have to face another form of competition by the consulting engineer who acts as buyer to the client, and personally orders plant and materials at trade prices, which are passed on to the client, who, although a private individual, thus obtains plant and materials at prices only intended for the trade.

The consulting engineer will further engage men, and send them on to the work where they are paid by the client at the men's ordinary rates.

This is obviously unfair to electrical engineers and contractors, whose business requires the maintenance of plant and staff, and it is regrettable that some supply houses and manufacturers of electrical plant are willing to give trade terms to the public through the consulting engineers. As a contractor, I avoid as far as possible doing business with those firms who I find have not the same consideration for their customers as is shown by the Stewart Electrical Syndicate.

Herbert E. Hall, A.M.I.E.E.

Tonbridge, *November 17th*, 1899.

Single-phase Motors.

With reference to Mr. C. E. L. Brown's letter on the above subject, appearing in your last issue, it would, I am sure, greatly interest all electrical engineers to know where single-phase motors, made by his firm, starting against full load, can be seen *at work*. It is not too much to say that the opinion of the electrical profession is, undoubtedly, that the design of the Brown motors does not lend itself to starting against any load greater than that offered by the usual loose-pulley arrangement invariably installed with them, *vide* the Brown motors running in London, Worcester, Frankfurt, Zurich, &c.

When Mr. Brown has given this information, it will be time to see if he can give guarantees to be compared with those given by Mr. Heyland.

A. C. Eborall.

Repeater for Wireless Telegraphy.

In reference to your article in last week's Review on Signor Guarini-Foresio's repeater for use in wireless telegraphy, we should like to point out that we already have secured patents for a precisely similar arrangement, including two other methods for getting over the disturbances due to "back surgings" when automatic relay stations are used; and which would, if no precautionary steps were taken, continue, until the battery power was exhausted. We have every confidence in its practical value, and when worked in conjunction with our multiplex selective system, it forms a complete method of inter-communication between towns or stations in a large country. For instance, in Great Britain a trunk line could be worked with repeating stations (at, say, 15 miles apart), from London to Edinburgh, and at different centres our automatic selective switches could be

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introduced, so that any station *en route* could communicate with any other.

As our patents are still in the provisional stage, we regret that we are unable to publish further details.

Philip H. Cole.
Bertram S. Cohen.

The Dublin Cable Contract.

With reference to the letter of the British Insulated Wire Company, Limited, appearing in the issue of your journal of the 17th inst., our clients, the National Conduit and Cable Company, instruct us to state that the facts alleged therein are inaccurate, and the conclusions drawn are misleading; and we have already, upon their instructions, commenced an action for libel against the British Insulated Wire Company, Limited.

We are to ask you to be good enough to insert this letter in your next issue, together with a statement that your journal must in no sense be taken to concur in the imputations or purport of the British Insulated Wire Company's letter.

Renshaw, Kekewich & Smith.

Suffolk Lane, E.C.,
November 20th.

[It is generally understood that the editors of a journal are not responsible for the opinions expressed by their correspondents, and so far as the Electrical Review is concerned this has been known to our readers for many years past. Naturally this would be so, as it is quite impossible for us to verify all statements that are made in letters published in our pages.—Eds. Elec. Rev.]

Electric Cranes.

We see in your article on the above subject that you give some figures as to power taken for certain work which are interesting, looking to the efficiency shown. We think, however, that referring to the crane shown on fig. 3A, there must be some mistake, as you say it only takes 21 amperes at 203 volts to lift the full load, 25 cwt., at the rate of 80 feet per minute. This must be wrong, and we suppose the speed has really been very much less, and that when lifting and slewing at the same time the speed of lift has been still further reduced.

Rosling & Appleby.

[The load in this case was a full skep of coal, weighing about 18 cwt.—Eds. Elec. Rev.]

ELECTRIC LIGHTING IN SHOREDITCH.

The "Profit" Question Settled.

The Vestry on Tuesday devoted two hours and a half to a discussion of the proposals of the Electric Lighting Committee in regard to the allocation of the profits (£6,463) on the electricity undertaking during the past year. The recommendations of the Committee may be recalled as follows:—

(1) That the sum of £1,255 8s. 2d. be paid by the electric lighting revenue account out of the electricity surplus to the credit of the general rates, which sum represents all moneys heretofore advanced from that rate to the electric lighting undertaking; (2) that the sum of £2,921 12s. 2d. be paid by the electric lighting revenue account out of the electricity surplus to the dust destructor revenue account, and that the deficiency, amounting to £694 10s. 4d., on the dust destructor revenue account be written off as the value of steam supplied to the baths and wash-houses: (3) that an order on the treasurer be signed for £250, to be paid by the electric lighting revenue account out of the electricity surplus to the credit of the public libraries revenue account independently of their income from rates; (4) that the sum of £1,000 be transferred from the electric lighting revenue account to a reserve fund, to be called the "Electric Lighting Undertaking Reserve Fund," and that the amount be placed on deposit at the Vestry's bankers on the best terms as regards interest obtainable; (5) that the balance of £1,036 10s. 4d. be carried forward to next year's accounts.

Mr. H. Winkler, as an amendment to No. 1, proposed that all profits made by the electric lighting undertaking up to March 25th last, should be appropriated to liquidate the losses and deficiencies incurred by the dust destructor.

Mr. Elsdon seconded the amendment.

Mr. S. G. Porter contended that the statements made by Mr. Winkler were only good if they were correct, but the speaker expressed the opinion that they were inaccurate. The dust destructor, far from being a loss, could be turned into a remunerative concern if the Vestry were prepared to place upon its produce the full market value and for the steam supplied to the electric light station, and baths and wash-houses.

Mr. J. Hepburn said a business man, on striking a balance-sheet, would have a profit represented by debts owing, cash in hand, and stock. Last year there was said to be a profit of £3,000, and this year one of £6,000, and he expected the latter would vanish as the former had done.

Mr. A. C. Hodder was not prepared to deny that the £6,000 had been realised by way of profit, but he thought Mr. Porter had given the show away when he stated that the destructor had not been credited with the due amount for power supplied. The profit had been earned by the destructor, and it was impossible to separate the two accounts.

Mr. H. E. Kershaw said that the report of the Committee was practically unanimous. It was the desire of the Committee to pay into the general rate account—the losses made by the undertaking in the three years. With regard to the statement of Mr. Hepburn, he considered that that gentleman had answered himself. There was £800 in the bank, there was the stock in hand, and debts owing. They would be eternally discussing the question so long as members doubted the accuracy of the facts of the accounts.

Mr. J. J. Freeman did not think the members could be blamed for not accepting statements presented as facts to the Vestry. If the Committee desired the profits to be devoted to the general rates, why should there be so much palaver. He believed there had been a profit on the electric lighting undertaking, but a loss on the destructor which, however, he wished to see run on a financial basis. If they carried the amendment, they would be able to start with a clean sheet.

Mr. J. Vandy said that Mr. Freeman was anxious that the destructor should be a paying concern, but the Scavenging Department sought to attain that object by disposing of the refuse at 1s. per ton less than by barging it away. The undertaking was a success, and he believed that next year a profit of £12,000 would be realised. Every department should be charged its proportion of the expenditure.

Mr. E. T. Adams, in reply to Mr. Winkler, stated that the figures he had quoted were quite correct. The figures were that a loss of £8,000 had been made on the dust destructor, and a profit of £6,000 on the electric lighting department.

Mr. G. W. Howlett was in favour of the Committee's first recommendation in regard to the payment to the general rate account. He failed, however, to see that there had been a loss of £8,000, and it seemed to him that the amount proposed to be credited to the destructor for steam ought to have been so credited before the accounts were made up.

Major Wenborn remarked that, after Mr. Winkler's statement had been corroborated by a responsible officer, he did not see why it should be ridiculed. If he had two shops, he would have put the loss on the one against the profits on the other, and that should have been done in the present case.

Mr. N. Moss stated, in the course of his reply to the discussion, that the accounts of the two undertakings would, in future, be combined as the Vestry had ordered.

The amendment having been rejected by a large majority, Mr. Trowbridge, as a further amendment, proposed that the sum of £5,463 out of the available surplus of £6,463 should be paid from the electric lighting revenue to the credit of the general rate.

Mr. W. Smither seconded the amendment, which on a division was rejected by 25 to 23 votes. The first recommendation of the Committee was then agreed to, and, after some further discussion, the other proposals made by the Committee were adopted.

LEGAL.

Stegmann *v.* O'Connor.

In the Appeal Court on Thursday, November 16th, before Lord Justices A. L. Smith, Henn Collins, and Vaughan Williams, the case of Stegmann *v.* O'Connor came on for hearing. This was the appeal of the plaintiff, an electrical engineer, for a judgment of a Divisional Court, composed of Mr. Justices Bruce and Ridley, on February 18th this year, confirming the decision of the Official Referee. Counsel for the appellant (the plaintiff in the action) was Mr. Tindal Atkinson, and Mr. Clavell Salter represented the respondent (the defendant in the action).

In opening the case,

Mr. Tindal Atkinson said that he merely proposed to ask for the judgment of the Court on a single point, and it was really a question of the construction of a contract. That was a question of law. The point at issue was whether or not the plaintiff was entitled to £50, which the Official Referee had awarded him on his counterclaim, as being a penalty of the liquidated damages provided for by the contract. He (Mr. Atkinson) urged that the Official Referee had no right whatever to give that £50. Plaintiff (the appellant) was an electrical engineer, and the defendant owned a house at Nightingale Lane, Clapham, known as "Mont Cashel." On April 16th, 1898, plaintiff entered into a contract with the defendant, which was contained in two letters that passed between the parties, and there were specifications for an installation of the electric light at plaintiff's residence. Defendant was also to supply and put up the fittings for a sum of £76 10s., the work to be done to the satisfaction of defendant's architect, and the contract provided that plaintiff should pay £5 a day by way of liquidated damages for every day exceeding 20 days, within which time the work was to be completed. Defendant, when the job was concluded, declared that it constituted a breach of contract, and that it would have to be all done over again. In so doing, defendant used certain material belonging to the plaintiff which had been left in the house, and he counterclaimed for £150 as penalties. The Official Referee found

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that the plaintiff had not executed the work according to contract and specification, and the defendant had occasion to call in another electrician to complete the work. He also found that the material used by the defendant, and which belonged to the plaintiff, was of the value of £2 16s., and allowed the plaintiff £9 3s. for extra work, or in all, £11 19s. Then, by way of liquidated damages under the contract, the Official Referee awarded the defendant £50, and deducting the £11 19s. for which he had found in plaintiff's favour, the Official Referee gave his certificate in favour of defendant for the balance of £38 1s. Mr. Tindal Atkinson said it was never suggested, nor was there any evidence to support such a finding, that the defendant had sustained any damage at all by reason of the delay or alleged breach of contract. The electric lighting installation was put up by the plaintiff within the specified contract time; it was found to be perfectly satisfactory, and was handed over to defendant in that state. Defendant had set forth a two-fold complaint. First, he said it was a term or contract that plaintiff should put in Silvertown wire—a well-known wire manufactured at Silvertown. It was true that plaintiff did not use that wire, although he had contracted to do so, for the reason that at the time he had not any such wire in his possession, and it being the Easter holiday time, when the Silvertown manufactory was closed, he (plaintiff) was unable to procure it. In those circumstances, and having only a short time in which to complete his contract, plaintiff put in another kind of wire, but one equally as good as Silvertown. Secondly, defendant complained that the plaintiff had put the wire in the lead tubing tight instead of loose. For these reasons the defendant had said that plaintiff was bound to do the work all over again.

Lord Justice VAUGHAN WILLIAMS said he noticed that the plaintiff only sued for £56, whereas the contract was for £76 10s.

COUNSEL, in answer to his LORDSHIP, said that the contract was to put up the wires and fittings, the latter to be supplied by the defendant; but as the defendant never supplied any, plaintiff did not put them up, and therefore he only sued for the price of putting up the wires; in other words, for the installation only.

Lord Justice VAUGHAN WILLIAMS said the Official Referee had found that plaintiff was not entitled to anything for that.

Mr. TINDAL ATKINSON: Yes, he found that.

Lord Justice VAUGHAN WILLIAMS: And nothing for the fittings, because you did not put them up, and therefore on the original contract you were entitled to nothing.

Mr. TINDAL ATKINSON admitted that that was so, but he withdrew that part of the case now. However, he ought to mention that when the plaintiff went to defendant's house for the purpose of substituting Silvertown wire for that which had been put in, he was refused access to the premises, and was not allowed to do the work he was entitled to do.

Lord Justice VAUGHAN WILLIAMS: The only question is now whether the Official Referee was justified in giving the £50 damages against you. I suppose they were damages for not having carried out your contract?

Mr. TINDAL ATKINSON: Plaintiff was not allowed to complete his contract in its entirety, as he was not allowed to go on the premises for the purpose of finishing the work and receiving the promised fittings from the defendant. Counsel urged that defendant could not claim the £50 awarded to him under his counterclaim, when he himself had put an end to the contract. Mr. Tindal Atkinson submitted to the Court that the £5 a day provided by the contract was clearly a penalty and not liquidated damages. According to that construction of the contract the learned counsel asked the Court to say that the penalty could not begin to run until the whole of the contract had been completed, and that defendant could not claim any penalty when he had himself put an end to the contract.

Mr. SALTER, for the respondent, asked that the finding of the Official Referee and the Divisional Court should not be disturbed. It had been shown in evidence that plaintiff's work was wholly bad and useless.

At the close of the arguments, their Lordships reserved judgment.

CHICK & Co. *v.* GROTH.

In the High Court of Justice on 16th inst., Mr. Justice Grantham, sitting in the Queen's Bench Division for the hearing of non-jury actions, had before him the case of Messrs. Chick & Co., City, exchange dealers and foreign brokers, who sought to recover from the defendant, Dr. Lorenz Albert Groth, consulting engineer, the sum of £773, being money lent, money paid at defendant's request, and for interest on advances. Mr. McMillan appeared for the plaintiffs, and Mr. Drake for the defence.

It appeared that the defendant, who had studied at Strasburg, Germany, and now carries on his profession in London, had invented certain processes for tanning by means of electricity, and he was introduced to Mr Alfred Young Chick, one of the plaintiff firm, with a view to obtaining an advance of money from them. Plaintiffs' case was, that after going into the matter of the patents with him, they lent him money wherewith to complete his inventions here and abroad. Defendant pleaded that it was part of his contract that the loans were only to be repaid from funds to be obtained by the flotation of a company to work his patents; but on the other hand, plaintiffs alleged that the arrangement was that in the event of a company being formed, they were to receive a bonus, but that the amount of their advances was to be paid back to them, whether or not a company was successfully floated. Defendant was introduced to them in 1892, and the advances went on down to 1898, some of the money being payments for the purpose of keeping the patents alive. The patents were assigned to plaintiffs by way of security for their advances. Defendant pleaded that plaintiffs were the real promoters of the company, and that the fact of its not having been brought out was due to their fault. The validity of the patent had been established in the Chancery action, and there had been a successful flotation of a company in Sweden to work defendant's patents there.

His LORDSHIP gave judgment for plaintiffs with costs.

BUSINESS NOTICES, &c.

Universal Electrical Directory (1900).—We are asked to announce that in order to publish the new issue reasonably early, the latest date for receiving new matter for advertisements and entries in the classified trades section has been fixed for Monday, December 4th. Those who have not already notified their requirements are asked to note this date.

American Machinery for Shropshire Mines.—We read in the *Iron and Coal Trades Review* that Mr. Duncan Sinclair, general manager of the Coalbrookdale Company, Limited, of Shropshire, is in the United States making some purchases of electric machinery for his company.

Bankruptcy Proceedings.—The first meeting of creditors was held on 17th inst. at the London Bankruptcy Court under the failure of E. A. M. Winter, Amberley House, Norfolk Street, Strand, electrical engineer. The debtor has filed accounts showing total liabilities of £1,550, of which £975 is unsecured and assets *nil*. He states that he is a German subject and came to this country in 1889. For some years he was in employment, but in May, 1897, having a capital of £700 or £800, he started business as the Imperial Electric Light and Power Company, his idea being to obtain concessions from public bodies and others for the supply of electricity, and to eventually form the business into a limited company. He travelled all over England, Scotland and Ireland, and entered into various contracts, but the business resulted in a loss to which he attributes the failure. In the absence of any offer, the case was left in the hands of the Official Receiver to be wound up in bankruptcy.

A sitting of the London Bankruptcy Court was held last week before Mr. Registrar Hope, for the public examination of E. C. Glass, lately carrying on business as an electrical engineer, &c., at 6 and 7, Nevill's Court, Fetter Lane, E.C. The debtor purchased the business for £2,000 in October, 1896, and subsequently introduced therein a further £1,000. He carried it on until November, 1898, when it was taken over by his sister in consideration of £3,000 previously advanced. During the next six months he remained in the business on her behalf, but then went abroad. He attributes his failure to heavy interest charged on borrowed money, and to his having lived beyond his means by reason of having over-estimated the profits of the business. The accounts filed under the proceedings show liabilities £1,098, and assets *nil*. The Official Receiver desiring further time for the purposes of investigation, His Honour adjourned the examination until December 7th.

Liquidations, Dissolutions, &c.—A general meeting of the Sheffield Electric Light and Power Company will be held on December 22nd at the office of T. G Shuttleworth & Son, Royal Insurance Buildings, Church Street, Sheffield, to hear an account of the winding up from the liquidators, Messrs. G. Franklin and J. Gamble.

Messrs. C. H. Strong and W. H. Hartley (Electro-Medical and Surgical Institute, 18, Pall Mall East) have dissolved partnership.

Messrs. H. J. Dowsing and W. S. Hedley (trading as H. J. Dowsing, electrical engineers, Budge Row, E.C.) have dissolved partnership. Mr. Dowsing attends to debts.

Messrs. H. G. Massingham and F. H. Rippon (Massingham, Rippon and Co., electricians and electrical engineers, 82, Fore Street, Exeter) have dissolved partnership. Debts due to the firm will be payable to Mr. Rippon, 7 and 8, Queen Street, Exeter, and all accounts owing by the firm are to be sent to the firm at Fore Street as above.

Books Received.—"Le Phénomène de Zeeman," par A. Cotton. Paris: Georges Carré et Cie, Naud. 2 francs

No. 41. "The Safety of Theatre Audiences and the Stage Personnel against Danger from Fire and Panic." By Wm. Paul Gerhard. London: The British Fire Prevention Committee. 1s.

Brill Cars.—Some idea of the business at present being done by the Brill Company, of Philadelphia, is obtained from a notice in a New York electrical journal. The company is now engaged in building a large number of double-deck trolley cars for the General Traction Company, of Paris, which will operate street tramways from the centre of the city to the Exposition grounds in 1900. Owing to the size and weight of the cars they will be mounted upon heavy double trucks. Over 40 per cent. of the output of the Brill plant is for export. In addition to the French contract the company has one for 150 trolley cars for Lisbon, Portugal. Within the past few months the firm has shipped cars and trucks not only to several European countries, but to China, South Africa and South America. Large contracts for cars for street railways in Mexico and South American countries have been received, and will be filled within two months. Other foreign orders for car trucks are being filled for cities and tramway companies in Italy, France and England. The Brill plant is building at present over 2,600 trucks on foreign orders.

Correction.—In our notice of Watts, Rumford & Co. last week, under "New Companies Registered," we stated the qualification of directors at £100. We are asked to state that this was an error, the correct figure being £500.

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Charge of Stealing Electricity.—A. J. Harrison, trading as Harrison & Co., electrical engineers, in King Street, Hammersmith, was brought before Mr. Lane, Q.C., on a warrant, in default of appearing to a summons, charged with stealing electricity by forming a connection with the Vestry's main wires.—Mr. A. B. Watson appeared to prosecute on behalf of the Hammersmith Vestry. With respect to the charge the prisoner said it was the result of a mistake.—A remand was granted, and it was suggested that the prisoner should be liberated on his own recognisances to appear, but Sergeant West objected, as the accused had left Hammersmith.—The prisoner said at the present time he was employing 20 men in Hammersmith.—Mr. Lane, Q.C., decided to call upon the prisoner to find bail, stating that he would accept a surety of £50, or two each in £25.

Prisoner was again before the West London Court on Tuesday. Mr. A. B Watson (Hammersmith Vestry) said the prisoner rented two rooms in the house of Mrs. Thomas, who had an installation of the electric light in her front shop, and in consequence of a dispute an examination of the wires disclosed that the meter had been tampered with. Mr. Bell, the resident electrical engineer to the Vestry, produced a meter with the fuse and indicator, and explained the working of it. He said he went into the cellar and found the fuse box broken. Larger fuses of a different material had been inserted with extra wires, allowing four times the quantity of electricity to be drawn from the supply. The prisoner was again remanded.

Colliery Equipment.—With reference to our note under this heading last week, the secretary of the Sussmann Electric Miner's Lamp Company, Limited, writes to make a correction. He asks us to state that Messrs. Reid, Ferens & Co., Limited, have no contract with the company, though he believes that they do contract with the South Moor Company to *repair* lamps supplied by the Sussmann Company. The point that he desires to emphasise is that the Sussmann Company are the sole manufacturers of the lamp.

The Copper Market in November.—Messrs. H. R. Merton & Co.'s mid-monthly circular on the state of the copper market shows that stocks have been reduced by 1,276 tons since the commencement of the month, the total now standing at 25,526 tons. A slight upward movement in price has attended this fall in stocks, the price of G.M.B.'s on November 15th being £73, as against £72 17s 6d. on October 31st. The deliveries have been 8,671 tons, the shipments to America, 343 tons, and the supplies 7,736 tons. The supplies are nearly all below the average, those from Spain and Portugal amounting for the fortnight under notice to only 5 tons; and those from North America to only 621 tons. Doubtless, the returns for the second half of November will help to restore the missing balance from these two sources of supply.

Dynamo Brushes.—Mr. W. Patterson, of Newcastle-on-Tyne, sends us a copy of a report of tests made by Mr. W. W. H. Gee, chief lecturer in the electrical engineering department at the Manchester Municipal Technical School, of his self-lubricating dynamo brushes on a small dynamo. The commutator is stated to have been cooler, the surface attained a highly polished surface with very little wear, and the use of lubricants is dispensed with. The maker claims that with these brushes there is no tendency to spark or fuse, and that the friction is reduced to a minimum, thus adding longer life to the commutator and brushes, and after setting require little attention.

Electric Swing Bridges.—The second of the new electrical swing bridges at Northwich was swung across the River Weaver on 14th inst. for the first time, although it was not then permanently opened for traffic. £25,000 has been spent on the two bridges. Each bridge is opened and closed by electric motors controlled by operators on duty in boxes at the bridges.

Important Steel Contract.—We understand that Messrs. Edgar Allen & Co., of the Imperial Steel Works, Sheffield, have secured the War Office contract for the supply of all the crucible cast-steels, grades B and C, required for the ordnance factories at Woolwich, Enfield and Birmingham during the next three years. Mr. J. C. Ward, A.M.I.M.E., is the London agent of the firm.

Intended Dividend.—The *London Gazette* contains notice of intended dividend in *re* B. Wild and J. H. Clarke (Wild, Rothwell & Co.), general and electrical engineers, Southport. December 9th is the last day for receiving proofs at the offices of Nathan Yates, liquidator, 4 and 6, Wood Street, Bolton.

Map of South Africa.—He would be an exceedingly unpatriotic man who could in these days keep his attention away from South Africa for long at a time. Full as the busy man may be with a thousand and one occupations, he finds it compulsory to sandwich in with them a dozen times during the day "the latest" from the front. But war news without some index of the situation of the various points of interest loses very much of its value and significance. To meet this want various maps have been issued by newspaper and other publishers, but we think that the most convenient and interesting so far is that which has just come to hand from the Exchange Telegraph Company. It contains several coloured maps in one of Natal, Orange Free State, Cape Colony, &c., and gives a very useful table of distances showing how many miles away from London are the various coast towns of importance, and how far it is from Cape Town, Delagoa Bay, Durban, &c., across country to the principal places now waiting for relief, and those likely to be the scene of action later when the real work of the war commences. The figures are ready to hand without the trouble of calculating.

Provisional Orders.—The *London Gazette* contains the usual notices of application for electric lighting and tramway powers as follows:—*Electric Lighting.*—Totnes Electricity Supply Company (Arundel Street, Strand, W.C.); Hebburn Urban District Council; Penzance Council; Vestry of the Hamlet of Mile End Old Town; Barnstaple Corporation; St. George's in the East Vestry (London). *Tramways.*—Walthamstow Urban District Council; Aston Manor Urban District Council; Hurst Urban District Council; Barnsley Corporation; Newcastle-on-Tyne Corporation (to grant a lease of certain lines to the Newcastle and Gosforth Tramways and Carriage Company, Limited).

Sale Announcement.—When the undertaking of the Midland Acetylene (Patent) Syndicate, Limited, was offered for sale by auction at Birmingham last week, there was not a single bid. The works will therefore be dismantled and sold piecemeal at an early date by Mr. H. Humphries, auctioneer, of Brierley Hill and Stourbridge, from whom particulars may be obtained. The undertaking comprises the freehold works, with the whole of the electrical plant, Peach engines, three Danks's Lancashire boilers, &c.

Scotch Water-Power Scheme.—The Glasgow newspapers contain references to a scheme which is understood to be on foot, under which a syndicate proposes to consider the advisability of utilising the waters of Loch Doon for manufacturing purposes. The proposal is to raise the loch 20 feet, and construct a dam close to the famous Ness Glen, where the electricity would be generated. This glen is expected to yield 5,000 H.P. In the event of powers being obtained, it is not at all unlikely that the power would also be used for the proposed light railway from the village of Dalmellington to Carsphairn. For some time parties have been prospecting for hematite in the hills at the head of the loch, so a mineral railway may also be required. At the present time Loch Doon and the Ness Glen are annually resorted to by thousands of anglers and holiday makers.

The Society of Model Engineers' Conversazione.—The first annual conversazione of the Society of Model Engineers was held on November 11th, at the Memorial Hall, Farringdon Street, E.C. The guests were received by the chairman, Mr. Percival Marshall, A.I.Mech.E., and Mrs. Marshall. A splendid collection of engineering models and tools was on view, the exhibitors including Messrs. C. A. Parsons & Co., who sent a model of a 35-knot torpedo boat destroyer, and a model of a 30-knot cross-Channel steamer; the Great Eastern Railway Company, who sent a model of a single-driver express engine, and samples of Mr. Holden's oil fuel burner and other models; and the General Electric Company, who showed electrical apparatus for domestic uses. A lecture was given on "The Light Side of Science" by Mr. W. J. Tennant, A.I.Mech.E., and demonstrations of the X rays and of Edison's latest phonograph afforded additional entertainment for the guests. Mr. Herbert Sanderson, The Mount, Ealing, W., is secretary of the Society.

South Wales Electric Power Scheme.—It is stated in the South Wales papers that statutory notices have been filed for a private Bill by the South Wales Electrical Power Distribution Company. Briefly stated, the promoters' object is to establish three stations for the generation of electricity; one in the parish of Panteg, near Pontypool; another at Treforest, near Pontypridd; and a third at Neath; and from these to supply electric current both for trade and lighting purposes. It is intended, by arrangement with the railway companies, to lay the electricity cables alongside the railways, and thus to minimise the difficulty of transmission; and the desire of the promoters is to make the delivery in bulk, leaving consumers to undertake all the detail of application, whether for illumination, colliery haulage, dock work, or any other form of trade adaptation. As the company do not seek a monopoly, the antagonism of local authorities is not anticipated. It is considered that instead of undergoing the trouble and entailing the trouble and expense of a separate installation, many of the local Councils would prefer to become customers of the company. The districts affected are the Monmouthshire valleys, with the borough of Newport, the Glamorgan valleys, with Merthyr, Aberdare, &c., the borough of Cardiff, Port Talbot, Swansea, Barry, Neath, and the numerous intervening parts of the populous region indicated. All these places being connected by electric mains laid along the railways, any manufacturer or resident will be able to get a supply of electricity by meter; and the local Councils, the proprietors of light railways, the owners of collieries, tinplate works, dry docks, brickyards, &c., will get in cheapest form an abundant service of power and light. The extensive ramifications of the railway systems in this part of South Wales afford easy and plentiful access to every part of the district to be served. It is estimated that the cost of electric power will be very low. Hydraulic power has been worked out as having a minimum cost of £26 per horse-power per annum for 300 days of 10 hours each; and gas engine power at £22 10s.; whereas the South Wales Company expect to be able to make their supply of electricity for a charge which would amount to not more than £15; the great facility being the wholesale production and consequent relative cheapness. Where street disturbance became necessary the company would leave the local authority to do the work at the company's cost. The engineers for the scheme are Sir Frederick Bramwell and Mr. Graham Harris, and the Bill is promoted by many of the most influential commercial men and colliery owners in South Wales. At first not more than half a million sterling would be required as subscribed capital.

The Steele Earthing Device.—This device, which is being manufactured by Messrs. Veritys, Limited, has been submitted to the Board of Trade for their approval. After a long series of tests we are informed that these instruments have been shown to yield very reliable results, under crucial conditions, to the satisfaction of the Board

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of Trade authorities as stated in their following letter dated July 21st:—

With reference to your letter of the 12th inst., on the subject of the Steele Earthing Device, I am directed by the Board of Trade to state that this form of earthing device was recommended to them for approval, but as a modification has been made in the regulation, under which the Board of Trade approval to an earthing device of this nature was required, the Board regret that a formal approval cannot now be given.

(Signed) T. H. PELHAM.

The Board of Trade Fisheries and Harbour Department,
7, Whitehall Gardens, London, S.W.

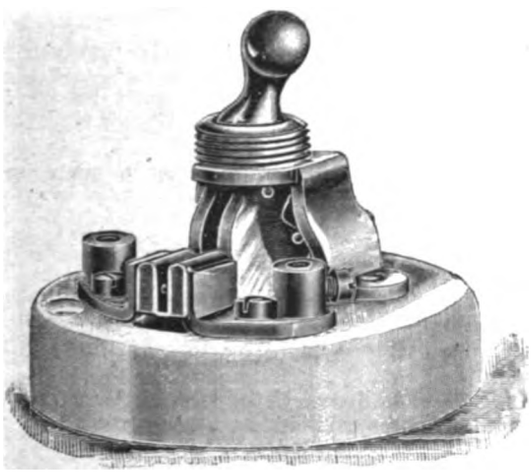
Temporary Scaffolds.—Mr. Heathman has produced folding brackets to hook on the rungs of any ladder and sustain scaffold boards as well as to act as a guard protection rail. The illustration shows how the brackets can be used either in front of or behind ladders and adjusted at various angles to suit the rake of the ladders. The brackets are of wrought-iron wide enough to hold two boards, side by side, and any piece of quartering can be passed through the sockets and jambed by the fixed thumb screws so as to guard the worker against inadvertently stepping backward. The brackets are made by Heathman & Co., of Edell Street, London, W.C.

Trade Announcements.—Mons. A. Molteni is announcing to the trade that after having been for more than 40 years at the head of the firm founded at Paris in 1782 by his great-grandfather, he has given up the business to Messrs. Radiguet & Massiot. All orders should be addressed either to 44, Rue du Chateau d'Eau, or to 15, Boulevard des Filles du Calvaire, Paris. Accompanying this notice is another stating that Mons. Radiguet has taken into partnership M. Massiot, his collaborateur. They have amalgamated their works for the construction of mechanical instruments, and X ray apparatus, with M. Molteni's works for constructing apparatus for projections. The new works have been considerably enlarged and fitted up with up-to-date machinery. The style under which the new business will be known is MM. Radiguet & Massiot.

We are asked to state that the showroom and depôt of the Edison and Swan Company, at 59, Parliament Street, S.W., have recently undergone alterations, and been completely renovated, and inspection of the fine collection of latest designs in electrical fittings is respectfully invited.

The Renewable Electric Lamp Company, Limited, have occupied the premises 47, Brunswick Place, City Road, E.C.

Undertype Switches.—The Imperial Electrical Engineering and Stamping Company, 63, Lionel Street, Birmingham, send us samples of switches which they are putting on the market. Both are well designed, and made to fulfil ordinary requirements.



The undertype switch, which we illustrate, has a long break obtained by countersinking the porcelain to admit of the plunger being withdrawn below the jaws of the contacts, and the distance from metal to metal is ample throughout for the carrying capacity of the switch. The ordinary tumbler type is much superior to any we have seen.

Totnes.—The Totnes Electricity Supply Company, Limited, has given notice of intention to apply to the Board of Trade to obtain a provisional order for the supply of electricity for public and private lighting in the borough.

ELECTRIC LIGHTING NOTES.

Abertillery.—The District Council has appointed Mr. L. A. B. Atkinson, electrical engineer, Cardiff, at a fee of 20 guineas, to report upon the lighting of the South Ward of the district by electricity.

Barmouth.—The report of Mr. Warden-Stevens on an electric lighting scheme was before the District Council last week. He details both steam and water-power plants. The cost of a water-power scheme is given at £9,500. A light electric railway is suggested for running along the sands, costing £6,500. It was decided by the Council not to take any steps until the public had been consulted, and a public meeting was arranged for.

Bermondsey.—The Vestry on Monday resolved that Messrs. Kincaid, Waller & Manville should be instructed to prepare a specification for the erection of a refuse destructor in connection with the electric lighting station.

Bolton.—Considerable friction has recently been occasioned between the Gas and Electricity Committees with reference to the question of street lighting, both contending for the privilege of doing the work. When the matter was last before the General Purposes Committee, the proposal to leave the street lighting in the hands of the Gas Committee was adopted, but at last week's Council meeting it was contended by Mr. Smith that it was only fair that the Electricity Committee should be represented on the Lighting Committee. Mr. Alderman Miles, chairman of the Gas Committee, said until it could be shown that the Electricity Committee could light the borough better and cheaper than the Gas Committee, he should most strenuously oppose the work being taken away from the Gas Committee. The chairman of the Electricity Committee, Dr. Pantoa, accused Alderman Miles of having made erroneous statements as to what had taken place in reference to the lighting question. The Electricity Committee hoped to be able to show what they could do in the way of arc lighting, and he believed they could do it efficiently and at no great cost. The proceedings were adopted,

Beetle.—A Local Government Board inquiry was held last week re the Council's proposal to borrow £15,393 for additional mains and feeders, and £1,000 for a new boiler for the electricity works.

Bristol.—The Electrical Committee have considered the position of the negotiations with the promoter of the proposed local Free Wiring Company, and resolved to confirm their previous resolution to terminate the negotiations.

Burnley.—The municipal electric lighting plant was started in 1893. It then consisted of two 180-H.P. compound condensing engines, capable of supplying electrical energy to some 6,000 8 C.P. lamps. The lamp connection, however, so much increased above the plant capacity that the Electric Lighting Committee decided to make a very substantial increase in the plant by putting down extensions capable of dealing with some 16,000 8-C.P. lamps. The completion of these extensions was celebrated on Monday, when the Mayoress (Mrs. Dickinson) performed the ceremony of starting new engines, &c.

Bury.—The Local Government Board has notified that it will hold a local inquiry regarding the Council's proposal to borrow £800 for lighting the road on the Brown estate by electricity.

Buxton.—The Electric Lighting Committee has suggested the appointment of an electrical engineer at £200 per annum. It is stated that the works will not be ready in January.

Camberwell.—The Vestry will hold a statutory meeting on December 18th to consider the question of the purchase, &c., of the County of London and Brush Provincial Electric Lighting Company's undertaking in Camberwell, or to apply for a provisional order to enable the Vestry to supply the parish.

Cardiff.—The Board of Guardians have deferred the question of lighting the workhouse by electricity for the present.

Cheadle.—The Cheadle Urban Council has adopted a resolution to the effect that application be made to the Board of Trade for a provisional order to authorise the Urban District Council of Cheadle and Gatley to supply electricity within their own district.

Cheltenham.—The Borough Council has given notice of its intention to apply to the Board of Trade for leave to alter the standard pressure from 100 to 200 volts.

Cleethorpes.—The Council is applying for an electric lighting order.

Clontarf.—The District Council is negotiating with the Tramway Company with a view to obtaining electric supply for lighting from the tramway generating station.

Colwyn Bay.—A Local Government Board inquiry was held last week re the Council's application for powers to borrow £5,120 for electric lighting. The previous loan was for £1,564. The contract has been let to Mr. B. Thomas at £3,678, and the applications to date are 1,105 lights, but the new pier company and other parties will take an equal number when the extensions are completed. Mr. Clirehugh, consulting engineer, detailed the scheme, which is for 10,000 8 C.P. lamps. The loan was opposed by the vicar, who was stated to be a gas director.

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Coventry.—The quarterly statement of the electric lighting department of the Corporation to September 30th shows 36,007 units supplied, and a revenue of £764 with 159 consumers, as against 15,875 units, £411 revenue and 118 customers, for the corresponding quarter last year.

Cumberland.—The Egremont Urban District Council and the Maryport Urban District Council have both decided to apply to the Board of Trade for provisional orders for the supply of electricity in their respective districts.

Dawlish.—CORRECTION.—The public meeting which was called to consider the question of electric lighting decided, not in favour as stated last week, but against the proposition, which has, therefore, been dropped.

East London (S. Africa).—Particulars are given in the Cape newspapers of the new electrical installation at East London. The installation is for both lighting and tramway traction. The plant consists of three continuous-current dynamos of 75 KW., one to be used for arc lighting, and another for tramway work, the switchboard being so arranged that the third can be used for either lighting or traction as required. Two alternators, each capable of supplying 2,500 16-C.P. lamps, are used for private lighting and the street incandescent lamps. The current is supplied from the alternators at a pressure of 2,000 volts, and in the transformer houses is converted to 110 volts. All the engines are of the Belliss enclosed type, and there are three water-tube boilers of the Babcock & Wilcox type, fitted with superheaters. The installation has been carried out by Messrs. Reunert & Lenz.

Epsom.—The surveyor having declined the appointment of architect in connection with the electric light station, on the ground that his time is fully occupied by his ordinary duties, the Council has decided to ask Mr. Hawtayne to do the work or provide an architect at a fee of 5 per cent. on the contract, to include quantities.

Glasgow.—On Friday evening last the electricity supply to the north-western district of the city was interrupted for about 15 minutes, owing to the heating of the bearings of a 900 H.P. engine at the Port Dundas station. Another stoppage occurred at a later hour, due to the blowing of the battery fuses; the district was this time in darkness for about 20 minutes.

Gloucester.—We are informed that the National Electric Free Wiring Company, which has been at work here for three weeks only, has already secured contracts for electric lighting totalling up to 1,020 8-C.P. lamps. Amongst the orders are All Saints' Church, 112 lights; the Wellington Hotel, 120 lights; Messrs. Lloyds & Co.'s new bank, 270 lights. Current will not be available until next March, so that the prospects of supply here seem excellent.

Grantham.—The Urban Electric Supply Company, Limited, has given notice of an application to the Board of Trade for a provisional order for the supply of electricity for public and private purposes within the borough of Grantham.

Greenock.—The Police Board is going to hold an electrical exhibition of a week's duration.

Guisborough.—The Northern Electric Supply Company has applied to the Guisborough Urban District Council for consent to its obtaining powers for laying down electric plant in the Council's district. As the Board had not had time to consider the proposals its consent was withheld, but no opposition will be raised provided satisfactory terms can be obtained.

Harrogate.—Mr. F. H. Tulloch, on behalf of the Local Government Board, on Thursday, last week, conducted an inquiry into an application made by the Harrogate Corporation for sanction to a loan of £28,000 for the purchase and extending of the electric lighting installation. At the present time there are 22,341 lamps connected with the mains. The profits for this year up to date, after meeting interest and sinking fund and all charges, were over £700. The present mains are 10 per cent. overloaded during the heavy lighting season, and additional trunk mains are urgently required. There was no opposition.

Hastings.—The Local Government Board has sanctioned the borrowing of £38,334, being portion of the sum of £38,613 for which sanction was sought by the Town Council to meet the amount expended in excess of the loan of £58,000 sanctioned for the purchase of the undertaking of the electric light company, the excess being for additional machinery, mains, and buildings.

Hereford.—The electric light installation at Hereford is expected to be completed and ready for opening by December 13th. It is understood that the supply to commence will be equal to 3,000 8-C.P. lamps. The opening ceremony has been delayed in consequence of the machinery at the head station not being delivered to time.

Hornsey.—The District Council on Monday resolved to appoint an expert to advise them as to the question of an electric installation. The Council have the provisional order, and many offers have been made by private companies to take it over. The Council also decided to ask these companies for definite offers.

Hounslow.—The Heston-Isleworth District Council have decided to make an application to the Board of Trade for powers to light a portion of their district with electricity.

Hoylake.—The District Council is reported to have accepted tenders to the amount of £20,660 for electricity supply purposes.

Ingleton.—The work of laying the cables is now being rapidly proceeded with. The weir has been finished and the pipes and troughs conducting the water to the turbines almost completed. The directors hope to have the streets lighted by the middle of December.

Jarrow and Hebburn.—The Walker and Wallsend Union Gas Company is seeking powers to supply electricity within the borough of Jarrow and urban district of Hebburn.

Liverpool.—Last Friday Colonel C. H. Luard, R.E., Local Government Board inspector, held an inquiry into an application of the City Council for sanction to borrow £300,000 for purposes of electric lighting. The town clerk stated that in the year 1896 the Corporation purchased the undertaking of the Electric Supply Company, and £500,000 was authorised to be raised for the purpose of providing the purchase money and erecting works. That money had already been spent, as also a further sum of £100,000. The number of 16-C.P. lamps in existence when the purchase was completed was 41,515, now it stood in round numbers at 100,000. There had also been a reduction in the charges, which in 1896 were 7½d. per unit for lighting and 5d. for power, and were now for private lighting 4d., for public lighting 2d., for power 2d. and 1d. In spite of these substantial reductions a profit of over £8,000 was made in 1898 after providing for sinking fund and interest. The demand for electric light was increasing, and with the extensions now proposed it would no doubt be accentuated. An important factor was the acquisition by the Corporation of the tramways and the introduction of electrical haulage, which made increasing demands upon the electric supply stations. Excluding Pumpfields station, which was erected out of money recently borrowed, the stations were producing 10,000 B.H.P., and the stations to be erected would furnish a further horse-power of about 15,000, of which about 500 H.P. would be required for tramways. Really the Corporation would require £388,000 to carry out the proposed extensions. Although the £300,000 might seem a large sum, the Corporation at no distant date would have to ask for powers to borrow a further sum. The cost of buildings, land, and sidings for Pumpfields, Lister Drive, Smithdown Road, Lodge Lane, and Lowhill stations came to £102,000; the plant would cost £167,300, and the mains £119,400. The sites of the Pumpfields and Lister Drive stations belong to the Corporation, but the electric supply accounts would be charged a rental on the capital value. Mr. Holmes and Mr. Shelmerdine explained the plans and the details of the scheme to the inspector. The Tramways Committee is laying lines for electric trams at the rate of one mile per week. It has three or four lines of tramways almost ready, waiting for the electric power for which the money now asked is required. No opposition was offered to the application.

Llandudno.—The report of M. A. H. Preece on electric lighting plant extensions has been received by the Council.

London.—The tender of Mr. J. C. Christie for electric wiring of Paragon School, New Kent Road, offices, &c., has been accepted by the London School Board.

Lynn.—The resident engineer of the electric lighting works having reported that owing to the number of applications for current it has become necessary to extend the plant, the Town Council has resolved to purchase temporary plant at an estimated cost of £750 or £800.

The question of wiring the workhouse for electric lighting has been occupying the attention of the Board of Guardians.

Newhaven and Seaford.—An application is to be made to the Board of Trade by a company for provisional orders under the Electric Lighting Acts, 1882 and 1888, to supply electricity for public and private purposes within the urban districts of Newhaven and Seaford.

North Ormesby.—The Council is to apply for a provisional order.

Northampton.—There was a gas explosion in an electric light culvert last Saturday evening.

Oswaldtwistle.—The Lancashire Electric Power Company, having solicited the support of the District Council to a Bill in Parliament, the Council decided that the request be complied with.

Redcar.—The Redcar Urban District Council has resolved to apply for a provisional order for the supply of electricity in the district.

St. Pancras.—The Vestry on Wednesday resolved to forward to the Islington Vestry a copy of a letter received from the Board of Trade on the subject of the long-pending dispute between the two authorities as to the laying of mains in Brecknock Road and York Road, Islington, for the supply of consumers whose houses are situated in St. Pancras. The letter intimated that as the Vestry sought a license merely to lay mains, but not to supply current in Islington, and as Section 3 of the Electric Lighting Act, 1882, only empowers the Board to authorise *the supply of electricity* within any area, the Board could not entertain the application for a license. The Board further stated, as mentioned a year ago, that the question was one for friendly agreement between the two authorities. On the recommendation of the Electricity Committee, the Vestry also decided to ask Islington now to consent to St. Pancras laying the necessary mains.

(*Continued on page* 849.)

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ELECTRIC CRANES.

(*Continued from page* 807.)

WHERE single motor overhead cranes are used they may take either of two forms; the winding drum may be retained at the end of the crane where the motor is fixed, and the load raised by means of a return block carried in a bight of the chain. One end of the chain is fixed at the end of the crane opposite to that which carries the motor, and the bight of the chain supporting the block is borne on a travelling jenny, which is pulled to and fro by means of chains. This construction was well shown in one of our illustrations last week; it is better suited for small loads than for large.

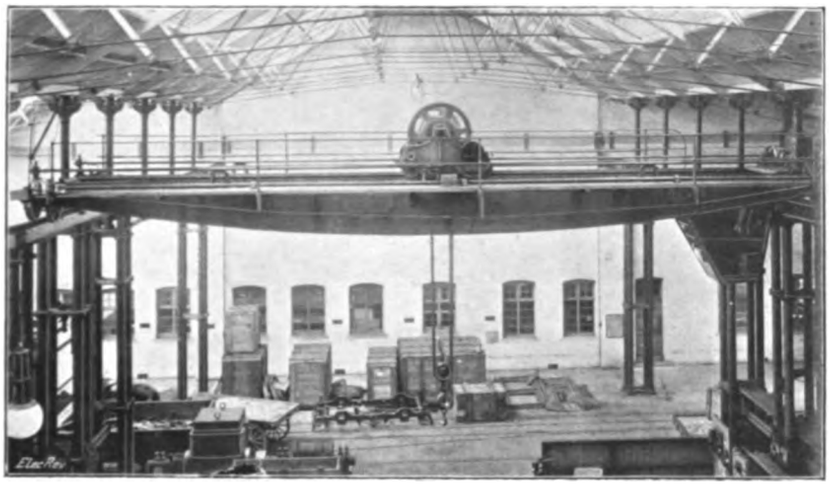

FIG. 12.

Another method is that in which the traversing and heaving gear is mounted on a crab running along the beams, and receiving power for these motions from square shafts or round shafts with sliding feather. Figs. 12 and 13 show the construction of a crane on the latter system, one of five supplied to the Electric Construction Company, Limited, for their works at Wolverhampton, by Messrs. Carrick & Ritchie. Fig. 14 is a view of a similar crane, showing the arrangement of the friction gear and electromotor.

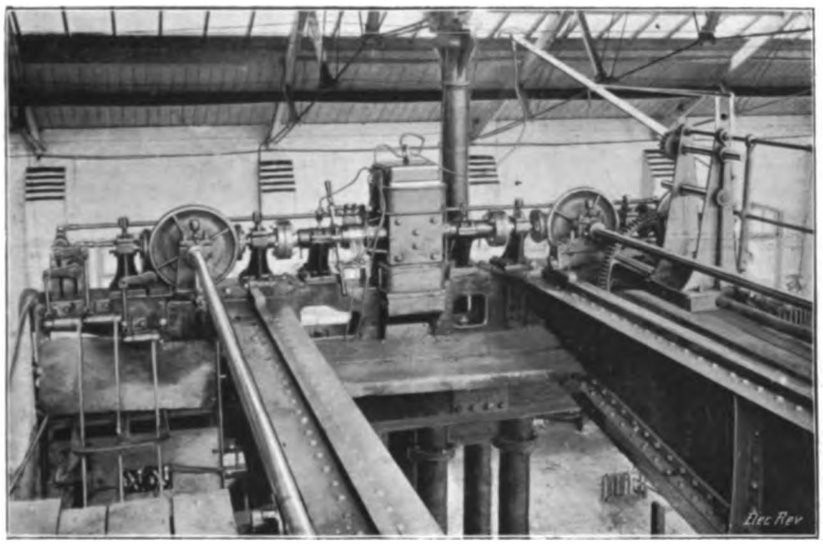

FIG. 13.

The crane illustrated is designed for a maximum load of 10 tons; cranes intended for larger loads are provided with three speeds of lift. The motor is shunt-wound, and is kept running, except when the crane is not likely to be wanted for some time. Reversing is provided for by means of the double friction cones, as explained in our last issue. All the motions may be utilised simultaneously, and are controlled by the driver from a cage beneath the crane.

Power is supplied to the traveller by means of a simple overhead wire and sliding shoe at each end of the crane, one of which is clearly seen in fig. 13.

It will be noticed that all the bearings are provided with removable covers, and that there is a platform on each side of the crane; the construction is as far as possible of steel.

The system of operating all the motions with a single motor obviously resembles closely that used on cranes supplied with power by mechanical means, the only fundamental change being the substitution of electrical apparatus for the continuously running shaft or rope; while, therefore, it affords a cheap and easy means of converting mechanical to electrical cranes, it does not fully utilise the advantages of electrical driving. Even so, the gain is undoubtedly great, for the power wasted in running a shunt motor on zero load for a great part of the day is certainly far less than that absorbed by a rope or other mechanical drive, which, moreover, is generally running the whole day long. Still, the use of three motors is clearly more economical in running cost, though the initial outlay may be somewhat greater; the motors may also be reversed electrically, so dispensing with mechanical reversing gear, which is not possible with a single motor outfit unless the motions are never used simultaneously.

In this connection the suitability of three-phase motors for crane driving deserves special notice. While they can be reversed most easily, without the possibility of sparking which is ever present in the use of direct-current motors, they can also be switched on at full load, when of moderate power, without starting resistances of any kind. Even when the motors are too large to dispense with resistances, these can easily be incorporated with the rotors in such a way as to be automatically cut out by means of a centrifugal device when full speed is attained. The controlling apparatus is therefore of the simplest, while the motors themselves are capable of running for long periods without the slightest attention.

Unfortunately, however, though this system has been largely adopted in Continental works, it is as yet almost

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unknown in practice in this country; that its advantages will eventually be recognised here also, for transmission of power for all workshop purposes, cannot be doubted, though it is not likely ever to supersede direct current for lighting purposes.

Returning to our subject, we illustrate in fig. 15, one of a number of swing pillar cranes, made by Messrs. Carrick and Ritchie for Messrs. Thomas Parker, Limited, and fitted with Messrs. Parker's motors.

These cranes are used for discharging goods from barges on a canal and transferring them to a warehouse at the back. This is a single motor crane, fitted with friction gear, as seen in the figure; the motor is of the enclosed type, with radiating fins cast in the yoke.

As soon as the load is clear of the barge it is run in along the jib by means of the jenny and swung round for deposit in the warehouse, all three motions being in use simultaneously. The weight of the motor and gearing is applied to partly counterbalance the load. The simplicity of the crane, and the small space occupied by it, are noteworthy; the gearing, however, is necessarily somewhat complex.

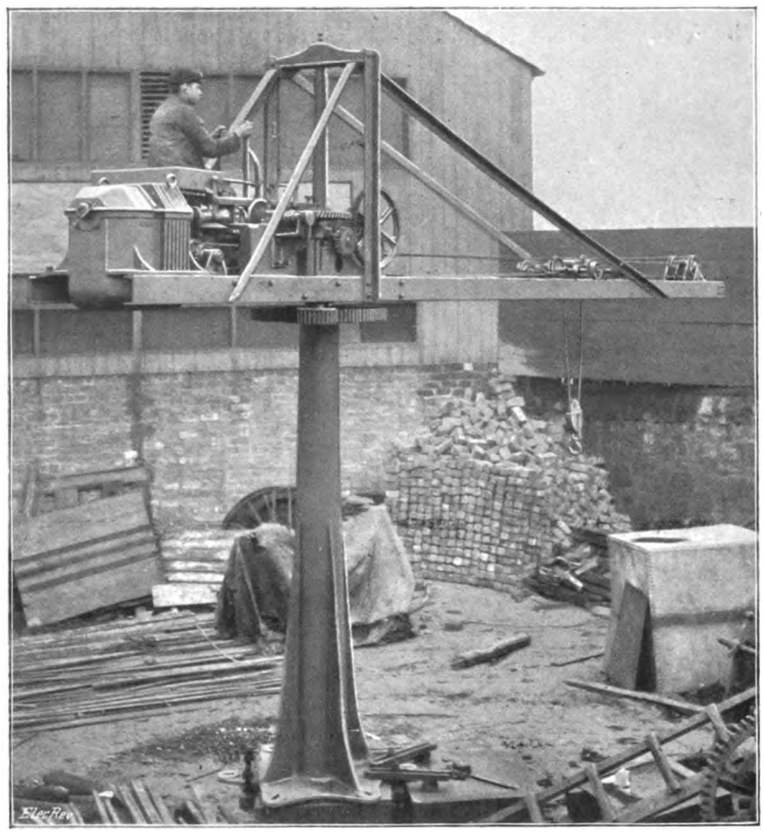

Fig. 15.

A three-motor 30-ton crane, of 60 feet span, is shown in fig. 16. This is provided also with a quick lift for loads up to 5 tons. The travelling gear is driven from the middle of the span by a motor fixed at the end. This crane was constructed by Messrs. Cowans, Sheldon & Co., Limited, of Carlisle; another example of their work, of a type which we have not previously illustrated, is the walking crane shown in fig. 17. This is a cheap and handy type of crane for dealing with moderate loads, not requiring a high lift, and may easily be fitted up in buildings of too light construction to bear the weight of an overhead traveller. The crane illustrated is capable of lifting 5 tons, and is provided with two motors for lifting and travelling; both are of the Bushbury enclosed type, and the first speed reduction is effected by means of worm gear. The jib is swung by hand, friction rollers being used to facilitate the motion. Current is conveyed to the crane by overhead sliding shoes, as usual; the conductors are carried down the column to the hollow base, upon which the controlling switches are fixed, and current is supplied to the lifting motor by means of contact rings fixed on the upright column and brushes carried by the swinging frame.

The Goliath crane shown in fig. 18 is intended for use in timber or goods yards, spanning several lines of rails, or for erecting heavy machinery in the open. The clear height below the beams is 50 feet, span 50 feet, maximum load 20 tons. A separate motor with worm gear is used for each motion, current being conveyed to the motors on the crab by means of the six bare wires seen in the figure; the main supply is brought to the crane by overhead conductors supported on poles.

The travelling motion is effected by means of a single motor driving three shafts of a total length of about 150

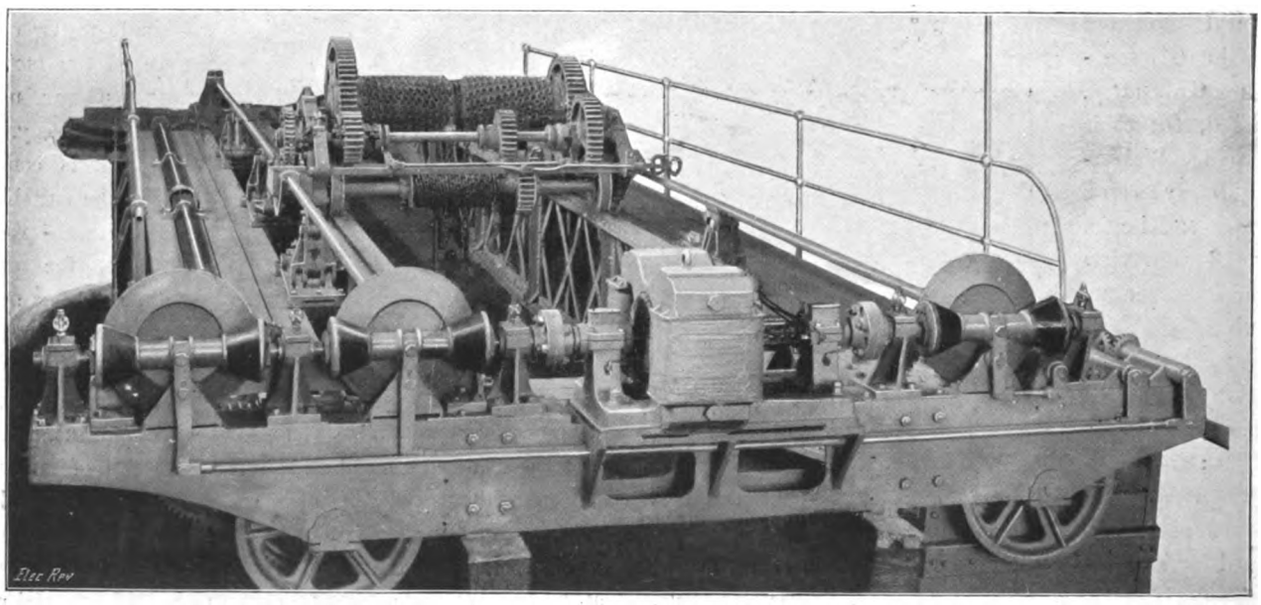

Fig. 14.

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feet; to as far as possible avoid difficulties due to the spring of such great lengths, which would introduce injurious stresses on the framing, the motor, which is fixed at one end, drives the shafting by spur gear mounted at the middle of the span. All the motions are controlled by liquid resistance switch gear from a cabin mounted half-way up one side of the framing.

This is an instance in which no other means of transmitting power to the crane could be practically applied, the only alternative being the use of a self-contained steam plant, with its obvious drawbacks and excessive coal consumption.

(To be continued.)

APPLICATIONS OF ELECTRICITY AT CRIPPLE CREEK, COLO.*

Few mining districts in the United States are so well adapted to the use of electric power as Cripple Creek. The small area of the district and the close proximity of the mines make the transmission of electricity an easy matter; while the fact that most of the mines are small in extent—whatever their output may be—makes the maintenance of separate steam plants costly, and the purchase of power from others an economy as well as a convenience. The pioneers in this district were quick to recognise the facilities for domestic and mining operations which electric transmission would afford. Probably no other mining district is so thoroughly supplied with electricity, for the home of the miner is lighted by incandescent lamps; he goes to his work in an electric street car; by an electric hoist he descends the mine; electric lamps furnish illumination for his work; electrically-driven pumps keep the mine dry; electric air compressors run drills; electric hoists raise the ore, and by electricity the blasts are fired from switchboards remote from the point of explosion.

* *Engineering and Mining Journal.*

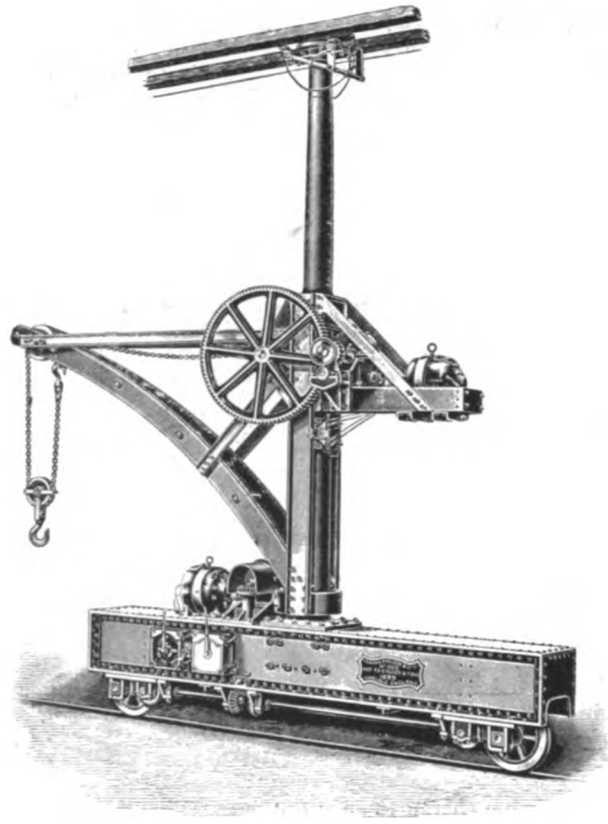

Fig. 17.

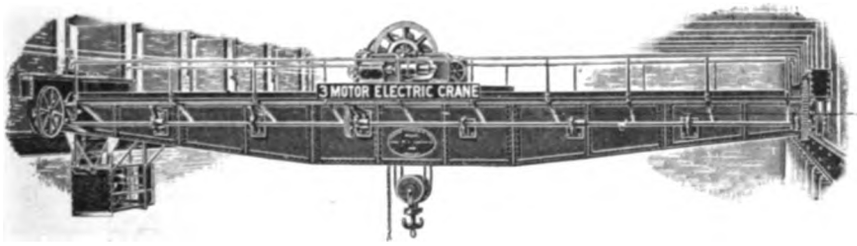

Fig. 16.

Fig. 18.

Electric current is supplied to the mines by the Colorado Electric Power Company, which operates three Westinghouse alternating current 470-kw. generators, three-phase, 500 volts, capable of supplying 2,250 h.p. This station transmits current 27 miles to Cripple Creek, at 20,000 volts. A plant has also recently been established by the La Bella Mill, Water and Power Company for supplying power to its mills and mines.

In many mines in the district Westinghouse type C induction motors have been introduced for hoisting, pumping, operating air compressors for drills, lighting, and for operating crushers and other machinery. The Colorado Ore Reduction Company has a 150-h.p. Westinghouse motor for operating its crushing machinery. Fig. 1 shows two Westinghouse type C motors operating crushers, the motors being partitioned off from the crushers to preserve them from the dust, and the belts passing through the partition to operate the machines. Fig. 2 shows a Westinghouse type C motor operating the mine hoist of the Wisconsin Mine, Cripple Creek. The Lily Gold Mining Company uses 100 h.p. for operating hoists and air compressor; the Moon Anchor Gold Mining Company has a 100-h.p. Westinghouse type C motor for pumping from a depth of 600 feet. The needs of the majority of consumers range from 75 h.p. down to 5 h.p. A Westinghouse type C motor of 15 h.p. suffices for hoisting through a shaft 450 feet deep; when this depth is exceeded a motor of 30 h.p. is used, which will be sufficient for a depth of 800 feet; for still greater depths motors of from 75 to 100 h.p. are installed.

The companies supplying electric power give every facility to lessees and prospectors; they rent small hoists, worked with electric motors, from 5 to 30 h.p., thereby enabling the lessee or prospector to use practically the whole of his capital in development work,

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avoiding the necessity of purchasing and installing a power plant. If they are successful, and ore is found in paying quantities, making it desirable to purchase the electrical power plant, an option of purchase is exercised

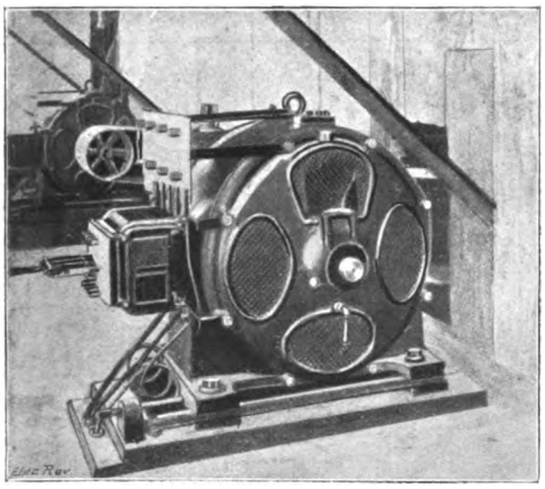

Fig. 1.—Motors Operating Crushers.

which the company granted in the first instance, the rent which has been paid applying on the purchase price. The minimum charge for a 5-H P. electric hoist is $50 per month, which includes the power used. The plants from 15 H P. to 30 H P. range from $65 to $200 per month for rent of motor, &c., and power supplied, depending on tonnage and depth of shaft. The Electric Power Company has

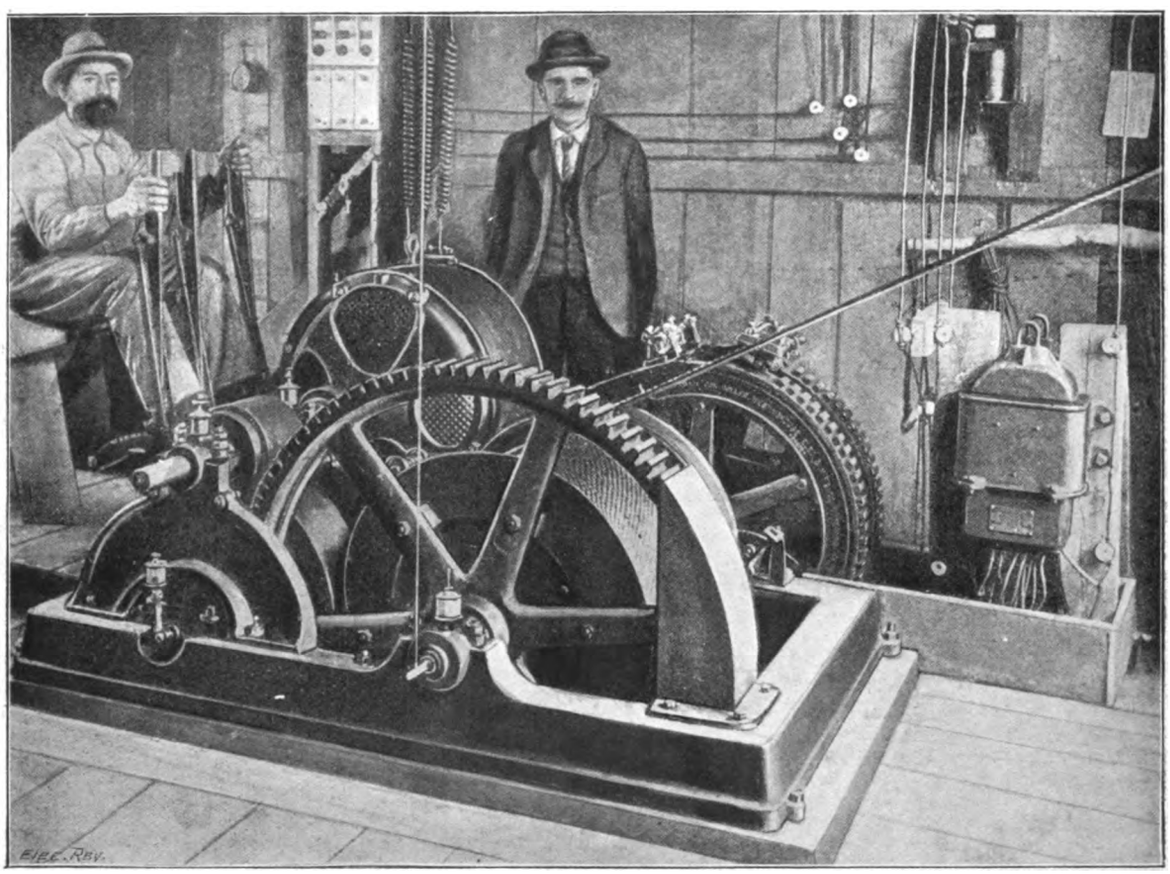

Fig. 2.—Electric Hoist at Wisconsin Mine.

upwards of $60,000 worth of machinery rented out, and is continually making additions.

The principal uses of electric power here are for hoisting and compressing air for the operation of machine drills. Air compressing in the large mines consumes about four times the amount of power required in any other service, for the reason that the compressor is worked almost continuously, while the hoist, though it consumes a large amount of power while in use, is in active operation less than one-fourth of the time. Fig. 3 shows a Westinghouse electric motor operating a mine pump.

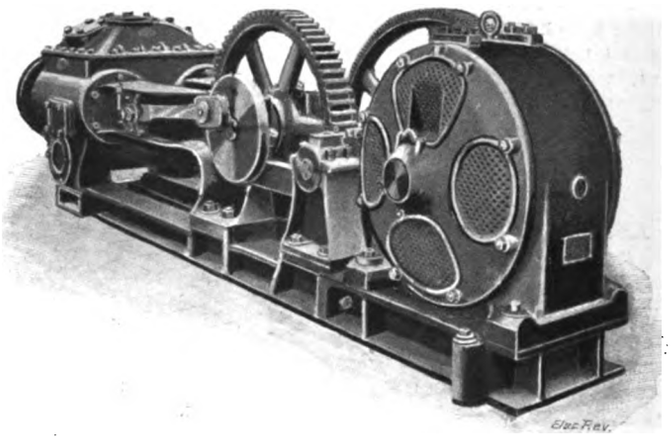

Fig. 3.—Motor Operating Pump.

It is estimated that in the Cripple Creek District the use of electric power as compared with steam power effects a saving of from 15 to 50 per cent., according to the position and circumstances of the mine. This saving is irrespective of reduced wage account, and also irrespective of its greater reliability and convenience, since it is unaffected by frosts. Drills operated directly by electricity without the intervention of an air compressor have been in successful operation elsewhere in Colorado, though no such drills are as yet used in the Cripple Creek District.

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ELECTRIC LIGHTING NOTES.

(*Continued from page* 844.)

Surbiton.—The Ratepayers' Association has written asking the District Council for a copy of the agreement which the Council proposes "to enter into with Callender's, Limited, for the supply of electric light to the district." The request has been refused.

Torquay.—In connection with the recent electric lighting inquiry, it appears that a letter has been received informing the Corporation that the Local Government Board would not sanction the whole of the loan applied for unless further information was supplied showing how the money had been expended on the works. It is stated that the Local Government Board have only sanctioned the borrowing of £7,000 of the £10,000 applied for.

Twickenham and Teddington.—After a year or two in coming to maturity, a company under the title of the Twickenham and Teddington Electric Supply Company, Limited, intends applying to the Board of Trade for powers to construct the necessary works for the supply of electricity to the two parishes of Twickenham and Teddington. According to the terms of the draft Bill, only certain portions will be lit at the start, but powers will be asked to extend as need may arise.

Warlingham (Surrey).—The Council has been considering a communication from Edmundson's Electricity Corporation, Limited, *re* applying for a provisional order, and has replied that it is not itself applying for an order, and would not oppose the application if terms and conditions could be arranged.

Warminster.—At the last District Council meeting Mr. Trollope proposed that the electric lighting plant, purchased some years ago with the view of public lighting by electricity, and which had never been used, be disposed of. The matter was discussed at some length, and eventually it was decided to advertise the plant to see what could be obtained for it.

Weybridge.—A committee of the Council is considering a proposal of the Edmundson's Electricity Corporation to apply for a provisional order.

Withnell.—The District Council has resolved that the application for a provisional order for electric lighting be postponed. A sub-committee will continue the work, and draw up a scheme for lighting the district by electricity as soon as possible.

Worksop.—The District Council has resolved to adopt a scheme set forth in the report of the electrical engineer, estimated to cost £15,779, and that Mr. A. B. Mountain be retained to carry out the scheme.

Yarmouth.—The Corporation has decided to order a 150 KW. steam alternator, to cost £1,611, from Messrs. Willans and Robinson, and to enclose some land contiguous to the generating station at a cost of £250.

York.—The City Council has resolved that the price of electricity supplied to places of worship be 3½d. per unit, and has decided to extend the supply to the end of Barton Lane at an estimated cost, including mains for arc lighting, of £3,000. The electric lighting works are approaching completion.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Airdrie and Coatbridge.—For some time past the Town Councils of Airdrie and Coatbridge have been carrying on negotiations for promoting a tramway Bill in the ensuing session of Parliament. We are informed that for certain reasons Coatbridge now refuses to join Airdrie in the proposed tramway trust. The Coatbridge Town Council has discussed the situation, and in the end it was agreed to have the joint tramway and water scheme proceeded with in the form of a provisional order, on the understanding that they could arrange details amicably later on.

Barnes and Richmond (Surrey).—A newly formed company has notified its intention to apply for an Act of Parliament to enable them to lay down and maintain an electric tramway connecting Barnes with the Royal Borough of Richmond. The length of lines would cover several miles. They would start from Hammersmith Bridge, in the London County area, and proceed by way of Barnes Common and the river side, through Castlenaut, to Mortlake, and thence to Richmond Bridge. To enable the line to reach its objective point with facility, the promoters intend to undertake the construction of a new street in Richmond at the cost of several thousands of pounds, and also to give the Town Council and other authorities concerned easy terms on which the undertaking can be acquired.

Blackpool.—Mr. Quin's automatic cut-out, which has been described in the ELECTRICAL REVIEW, rendered good service one day last week when an overhead wire snapped. Current was immediately cut off, so that the falling wire was dead before it reached the ground and there was no danger to the public.

Blackpool and Garstang.—Notice is published in the Blackpool press to the effect that the Blackpool and Garstang Electric Light Railway Company, Limited, will apply to the Light Railway Commissioners for an order to construct and work light railways between these two towns. The proposal is to run over and use the ways of the Blackpool Corporation and the Blackpool and Fleetwood Tramroad Company by agreement.

Blyth.—A Newcastle paper says that the British Electric Traction Company is proceeding with the arrangements for an electric tram system for this neighbourhood.

Bournemouth.—We learn that the Town Council, after having for several years past offered strenuous opposition to companies that have proposed to construct tramways within the borough, has now adopted, by 15 votes to 3, a proposal to obtain powers to construct tramways over several miles of roads, under the Corporation's own control. The application of a private company, seeking for powers both inside and outside the borough, is to be opposed.

Bradford.—A Tramways Sub-Committee is to interview the Bradford and Bradford and Shelf Tramways Companies with respect to terms for acquiring the unexpired portions of their leases. The idea is to electrically equip the lines if the negotiations are successful. With the exception of the two new municipal electrical lines (Eccleshill and Great Horton) the Bradford tramways are leased until February 1st, 1903, to two companies.

Cambridge.—The Council last week approved of the acquisition of the tramways of the Cambridge Street Tramways Company, and the construction of further tramways to be adapted for electrical power.

Cork.—At a meeting of the Judicial Committee of the Privy Council last Saturday at Dublin Castle, the Dublin Electric Tramways and Lighting Company, Limited, applied for an order authorising the construction of certain tramways in the County of Cork, which would be an extension of the tramways already constructed. The proposed line is intended to run along the Western Road and across the Wellington Bridge, both of which are in the county, and back by Sunday's Well, rejoining the city line. The Council granted the order asked for.

Devonport.—Construction of the Devonport and district tramways was commenced on Tuesday last week. It is expected to be completed by August next, and the Corporation hope by that time to be able to supply electricity generated by a temporary plant. It is certain that the proposed permanent generating station will not be completed by that time. The trolley standards are to be used by the Corporation for arc lighting purposes. There will be 30 cars.

Dewsbury.—The Corporation has decided to apply to the Board of Trade for a provisional order to construct tramways within the borough.

Driffield.—The Driffield Urban Council has discussed a proposal by a Manchester company to construct an electric railway from Driffield to Beeford (10 miles). The Council decided that it was unable to approve of the scheme until it had had an opportunity of considering the details.

Dudley and Sedgley.—At a meeting of the Sedgley Urban District Council last week, a report by the Tramways Committee was adopted, in which was a recommendation that an expert be employed to act on behalf of the Council, in order to see that the work of reconstruction by the British Electric Traction Company of the line between Dudley and Sedgley is properly carried out.

Dumbarton.—The Glasgow District Tramways Company have intimated that application is intended to be made to Parliament in the ensuing session to authorise the construction of electric tramways in Dumbarton.

Edinburgh.—The lessees of the tramways have resolved not to use electricity as the motive power on the Portobello route. The Corporation will now proceed with the erection of a cable power station for this route.

Folkestone, Sandgate, and Hythe.—*Herapath's Railway Journal* says that the South-Eastern Railway Company has in contemplation the construction of a new line from New Romney to Folkestone. The Sandgate and Hythe Electric Tramway Company, Limited, an offshoot of the British Electric Traction Company, Limited, is in the field with a proposal to run an electric tramway between the two places mentioned, passing through Dymchurch and Hythe, and crossing Shornecliffe Camp on its way to Folkestone Harbour.

Garston.—The decision of the Liverpool City Council not to continue the electric tramway along Aigburth Road, a distance of about two miles to Garston Village, has been followed by the formation of the Garston and District Tramways Company, Limited, who announce their intention of applying to the Board of Trade for a provisional order authorising the laying of a tramway.

Grimsby.—The Grimsby Street Tramways Company are applying for additional powers in the ensuing session of Parliament, under which they will use electricity as a means of traction, and will also extend their lines down Welholme Road, thus completing the circuit of the town.

Havana.—We read in a New York journal that the orders for the new electric railway system for Havana begin to mount up into large figures. Following the order to the General Electric

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Company for the generating plant, &c., E. P. Allis & Co. now report that they have received an order for three direct driving vertical cross-compound engines of 1,600 H.P. each for the power house. Work is being pushed very actively, and nearly all the orders are for early delivery in 1900.

Leeds.—It is proposed to reduce the fares on the tramways with the introduction of the electric system on the Headingley and Chapeltown lines, which cannot be much longer delayed.

London.—A daily paper says that the South-Eastern Metropolitan Tramways Company has given notice of its intention to apply to Parliament in the ensuing session for powers to extend its tramways from the present terminus at the Black Horse, Catford, along the Bromley Road to Bromley, and along the Catford Road by way of Bell Green, Beckenham, and Anerley to Norwood. It is also proposed to construct connecting lines between Bell Green, Lower Sydenham, and the Crystal Palace, and from Catford Hill to Sydenham Railway Station. It is intended to construct the lines on the electrical surface contact system.

Manchester and Liverpool.—The promoters of this electric railway have issued circular letters to the owners of land at Eccles and Barton, situate between the highway and the Ship Canal, as a preliminary step in connection with the scheme.

Manhattan Elevated.—The Manhattan Elevated Railway Company has equipped experimentally with the third rail a section of its road at Third Avenue and Eighty-ninth Street. The *Electrical World* says that the third rails with which all the company's lines will be equipped are now in course of delivery under the contract made some time ago, but the work of placing them has not yet begun.

Mansfield.—The Council has considered a letter from Mr. C. H. Gadsby, engineer, Westminster, submitting an electric tram scheme proposed by his syndicate. The system would extend from Sutton-in-Ashfield, through Mansfield, to Mansfield Woodhouse, with a branch line along Chesterfield Road. The syndicate is to apply for a light railway order. The Council has appointed a committee to make inquiries and report.

The Mersey Railway and Electricity.—The *Times* records that the Mersey Railway Company intend to apply for leave to bring in a Bill to enable them, or the company and a joint committee, to work by electrical power the traffic on the company's existing and authorised railways, to light the railways and works by electricity, and to authorise the company, or the company and the joint committee referred to, to work by electrical power the traffic:—

(1) On the railways and stations vested in or under the control of the Mersey and Wirral Joint Committee; (2) on such portions of the Birkenhead Joint Railways of the North-Western and Great Western Companies as the company had, under an agreement, scheduled to and confirmed by the North-Western Railway Act, 1889, the right to run over and use; and (3) on the railways of the Wirral Railway Company. Authority will also be asked for to acquire patent and other rights and licenses in relation to the generation and use of electrical power; to constitute the intended generating stations, &c., an undertaking separate from that of the company. The Bill will also contain a clause to authorise the company or the joint committee to pay out of capital or out of revenue or any of their funds during the construction of the works for adapting the railways mentioned to working by electrical power, or during such time as may be prescribed by the intended Act, interest or dividend on any shares, &c., of the company or the joint committee to be created or issued for the purposes of the Act.

Musselburgh.—With regard to the proposed electric tramway between Portobello and Musselburgh, an agent of the company has attended before the Council and accepted its terms, upon which the promotion of a provisional order will be gone on with. The company had proposed to add in the cost of the unsuccessful promotion of the scheme as a light railway to the purchase price of the tramway as a going concern. The Council objected to this, but was agreeable to £350 being added, and the agent acquiesced.

Newcastle.—A deputation from the Town Council, consisting of Councillor Cail, chairman of the Tramways Committee; the burgh engineer, Mr. Laws; and the electrical engineer, Mr. Hopkinson, visited Glasgow last week, and inspected the electric tramways.

Oldham.—In the Corporation's new Bill to be presented in the next session is the following clause:—

Provisions for the widening of streets for tramway purposes by reducing the footpaths in certain cases, and for the attaching of brackets and wires to houses or buildings for tramway purposes, and in connection with the supply of electric energy.

Paisley.—The Glasgow District Council proposes to apply for powers for electric tramways for Renfrew, Paisley, Johnstone, and Lanark. It is stated that the scheme is introduced by Mr. Murphy, of Dublin.

Plymouth.—Considerable discussion took place at the last meeting of the Town Council with reference to a proposal by Mr. J. H. Rider to carry out the erection of the electric equipment of the Compton section of the tramways by means of workmen in the direct employ of the Corporation. The Tramways Committee approved of this, but as an amendment to their recommendation it was proposed that the electrical engineer should be instructed to prepare specifications of the work, that tenders be asked for, and that the engineer's estimate be presented in a sealed envelope with the other tenders. The mover of the resolution expressed his sympathy with the motion that the Corporation should as far as possible carry out work as the direct employer of labour instead of by the contract system, but said he thought they ought to have more information. Amongst others who supported the motion was the Mayor (Mr. Pethick) whose business is that of a contractor, and who pointed out that the estimate of the Corporation engineers was frequently exceeded when the tenders came in. In opposition to the amendment it was suggested that no contractor would tender under the conditions named, and as to the cost, they already had the engineer's estimate of £3,210. Mr. Rider explained that his proposal meant that all the material should be purchased by contract and that only the actual erection should be done by their own men. The present line to Prince Rock was practically equipped in this way, and it certainly was cheaper. The Council, however, decided by a substantial majority in favour of the amendment.

Preston.—The Town Council has resolved to promote a Bill to obtain powers relating to tramways and producing electric energy, &c.

Reading.—The Town Council has decided to apply for the necessary powers for instituting an electric tramway service forthwith.

Rhondda.—The Pontypridd District Council is engaging Mr. Pritchard, Westminster, at 10 guineas a day and expenses, to report on the feasibility or otherwise of erecting tramways within the district, as suggested by the British Electric Traction Company.

Rossendale Valley.—A committee of the Accrington Town Council has been considering proposals, made by the Accrington Steam Tramways Company and the British Electric Traction Company, Limited, for the extension of the tramway system in the Rossendale Valley. The chairman of the first-named company, in a letter addressed to the town clerk of Accrington, intimated that it was the intention, subject to terms being arranged with the Corporation, to work the two companies in conjunction, so as to provide for the inhabitants of the district a continuous and efficient tramway system from Bacup, through Accrington, to Clayton-le-Moors and Church. "It is intended," he said, "to apply for powers to extend the present systems to Rishton and Great Harwood (and probably in time to Whalley), on the one side, and to Helmshore, and in the direction of Ramsbottom on the other side. All these lines will centre in Accrington." It is proposed to adopt the overhead trolley system, and the Corporation is invited to carry out the necessary work upon all the lines now leased by it to the company, and to adopt them for electric traction, the company being granted a 21 years' lease upon terms to be arranged. The secretary of the British Electric Traction Company wrote as follows to the Corporation:—

In carrying out the proposed scheme, it will be necessary, as stated, to consolidate the Accrington and Rossendale companies. In doing this, however, it is our intention to retain the local character of the company, not only with respect to the name, but also in the constitution of the board of directors. Local representatives will be elected to seats on the board of the consolidated companies. . . . . In the case of the Oldham-Ashton, which was a new line constructed by us with the concurrence of the local authorities, we have entered into an agreement with the Ashton Corporation for the supply of current by them for the purposes of the tramways, similar to that proposed by the Accrington company, at a price of 1½d. per unit for a minimum of 850,000 units, and reducing to 1d. per unit as the supply increases. At North Shields again we made a similar arrangement with the Corporation, whereby they undertook to supply electrical energy for the tramways at practically the same rates as at Ashton. In most cases the Corporations have agreed that our engineer shall be consulted with regard to the plant installed by the Corporation for the purposes of the tramway supply.

The Legal and Parliamentary Committee of the Corporation decided that before definitely considering the proposals made it would be advisable to ascertain the views of the Haslingden and Rawtenstall Corporations as to the issues involved, and they accordingly instructed the town clerk to write to those Corporations, asking them:—

(1) Whether they would be disposed to join in the purchase of the tramways undertaking by each buying the lines in its own district and a proportionate amount of the rolling stock and plant. (2) Whether they would be willing to waive their respective paramount powers to purchase the lines in their own districts for 21 years in the event of Accrington Corporation agreeing to buy the whole undertaking and convert the system into an electric traction one. (3) Whether they would be prepared to waive their paramount purchasing powers for 21 years in case the Accrington Corporation agreed to extend the lease for a like period.

It is expected that a conference between the three Corporations will be arranged.

Stirling.—It is stated that an arrangement has been come to between the British Electric Traction Company and the Stirling and Bridge of Allan Tramway Company, under which the former takes over the tramways from Bridge of Allan to St. Ninians, subject to arrangements being made with the municipal bodies interested.

Surrey.—The Surrey County Council has adjourned for three months the proposals which their Highways Committee drew up for the construction of electric light railways in the county covering a distance of about 30 miles, and springing from Hammersmith Bridge as a common starting point.

A Tribute to the Trolley.—At Birmingham they have always had a remarkable antipathy to the trolley, not so much that they have any real knowledge against it worth considering, but æsthetic feeling at sublime Birmingham is very strong, and for years the opposition has been most determined in the Council. If impartial statements are to have any effect at all in settling the question, the following very excellent tribute from Leeds, appearing in the *Birmingham Argus*, ought to bring matters to a head:—

"Sir,—In reply to your letter of 10th inst., I have to inform you that the system of overhead electrical traction at present in operation in this city has proved successful and given satisfaction to the inhabitants, the electric cars being patronised in preference to horse and steam cars. The only route at present worked by the electric system consists of about eight miles of double track. Two other

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routes have since been equipped, and it is hoped they will soon be opened for public traffic. I should add that at a meeting of the Council of this city, held on 4th ult., a resolution was passed that the system be applied to practically the whole of our tramways, about 53 miles reckoned as single track. I am informed that generally the system has not led to any depreciation in the value of property in its neighbourhood. So far as I am aware, it is not more dangerous than tramways generally are, and, as a matter of fact, nothing serious has happened up to the present.

"Leeds." "W. J. Jeeves, Town Clerk.

Twickenham and Hampton Court.—The London United Tramways Company are seeking for Parliamentary powers to construct an electric tramway from Brentford through Isleworth and Twickenham to Teddington and Hampton Court. This scheme is practically the same in respect of which they wanted a light railway order in the summer, but which was rejected owing to the opposition of the London and South-Western Railway Company, with which line it would compete. So far as the local authorities, through whose districts the line is to run, are concerned, they have already agreements with the promoters that they will assist the measure, the promoters in return making extensive alterations and improvements in main roads.

Walsall.—The Town Council last week considered the proposal to promote a Bill to give the Corporation power in regard to the tramways and other matters. The Bill will cover acquisition of tramways and applications for powers to extend the tramway lines in various directions, and also to work them. The Bill proposed to give the Corporation power to extend the lines as far as Walsall Wood in one direction, through Great Barr and Handsworth to Perry Barr in another direction, terminating with a junction with the lines of the Birmingham Central Company, near to Perry Barr Railway Station. A third extension proposed was to Willenhall, connecting there with the Wolverhampton tramways; and a fourth extension was from the present terminus at Bloxwich to the borough boundary on the Stafford Road. These extensions meant the construction of about 13 or 14 miles of tramway, and the total cost, including electrical equipment and cars, was in round figures from £100,000 to £120,000. The town clerk mentioned that a site for an electric generating station for the tramways had been selected, this being necessary to meet Parliamentary requirements. Among the other provisions in the Bill is "power to supply electrical fittings." The town clerk was formally authorised to take all necessary steps for the promotion of the Bill.

Warrington to Northwich.—Parliamentary powers are to be sought for the construction of an electrical railway between the above towns. The solicitor and the engineer of the scheme attended before the General Purposes Committee of the Northwich Council on Monday, and explained the proposal. The Committee approved of the undertaking.

Yarmouth.—The Town Council last week resolved to proceed with its electric tramway scheme, for which powers have been obtained to spend £55,000. The overhead wire system is to be adopted.

York.—The Council has decided to purchase the tramways company's undertaking either at once or in 1900 and 1902, according to the result of certain negotiations now proceeding. The idea is to have the lines extended and worked electrically.

TELEGRAPH AND TELEPHONE NOTES.

The African Trans-Continental Telegraph Line.—Reuter's correspondent at Abercorn (Rhodesia), writing under date September 2nd, says that the African trans-Continental telegraph line is at present only 15 miles from Abercorn, or 29 miles from Kituta, the south end of Lake Tanganyika. In the present scarcity of labour the chief of the construction, Mr. Fox, does not expect to get this small section of line finished for two or three months. From the *Times* we gather that the Tanganyika Concessions Company are going to put a steamer on Lake Tanganyika. She should be out in about three months' time and floated in about nine months. It is mainly for the transport of telegraph materials up the lake. The *Cecil Rhodes*, which presumably is the vessel referred to, was launched at Wyvenhoe on Saturday last. She will be employed primarily in laying the wires of the Cape-Cairo telegraph line along the shores of the lake.

Cable Interruption.—According to the *Levant Herald*, the submarine cable between Lattakieh and Cyprus has been damaged, and the Turkish Government has invited several European firms to submit estimates of cost for the repair or the renewal of the cable.

Cables for French Colonies.—From the *Morning Post* we learn that inspired, of course, by current events, M. Marc Landry, the well-known writer on Naval matters, is again expatiating on his favourite theme of the urgent necessity France is under of establishing direct telegraphic communication with its Colonies. In order to emphasise his arguments he prints two maps, showing how Great Britain has been "putting girdles round the earth," for half a century, while France has only two direct lines from Europe to the Western Continent, and another from Cape Cod to Hayti, continued to Puerto Rico, Guadeloupe, Martinique, and Cayenne, with small loop lines connected. M. Landry dwells strongly on the great advantages Great Britain has obtained by controlling all the news from South Africa, and asserts that the British are in a similar favoured position throughout the globe. Even French Colonies, like Madagascar and New Caledonia, he says, are under the control of British telegraph clerks. "What," he asks, "would be our situation in case of war with Great Britain? It would be only too simple. Great Britain would begin by cutting us off from our Colonies. After that she could disembark troops in them, concentrate squadrons, and bombard ports and capture our merchant ships without our being even able to warn our possessions of the imminence of hostilities. Is it not manifest that a Power that has a complete telegraph network will be mistress of the seas?" From all these facts M. Landry concludes that it is the duty of the Chambers to facilitate the creation of a system of French submarine cables.

In another place it is stated that recent events in the Transvaal have revealed to the French legislators the advisability of emancipating France from dependence upon English submarine cables, and the colonial group of foreign trade advisers decided last week, at M. J. Siegfried's suggestion, to impress upon the Government the necessity of prompt action in order to obviate the dangers of the situation. The authorities of Indo-China have decided to lay down a submarine cable between Saigon and Port Arthur. All the Indian Ocean and Pacific Ocean cables being now in English hands, France, in the event of war, would be at the mercy of England for the transmission of news.

The Rival Cables.—A Sydney paper has the following: "It has already been stated that at the recent conference between the Postmasters-General of New South Wales and Victoria it was agreed that if official recognition was given to the proposed Cape cable it must be on the understanding that there should be no undercutting of rates which would affect the business on the Pacific cable. The whole question, as to the influence this Cape project might have upon the Pacific cable, was discussed by the Ministers. The decision of the conference has been transmitted home by the representative of the Eastern Extension Company in Australia, with the object of ascertaining the views of the governor of the company on the matter.

The same paper also says:—

Sir Sandford Fleming has gone back to Canada, and it is understood that he is not at all satisfied, not to say grievously disappointed, with the results of the recent confabulations with the Imperial authorities on the proposed Pacific cable scheme. In these later discussions the Agents-General for South and West Australia have had no part—a peculiar fact, seeing that they were both assisting in the attempt on the Treasury which resulted in the offer of an annual subsidy from the Imperial Government. It would be interesting to know why Dr. Cockburn and Mr. Wittenoom were ignored.

For myself, I think that from an Australian point of view it would have been policy to have let the "All Red Cable" scheme lay dormant until Federation was an accomplished fact, and Australia could speak with one voice to the guardian of our national purse. That section of the British public interested in Imperial schemes now recognises that to be effective the all red cable must be duplicated, a fact which greatly increases the financial responsibility of the partners in its construction. They know also that at present Australia as a whole is not particularly keen upon the new line, and would like to be assured that when having, through Federation, obtained an interest in the South Australian trans-Continental line, the colonies which have been so eager for the construction of the Pacific cable will not modify their view as to the commercial worth of the "all red" route to them.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies:—		
Jamaica-Colon	June 30, 1899 ...	...
Trinidad-Demerara (1871 original)	Oct. 20, 1899	Nov. 9, 1899.
Do. do. (1891 duplicate)	Oct. 6, 1899	one cable restored.
South African:—		
Zanzibar-Mombasa	Oct. 27, 1899 ...	...
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Havre-Waterville	Oct. 25, 1899 ...	Nov. 19, 1899
Latakia-Cyprus	June 20, 1899 ...	...
Landlines.		
West Indies:—		
Cuban Government lines... ...	Oct. 30, 1899 ...	...
Communication with Jeremie and Port de Paix (Haiti)	Oct. 14, 1899 ...	Nov. 18, 1899
Communication with Les Cayes (Haiti)	Nov. 22, 1899 ...	...
South African:—		
Communication with Mafeking...	Oct. 13, 1899 ...	...
Communication with all offices beyond Orange River	Oct. 18, 1899 ...	...
Communication beyond Burghersdorp, Cape of Good Hope, and Estcourt, Natal...	Nov. 7, 1899 ...	...
Colombian Government lines to Bogota	Oct. 21, 1899 ...	...
Communication with interior of Colombia, excepting Amalfi, Ambalema, Buga, Cartago, Ibagua, Manizales, Medellin, Palmire, Pasto, Popoyans, Reimedos, Honson, and Santo Domingo... ...	Nov. 6, 1899 ...	...
Communication with Valentia (Venezuela)	Nov. 18, 1899 ...	...

The Telephone Service.—The question of municipal telephones has been taken up at Burnlem. According to the *Municipal Journal* the General Purposes Committee of the Town Council has reported that at the recent conference of local authorities at Longton on the question of providing a cheaper telephone service, the principle of competition was agreed to be desirable, and it was recommended that a committee be formed to obtain information as to the practicability of establishing a cheap telephone service, either by combination of local authorities or by a company. Our contemporary says that at Glasgow matters have advanced another stage. The Postmaster-

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General has asked that, in order to enable him to complete the license to the Corporation for the erection of a telephone exchange, he should be furnished with new resolutions of the various local authorities similar to those formerly passed. The burghs included in the area have been asked to comply with this request.

English Industrials, Limited, having written to the Withnell District Council regarding a proposed telephone service, that body has decided to give the company support and grant them wayleaves on terms to be arranged.

The York City Council is to apply to the Postmaster-General for a license to provide a system of public telephones.

The Moss Side District Council has approved of the proposal of the Mutual Telephone Company to apply for a license to establish telephonic communication in that district.

Telegraphic Communication with South Africa.—The postal telegraph authorities issued the subjoined notice on Monday:—

The Mozambique-Lourenço Marquez cable has been repaired, thus restoring communication with South Africa by the east coast route. It has been found necessary to suspend at Aden, as well as at the Cape of Good Hope, the transmission of all telegrams in code or cipher, whether of foreign Governments or private persons, to and from Zanzibar, Seychelles, Mauritius, Madagascar, British East Africa, German East Africa, Mozambique, Delagoa Bay, Rhodesia, British Central Africa, Orange Free State, Transvaal, Cape Colony, and Natal. Telegrams in plain language will be subject to censorship, and be at the sender's risk.

It is stated that the *Anglia*, cable ship, started on 19th inst. laying the new deep-sea cable from Capetown to St. Helena.

Wireless Telegraphy.—The *Scientific American* says that the director of the Meteorological Observatory on Mt. Blanc has been considering the advisability of installing the Marconi wireless telegraphy system upon the mountain. The ordinary system of telegraphy is used normally, but the great snow-drifts have played havoc with the telegraph wires. It is believed that the wireless system of telegraphy would prove not only valuable from a scientific point of view, but would also increase the safety of travellers upon the mountain.

CONTRACTS OPEN AND CLOSED.

OPEN.

Battersea.—December 4th. The Vestry wants tenders for arc lamps and posts. See "Official Notices" November 17th.

Birkenhead.—December 12th. The Corporation wants tenders for the supply of condensing plant, overhead crane, and feeder mains for the electric tramway works and scheme. See "Official Notes" this week.

Blackburn.—December 23rd. The Corporation wants tenders for overhead trolley line equipment. See "Official Notices" to-day.

Blackpool.—December 15th. The Corporation wants for the electricity works four boilers and accessorial steam plant; two 600-KW. steam alternators (or one 1,200-KW.), switchboard, mains, transformers, and battery. See "Official Notices" to-day.

Cork.—November 28th. The Committee of Management of the Cork District Lunatic Asylum wants tenders for fitting and lighting and driving plant, according to specifications to be seen at the office of Messrs. Hill & Son, 28, South Mall, Cork, or at Messrs. Edmundson's, Capel Street, Dublin.

Darwen.—November 27th. The Corporation wants tenders for one Lancashire boiler and accessories, one tramway switchboard. See "Official Notices" November 10th.

Denmark.—December 28th. The Corporation of Aarhus is inviting tenders for the water-tube boiler plant, steam dynamos and switchboard, accumulators for electricity works. From our "Official Notices," November 3rd, further particulars may be obtained.

Essex.—November 27th. The Governors of Felsted School, Essex, are inviting tenders for boiler, two 27-KW. steam dynamos, condenser, pipework, accumulators, cables, and switchboard for electric lighting. See "Official Notices" October 27th.

Gloucester.—December 28th. The Electricity Committee wants tenders for extension plant including Lancashire boiler, &c., one 300-KW. steam dynamo, switchboard work, condensing plant. See "Official Notices" to-day.

Hackney.—December 12th. The Vestry Electric Lighting Committee is inviting tenders for refuse destructors to deal with the whole of the refuse of the parish. Specification, &c., may be obtained at the offices of Mr. Robert Hammond, M.Inst.C.E.

Harrow.—December 4th. The Electric Light and Power Company wants tenders for a 150 KW. steam dynamo and switchboard extension. See "Official Notices" November 17th.

Lambeth.—December 6th. The Vestry is prepared to receive tenders for 25 arc lamps and posts. For particulars, see "Official Notices" November 10th.

Manchester.—December 2nd. The Tramways Committee wants tenders for 5,000 tons of steel girder rails and 250 tons of steel fish-plates. See "Official Notices" November 17th.

The Midland Corporation.—December 18th. From an "Official Notice" this week, particulars may be obtained of certain plant and machinery and conductors, for 10,000 B.H.P. output, required for the new power house to be erected by the Midland Electric Corporation for Power Distribution, Limited. There will be 16 water-tube boilers, six sets of Corliss engines and three-phase generators, transformers, switchboards, mains, batteries, &c.

Mistretta (Sicily).—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Palermo, stating that tenders are invited by the Municipality of Mistretta, not later than December 31st next, for the establishment of a service of electric lighting in that town. Such particulars as have been received may be examined on personal application at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 5 p.m.

Newcastle-on-Tyne.—November 30th. The Tramways Committee wants tenders for two 1,000-H.P. steam dynamos for electric tramway works. See "Official Notices" October 27th.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

Plymouth.—December 8th. The Corporation wants tenders for tramcars, trucks, motors, trolley arms, &c. See "Official Notices" November 17th.

Rathmines and Rathgar.—December 13th. The Council is inviting tenders for additional feeding and distributing mains, including trenching, cables, joint boxes and house services. See "Official Notices" this week.

Stockport.—November 29th. The Council wants tenders for three-wire feeder cables and pilot wires. See "Official Notices" this week.

Weybridge.—December 4th. The Oatlands Park Hotel Company, Limited, wants tenders for wiring and fittings for 423 lamps at their hotel. See "Official Notices" to-day.

York.—December 4th. The Corporation invites tenders for the electric wiring and fitting of the Guildhall municipal offices and Mansion House. See two "Official Notices" in this issue.

CLOSED.

Darlington.—The contract for supplying the engines and electric lighting plant for the new installation at Darlington has been placed with Messrs. Ernest Scott & Mountain, of Newcastle-on-Tyne. Prof. Kennedy is consulting engineer. The work at present is not proceeding as fast as desired, pending the completion of the negotiations between the Corporation and the Imperial Tramways Company as to the supply of electric power.

Hammersmith.—At the Vestry meeting on Wednesday tenders, as under, for wiring and supplying fittings for the electric lighting of the Vestry's stables depôt, were received:—

Messrs. H. Beard & Co.	£165 0 0
Messrs. Russell & Russell	133 0 0
National Electric Wiring Company	197 17 0
Messrs. Peto & Radford	185 0 0
Messrs. Allen & Co	182 0 0
Messrs. A. Thatcher & Co.	153 17 10
Messrs. A. Hunt & Co.	168 10 0
Messrs. J. Bakewell & Co.	108 2 0
Messrs. Foote & Milne	129 0 0
Electrical Transmission Company	170 0 0
Messrs. Vaughan & Brown	165 10 0
Messrs. Newsome, Pinching & Co.	159 6 0
Mr. T. H. Hellyar	105 5 0
Mr. W. J. Adams	162 16 9
Mr. H. J. Godfray	168 0 0

The tenders were referred to Committee.

Llandudno.—For the supply of three high-speed engines and dynamos (150 KW each), motors, &c., for the District Council, the contract has been given to the India-Rubber Company, of Silvertown, at £4,020. The engines will be supplied by Messrs. Allen. Messrs. Babcock & Wilcox will supply a boiler at £1,200.

Swansea.—The Council has accepted the tender of the British Electric Schuckert Company for an engine and dynamo for the electricity works at £8,440.

Wigan.—The Town Council has accepted the tender of the E.P.S. Company for accumulators for the electricity works at £1,563. The Council is making application to the Public Works Loan Board for an £85,000 loan for electric lighting purposes.

FORTHCOMING EVENTS.

Friday, November 24th.—At 5 p.m. Physical Society. Agenda.—"On the Conductivities of certain Heterogeneous Media for a Steady Flux having a Potential." By Dr. C. H. Lees. "On the Thermal Conductivities of Mixtures and of their Constituents." By Dr. C. H. Lees.

At 8 p.m. Electro-Harmonic Concert, Café Monico, Regent Street.

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Tuesday, November 28th.—At 8 p.m. The Institution of Civil Engineers. Papers to be further discussed:—"The Waterloo and City Railway." By H. H. Dalrymple-Hay, M.Inst.C.E. "The Electrical Equipment of the Waterloo and City Railway." By Bernard M. Jenkin, Assoc.M.Inst.C.E. Time permitting, paper on "Combined Refuse Destructors and Power Plants." By C. Newton Russell, Assoc.M.Inst.C.E.

Manchester Society of Junior Electrical Engineers. Meeting at Deansgate Hotel, Manchester. Paper by Mr. J. H. Henderson on "Aluminium, Its Treatment and Use, as Applied to Electrical Engineering."

Thursday, November 30th.—At 4 p.m. Royal Society anniversary meeting.

Tuesday, December 5th.—At 8 p.m. Northern Society of Electrical Engineers, Grand Hotel, Aytoun Street, Manchester. Paper on "Methods of Suppressing Arcing at Switch and Fuse Contacts," by E. K. Scott.

Wednesday, December 6th.—Institution of Electrical Engineers' annual dinner, Grand Hall, Hotel Cecil.

NOTES.

The Demand for Skilled Mechanics.—The Westinghouse Machine Company are advertising in American papers that they are enlarging their works and require skilled mechanics, &c. There may be nothing in this more than appears on the face of it, but it may mean that men are required for the new English works at Manchester. If these works are to employ 5,000 men, it is not easy to see how they can be secured except by special purchase on this side if the present condition of business holds out.

High Voltage Lamps.—Mr. A. H. Gibbings, in a letter to a contemporary, states that he considers 6 and 8 C.P. lamps for 230 volts to be as good in every way as the larger sizes, and that out of 800 8-C.P. lamps in Bradford not one has caused complaint since the pressure was raised in 1897. As the Bradford Corporation supplies lamps for renewal, free of charge, the staff has had occasion to make thorough tests of all kinds of glow lamps, as a result of which Mr. Gibbings says "there can be no question that at the present time the majority of manufacturers make equally as good, if not better, 200—230-volt lamps for all candle-powers than was the case when 110—115 volts was the standard voltage." The literal meaning of this remark is that manufacturers make 200—230-volt lamps now as well as, if not better than, they did some years ago, which might well go without saying. If, however, as we hope, and as the earlier part of his letter implies, Mr. Gibbings means that 200—230-volt lamps are as good now as 100—115-volt lamps were then, we must congratulate lamp makers upon the excellent progress which they have made in the interim.

Aluminium Electric Cable.—The *Electrical World* says that the Hartford Electric Light Company is just completing the installation of its aluminium cable between the new power house in Tariffville, on the Farmington River, and Hartford. The cable has seven strands and a diameter of three-fourths of an inch. It weighs about 1,500 lbs. to the mile, or nine tons for the whole line. The cable is not insulated, as is the copper cable which brings the 10,000-volt current from the Poquonock power house. The poles are short and very strong. No trouble is apprehended from weather conditions, as the cable is so light and strong that no amount of snow or ice which may accumulate on it in winter is likely to break it. The cable has been furnished by the Pittsburg Reduction Company, and its use in Hartford will, it is said, be the first practical electric test of aluminium on a large scale and over so long a distance.

Granite as an Insulator.—Granite is not usually considered to be an insulator, but one of the electrical journals reports that insulators are made as follows:—Maine granite is crushed and moulded into form and fused at 3,000° F. It resists all but hydrofluoric acid, and does not crush at a lower pressure than 14,560 lbs. per square inch, and gives a tensile strength of 480 lbs. per square inch; 56,600 volts were required to pierce ¼ of an inch of this material in the shape of cup insulators.—*Scientific American.*

Local Authorities and Telephones.—We call the following from the *Local Government Journal*, again without comment:—

The attention of General Webber has been called to the paragraph headed "Sweet are the uses of Advertisement," in the last issue of the ELECTRICAL REVIEW, and he has reminded us that throughout the controversy in the past on the subject of the telephone the REVIEW has uniformly taken the side of ante-localisation, which view naturally the National Telephone Company strongly supports. The number of experts in telephone engineering are so very few that we think General Webber should be thanked for letting Municipalities and Local Authorities know that the advice he can give them, in a way second to none, is available—particularly, as he tells us that any preliminary general advice he may offer will be gratuitous—in view of the prominent independent position and interest he has taken up on the question from its earliest stages until now.

The Institution of Electrical Engineers.—The opening meeting of the session was held on Thursday of last week, when the premiums were presented to those to whom they had been awarded for papers read or published during the past session. The President announced that Mr. Henry Wilde, of Manchester, had donated £1,500 to the Benevolent Fund. Amongst those who had gained premiums were Messrs. McMahon, Duddell and Marchant, Oliver Lodge, Marconi, Young, and last, but, in the opinion of the meeting, by no means least, Mrs. Ayrton. Mr. J. W. Swan, having resigned the chair to Prof. S. P. Thompson, was awarded the usual vote of thanks. The presidential address will be dealt with elsewhere, so we need only say that it covered considerable ground and was full of terse and pithy hits at some of the weaknesses of the day—for example: "A grindstone is more likely to cause a fire than an alternate current motor, but there are no rules prescribed for enclosing grindstones." Mr. Gray proposed, and Mr. Mordey seconded, the vote of thanks to the President on his address. The seconder neatly summarised the address as a new feature, for the President took the *rôle* of a prophet, and spoke rather of the future than of the past. It was a fighting address, and he suggested that the rest of the session should be devoted to discussing it. The President gently vetoed this proposal, but as his interdict does not extend to technical journals, we have taken up the cudgels on our own account. The address will be valued as an able and critical survey of the present position of the field of electrical industry, and those who were unable to hear it delivered, although they will lose a good deal, will find it well worthy of perusal in cold print. Yesterday evening the meeting was to be devoted to mechanical and steam engineering questions.

Appointments.—Mr. A. G. Cooper, at present electrical engineer to Messrs. Davy Brothers, Limited, and formerly station superintendent of the Sheffield Company, has been appointed electrical engineer to the borough of Colne (Lancashire) to design and lay down a combined plant for electric lighting and traction purposes.

The recent advertisement for a second electrical engineer for the St. John Del Rey Mines in Brazil, elicited a large number of replies. Mr. W. C. Rooper wishes to state to applicants that the company have appointed Mr. A. J. Ewing, one of the assistant electrical engineers at the Elswick Works of Sir W. G. Armstong & Whitworth & Co., Limited, who applied through the advertisement in this paper.

Obituary.—The death is announced of Sir J. William Dawson, Emeritus Principal of M'Gill University. He was not only a teacher and administrator, but a diligent worker at more than one branch of geology, and the author of many books and of many contributions to scientific journals. He was knighted on the occasion of the visit of the British Association to Montreal, having received a C.M.G. two years before. He was a Fellow of the Royal Society in England, and first President of that in Canada, President of the American Association in 1882, and of the British Association in 1886.

Royal Society Medals.—We read in *Nature* that the council of the Royal Society has adjudicated medals for the current year as follows:—The Copley medal to Lord Rayleigh, F.R.S., for his contributions to physical science; a Royal medal to Prof. George Francis Fitzgerald, F.R.S., for his contributions to the advancement of physical science, especially in the domains of optics and electricity.

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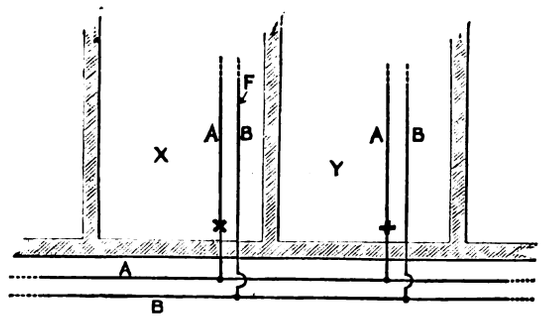
Warning.—Many of our readers have a very lively remembrance of the recent charge made against a "consulting engineer," who sought to attain certain ends by means of advertisements published in this and other journals. In order to place our readers well upon their guard, we feel compelled to utter a warning about another offending party. It is at the moment inadvisable to mention either the character of the offence, or the names of the delinquents, but we may just say that they are offering to do very big things for a comparatively small charge—things which our own personal experience in searching out information shows to be impossible at the price. If those who have lately had dealings with a suspicious firm up Manchester way will communicate with us, we will undertake to treat their letters with the strictest confidence and again communicate with them if thought desirable.

Earthing the Middle Wire.—A possible source of danger, due to the practice of earthing the neutral of a three-wire system, has been brought to our notice by Mr. Musgrave Heaphy, whose vigilance in the detection of fire risks is well known. Referring to the figure, where A and B are the street mains, of which B is earthed, X and Y are separate consumers (not necessarily adjacent), and F is an earth fault in X's wiring—suppose that X is taking a large current; then owing to the fact that the neutral is earthed at the station only, and that there is often a drop of pressure in the neutral, a considerable part of the return current may be shunted through the fault to earth, and it is easy to imagine conditions under which a fire would ensue. We have, in fact, seen a compo gas-pipe melted and the gas ignited, by an accidental contact between a lampholder of the old-fashioned type and a gas bracket. While an earth

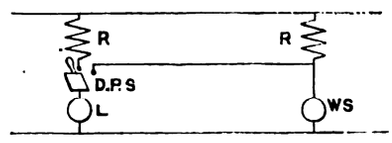


occurring on the *other* pole would immediately blow the fuse, the kind of fault suggested would not do so, and would therefore be all the more dangerous; further, as Mr. Heaphy points out, in some cases no switch is inserted in the conductor connected with the earthed main, so that, even if X opens his main switch, as shown in the figure, it is quite possible that Y may be using a large current, part of which will flow through the fault in X's premises as before, with the added risk that the latter may be unoccupied. The use of a double-pole switch in every consumer's main circuit does away with the last-mentioned danger, and should in our opinion be insisted on when one pole is earthed; but to guard against the first is more difficult. If the neutral were earthed not only at the station, but also at several points in the network, the fire risk would be eliminated, but electrolytic troubles would be brought on; possibly the cure would be worse than the disease!

Christmas Comfort for Tommy Atkins.—It is very pleasing to hear that the brave defenders of our honour in South Africa are being well thought of in connection with the approaching Christmas season. Among others we note the name of Messrs. Richard Johnson, Clapham & Morris, Limited, of Manchester, dynamo brush manufacturers, &c., who, together with their employés, are sending out 2,000 woollen and other comforters as a Christmas present for the men of the various Lancashire Regiments now engaged at Ladysmith.

Wireless Telegraphy.—A Laffan telegram from New York says that the Marconi Wireless Telegraph Company has been incorporated with a capital of 10,000,000 dollars.

The "Same Circuit" Method of Incandescent Lamp Photometry.—In the Electrical Review for October 27, p. 667, appeared an article on this subject which we reprinted from the *American Electrician*. The following letter has now been sent to that journal by S. E. Doane, of Marlborough, Mass.:—"I notice you mention the care that must be taken when turning off the lamp under test to prevent the diminished drop in the rheostat feeding the lamps from overburning the working standard. In practice a much more satisfactory arrangement than that shown in your diagrams has been developed, which consists in the use of two separate resistances, one for each lamp, and connected in series with that lamp as shown in the accompanying



R, R, Resistances; D P S, Double-pole switch; L, Lamp under test; W S, Working standard.

The Connection of Two Resistances and an Equaliser for the "Same Circuit" Method of Photometry.

figure. If, then, one lamp is turned off, the voltage on the other is not changed. The drawback to this method is that incandescent lamps, although supposed to be similar, are not exactly identical in resistance. Therefore this method of working would introduce an error wherever the resistances of the lamps departed from the average, due to the fact that the drop in one resistance would vary while that in series with the working standard would remain constant. This can be compensated for by putting an equaliser wire between the lamp terminals and arranging to have the circuit through this wire broken at the time the lamp being measured is removed from the socket. In central station work this can be done by means of a double-pole switch, as indicated in the diagram. In case rapidity in the measurement of a large number of lamps is desired, the insertion of the lamp to be tested can be made to close the equaliser wire circuit automatically and open it again when the lamp is removed."

Personal.—Mr. Claude W. Hill, who was for several years manager to Messrs. Paterson & Cooper, at Dalston, and has lately held the same position with Messrs. J. P. Hall & Co., Oldham, has been appointed London representative to the latter firm. Mr. Hill's address is Broad Street House, E.C.

Our trans-Atlantic namesake says that Prof. Henry S. Carhart, of the Department of Physics of the University of Michigan, who is absent on leave, is at the Physical Technical Institute, Berlin. He is comparing the electromotive force of the standard Clark cell with that of the standard cell of the Institute.

Prof. A. Jamieson returned some weeks ago from Cape Town, where he has been investigating a case of interference between the electric tramways and submarine telegraph cables. His evidence will be taken before a commission to-day at the Law Society's, Chancery Lane, and will be heard at the Supreme Court, Cape Town, in January.

Electrical Congress at St. Petersburg.—The first Congress of Russian electricians, convoked on the authority of the Ministers of the Interior and of Finance, will be held at St. Petersburg from December 27th to January 8th, under the auspices of the Société Imperiale Technique de Russie. The objects of the Congress are the promotion of intercourse between Russian electricians, the demonstration of the most recent electrical inventions, the study of the present state of the industry, &c. At the same time and place there will be held an exhibition of the most modern electrical apparatus, which will be international in character. Foreign exhibits will be admitted free of duty, on condition that they are removed from the country within one month from the close of the exhibition. Particulars of the regulations of the exhibition and of the Congress may be obtained from the committee of the Congress at the offices of the Société Imperiale Technique de Russie, Panteleimonskaja 2, St. Petersburg.

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NEW COMPANIES REGISTERED.

Westmacott, Stewart & Co., Limited (64,160).—This company was registered on November 13th, with a capital of £60,000 in £1 shares, to acquire the undertaking and all or any of the assets and liabilities of A. Westmacott in connection with the business of "Vril Launches, Limited," recently purchased by him, and to carry on the business of launch, boat, car, carriage and vehicle manufacturers, electrical and general engineers, suppliers of electricity for light, heat or motive power, &c. The first subscribers (each with one share) are:—Alfred Westmacott, 62, Ashley Gardens, Westminster, shipbuilder; P. G. W. Westmacott, Rose Mount, Ascot, engineer; W. Burton Stewart, Hockcliffe Grange, Leighton Buzzard, underwriter; J. Westmacott, Widbury House, Ware, stockbrocker; W. H. G. Elliott, 94, Mallinson Road, Wandsworth Common, S.W., gentleman; S. H. Bath, Beech Villa, Geraldine Road, Wandsworth Common, S.W., clerk; and N. Chaplin, 19, Lincoln's Inn Fields, solicitor. The number of directors is not to be less than two nor more than five. The first are A. Westmacott, chairman, W. B. Stewart and J. Westmacott; qualification, £200; remuneration as fixed by the company.

Dublin Electric Lighting Syndicate, Limited (2,419).—This company was registered in Dublin on November 17th, with a capital of £5,000 in £1 shares, to carry on the business of an electric light and gas supply company and suppliers of motive power, whether electric, steam, hydraulic, gas, or otherwise, in all their branches. The first subscribers (each with one share) are:—Charles Wisdom Hely, Oakland, Rathgar, co. Dublin, J.P.; Vere Ward Brown, Balnagowan, Rathmines, co. Dublin, merchant; Henry Cochrane, 45, Kildare Street, Dublin, Knight, D.L., J.P.; John D. Wallis, 33, Bachelor's Walk, Dublin, carrier; John D. Chaytor, 30, Anglesea Street, Dublin, stockbroker; David Kellett, South George's Street, Dublin, J.P.; and Wilfred Fitzgerald, 17, St. Andrew Street, Dublin, stockbroker. The number of directors is not to be less than three nor more than five. The first are Sir Henry Cochrane, Knight, D.L., Charles Wisdom Hely, and Vere Ward Brown; qualification, £100; remuneration as fixed by the company.

SUPPLY STATION ACCOUNTS.

Sunderland Corporation Electricity Accounts.

Public lighting and private supply.

The accounts of the Sunderland electric lighting undertaking for 1898 cover the period of transition from a losing business to profit earning. Perhaps the most noticeable item is the enormous increase in units sold—over 200,000 in a total of 472,000. Not less satisfactory is the rise in gross profit. Probably the accounts will bear a still more favourable aspect when the new tramway scheme gets to work. Mr. J. F. C. Snell, the engineer for both the electric lighting and tramways, is, we believe, contemplating an extensive scheme of conversion from horse to electric traction, and the station costs, already good, should gain materially. The capital expenditure is low for the output, as will be seen from the general statement which follows:—

GENERAL STATEMENT.

	1897.	1898.	Increase.
Total capital expenditure ...	£45,084	£61,931	£16,847
Number of units sold	270,362	472,240	201,838
Maximum KW. demanded... ...	361 KW.	424 KW.	63 KW.
Gross revenue	£4,251	£6,959	£2,708
Gross profit	£1,653	£2,854	£1,201
Average price per unit sold ...	3·00d.	3·41d.	−·19d.

There is a reduction in the returns from each item under the head of revenue per unit sold, the only important figure being nearly one-fifth of a penny on sale of current, the total being just under a farthing. At about 3¼d. per unit sold it is evident that consumers have every reason to be satisfied, the margin between this and the works' cost of 2d. being almost wholly taken up in providing for sinking fund and interest.

REVENUE STATEMENT.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current	£4,051	3·60d.	£6,718	3·41d.	−·19d.
Meter rents	131	·11d.	187	·10d.	−·01d.
Supply of lamps, &c. ..	27	·02d.	15	·01d.	−·01d.
Sundry	42	·04d.	44	·02d.	−·02d.
Gross revenue ...	£4,251	3·77d.	£6,959	3·54d.	−·23d.

The costs of production show increases under the headings of "coal" and "oil, waste, &c." The fuel item suffers, we suppose, in common with works all over the country from the strike of last year and consequent scarcity which has left a stiffer market, even up to the present. Labour troubles are still hanging round the coal agent and colliery owner, and when we were told that at Sunderland the cost per ton had risen from 6s. 9d. to 8s. 9d., our only feeling was one of sympathy for those North Country engineers whose percentage coal bill is increased so much more in proportion than their Southern rivals, whose lamentations on the question of carriage and freightage charges may be modified by the thought that an increase of 2s. per ton will affect their costs per unit less when paying 16s. 9d. per ton than if they had been fortunate enough before to get their fuel for 6s. 9d. per ton. Water is costing 5d. per 1,000 gallons, to which ¾d. has to be added for softening, but Sunderland is again well off in comparison with many metropolitan works, who are mulcted at the rate of 8d. per 1,000 gallons.

COSTS OF PRODUCTION.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal	£463	·41d.	£1,047	·53d.	+·12d.
Oil, waste, water and engine room stores.	128	·11d.	231	·12d.	+·01d.
Salaries and wages incurred in generation and distribution.	736	·65d.	1,040	·53d.	−·12d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	310	·28d.	464	·23d.	−·05d.
Works' cost ..	£1,637	1·45d.	£2,782	1·41d.	−·04d.
Rent, rates, and taxes ..	279	·25d.	311	·16d.	−·09d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	450	·40d.	719	·36d.	−·04d.
General establishment charges, stationery and printing, law charges and insurance.	232	·21d.	293	·15d.	−·06d.
Other expenses	...	...	...	...	...
Total costs ...	£2,598	2·31d.	£4,105	2·08d.	−·23d.

The net surplus of £352 has been carried to the general district rate account. The distribution of the gross profit is as follows:—

PROFIT STATEMENT.

	1897.	1898.
Interest on loans	£1,051	£1,166
Sinking fund for repayments	1,205	1,336
Net profit, carried to rates	−605*	352
Gross profit	£1,653	£2,854

* Deficiency charged to rates.

CITY NOTES.

The Blackheath and Greenwich District Electric Light Company, Limited.

THE directors' report reads as follows:—"The total expenditure to September 30th, 1899, as certified by the auditors, was £84,809 4s. 1d. The main buildings of the company's generating station at Blackwall Point are practically finished. They provide engine and boiler space for plant capable of supplying about 80,000 8-C.P. lamps on circuit. The chimney shaft will be adequate to meet future extension of the works. Generating plant of a capacity of about 50,000 8-C.P. lamps on circuit is now being installed. The contractors expect to have two machines at work at an early date. About 16 miles of the principal streets of Blackheath, Greenwich, and Lee have been opened up by the company, and 42 miles of cable laid therein. In Blackheath and Lee a temporary supply of electrical energy, obtained from a neighbouring company, has been available since July 18th last. The lighting of the district by electricity has therefore commenced, and will be speedily extended from the company's own station; 140 signed applications have been received up to October 31st last, equivalent to 6,896 lamps of 8 C.P., of which 3,625 were then connected to the company's mains. In addition, applications for motor power have been received to the extent of 40 H.P. The company's area of supply has been largely extended by the Lee (extension) provisional order, which the company promoted in the last session of Parliament, with the approval of the Board of Works, for the Lee district. The order empowers the company to supply electrical energy in those parts of the parishes of Lee, Eltham, Kidbrook, and Charlton, which were not comprised in the company's provisional order of 1897. A map showing the areas over which the company now holds Parliamentary powers is attached to the report. To carry out the provisions of the new order, and to complete the necessary extensions, further capital will be required by the company. The directors will shortly have to consider the question of raising such capital. The application made to Parliament last session by the County of London and Brush Provincial Electric Lighting Company, Limited, for powers to supply electrical energy in part of this company's area, was successfully opposed by your directors, acting in conjunction with other supply companies and local authorities interested. The company also successfully opposed the inclusion in the provisional order, promoted by the Board of Works for Lewisham, of the Blackheath portion of the Lewisham district comprised in the company's provisional order of 1897. Now that the works are approach-

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ing completion it is the intention of the directors to make up the accounts to December 31st in each year, in accordance with the forms required by the Board of Trade, and to hold the annual meeting as soon as practicable after that date. The directors regret the death of their esteemed colleague, Mr. Thomas Evans. They have filled the vacancy thus created, and further strengthened the board by the appointment of Captain E. I. Bax and Mr. Henry St. John Winkworth. The board desire especially to acknowledge the assistance rendered by those of their colleagues who have placed their practical and expert knowledge of electrical works freely at the service of the board, and have thus given invaluable help in furthering the interests of the company. The rapid progress of the works is largely due to this assistance. Messrs. W. H. Pannell & Co. retire, and, being eligible, offer themselves for re-election."

Prospectus.

This week the list of subscriptions has been open from Tuesday until Thursday for an issue of 20,000 6 per cent. British Electric Traction Company cumulative preference shares of £10 each, offered at £12 per share by the Electric and General Investment Company. Out of 60,000 ordinary and 60,000 preference, 45,000 ordinary and 30,000 preference have been already subscribed, and £200,000 5 per cent. debentures issued. Our readers do not need to be told what the objects of the company are nor to have indicated to them the enormous amount of excellent projects it has in hand. A list of some of the principal undertakings in which it has a controlling voice is given in the prospectus, and notes of the profits for 1898 are stated, the directors adding that they are of opinion that the net profits for the current year will exceed the 1898 figures.

Official Announcements re Companies.

The *London Gazette* contains notice to the effect that the following companies have been struck off the Register of Companies:—

British Electrical and Industries Company, Limited.
British Electrical Cycle and Motor Engineering Company, Limited.
Electrical Investments Trust, Limited.
Electric and General Exploring Syndicate, Limited.
Electric Transformer System, Limited.
Leatherhead Electric Lighting and Power Company, Limited.
Phœnix Accumulator Syndicate, Limited.
Practical Primary Electric Battery Syndicate, Limited.
Randall Telephone Syndicate, Limited.
Rottingdean Electric Lighting and Power Company, Limited.
South Manchester Electric Supply Company, Limited.
Walton-on-Thames Electric Lighting and Power Company, Limited.

Richmond Electric Light and Power Company.—It is announced that at a meeting of the shareholders of the Bournemouth and Poole Electricity Supply Company, Limited, held on Thursday, last week, the provisional agreement between the company and the County of London and Brush Provincial Electric Lighting Company, Limited, for the purchase of the latter company's interests in the Richmond (Surrey) Electric Light and Power Company, Limited, was duly approved.

Commercial Cable Company.—The directors have called a special meeting for December 4th, when authority will be sought to increase the capital to $15,000,000. It is proposed to issue $3,500,000 of the new capital to the present shareholders at par in the proportion of one new share for every three old shares. The object of the increase is "to provide an additional cable to meet the increasing business of the company."

Stock Exchange Notices.—Application has been made to the Stock Exchange Committee to allow the following securities to be quoted in the Official List:—W. T. Henley's Telegraph Works Company, Limited—further issue of 6,000 4½ per cent. cumulative preference shares of £5 each, fully paid.

Aron Electricity Meter Company.—A meeting of this company was held yesterday afternoon at Winchester House. A report will appear next week.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending November 18th, 1899, were £172 2s. 5d.: November 18th, 1898, £201 8s. 9d.; aggregate for half-year to date, £19,415 17s. 5d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending November 17th, 1899, were £4,897 13s. 8d.; corresponding period, 1898, £2,667 19s. 6d.; increase, £2,229 13s. 9d.

The City and South London Railway Company.—The receipts for the week ending November 19th, 1899, were £1,046; November 20th, 1898, £1,044; increase £2. Total receipts for half-year, 1899, £20,452; total receipts corresponding period, 1898, £20,403; increase, £49. Miles open, 8½.

The Dover Corporation Electric Tramways.—The receipts for the week ending November 18th, 1899, were £159 8s. 0d.; November 19th, 1898, £150 9s. 11d.; increase, £8 18s. 1d. Total receipts to date, 1899, £9,149 14s. 11d.; corresponding period 1898, £7,652 18s. 9d.; increase, £1,497 6s. 2d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,786, 1898, 4,868. Number of cars, 1899, 11; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, November 17th, 1899, were as follows:—D. U. T. Co., horse cars, £184 16s. 4d.; ditto, electric cars, £2,805 18s. 2d.; D. S. D. Co., electric cars, £699 19s. 6d.; total, £3,690 14s. 0d.; corresponding week last year—D. U. T. Co., horse cars, £2,295 7s. 2d.; ditto, electric cars, £333 4s. 8d.; D. S. D. Co., electric cars, £690 6s. 10d.; total, £3,808 18s. 8d.; increase, £881 15s. 9d. Aggregate to date, £85,670 10s. 10d.; aggregate to date last year, £82,211 11s. 9d.; increase to date, £3,457 19s. 1d. Worked:—The mileage open is 39 miles electrically, 5 miles by horses, as against 18 miles electrically, and 29 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending November 19th, 1899, were £571; November 23rd, 1898, £241; Increase, £357; Car miles run, 1898, 3,148. Number of cars, 1899, 22; 1898, 10. Total receipts to date, from April 1st, 1899, £20,044; 1898, from June 29th, 1898, £5,628. Miles of track open, 12; 1898, 8½.

The Liverpool Overhead Railway Company.—The receipts for the week ending November 19th, 1899, amounted to £1,438; corresponding week last year, £1,358; increase, £80.

The South Staffordshire Tramways Company.—The receipts for week ending November 17th, 1899, were £654 9s. 7d.; November 18th, 1898, £631 17s. 1d.; aggregate receipts for 46 weeks £30,749 16s. 9d.; 1898, £29,179 9s.

STOCKS AND SHARES.

Wednesday Evening.

Prominent among the features characterising the electrical markets this week is the District Railway disappointment. Frequent mention has been made in this column of the speculation in the stock engendered by reports of electric traction, and so on, but the reason for the rise is now stated to be the working union that is projected between the District line and the South-Eastern-cum-Chatham Railways. This is, the market considers, a disappointing consummation to the hopes that have been raised, and it is hinted that there may be other arrangements up the directors' sleeve which so far have not been disclosed.

In other electrical railway securities, the only move has been a rise of 5s. in Central London Deferred half-shares. It is thought probable that the near approach of the line's opening may be used as a lever for raising Centrals out of the comatose state into which they have relapsed for some months past. No change has taken place in Waterloo and City stock or City and South Londons.

The new issue of British Electric Traction Preference shares has had no effect upon the price of the Ordinary, but the existing Preferences have fallen a fraction, holders electing to sell these to pay for the new shares, for which they are applying at the issue price of 12. Could an allotment be guaranteed, the exchange would, of course, be an excellent one; but as it cannot, there is some element of risk in selling old Preference at the low prices now ruling.

The company's prospectus accompanying the particulars of the new issue is principally interesting as a proof of the enterprise and breadth with which the British Electric Traction is run. For anyone who can afford to hold them during the next few years, the shares are an attractive investment.

Supply shares—with the usual exception of London Electrics and South Londons—are hard, and in some request. It is the better class shares which are being bought—Notting Hill, Metropolitan, &c. The new shares of the latter company are now approximating very closely to the price of the old. City of Londons are ¼ better, but Charing Cross have not moved. The report from the Blackheath and Greenwich Company has not sufficed to raise the shares over par. Provincial shares are hard, and amongst those not mentioned in our regular list, on account of the limited market prevailing in them, we may instance Oxford Electrics, which are 7, Bournemouth and Poole, now 13, and the Preference shares of the last-named, which stand at 10½. The "Foreign" shares are quiet, Calcutta Electric at 5¾ being slightly depressed by the fact that a call is pending (as is also the case in South London Electric Ordinary).

The tramway market presents few features. Anglo-Argentines are still sellers at 4, but Barcelonas keep firm at 13. We may mention that a well-known London banker is now making a tour through Spain, mainly with the idea of finding out what needs and what facilities there are in the country for electric tramways. His travels will probably bear fruit in the near future, for he is no novice in the economy of light railways.

Backed by ardent bulls, Anglo-American Telegraph stocks have again improved their position, the Deferred being more particularly to the fore. But fresh attention has been diverted to the South African telegraph lines, and now that the cables are once more in working order, Eastern Ordinary has been bought "on the war." The price, however, is still some 20 per cent. below the highest touched this year. Eastern Extension shares—"Chinas," as the Stock Exchange calls them—do not move, although, to keep their due relation to Eastern stock, they should be about ¼ higher than they now are. Submarine Cables Trust has advanced a point.

In the miscellaneous list, British Insulated Wire are harder and Edison & Swan are weak, competition being said to account for the latter.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Nov. 15th.	Closing Quotation, Nov. 22nd.	Business done during week ended Nov. 22nd, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	101	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red.	100	...	...	...	85 — 90	85 — 90	..	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	63 — 69	66 — 69	68	67
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	117 —118	117 —118	118	117½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	17½— 18	17⅜— 18¼	18⅜	17 11/16
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15½— 15⅝	15 7/16	15 5/16
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	190 —200	198 —202	201	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	103 —105	103 —105	104½	103⅜
234,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	9⅜	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20 xd	...	...
12,981	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3¼ %	3½ %	12 — 12⅛	12 — 12⅛	12⅛	12 1/16
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101 —104	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½ %	7 %	7 %	157 —162	158 —163	161	158
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	99 —102	99 —102	100½	...
89,900	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	117 —122	117 —122	120	...
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	15½— 16	15½— 16	16	15⅝
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	118 —123	118 —123	...	...
85,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	103⅛	101⅛
300,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	4 %	...	...	101 —104%	101—104% xd	...	...
180,237	Globe Telegraph and Trust	10	4½ %	4½ %	5⅛ %	11¼— 11⅜	11¼— 11⅜	11⅛	11 1/16
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15½— 16	15½— 16	15⅞	15⅝
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	80 — 82	81 — 83	...	...
80,500	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¼— ⅜	¼— ⅜	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5⅛ %	6 %	6 %	5 — 5½	5 — 5½	5½	5 1/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5⅜	5¼— 5⅜	5⅜	...
1,339,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —102	100 —102	101	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	¾— 1	¾— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —106	...	...
11,589	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
8,881	Submarine Cables Trust	Cert.	...	...	...	129 —134	130 —135	...	...
56,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5⅛	4⅜— 5⅛	4⅞	...
151,738£	Do. do. 5 % Debs.	Stock	...	..	...	105 —108	105 —108	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	%	...	99 —102	99 —102	...	...
80,008	West Coast of America, Nos. 1—30,000 and 58,001—58,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	103 —105	103 —105	...	...
339,521	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph	10	1 %	3%	...	1½— 1⅝	1 — 1½	1⅛	1 1/16
34,568	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10½— 10⅝	10½— 10⅝	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	9 — 10	9 — 10	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	5 %	5 %	...	105 —108	105 —108	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7⅛— 8⅛	7⅛— 8⅛	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	10 — 11	10⅜	10 3/16
20,000	Do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅝— 6⅛	5⅝— 6⅛	...	...
34,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	8 — 9	8 — 9	...	...
100,000	Do. do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	111 —113	111 —113	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11½— 12	11½— 12⅛	12 1/16	11⅝
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10½— 11½	10½— 11½	10⅞	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	111 —114	111 —114	112	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5½	5 — 5½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	3½— 3⅝	3 — 3⅛	3⅜	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6½— 6⅝	6 — 6⅛	6½	6⅜
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	15 — 16	15⅜	15⅜
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14 — 15	14½— 15½	15	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	118	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½— 16½	15½— 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	15½— 16½	16 — 17	16⅝	16½
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3½— 4	3½— 3⅝	3 9/16	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14½— 15½	14½—15⅝	14⅝	14½

* Subject to Founder's Shares.
Unless otherwise stated all shares are fully paid.
‡ Quotations on Liverpool Stock Exchange.
§ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Nov. 15th.	Closing Quotation Nov. 22nd.	Business done during week ended Nov. 22nd, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2⅜— 3½	2⅜— 3½	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
80,000	British Electric Traction	10	...	...	6 %	16½— 17½	16½— 17	17⅛	16½
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13½— 14	13½— 13⅝	13 1/16	13½
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11 — 12	11⅛— 12⅛	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6⅝	6½— 6⅝	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅝— 2⅛	1⅝— 2⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	3	4 %	6 %	6 %	2¼— 2⅜	2¼— 2⅜	2⅜	2 5/16
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —115	110 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13 — 14	13 — 14	13⅜	...
90,000	Do. do 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	113 —116	113 —116	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10⅛— 10⅜	10⅛— 10⅜	10⅜	10⅛
178,808	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,083	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5⅛	4⅜— 5⅛	...	...
71,447	Do. do. Def. do.	5	...	...	...	5 — 5⅛	5⅛— 5⅜	5⅛	5 1/16
630,000£	City and Sonth London Railway	Stock	1 1/16 %	1⅛ %	2⅛ %	63 — 66	63 — 66	64½	...
22,500	Do. do. Ord. shares, Nos. 1 to 22,500 ...	10	...	...	...	6½— 6⅝	6½— 6⅝	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3⅜— 4	3⅜— 4⅛	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛ %	6 %	6 %	2 — 2⅛	2 — 2⅛	2⅛	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛ %	6 %	6 %	4 — 5	3⅞— 4⅛	4 1/16	3 15/16
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2 — 2¼	2 — 2¼	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3⅛	3 — 3⅛	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	104 —107	104 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	¼ — ⅜	¼— ⅜	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
15,000	Henley's (W. T.) Telegraph Works, Ord.	10	10 %	12 %	14 %	...	...	...	...
3,000	Do. do. do. 7 % Pref.	10	7 %	7 %	7 %	...	...	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21⅜	21 1/16
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	...	...
[37,500	†Liverpool Overhead Railway, Ord.	10	2⅞ %	3½ %	3½ %	9 — 9½	9 — 9½	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½— 13⅝	13½— 13⅝	...	...
[37,850	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	37⅛	37
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9½— 9⅝	9½— 9⅝	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	101 —104	102	...

† Quotations on Liverpool Stock Exchange.

‡ Unless otherwise stated all shares are fully paid.

Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½% Debentures of £100, 105—108.
National Electric Free Wiring, 10s. paid, 5s.—7s.
Smithfield Market Electric, 1—3.

Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6%, £5 (fully paid), 7⅛—8. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
*T. Parker, £10 (fully paid), 18½.

* From Birmingham Share List.

Bank rate of discount 5 per cent. (October 5th, 1899).

MARKET QUOTATIONS, Wednesday, November 22nd.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a " Nitric .. .. .. per cwt.	22/-	22/-	..
a " Oxalic .. .. .. per cwt.	32/-	32/-	..
a " Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) .. per ton	£29	£29	..
a " " .. .. per ton	£27	£27	..
a Bleaching powder .. .. per ton	£6 1	£6 10	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a " (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25 10	£25 10	..
a Lead, Nitrate .. .. .. per ton	£25	£25	..
a " White Sugar .. .. per ton	£31	£31	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	3½d.	3½d.	..
a " Caustic (75/80 %) .. per ton	£24	£24	..
a " Bisulphate .. .. per ton	£25	£25	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a " Recovered .. .. per ton	£5 10	£5 10	..
a " Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
a " Crystals .. .. .. per ton	£3	£3	..
a " Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£294	£294	..
b " Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 3" to 12") basis per lb.	8½d.	8½d.	..
c " Tube (brazed) .. .. per lb.	10d.	10d.	..
c " Wire, basis .. .. per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f " Sheet .. .. .. per lb.	3/-	3/-	..
g Copper Bars .. .. .. per ton	£95	£95	..
g " Wire (basis price) .. per lb.	10½d.	10½d.	..
g " Sheet .. .. .. per ton	£95	£95	..
g " Rod .. .. .. per ton	£95	£95	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	7/-	7/-	..
h India-rubber, Para fine .. .. per lb.	4/5 to 4/7	4/ to 4/6	inc.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i " Pig (Cleveland warrants) per ton	69/10d.	70/7½	9½d. dec.
i " Forgings, according to size per ton	From £11	From £11	..
i " Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8 .. per ton	£14 5	£14 5	..
g Lead, English Ingot .. .. per ton	£17 12 6	£17 12 6	..
g " Sheet .. .. per ton	£18 16	£18 16	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. .. per bottle	£9 10	£9 7 6	2/6 inc.
d Mica (in original cases), small per lb.	2d. to 8d.	2d. to 8d.	..
d " " " medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d " " " large per lb.	5/6 to 7/6	5/6 to 7/6	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p " rolled bars & rods per lb.	1/1 to 1/4½	1/1 to 1/4½	..
p " r'l'd str'p & sheet per lb.	From 1/2½	From 1/2½	..
e Platinum .. .. per oz.	£3 11	£3 11	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15 to £40	From £15 to £40	..
i Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£132 10	nominal	..
g " foil .. .. per lb.	1/6	1/6	..
n " wire Nos. 1 to 16 .. .. per lb.	1/11	1/11	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7½d.	7½d.	..
j " Best Flax, 6 lea. .. per lb.	5d.	5d.	..
j " Hemp, 8 ply 10 lbs. .. per lb.	8½d.	8½d.	..
j " " Russian, 10 lbs. per lb.	4½d.	4½d.	..
j " Jute, 180 lbs. rove .. per ton	£14	£14	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£26	£26	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Boiling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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WATERLOO AND CITY ELECTRIC RAILWAY.

At the ordinary meeting of the Institution of Civil Engineers on Tuesday, November 14th, Sir Douglas Fox, president, in the chair, two papers dealing with the construction and equipment of the Waterloo and City Railway were read.

The first paper, by Mr. H. H. Dalrymple-Hay, M Inst.C.E., was devoted to a description of the general features of the line and the methods used in its construction. Since the opening of the Waterloo Station in 1848 various schemes have been considered for extending the London and South-Western line into the City, but none were feasible until the Greathead system was proposed in 1891. The new line was 1¼ mile long, and, with the exception of a short length at Waterloo, consisted of two iron tunnels with a station at each end, approached by stairs and inclines. The route taken from Waterloo was by Stamford Street, Blackfriars Bridge, and Queen Victoria Street to the City.

A stage with temporary shafts in the river at Blackfriars was first constructed, and on completion shields were set to work in both directions. Where the new line passed under the South-Eastern Company's viaduct at the centre of a 30-foot arch, the abutments were underpinned to the level of the proposed tunnels below, and a cross trench was sunk between the abutments and both tunnels driven towards Waterloo from that point. The tunnels between Waterloo and the river shafts were 12 feet 9 inches, and those between the latter point and the City 12 feet 1¼ inches, internal diameter. The larger diameter admitted of the carriages passing round 5-chain curves, of which there are four towards Waterloo.

The method of tunnelling in the London clay and in water-bearing strata was the well-known Greathead system, except in the case of a short length of tunnel which was driven by a new method not requiring the employment of a heading or timbers outside the shield.

At the City station, where the tunnels are 23 feet internal diameter, there was a scissors crossing near the West end to admit of trains arriving at or departing from either platform. At Waterloo there was a tail siding at the South end of the platforms, instead of a scissors crossing at the City.

The average rate of working in the small tunnels was 10 feet every 24 hours where the tunnels were in the clay. In the larger tunnels at the City station, which were also in the clay, 6 feet was completed regularly in the same time. In water-bearing strata, however, the speed varied greatly, depending upon the character of the ground and the depth of ballast and head of water at the face.

The iron segments of the small tunnels were erected by manual labour, but those of the large tunnels were erected by hydraulic machines fixed to the shield. The small tunnels were grouted with blue lias lime (three parts) to sand (one part), but the large tunnels were grouted with neat cement for the lower half, and equal parts of cement and blue lias lime for the upper half.

The work at Waterloo consisted of underpinning the existing piers of the arched viaduct upon which the South-Western station is built. The new station occupied two of the arches, and directly to the south of the platforms, but still under Waterloo station, it was necessary to introduce a cross-over road for the tail line, as there was not sufficient space for it between the south side of the station and the end of the company's property. This necessitated the removal of the central pier of the viaduct, and the substitution for it of a 40-foot arch with spandril walls to carry the old arches above. The repairing and cleaning sidings were in a depot directly to the south of Waterloo.

On the northern side of Waterloo a short length of tunnel joining the up line with a lift had been constructed, and by this means the rolling stock and coals were lowered from the South-Western sidings to the tunnel below.

The second paper, by Mr. Bernard M. Jenkin, Assoc.M Inst.C.E., gave an account of the electrical equipment of the line, which was the second underground railway that had been built to be worked electrically. The electric energy was generated at the power station, at the Waterloo end of the line, by high-speed engines coupled direct to two-pole dynamos. The energy was transmitted to the trains by feeders connected to an insulated rail, or conductor, placed between the two running rails of the permanent way. This central conductor consisted of an inverted steel channel, carried on porcelain oil insulators, the top surface being level with the top of the running rails. The feeders and central conductor for the up and down lines were independent of each other, and should an accident occur on one line or in one of the tunnels it did not affect the supply of current to the other line or tunnel. There was an independent system of feeders and distributing mains for lighting the tunnels and stations. The trains were lighted from the circuit supplying power to the motors. The current from the motors and lamps was carried back to the power station by the running rails of the permanent way, which were bonded and connected in parallel throughout.

Each train consisted of two motor carriages, one at each end, and two trailer carriages in the centre between them. The motor cars were fitted with collector shoes, which rubbed on the top surface of the central conductor rail and carried the current from it to the motors driving the train. Each carriage was carried by two four-wheeled bogies, and one bogie on each motor carriage was fitted with two series-wound motors. Thus each train was driven by four motors in all, two on the front bogie and two on the last bogie in the train. The armature of each motor was built directly on the axle of the driving wheels, with the field magnets surrounding it fixed in position, so that they moved in a horizontal plane with the bogie, but could not rotate. No reduction gearing was used. There was a driver's cab in each motor carriage, placed over the bogie carrying the motors, in which was placed a controller and the necessary instruments for regulating the current to the four motors driving the train, and for reversing or connecting them as required, either all in series, or two in series in parallel with two in series, or all four in parallel. The two controllers were so made that that it was not possible to have more than one in use at the same time. The cables connecting the motors and controllers at opposite ends of the train were carried along the top of the cars outside the roof, and were connected by couplers between the cars.

The trains were fitted with Westinghouse compressed air brakes which could be worked from both ends of the train by valves placed in the driver's cabs. The pumps compressing the air were placed in the power station, and could be worked continuously to charge a reservoir from which the supply for charging reservoirs on the trains could be drawn as wanted. The reservoirs on the trains consisted of steel cylinders hung beneath the floor of the carriages, and were placed both on the trailer and motor carriages.

Experiments and tests had been made on completion of the line to ascertain the time and power taken to drive a train from one station to the other under different conditions and with different limits of speed on the sharp curves. The time in which a train could traverse the whole of the distance from one station to the other depended mainly upon the maximum speed which could be allowed on the sharpest curves. There were some very sharp curves at the bottom of the dip in the line where it passed under the river, and it was originally intended that the speed on these curves should be limited to 24 miles an hour. Before the line could be opened it was inspected by the Board of Trade, and Sir Francis Marindin decided to limit the speed round the sharpest curves to 15 miles an hour instead of 24 miles an hour, for which the whole of the electrical equipment of the line had been designed. This alteration had naturally a very great effect on the whole working of the traffic on the line, the brakes having to be applied to the train on the down gradients, as the speed which would be attained by gravity alone would very much exceed the limit of 15 miles an hour by the time the curves were reached. The switchback principle of working the line could not, therefore, be adopted as it might otherwise have been with the particular arrangements of gradients and the absence of intermediate stations which was the peculiarity of this line.

A complete system of block-signalling had been provided, and the shortness of the line made it necessary to place signals near the bottom of the dip close to the sharp curves referred to above. The position of these signals had an effect on the working of the line similar to the reduction of speed on the curves, as the speed on the down gradients had to be checked in order to enable the train to be brought to a standstill should the signal be against it.

A COMBINED TROLLEY AND STORAGE BATTERY LOCOMOTIVE FOR MINES.*

The numerous accidents to mules coming in contact with overhead trolley wires in mines have raised a demand for some sort of a system whereby the animal will become an unnecessary evil in the operation of a mine. To construct a bonded track and stretch a trolley wire to the face of all workings would be too expensive for general mine practice, and, in consequence, it is the custom in some mines to use a small mine wagon and have the miner push it to and fro from face to parting, from which place it is taken with the locomotive. In order to eliminate the mule from the mine and haul from the face of all workings, a combined storage and trolley locomotive has been devised, whereby the heavy work on headings is done from trolley, and while so running the attached battery, which is carried in circuit, absorbs sufficient current to do the necessary room work. Such a locomotive, the only one of its class, was built by the Baldwin-Westinghouse combination for the South-west Virginia Improvement Company, having the following dimensions:—

Gauge	36 inches.
Width over all	42 „
Height, including battery box	44 „
Length	124 „
Weight, including battery	9,000 lbs.
Electric equipment	2 10-H.P. motors.
Rheostatic controller.	

This locomotive was designed to haul on the level one loaded car weighing 9,000 lbs. on storage, and was accordingly equipped with 90 5-D. cells, and having mounted therewith a special battery circuit breaker, &c.

After the locomotive was built the mine manager changed his plans, and concluded to try it in a part of the mine where the battery would be required to handle loaded cars up a 4 per cent. grade and empties up 8 per cent. In addition, the trolley line was an extension of the feed line for some 10 or 12 mining machines, in consequence of which the voltage varied from 110 to 200, and the battery would either feed back into the line or throw the circuit breaker. In order to prevent the latter it was so adjusted that it would not fly out, and the battery was virtually short-circuited a large number of times each day without any bad effect. With this condition of affairs it was impossible to hold sufficient current in the battery to do the desired amount of room work, and it became necessary to stop a total of about 30 minutes each day for renewals. It must be remembered that this work was under the supervision

* Extract in the *American Electrician* from paper read by Harry K. Myers before the Engineers' Club of Philadelphia.

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of a mine foreman unacquainted with storage batteries. Having gone to such extremes in the use of this locomotive it was suggested that a new and independent feed line would be a great improvement; it was installed, with marvellous results. The voltage became constant, and, the battery often discharged for a short time at three times its rated capacity; yet the work has been ideal, and after almost three months' service there is no appreciable wear on the battery. It produces a tractive effort up to the point of adhesion of the locomotive when working on storage, and the regular work is to take 17 empties weighing 60,000 lbs., including locomotive, from side track up a short 1 per cent. grade, then down a 4 per cent. to a level, from which place it starts to distribute in rooms having a maximum of 8 per cent. in favour of loads. After distribution it proceeds to collect the loads in trips of two cars each, on account of the 4 per cent. grade against loads on heading, and deliver them to the side track while working on trolley. In this manner this one locomotive is capable of delivering to this side track, over an average round-trip haul of 4,000 feet, 200 loaded wagons daily direct from face of working, which is the work, under existing conditions, of 12 mules and 8 drivers. It is the intention to place a night force, and if sufficiently large, the saving will be the care of 24 mules and time of 12 men, or an amount equal to $8,000 annually.

This same company has placed an order for six more of the same class of locomotives, and is considering the matter of constructing heavier ones of the same kind to take the place of steam locomotives now in use, but which are very injurious to both the ventilation of the mine and the timber work.

AMERICAN TRACK CONSTRUCTION.

When an American track departs from the usual practice of wooden ties, and the rails are laid on concrete, the method of work is as follows:—The trenches for the concrete are cut to a depth of 6 inches below the base of the rail. They are 20 feet wide at the top and 16 at the bottom. At intervals of 10 feet wooden blocks, 8 inches × 10 inches × 16 inches, are let into the trenches; the rails are spiked to these blocks, properly surfaced and put in alignment and true gauge. This done, the concrete is filled into the trenches and packed well up to the rail and up the side of the rail to within an inch of the bottom of the intended paving blocks. The rail joints, when to be cast-welded, are in the meantime held by temporary splicing. Rails are not less than 6 inches deep, and will be 9 inches on asphalted streets with stone toothing next the rails. Tie rods are 1 inch diameter, and are placed at 6 feet centres with double hexagon nuts to tightly clamp on the rail web, and the threaded end is long enough to enable a tie rod to be put in without bending.

For 80-lb. rails the cast joints weigh 150 lbs., and for 100-lb. rails they weigh 200 lbs., the cast metal being two-thirds pig and one-third scrap. It ought to be poured at a bright yellow, says the author of the paper under review, Mr. Ed. Butts, of Kansas City, but another speaker in discussion claimed at least a white heat as necessary. If the rail ends were carefully sand-blasted a perfect bond, electrically, would be formed. After the operation the rail surface is dressed off smooth, we believe with a portable emery wheel grinder. Paving should be the same as the rest of the street. Otherwise, if the track is paved on an asphalted street, heavy teams will follow the track, whereas if the track is asphalted on a paved street, light vehicles will overcrowd the track, and accidents are liable to be caused by any difference, leading to variation of traffic. The concreting is put round the rails before the welding is done, a space being left for the weld. The concrete holds the rail in place.

In Cleveland they found 12-bolt fish-plates to be more satisfactory than cast-welding. In Chicago, however, it had been tried as far back as 1895, and was still good, and the trouble anticipated by the Cleveland man, namely, failures due to expansion or contraction, had not been found to occur. He named several streets thus treated, including 10 miles on Halsted Street from Archer Avenue, where, we believe, "Dooley" lived in peace and war, to 79th Street. As much as 3,000 feet in one length had been welded, and had not failed in Kansas City.

We need not follow the discussion on "ties" or sleepers, and their material oak, chestnut, or hemlock. In this country we have no choice at present, and are confined practically to creosoted bodies in the very few cases where non-concreted track is used at all. As regards life of ties, we might name Jarrah and Ironbark, Australian timbers, which will last 25 years, and be sound even then. The timbers of Australia are too little known, and only lately have been used much in street paving blocks; notably, on Tottenham Court Road and Piccadilly Circus.

The general impression conveyed by all we can gather as to cast-welding is that it rarely fails if well and properly done. This implies thorough cleaning of the rail ends by sand blasting and the pouring of the metal at a white heat. It appears that even more reliable results would be obtained by a preliminary warming of the rail by means of a producer gas flame so as to mitigate the chilling effect upon the iron, of the cold rail. On English tramway work, exposed to about half the temperature ranges of America, and invariably bedded on concrete and buried up to the top of the rail, it certainly may be expected that even more satisfactory results will be obtained. We doubt if the temperature of tram rails in this country often falls below 32°, though information on the point is wanted. It was only in a very severe winter that water mains buried 18 inches froze up in London where the water in winter was practically at freezing point when pumped into the mains. Nor in summer time is it probable that rails ever approach the temperature of the air. In America it is common for the ground to be frozen several feet deep, while the summer temperature is equally severe the other way. Well bedded both in and on concrete, each unit length of rail is held against the stresses due to its own expansion or contraction, and heavy stress cannot take effect at weak points. There should be a future for cast-welding if only to save the establishment of a quiet corner in scrap copper.

A LARGE SUBMARINE TELEPHONE CABLE.

What is claimed to be the longest submarine telephone cable of its size in the world was laid a few weeks ago across the Straits of Mackinaw, from Mackinaw City to St. Ignace, by the Michigan Telephone Company—the Michigan end of the Erie Telephone Company. The *Electrical World and Engineer* says that the cable renders possible telephonic communication between the upper and lower peninsulas of the State. This heretofore has been impossible, with the single exception that Menominee, which is in the Upper Peninsula, just across the border from Wisconsin, has been reached by a very circuitous route around the southern end of Lake Michigan, *vid* Chicago and Milwaukee. The great copper country of the north, however, has been out of the telephonic reach of Grand Rapids, Detroit, and other points in the lower peninsula, and this undoubtedly has had something to do with the fact that Chicago and Milwaukee have virtually controlled the trade in various lines in Northern Michigan.

The cable is one of 20 "Simplex" strands, bound in tape and jute and armoured with No. 6 iron wires. Two of these conductors are larger than the others, and form the core; their conductivity is about that of a No. 8 wire. The other nine pairs—for the circuits are full metallic, and the conductors will be used in pairs—are equal in sectional area of copper to No. 12 wires. The outside diameter of the cable is about 2½ inches. The cable terminals are in cable boxes mounted on poles on either shore of the straits, and the whole length is 5 miles and 175 feet. A representative of the company states that it cost $35,000, delivered at Mackinaw City.

Our contemporary says that after a week of preparation, which included the work of splicing the several lengths together, the cable was loaded upon a barge in tow of two tugs. A crew of 20 men was in charge of the work upon the barge, and the whole undertaking was under the personal supervision of Louis Hall, of Detroit, State superintendent of construction for the Michigan Telephone Company. The actual work of planting below the waters the great rope of insulated copper conductors was commenced on October 26th, and the trip across was made in a few hours. The greatest depth of water on the line surveyed for the cable was 256 feet. At 5 o'clock Thursday afternoon communication by telephone was had across the Straits of Mackinaw for the first time in history. A Western Union cable has been in operation at this point for some time, but that is all.

The expense of laying the new cable was very great. For more than a week prior to the day it was placed in the water the company was put to an expense of $80 per day for the tugs, and the labourers in the crew received $5 per day. They demanded this amount, and it was found more expedient to give it to them than to delay the work for the purpose of getting others to take their places. Of course, the salaries of the experts were much larger.

Six of the ten metallic circuits will be put into use as soon as the landlines on either side of the strait are completed. Some lines already reach Mackinaw, but others are being constructed, and the lines of the Upper Peninsula are being pushed forward with wonderful rapidity. Between Soo City and Marquette there are now working five crews of 50 men each. These crews have their camping outfits, special cars, and commissary departments. Another large crew is completing the lines this side of Mackinaw City. One of the six metallic circuits to be put into immediate use is for a local line connecting Mackinaw City and St. Ignace. The other four of the ten are a reserve to provide against possible needs in future.

CONDENSERS AND CONDENSING.

A paper on this subject, read by Mr. S. Payne before the Manchester Society of Junior Engineers, was needlessly prefaced by an apology for presenting the paper before electrical rather than mechanical engineers. Had the latter course been taken, this might well have been likened to taking coals to Newcastle, for the mechanical engineer of the kind evidently in the author's mind, has long since got beyond the stage of argument in respect of the advantage or otherwise of condensing. He never, at any rate, omits to condense if he has a supply of water at hand, though he may still be backward in the application of coolers or of evaporative condensers where water is scarce. But he never doubts the economy of condensing, as do so many electrical engineers, to whom a matter of 12 lbs. gratis mean pressure, or of an additional 200° of feed water temperature has no powers of appeal.

Taking approximate figures, the author points out that with an initial pressure of 80 lbs. absolute, and a cut off at one-third, the mean pressure is 41 lbs. Add a condenser and cut off at a fourth the stroke and allow 4 lbs. back pressure, and the mean diagram pressure will be 44·3, showing a steam economy of 25 per cent. and a power increase of 10 per cent. nearly—a total of 35 per cent. approximately, or, say, 30 per cent., not allowing for air pumps, &c.

Obviously, such a saving is not always to be effected, and if we

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are to judge by many modern installations of condensing plant, we must confess that to us it appears that the capital account on the engine plant must have been nearly doubled, in order that by the use of auxiliary steam very wastefully applied, the main engines might be made to appear to save about the same amount as the auxiliaries waste. Properly applied, condensing will give great economy, but some modern condensing plant of the type that has grown up since the electrical business developed, is hardly worth the trouble it involves.

The author then gives a description of the ordinary jet condenser, and of the ejector condenser, the latter being useful where a free fall of water can be had under a head of 15 or 20 feet. The exhaust condenser is really an early type of the exhaust injector. It should be noted that there ought always to be an automatic check valve between the condenser and engine. Where a condenser can have a 34 feet down pipe to the hot well a small air pump alone is sufficient to remove the air, leaving the water to flow away by gravity. The air pump becomes simply what it is named. These barometric condensers may be used with circulating pumps, for the condenser vacuum helps the circulating pump at least to half the lift, but they are more properly applicable where a fall of water is constantly available and repumping is not called for.

Evaporative condensers act by the transference of the latent heat of the steam to be condensed to the water films upon the exterior of the condensing pipes, the heat so transferred becoming latent in the act of absorption and sweeping away of part of this water by air currents, often artificially set in motion by a fan.

Water-coolers are extended surfaces over which heated water is similarly cooled before being re-circulated through either jet or surface condensers, or even evaporative condensers.

Evaporative condensers are thought to lose about one-half to three-quarters of the weight of the steam they condense. They are thus capable of saving water not merely because they reduce the amount of feed-water necessary, owing to the economy of steam effected, but also because of the smaller weight of feed now wanted; they save a portion as compared with the non-condensing system of throwing all the feed away into the atmosphere.

In surface condensers, Peclet found that a square foot of copper plate would condense 21½ lbs. of steam per hour if supplied with water on the other side at 68° to 77° F. Ordinarily the cooling surface is one-eleventh of the weight to be condensed per hour, and brass tubes are preferred, as more durable.

As regards air pumps, we think a good deal of money has been wasted by the system of independent air pumps and condensers generally. We see no reason why high speed engines should not drive their own air pumps direct. Years ago we saw engines having a stroke of 5 feet or more, and running at 80 and 90 revolutions which drove their own air pumps from tail rods at this same piston speed of 800 to 900 feet per minute; and in air pump work it is perhaps less the speed of rotation than the bucket velocity that renders careful design necessary.

The author states that vertical air pumps are more efficient than horizontal pumps. Perhaps this is so where the horizontal pump bucket or plunger is run dry. But well-designed horizontal air pumps are drowned and do not leak air past their buckets.

Of modern air pumps, the author refers to the Edwards pump, an entirely novel design of great ingenuity, and one which has a future.

Cooling towers are referred to, the disadvantage of which often is that the water passed through them requires to be lifted through a considerable height, and power is thereby wasted. The Klein cooling tower occupies ¾ square foot per I.H.P.

Oil separators are referred to. In some cases oil is separated from the steam in a chamber fitted with condenser plates, placed between engine and condenser. This has the advantage of keeping the condenser clean, but the author asks for the avoidance of cylinder lubrication as oil is very difficult to remove. This is a very lame and impotent conclusion at which to arrive. Oil can be perfectly removed from the condensed steam.

As it comes from the cylinder the oil is much emulsified. It is reduced to such minute particles that the difference of specific gravity between oil and water and the mutual attraction of the oily particles for each other are together insufficient to overcome the viscidity of the water, and time is required for the oil to float to the surface and coalesce. But the gravity effect can be increased by centrifugal action, and the Laval centrifugal separator acts as well on oil as it does on the fatty particles in milk. It separates any two liquids, not soluble the one in the other, with ease, by intensifying the difference of gravitation.

We think the author is wrong when he asks for the condensing plant to be split up into numerous units. We rather consider that each engine should have its own air pumps, but that one condensing main and one condenser might well serve several engines. A condenser big enough to serve a dozen engines will better serve one engine alone, but an air pump large enough for the dozen engines would be wasteful of power when one engine alone was at work. Obviously, therefore, air pumps may be many and condensers few.

Fire Tests.—An important series of fire tests with floors, partitions and doors, took place last week at the British Fire Prevention Committee's testing station at Regent's Park. Three of the tests were by French manufacturers. The French floors, partitions and girder coverings, made of a material called "Gypsine," were subjected to tests of an hour's duration, the temperatures ranging as high as 1,800° F., and followed by the application of water, the floors, of course, being loaded. Some oak and walnut doors were tested for 60 minutes at temperatures up to 2,000° F.

UNITS OF MEASUREMENT.

By W. MOON.

(*Concluded from page* 737.)

The present electro-magnetic units with their different units of intensity of magnetisation and of induction are very inconvenient to use and difficult to understand. Mr. Oliver Heaviside has long since proposed to do away with the multiple 4π and to make the intensity of magnetisation of the same value as intensity of field. I would go farther and propose to do away with the multiple 8π and to start the electro-magnetic system of units from unit induction equals unit stress across unit area. To define induction simply as the square root of the stress across unit area conveys a better impression of its nature, than to speak of so many lines of force or of induction. And if the electro-magnetic units were started from this definition the constant π would be eliminated from a number of formulæ in constant use, only to be introduced into a few seldom used formulæ for the action of magnets at a distance, to which it more properly belongs.

Such a definition as that of a unit magnetic pole might well be abandoned altogether; one has never to deal with an isolated magnetic pole, though sometimes with the moment of a magnet.

Starting from the unit induction as unit force across unit area, the definition of the other units follow:—Flux = induction × area; unit magnetic moment = unit torque experienced by unit magnet when at right angles to unit field.

Unit E.M.F. is produced in a circuit through which the flux increases or diminishes at unit rate.

Unit current = unit power divided by unit E.M.F.

Unit resistance = unit E.M.F. divided by unit current.

	Symbol.	Dimensions.	No. of C.G.S. units in proposed units.
Magnetic force	H	$L T^{-1} \sqrt{8\pi}$	2321×10^3 { H earth's field $= 84 \times 10^{-6}$ B five proposed units = 11,600 C.G.S.
Magnetic induction	B	"	"
Flux	ϕ	$L^3 T^{-1} \sqrt{8\pi}$	$\cdot2321 \times 10^6$
Moment of magnet	M	$L^4 T^{-1} \frac{1}{\sqrt{8\pi}}$	$92\cdot32 \times 10^3$ moment of steel magnets about their volume.
E.M.F.	E	$L^3 T^{-2} \sqrt{8\pi}$	$10\,745 \times 10^6 = \frac{1}{10}$ Daniell cell.
Current	C	$L^{\frac{3}{2}} T^{-1} \frac{1}{\sqrt{8\pi}}$	$923\cdot2 = 9{,}232$ amperes.
Resistance	R	$L T^{-1} 8\pi$	$11\,625 \times 10^3 = 11\cdot5$ B.A. microhm.
Specific resistance		$L^3 T^{-1} 8\pi$	$\cdot11625 \times 10^6$ { Copper = 014 units. Mercury = ·84 units.
Inductance	L	$L 8\pi$	$251\cdot33 = \cdot25133 \times 10^{-6}$ henrys.
Quantity	Q	$L^{\frac{3}{2}} \frac{1}{\sqrt{8\pi}}$	$19\cdot94 = 199\cdot4$ colombs.
Capacity	K	$L^{-1} T^2 \frac{1}{8\pi}$	$1\cdot856 \times 10^6 = 1\,856 \times 10^9$ microfarad.
Current density		$T^{-1} \frac{1}{\sqrt{8\pi}}$	9,232 = 600 amperes per square inch.

As unit of supply the meg-unit of work could be taken, that is, 6 KW.-hours nearly. This unit would be a more convenient one than the KW.-hour, as it would make the prices of gas and electric light more comparable.

The taking of 10^6 units of time, that is, 6 hours, instead of the hour and the minute, would simplify many calculations, such as the consumption of coal in boilers and of gas in gas engines.

With the proposed units some of the electrical formulæ would be altered. The intensity of magnetisation of a bar magnet could be taken as its magnetic moment divided by its volume. If the flux in a magnet of unit length and unit moment were uniform from end to end of the magnet it would be but ½ a unit; but as this is never the case it is not evident that there is much advantage in making unit

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intensity of magnetisation equal to unit induction, and to say that $B = \frac{I}{2}$ in the proposed units or $B = 4\pi I$ in the C.G.S. units is both inaccurate and misleading in the case of permanent magnets.

In electro-magnets $B = H\mu$ could always be used to the exclusion of the coefficient of susceptibility.

With the proposed units the magnetising force of a long solenoid would be

$$H = \frac{C n}{2 l},$$

and on a tangent galvanometer of diameter d.

$$C = \tan\theta \, H \, 2 d n^{-1},$$

and the inductance of a long solenoid would be

$$L = \frac{n^2 \text{ section } \mu}{2 l}.$$

In all three of the preceding formulæ the constant 2 would be omitted if 4π was eliminated from electrical formulæ instead of 8π. A reference to the table of electrical units will, however, show that the change from the C.G.S. system would be more troublesome if 4π was eliminated than 8π since the current and E.M.F. would not be so near decimal multiples of their present value.

On a tangent galvanometer, if H was adjusted to 100 micro-units by the use of a directing magnet and $d = 2$. c in micro-units would equal tan θ with 400 turns of wire.

The energy in unit volume of magnetised matter would be B H, so that with an endless solenoid

$$W = l a B H = l \phi H = \frac{\phi n c}{2} = \frac{L C^2}{2}$$

As a maximum energy in unit volume of magnetised iron, take $B = 5$, $\mu = 1{,}000$, then

$$W = \cdot0215, \text{ say, } \frac{1}{50}.$$

Steinmetz, formula for ½ a cycle gives

$$W = \cdot56 \times 10^{-3} B^{1\cdot6} \text{ to } 2\cdot8 \times 10^{-3} B^{1\cdot6}$$

for average iron, say,

$$W = 10^{-3} B^{1\cdot6} = \cdot0132 \text{ for } B = 5.$$

Verdet's constant in quadrants and proposed units $= L^2 T^{-1} \frac{16}{\sqrt{8\pi}} = 14{,}771$. C.G.S. units with water and thalium light $= \cdot0693 \, B \, l$, where l is the length of water acted on.

The time of oscillation to and fro of a suspended magnet would be—

$$t = 2\pi \sqrt{\frac{I}{H M}}$$

and $$\frac{M}{H} = 8\pi r^3 \tan\theta$$

whence $$H = \frac{1}{t} \sqrt{\frac{\pi I}{2 r^3 \tan\theta}}$$

and $$M = \frac{\sqrt{32 \pi^3 r^3 I \tan\theta}}{t}$$

with an infinitely long conductor—

$$H = \frac{c}{\text{distance } 4\pi}$$

These formulæ for the action between magnets at a distance, and for that of a straight current on a magnet are but seldom used.

Any alteration in the present system of units used would necessitate the recalibrating of the voltmeters and ampere-meters. But with the proposed units this alteration would be slight as they are nearly decimal multiples of the present units. An alteration in the figures on the dial and a slight re-adjustment would suffice.

The greatest difficulty would be experienced in the alteration of the resistance coils. But only a small proportion of the resistance coils in use are used for testing purposes and these alone would require re-winding.

The dimensions of the units most used would be

Magnetising force	... ...	in milli-units.
Magnetic induction	... ...	in units.
E.M.F.	... ...	in units or kilo-units.
Resistance, telegraphy	...	in meg-units.
" electric light	...	in kilo-units or units.
Current, large dynamos	...	in units.
" distribution	...	in milli-units.
" telegraphy	...	in micro-units.
Inductance	... ...	in meg-units
Capacity	... ...	in 10^{-9} units.

It might at first be wished that the unit of current could be smaller and the units of resistance and E.M.F. greater. But on consideration it would not be desirable to depart from an easily understood unit of force to make the unit of E.M.F. larger than that given, nor is it desirable that the unit of current should be severed from the mechanical units to make it smaller, and surely it is in the natural order of things that a short length of wire should have its resistance expressed in units, while a long telegraph line should have a resistance of meg-units.

The electrostatic units are but little used; they would, however, be easier to understand if they started from unit stress per unit area giving unit E.M.F. per unit distance.

In the absolute electrometer

$$\frac{E}{l} = \sqrt{\frac{F}{\text{area}}} = \sqrt{\frac{\text{L weight}}{\text{area}}},$$

so that in electro-magnetic measure

$$\frac{E}{l} = v \sqrt{\frac{F}{\text{area}}} = 64{\cdot}885 \times 10^6 \sqrt{\frac{\cdot04577 \text{ weight}}{\text{area}}} = 13\,885 \times 10^6 \sqrt{\frac{\text{weight}}{\text{area}}}.$$

The greatest value of $\frac{E}{l}$ that the dielectric strength of the air would permit of measuring is 10^6, so that with unit distance and unit area the weight would be about 5 grammes for that E.M.F.

The capacity of a sphere in electrostatic measure would be

$$K = 4\pi \text{ diameter},$$

and of two plates $K = \frac{2 \text{ area}}{l}$

and of two concentric cylinders

$$K = \frac{4\pi \text{ length}}{\log_e \frac{R}{r}}$$

dividing these values by v^2 to get electro-magnetic units,

sphere $K = 2{\cdot}97 \times 10^{-1}$ diameter.

concentric cylinders $K = \frac{2\,97 \times 10^{-15} \text{ length}}{\log_e \frac{R}{r}}$

of two plates $K = \frac{\text{area}}{\text{distance}} \times \cdot2367 \times 10^{-15}$

so that the capacity of a kilometre of cable would be about $\cdot125 \times 10^{-9}$ units, and of an aerial wire $\cdot005 \, 10^{-9}$ units.

STANDARDISING CARBON BRUSHES.

By E. KILBURN SCOTT.

Now that carbon brushes are becoming commonly used it is important that an effort should be made to standardise the sections. This is especially the case for those carbon blocks which are dovetailed into the brush holders. As things stand at present every firm, one might almost say every draughtsman, is getting out sections differing about a millimetre from those got out by someone else. As special tools are required for each size, the result is that it practically costs as much to equip a dynamo with carbon blocks as it

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does to fit it up with gauze brushes, although when compared in the raw state the carbon is, of course, very much cheaper than either brass or copper. Take, for example, a carbon block with dovetailed head and measuring, say, $1\frac{1}{2} \times 1\frac{1}{8} \times 2$ inches long and weighing 3 ozs. In quantities of a few dozen each block will cost 1s. 2d., or at the rate of, say, 6s. per lb., whereas the cost of the carbon itself is less than about one-tenth of this. A block, $1 \times \frac{7}{8} \times 1\frac{1}{2}$ inches long, costs about 7d., and a block, $\frac{3}{4} \times \frac{1}{2} \times 1$ inch long, costs 5d.; these prices being for small quantities of, say, three or four dozen only. If the carbon manufacturers were able to turn out large quantities to certain standard sizes the prices would quickly come down, and in order to advance this desirable object the writer suggests that the following sizes be generally adopted :—

CARBONS WITH DOVETAILED HEAD.

Size.	A.	B.	C.	D.	Suggested length E may be sawn off to any dimension.
	mm.	mm.	mm.	mm.	
1	6	8	3	5	19 mm. (¾ inch).
2	7	9	3½	5½	
3	8	10	4	6	
4	9	11	4½	6½	
5	10	12	5	7	
6	11	14	5½	8½	25 mm. (1 inch).
7	12	16	6	10	
8	13	18	7	11	
9	14	20	8	12	
10	15	22	9	13	
11	17	25	10	15	38 mm. (1½ inches).
12	19	28	11	17	
13	21	31	12	19	
14	23	34	13	21	
15	25	37	14	23	
16	27	41	15	26	51 mm. (2 inches).
17	29	45	16	29	
18	31	49	17	31	
19	33	53	18	35	
20	35	57	19	38	
21	38	62	20	42	63 mm. (2½ inches).
22	41	67	21	46	
23	43	72	22	50	
24	46	77	23	54	
25	49	82	24	58	

PLATE BRUSHES FOR TRACTION MOTORS.

Length.		Breadth.		Thickness.	Nearest mm. dimensions. Length.	Breadth.	Thickness.
Inches.		Inches.		Inches.	mm.	mm.	mm.
1¾	×	¾	×	7/32	44	19	5·6
1¾	×	¾	×	¼	44	22	6·3
2	×	1	×	9/32	51	25	7·2
2	×	1¼	×	11/32	51	32	8·0
2¼	×	1½	×	13/32	57	38	8·7
2¼	×	1¾	×	7/16	57	44	9·5
2½	×	2	×	15/32	63	51	11·0
2½	×	2¼	×	½	63	57	12·7
2¾	×	2½	×	17/32	70	63	14·3
2¾	×	2¾	×	9/16	70	70	15·8

LONG PLATE BRUSHES.

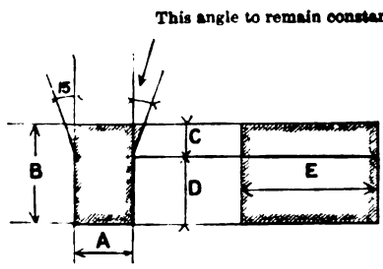
Length.		Breadth.		Thickness.	Nearest mm. dimensions. Length.	Breadth.	Thickness.
Inches.		Inches.		Inches.	mm.	mm.	mm.
5	×	1	×	¼	127	25	6·3
5	×	1¼	×	5/16	127	32	8·0
5	×	1½	×	3/8	127	38	9·5
7	×	1¾	×	7/16	178	44	11·0
7	×	2	×	½	178	51	12·7
7	×	2¼	×	9/16	178	57	14·3

In the case of the dovetailed carbons the dimensions are given in millimetres only, because, as the differences are small, it is more convenient than dimensioning in fractions of an inch. Several of the sizes in the tables are already standard.

Carbon brushes may be divided into two distinct categories:—First, those which have passed through an electric furnace on the Girard and Street process; and secondly, brushes which have only undergone baking in kilns in the ordinary way. The Le Carbone Company have given very great attention to the manufacture of carbon brushes, and that must be the writer's excuse for referring to their qualities only in the following notes.

In passing through the electric furnace electro-graphitic carbon brushes acquire a special texture, the molecules being, so to speak, soldered together by condensed carbon vapour, thus forming a mass similar to a substance heated to melting point. This reduces the contact resistance on the commutator and allows of its use (with the same degree of heating) for heavier currents than can be employed with ordinary agglomerated carbon.

There are two qualities of electro-graphitic carbon, viz.: "X" and "E G." The "X" quality has a resistance of 1,500 microhms per cubic centimetre, is particularly homogeneous, and keeps the surface of commutators on which it is employed in perfect condition. In normal work it may be employed for a current density of 15 amperes per square



DOVETAIL BRUSHES.

centimetre (27 amperes per square inch) of surface contact. The "E G" quality is also very homogeneous, but is not quite so hard as the "X" quality. Its resistance is about 4,500 microhms per cubic centimetre, and it can be used for a current density of 12 amperes per square centimetre (77 amperes per square inch) of contact surface.

Of the brushes baked in the ordinary way, a special quality, "Q S," has been supplied for some years. It is a uniformly dense carbon, and is suitable under normal conditions for a current density of 8 amperes per square centimetre (52 amperes per square inch) of surface contact. Its resistance is about 6,000 microhms per cubic centimetre, but for blocks of small dimensions this figure comes out rather lower.

All the above brushes are carefully made to gauge, but a cheaper quality, known as "F" carbon, is supplied, which is moulded by being simply forced through a die; an allowance of 2 or 3 per cent. must be made in the dimensions. The resistance of this material is about 4,500 microhms per cubic centimetre, and its normal working density 7 amperes per square centimetre (45 amperes per square inch) of surface contact. Generally speaking, this carbon answers well enough, and may be relied upon not to injure the commutator. It is very suitable for heavy current low voltage machines, and can only be supplied in large quantities.

The above current densities are the maximum that should be allowed. Of course the lower the density the better the result; about two-thirds of the above figures are recommended. On account of its high current carrying capacity the electro-graphite "X" quality carbon can frequently be successfully fitted to commutators which have been designed for metal brushes.

For the successful use of carbon brushes three points must be watched very carefully:—1. The connection between the carbon block and the holder and between the holder and the rocker stud must be above suspicion. For large currents flexible cables are absolutely necessary to connect the holder of the carbon block to the spindle on which it rotates. If the carbon block is large a hole may be drilled into it and the flexible soldered up direct, or the block may be cast into a white metal end having a stud projecting to which a cable eye can be bolted. Coppering

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is advisable for blocks which are merely gripped between two surfaces, but care must be taken to strip the coppering well back, so that it does not touch the commutator. The expense of coppering ranges from ¾d. to 2d. each block, according to size.

2. The brush holder should be as light as possible consistent with strength (large sizes made of aluminium), and the spring should be adjusted so that the pressure is about 50 grammes per square cm. contact surface for electrographitic, and 100 grammes per square cm. for ordinary carbon, ·7 lbs. and 1·44 lbs. per square inch respectively.

3. The surface of the commutator should be dead true, it is not enough to merely turn it up, it should be gone over with an emery wheel or else lapped to a burnished surface. It goes without saying that the commutator segments should be held absolutely rigid by the micanite end rings.

UGANDA STATE RAILWAY TELEGRAPHS.

A FRENCH newspaper a few weeks ago described the progress of English railways in Africa as so rapid as to turn one giddy. However this may be in comparison with those of other countries, with the most important of them which starts from Mombasa in British East Africa, and will ultimately extend to the shores of Lake Victoria, progress has, as a matter of fact, been comparatively slow.

There are difficulties in this part of tropical Africa to be met with nowhere else, and a combination of some such as rugged country, dense jungle, waterless tracts, unhealthy climate, and absence of transport leads anyone with a knowledge of the matter to marvel that things have progressed as rapidly and as well as they have.

At the time of writing some 362 miles of rails have been laid.

The construction of the permanent telegraph line has naturally kept pace, but has not been carried ahead because of cost and difficulty in obtaining transport.

The materials for the line were specified by Sir Alexander Rendel, K.C.I.E, the consulting engineer to the Uganda Railway, in communication with Mr. B. T. Ffinch, C.I.E., of the India Office.

The following is a brief description of the most important items:—

Posts.—Cast-iron base, 7 feet long; flange at bottom 11 inches in diameter; metal nowhere less than ½ inch thick; weight 195 lbs. Pole, 16 feet long; galvanised iron, tapered and butt-welded; metal not less than $\frac{3}{16}$ths inch thick; diameter at bottom 4 inches; weight 113 lbs; secured in base by a screw wedge.

Brackets. — Annealed maleable cast-iron, galvanised; weight 4·4 lbs.

Insulators.—White porcelain; weight 2 lbs.

Wire.—Galvanised iron, weighing 600 lbs. per statute mile; electrical resistance at 60° F. not more than 9 ohms per mile.

Up to the present two wires are erected. A third wire is in course of erection between Kilindini and Nyrobi, mile 326, and the ports, when placed 100 yards apart, are capable of carrying at least four such wires.

One of these wires is used exclusively for the signalling of trains by telegraph and the transmission of local telegraph messages. On it are the following stations, all of which are open for public work:—

	Miles.		Miles
Kilindini	0	Kibwezi	193
Makupa	2	Makindu	207
Changamwe	4	Simba	227
Mazeras	14	Sultan Hamud	246
Mariakani	23	Kimaa	255
Maji Chumvi	33	Kiu	265
Samburu	41	Machakos Road	274
Mackinnon Road	59	Kapite Plains	286
Maungo	83	Stony Athi...	297
Voi	100	Lucania	309
Ndi	109	Nyrobi	326
Tsavo	131	Kikuyu	327
Kinani	146	Ruaraki	345
Mtoto Andei	162	Lumoru	350
Darajani	173	Lari	357
Masongoleni	182	Escarpment	362

Kilindini Office is in connection with the Protectorate Post Office in Mombasa and also with the Eastern Telegraph Company's Station at Kilindini. With the latter direct working is carried on from Nyrobi, the headquarters of the railway.

The charge for messages all over the railway system is one rupee (1s. 4d.) for eight words. Names of sender and the address are sent free.

The second wire works from Kilindini to Voi direct with Mazeras in circuit, from Voi to Makindu, with Mtoto Andei in circuit, and from Makindu to Nyrobi with Machakos Road in circuit.

The third wire will work direct from Nyrobi to Kilindini.

With materials so substantial and of the highest quality, the maintenance of the lines naturally gives no trouble and is not likely to for many years. The wisdom of the 600-lb. iron wire throughout has been proved on more than one occasion when giraffes, which are fairly numerous in parts, have, in crossing the railway, somehow become entangled in the telegraph wires. Their frantic efforts, as evidenced on the ground, merely result in the wires being pulled out of level.

The posts, apart from their powers of withstanding corrosion, are not broken by zebra, wildebeest, and other animals galloping against them, nor displaced by the rhinoceros using them to rub himself against.

The instrument in use on the railway is the sounder, P.O. pattern, with No. 2 Leclanché batteries. The relays in use are the Siemens polarised.

Up to the time of the completion of the first 100 miles of line telephones were exclusively used for working trains and the transmission of messages. As many as seven worked on one wire, on the bridging system, with earth returns. The general direction of the line for this distance is from S E. to to N.W. No earth current was noticeable during the morning, but it began to be heard about noon, and increased during the afternoon until by evening speech was always seriously interfered with and was sometimes impossible.

TEMPORARY LINES.

As has been stated, the difficulty and cost of transport prohibiting the erection of a permanent line, even of the lightest description, beyond Railhead, advantage was taken of the peculiarly dry climate from mile 100 onwards to erect an absolutely uninsulated and, for long distances, unpoled line of such length as has perhaps never been constructed elsewhere. The immediate need for an advanced line was the mutiny in Uganda, which broke out at the end of 1897, when the Railhead was at mile 103. Instructions were received from the Foreign Office to push a temporary line ahead, using what materials happened to be in stock. The bundles of 600-lb. iron wire, each weighing 100 lbs., were therefore divided into two of about 50 lbs. each, and a slack bight of some 10 feet in length left between them. They were then carried forward by every available porter, at the rate of about 14 miles a day, on an average, and at a considerable cost. A mile of wire thus took 12 porters. A quantity was also transported by bullock carts, but cattle disease stopped this much more satisfactory means of transport. As the wire arrived at its destination it was payed out along the caravan road and afterwards lifted by means of forked sticks on the tops of the trees and bushes forming the almost impenetrable jungle between Tsavo, mile 131, and Kibwezi, mile 193.

Further than this no progress was made for a time, it being impossible to obtain porters, despite the greatest energy on the part of the transport officer of the railway. Animals had by this time become almost extinct.

The working of this length of 62 miles by telephone gave no trouble. Occasionally in the early morning or during a shower of rain communication would fail, but never for more than a few hours at a time, and the line proved of great value both to the Protectorate and to the railway.

The first message it ever transmitted was one giving news of the escape of King Mwanga from German territory, and urging forward the progress of the Indian Regiment, which was on its way to Uganda.

The maintenance of this section was not difficult. There were few actual breaks, and the chief trouble was in keeping the wire clear of the road. Giraffes would cross and carry the wire from the trees on one side to those on the other, or

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perhaps cause it to fall on to the road itself. Rhinoceros and other large animals would foul it in places where it was low, and though by the time they had pulled it taut they generally cleared themselves, sometimes they broke it. On one occasion when the maintenance party arrived at the scene of a break it found a rhinoceros still making hay with the wire, a length of which had become entangled on its horn. The members of the party betook themselves to neighbouring trees, and for some time remained impatient spectators.

A further extension was made to Nyrobi, mile 326, early in 1898. This point was then about 166 miles ahead of the rails.

Across the Athi plains no trees are to be seen, and there is little timber anywhere in the neighbourhood from which poles could be cut. Bamboos were therefore procured, and they were erected as tripods at intervals of about 160 yards all across. The butts of the bamboos were placed at the three corners of an equilateral triangle and about 10 feet apart. By the side of each a stout peg was driven into the ground, and to this the bamboo was secured by wire.

The height of the wire in the middle of the span was sufficient to enable the largest game frequenting the plains to pass safely under.

A few weeks after the completion of this part the rains came on, and as the grass grew game flocked in from the neighbouring country. The writer of this article rode for some 15 miles on his bicycle through one almost continuous string of zebra and wildebeest. Herds of these animals stampeding about at night, when frightened by him, soon knocked down most of the bamboos, and the wire left in places a few inches off the ground was broken by the next animal which passed. It was found impossible to keep the poles up, and the wire was ultimately taken down and left absolutely on the bare ground. In this position it gave no trouble whatever, and thanks to an abnormally dry season, the working proved satisfactory.

Controlling stations were established at Ngomeni, Kinani, Mtoto Andei, Darajani, Masongoleni, Kibwezi, Makindu, Kiboko, Muani, Kiu, Bondoni, Lucanis, and Athi, at all of which places are either streams or water holes which enabled a good earth to be obtained.

In ordinary weather, speech was quite possible over a length of 110 miles, for 30 of which the line was on bare ground and the remainder on trees, bushes, and uninsulated poles cut in the neighbouring jungle. On further extension being required, hard-drawn copper wire, weighing 100 lbs. per statute mile, was procured, and this with little trouble was carried on to the Eldoma Ravine, about 150 miles distant, in a comparatively short time. Poles cut locally were erected all along the caravan road and the wire was secured to them with 3-ply tarred spun yarn. A length of yarn was wrapped round the wire so as to form a bed between it and the pole, and its ends were then crossed at the back of the pole and tied in front over the wire. In this way the wire is not in contact with the wood, and in wet weather there is probably better insulation, while any chance of damage by chafe is prevented. The intermediate stations between Nyrobi and the Ravine are, First Kedong, Naivasha, M'Baruk, and Molo.

The services of four Royal Engineer signallers having been secured from the War Office, Cardew vibrating sounders, as made by Messrs. Siemens Bros & Co., were set to work at the Ravine, M'Baruk and Naivasha and the Railhead station of the permanent telegraph lines. The other two intermediate stations are only for the purpose of controlling the maintenance parties. All stations on the temporary lines are open for public messages at the railway rates.

An alteration to this line was recently made, and the cleared railway route from Ziwani, through the Kikuyn forest, down the escarpment to the Second Kedong, is now followed, instead of the caravan road, thus opening up communication with the advanced earthwork parties of the railway. Trouble was here caused by elephants, which for some nights regularly rooted up posts which had been erected across a piece of open country near the escarpment.

There have been cases of cutting and stealing both of the iron and copper wire, but it is believed to have been generally done by passing caravans and not by natives of the country, who, as a rule, have a most wholesome respect for the works of the white man.

Energetic measures have been taken by the officials of the East Africa and Uganda Protectorates, and there is not likely to be any more trouble from this cause.

Instructions have been received to carry on this temporary line without delay up to Kampala, the capital of Uganda, distant from the ravine some 350 miles. This will certainly establish a record as a temporary line of the kind.

FRICTION LOSSES IN DYNAMOS.

In several of the simplest methods of determining the efficiency of dynamos, it is very desirable to know the friction losses; these losses are also the ones which are more likely to change in the course of time when the dynamo is in use; the laws concerning these friction losses and the determinations of their value are therefore of practical interest. A somewhat prolonged discussion concerning these losses has been continued in a number of issues of the *Elektrotechnischs Zeitschrift*, and one of the results has been a long article by Mr. Dettmar, in which he goes into this subject very thoroughly and develops some points of practical value. The *American Electrician*, referring to this article, says one of the chief points which he brings out is that the loss of work due to friction is not proportional to the speed, as is often supposed, but that it increases quite appreciably with the speed; by this he refers to the sum of the various friction losses in the dynamo. This variation from a straight line law has been attributed to the air friction, but he shows that this is not correct, and that it is the coefficient of friction which is variable. There are three methods by which the friction may be measured, first by means of a calibrated motor, that is, driving the dynamo to be measured by means of a motor whose efficiency has been accurately determined. This method is not a good one if the motor drives through a belt, as that involves an unknown quantity in the form of the power absorbed by the belt; but if the machine is directly coupled the method is a good one though limited; the calibrated motor, for instance, should not be heavily loaded by the machine which it drives; the method has advantages when no convenient source of current is obtainable for the other methods. The second method is the well-known one of running the machine as a motor, unloaded; it combines great accuracy with relative simplicity. The third method consists in bringing the dynamo up to the proper speed either mechanically or electrically, and then letting it run down without doing any work other than overcoming the friction losses. The application of this method is, however, limited for absolute determinations, as it involves a knowledge of the moment of inertia, &c.; it is very serviceable, however, for determining relative values, that is, for comparing the losses at one time with those at another; moreover, the time required for making such a test is extremely short and this is of great value, as the other conditions, such as temperature, are not so likely to change during the test. If the losses are determined absolutely once for all, then the method serves very well for determining the condition of the bearings; moreover, by observing the action of the machine during the last turn before it stops, indications will be obtained as to the balancing of the armature. Sometimes the combination of two of these methods is of use, as, for instance, by using the first or second in order to find the absolute values of the relative ones given by the third method. In the third method, which he calls the "running down" method, a tachometer (this is an instrument for indicating the speed at any moment) must not be used, as that absorbs considerable power; in place of it the remanent magnetism may be used in connection with a voltmeter. The speed is measured once for all while running, and also the voltage at that speed due to the remanent magnetism; then the voltage readings may thereafter be used as a measure of the speed, correcting it, of course, by the factor thus determined. Otherwise a revolution counter, like a bicycle cyclometer, could be used. From this very lengthy series of tests Mr. Dettmar draws the following conclusions: At a constant temperature of the bearings and a constant specific pressure (that is, a constant pressure per square

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inch) the friction coefficient, and therefore the loss of power by friction, increases as the 1·5th power of the speed. The nature of the oil used does not change this law but merely affects the absolute values. The values for this exponent, which he found for a very large number of tests, varied between 1·3 and 1·55, the smaller one being for a smaller machine and the larger one for those of larger sizes.

COST OF CENTRAL STATION PLANT.

(*Continued from page* 788.)

Overhead Traveller.—It has been suggested that in electricity works electric cranes should be used, and some few stations in this country have been so fitted. The use of the traveller in a properly equipped station is, however, so infrequent that a hand crane will do all that is necessary and it is much cheaper.

Boilers.—There will always be a considerable amount of controversy on the question of the type of boilers to use. The Babcock & Wilcox is a greater favourite than ever, but some engineers still think that for moderate pressure of, say, 140 lbs. per square inch, the Lancashire boiler cannot be beaten, whilst others advocate the Economic, Locomotive, or Marine. When everything is taken into account there is not very much difference in the total cost of the various types, so the figures given in the table may be taken as good covering prices without specifying details. The output of the two boilers should be equal to the three steam sets taken together. It is better to start with a relatively large size of boiler, so that the extensions can be carried out with the same size.

Economiser.—Green & Son have, until recently, monopolised all the economiser work, although all the really essential patents have long ago run out. In the near future there will be more competition in this class of work, but at the same time Messrs. Green & Son are to be congratulated on their record in the laying down of economisers. It is a splendid testimonial to the quality of their manufactures.

The Green type of economisers are usually built up of pipes 9 feet long and 4½ inches in diameter, and the price per pipe runs out at about 30s, this being inclusive of the dampers and electric motor for working the scrapers.

Steam and Exhaust Pipes, &c.—Piping work has on many occasions been a stumbling block for contractors, and there is a good opening for a firm to specialise on the supply and erection of piping for generating stations. Electrical engineering firms only undertake the work very occasionally, but with a firm doing nothing else, and having the proper kind of draughtsmen and erectors, we should be able to get down to something like bed rock prices. At present pipe contracts may run out at anything between £2½ and £7 per KW. of plant installed. The following rough make-up estimate may be useful as showing how the £1,000 given in the third column of the table is arrived at:—

Complete pipe arrangement, including steam and exhaust, feed and drain pipes, valves, joint rings, bolts and nuts, covering, hanger brackets, chequer plating to pipe chases, steam traps, &c. The whole arranged for three 90-KW. high speed dynamo sets, two Lancashire boilers, Green's economiser, feed water heater, two pumps and a water meter. The steam and feed piping to be tested to 350 lbs.:—

Steam Piping.—The steam piping to be of steel, arranged as a steam ring of 8-inch diameter pipes, with 3½-inch branches to the engines and 7-inch branches to the boilers. About 160 feet of straight steam piping at 11s. per foot run	£88
The bends of the steam piping to be of copper, with steel flanges screwed and brazed on. About 110 feet run of steam bends at 16s. per foot run	£88
Exhaust Piping.—The exhaust piping to be of cast-iron, 16 inches diameter, with 7-inch branches to the engines, and a 16-inch pipe carried up the chimney to a height of 120 feet. About 255 feet of piping in all at 12s. per foot run	£154
Feed Piping.—The feed piping to consist of 3-inch cast-iron piping with connections to two steam pumps, water meter, water heater, and economiser. The bends to be of copper. About 360 feet of piping in all at 1s. 6d. per foot run	£27
Valves.—The valves to consist of six 8-inch and three 3½-inch steam, three 16-inch and three 7-inch exhaust, also 20 valves 4-inch, 3½-inch and 2½-inch, for feed, &c. Steam and feed tested to 350 lbs. Say about 35 valves, all sizes, at £5 a valve all round	£175
	£531
To cover steam traps, water meter, drain pipes, chequer plates for pipe chases, hangers and brackets, packing rings, covering, bolts, nuts, washers, &c. Allow 33⅓ per cent. of £532	178
	£710
Special drawing office work, allow 7½ per cent. on £710	53
Erecting, &c., allow 33⅓ per cent. on £710	237
	£1,000

Water Storage Tank.—The water storage tank generally forms the roof to the pump room, and a usual size is 45 feet × 13 feet × 4½ feet deep. It is generally constructed of strongly bracketed plates with machined joints and the necessary facings for delivery pipes, &c. A water level indicator with pulleys, weight and chain, is fixed in a position where it can be readily seen, or a Bailey's pneumatic gauge may be used. A wrought-iron ladder to give access to the tank and a fire hose fixing are required.

Pumps.—The usual practice now is to put down a steam and an electric pump for the boiler feed, and to also fit each boiler with an injector. The tank is kept filled by means of a small electric centrifugal pump arranged with a float controller switch to start and stop the motor automatically.

Feed-Water Heater.—There are several makers of this useful piece of apparatus, and the quotations generally come within a few pounds of each other. The quality of the water is the principal factor in deciding on the type. The ingenious indented Row tube gives an enormous heating surface in little room, but with dirty water the older fashioned Berry heater would probably be preferable.

Engines. — The generating plant is divided into three units, as this is preferable to having only two generating sets and a number of spare engine parts, an armature, field coil, &c. In case of breakdown the station engineer should be in a position to get a new set to work at once and not have to wait until the broken part is replaced. The want of confidence, which is still characteristic of the general public of this country, is due in great measure to the niggardly way in which spare plant has been treated. The extension units of plant should be about twice as large as those first installed.

Some engineers still prefer to start up a station on the two-wire, and, as soon as convenient, change over to the three-wire system. If this is done, then the first dynamos laid down must be wound for 220 volts, and a balancer can, if preferred, be dispensed with. One method, which was first introduced at Lancaster, is to have a dynamo with two windings; another method introduced recently is to couple two dynamos to one engine; whilst another is to have the dynamos wound for the full 440 volts, and use a transformer temporarily to give the lower voltage. It is, of course, always possible to get any voltage from the cells by simply arranging them in the necessary order. Most stations nowadays start with a good load, and seeing the great advantage of automatic regulation which is given by the balancing transformer, perhaps the best way after all is to wind the dynamos for the full voltage of 440, have the battery arranged in two halves, one on each side of the middle wire, and depend entirely on a balancer for the regulation.

Theoretically the size of the balancer may be said to be equal to about $\frac{1}{10}$th of the running output of the station, but as small units are apt to be a nuisance afterwards, it is advisable to look well ahead when deciding on the size (this also applies to the booster), say, to the time when the station will have twice the amount of plant which is first laid down.

Balancer.—The output of the balancer may therefore be taken at $\frac{1}{8}$th of the running output of the station when first erected. Thus for 9,000 8-C.P. lamps fixed there are three dynamos of 90 KW. each, one being spare. Each side of the balancer will therefore be made large enough to deal with 82 amperes 220 volts = 18 KW. The question of whether to use two separate armatures or have two windings on a single core is generally answered in favour of the first method, because by having separate fields the two sides

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may be easily and cheaply adjusted. A machine with the two windings on one core is, of course, cheaper so that if money is tight this gives an opening for a small saving.

Booster.—Since it was first introduced by Messrs. T. Parker, Limited, the method of separately boosting up the voltage for charging purposes has come rapidly into favour. It is undoubtedly the most scientific method, because speeding up an engine means poor governing, whilst a long range on the dynamo fields gives a more expensive machine and low efficiency when running on lights direct. One arrangement of booster is given by having a motor direct coupled to *one* dynamo, the cells being charged all in series, but two dynamos are generally coupled to one motor, the cells being charged in two sets. As in the case of the balancer, where there is one motor and one dynamo, the windings can be placed on a single core, this being cheaper as the armature reaction is neutralised. On account of the fixed ratio, however, the reduced voltage at commencing a charge has to be obtained by means of an expensive resistance in the main circuit.

Sometimes the balancing set and the booster are all coupled together, the balancing armatures acting as a motor for the booster. As many as four armatures are thus coupled in line, the two middle ones forming the balancer and the two outers being booster dynamos. This arrangement gives a long straggling piece of apparatus very liable to vibrate badly, and probably the best method is to have the two machines entirely separate.

Switchboard.—From very small beginnings the switchboard has grown and grown until it is now relatively the most expensive piece of apparatus in a central station, there is, in fact, a distinct tendency to go too far in this direction of elaboration. In the opinion of some the ideal arrangement is a skeleton board such as is in use at Manchester. It does not look pretty, but there is a utilitarian appearance about it which appeals to the engineer.

The board should be placed on the wall of the engine house with a room—preferably the testing room—immediately behind so that there is good daylight on each side.

A switchboard for a continuous current three-wire system, 220-volt lamps, with three generating units and, say, five circuits, and costing, say, £1,000, would be made up somewhat as follows:—

Dynamo panels	£200	
Feeder panels	300	
Balancer booster panel	100	
Battery panel	50	
		£650
Main switchboard connections including those between board and machines		100
Works' switchboard for lighting and power		75
Wattmeters and recording voltmeters		100
Erection on site		75
		£1,000

As a rough guide the following figures may be taken:—

£2·8 per kilowatt of plant installed.
£1·2 per point or per connection on the board.
£4·6 per square foot of superficial area including frame.

(*To be continued.*)

Electrostatic Measuring Instruments.—For many practical reasons, electrostatic instruments offer pre-eminent advantages in the measurement of high pressures; they suffer, however, from the tendency to spark across, on account of which the parts have to be placed so far apart as to greatly weaken the measuring forces. According to the *American Electrician*, Prof. Elihu Thomson proposes to overcome this difficulty by enclosing the instrument in a glass bulb, exhausted of air to a very high degree, so that the sparking distance for a given pressure is very much reduced. The vanes and quadrants can then be brought very closely together with safety, greatly increasing the sensibility of the instrument and reducing frictional errors, while the whole instrument can be of stronger construction. The pointer and scale are, of course, enclosed in the bulb, as well as the inductors, &c. The device is covered by a patent, which broadly claims the enclosure of measuring instruments in vacuo.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS. 1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

22,143. "Improvement in electrical accumulators." E. C. H. T. Lugard. Dated November 6th.

22,163. "Improvements in continuous current electricity meters." E. Schattner. Dated November 6th.

22,164. "Electro-magnetic ignition device with revolving armature for gas petroleum and similar motor engines." W. P. Thomson. (F. Sturm, Germany.)

22,181. "Improvements in or relating to electric taxameters." E. Johansson. Dated November 6th.

22,212. "Improvements in electric switches." C. Wood. Dated November 7th.

22,260. "Improvements in and relating to submarine telegraphy and apparatus for use in connection therewith." H. H. Lake. (J. B. Millet, United States.) Dated November 7th. (Complete.)

22,267. "Improvements in or relating to electric light fittings." H. Hill. Dated November 7th.

22,271. "Improved manufacture of electrical heating appliances of high electrical resistance capable of sustaining high temperature." A. Vogt. Dated November 7th.

22,291. "A new or improved system of telegraphy." J. G. Lorrain. (F. Bedell, United States.) Dated November 7th.

22,293. "Improvements in electric traction." W. A. Burns and H. E. Smith. Dated November 7th.

22,297. "Improvements in roller gearing and transmission dynamometers." T. Foster. Dated November 8th.

22,298. "Improvements in and connected with electric railways or tramways." T. Scott. Dated November 8th.

22,303. "Improved means for guiding collecting trolleys on to overhead electrical conductors." I. Dixon. Dated November 8th.

22,306. "Improvements in and relating to electric arc lamps." C. C. Ridings. Dated November 8th.

22,308. "Improvements in telephone switchboard cable." A. Whalley. Dated November 8th.

22,313. "Governor relay or speed controller for steam engines, especially adapted for controlling large engines for electric light and power stations." R. Wilby. Dated November 8th.

22,317. "Improvements in electric arc lamps." C. Curwen. Dated November 8th.

22,333. "Improvements in central battery telephone exchange systems with call wire." P. H. Cole. Dated November 8th.

22,338. "Improvements in electrical switches." Evered & Co., Limited, and S. Evered. Dated November 8th.

22,384 "Improvements in and relating to chemical electrical excitants." J. Post. Dated November 9th. (Complete.)

22,517. "Electrical influence machines." W. R. Pidgeon. Dated November 11th.

22,531. "Improvements relating to electric igniters." A. H. C. Gibson and W. Wright. Dated November 11th.

22,525. "New or improved means for placing, removing, and cleaning incandescent electric lamps." H. J. Haddan. (E. E. Simms, United States.) Dated November 11th. (Complete.)

22,533. "Improvements in systems of electrical distribution." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated November 11th. (Complete.)

22,534. "Improvements in means for generating alternating electric currents." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated November 11th. (Complete.)

22,535. "Improvements in starting rotary electric converters." The British Thomson-Houston Company, Limited. (W. B. Potter, United States.) Dated November 11th. (Complete.)

22,536. "Improvements in electric circuit changers." The British Thomson-Houston Company, Limited. (E. Oxley, United States.) Dated November 11th. (Complete.)

22,544. "Improvements in collectors for electric railways." O. Kirstein. Dated November 11th.

22,552. "Improvements in electric glow lamps." F. W. Schroeder, A. Couch, and P. W. Moran. Dated November 11th.

22,554. "Improvements in processes and appliances for obtaining carbon suitable for electrical and other industrial purposes, such as the manufacture of electrodes and calcium carbide, and at the same time obtaining a superior quality of pitch." L. Gaster. Dated November 11th.

22,556. "Improvements in and connected with electric bell pushes and light switches and other articles." W. G. Hicks. Dated November 11th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

4,888. "An improved method of, and means for, holding the bases of electrical fittings within boxes, or upon other surfaces." F. Eatherst. Dated February 24th, 1898. Relates to means for fixing the bases of electric fittings within boxes, or upon surfaces without the necessity for turning. The surface to which the base is to be attached is formed with a boss or projection, on to which a shouldered sleeve screws. The base is bored out so as to fit over the sleeve, and is secured by a screw. This screw may be soldered or otherwise fixed to the sleeve, so that both may be removed together. 4 claims.

4,821. "Improvements in electric arc lamps." A. F. Specner. (P. Vassia, France.) Dated February 24th, 1898. Relates to arc lamps. An escapement lamp for continuous or alternating current is constructed as shown. The heavier upper carbon holder is hung by a cord, which passes round pulleys to the lower holder. The pulleys are carried in stationary bearings. The pulley is connected by a ratchet wheel with a pawl on an adjacent toothed wheel, which is geared to a shaft carrying a fan and a star wheel. The pulley is carried by a lever fulcrumed in the frame and movable between stops by the core of a shunt solenoid acting in opposition to a spring. The lever also has a finger which engages and stops the star wheel in the position shown. The arc is struck by the lowering of the pulley and the lower carbon, when the core of the solenoid rises in consequence of the carbons coming in contact. Feed of the

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carbons occurs when the core is pulled down sufficiently to free the finger from the stop wheel. The arc is surrounded by a small globe supported by the side tubes. 3 claims.

4,636. "Improvements in apparatus for travelling through pipes or conduits more especially intended for use in threading through electric conductors." H. Edmunds. Dated February 24th, 1898. Relates to the insertion of a rope in a pipe or conduit applicable for threading through conductors. Two blocks are connected together by a spring and rod, which is attached to the block and slides through the block. The rod is grooved to receive a guide-feather, and has an enlarged end. Ropes are attached to the block, and after passing over pulleys on the block, return through guides on the block. The blocks are provided with spring arms or brushes which grip in one direction only. The spring connection between the blocks may be replaced by a double solenoid containing a sliding core; an extension on the solenoid carries a pair of wheels set at angle to each other and provided with notches and pawls to allow of rotation in one direction only. The extension on the core carries a similar pair of wheels. The current is switched from one solenoid to the other alternately. 2 claims.

4,649. "Improvements in apparatus for magnetic testing." J. A. Ewing. Dated February 25th, 1898. The magnetic qualities of different specimens of iron or steel are compared by observing the different mechanical forces necessary to remove turned specimen rods from a magnet, against which they are applied sideways. The magnet may be an electro-magnet, used with a constant magnetising force, obtained by supplying a measured current to it, or by adjusting the current until a standard rod is detachable by its proper determined force. In the apparatus shown, the tips of the pole-pieces of a straight electro-magnet are respectively rounded and notched to receive the turned specimen which, in testing, is detached from the rounded pole only. Distance pieces may be used to prevent actual contact. A beam is supported by two pointed screws in a locating hole and slot in brackets projecting laterally from the pole-piece, and carries a part through which the specimen passes. The beam is graduated, and carries a sliding weight to show directly magnetic inductions. A reversing switch and a rheostat for the magnetising current, and an adjustable stop for the beam, are provided. 4 claims.

4,678. "Improvements in insulation of wire for electrical purposes." C. E. Nearson. Dated February 25th, 1898. Conductors are insulated with a solution of celluloid or pyroxylin with colouring matter, such as cobalt blue, or other suitable material in powder form. 1 claim.

4,746. "Method of and means for measuring the work performed in a rotary phase current system." Siemens Bros. & Co., Limited. (Siemens and Halske, Aktiens Gesellschaft, Germany.) Dated February 25th, 1898. Relates to energy meters. In electro-dynameters and motor meters for three-phase alternating currents, two pressure coils are connected mechanically together and move in two fields produced by main current coils arranged so that their effects are additive. A star connection between the three mains is made through three non-inductive resistances, two of the connections including the pressure coils. These resistances are usually equal, but may be adjusted to compensate for inaccuracy in the relations of the coils. In the arrangement illustrated, two field coils inserted in the main oppose the magnetic action of the other coils, which are inserted in the mains connected with the respective pressure coils. In other arrangements, the main includes no field coil. Each of the other mains may include two field coils, one of which has twice the number of turns contained in the other, and which are placed so that the pressure coil is in a field due to the sum of the effects of the large coil in the main and the small one in the main; the other coils are related similarly. In a modification of this arrangement, the large and small coils in each main are replaced by single coils, placed so as to act on the two pressure coils unequally. In a third arrangement, the mains contain equal field coils, but each part of the movable armature has two windings; one of these in each part of the armature is between the main and the star connection. The other windings, situated in the fields due respectively to the currents in the mains are respectively between these mains and the star connection, and oppose the action of the windings connected with the main. 2 claims.

4,747. "Improved means for counterbalancing the frictional resistance in alternating current motor meters." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated February 25th, 1898. Relates to energy meters. Induction motor meters for single or polyphase alternating currents are provided with additional windings to balance their frictional resistances. The invention is applicable to meters having conducting drums rotating between stationary cylindrical laminated iron cores and the poles of laminated iron rings. In the meter shown, two poles have windings carrying the single main current, and two others have windings connected between the mains and carrying a current, which is made to differ 90° in phase from the main current by a bridge arrangement described in Specification No. 2,559, A.D. 1897. The additional winding is connected through an adjustable resistance with the ends of a resistance in the main circuit. These resistances may consist of a single wire with an adjustable connection between its ends. The pressure coils induce a current in the circuit, and the adjacent pole is thus magnetised, when no current is passing in the main circuit, to produce a starting moment nearly able to overcome the frictional resistance of the meter. When current is passing in the main circuit, the inductive action of the coils on the winding is balanced by the connection of this with the main resistance. 1 claim.

4,761. "Improvements in electric controlling and regulating apparatus." W. Emmett. Dated February 26th, 1898. Relates to a means for controlling the light from lamps, such as theatre lamps, supplied with alternating current. An impedance coil divided into sections is included in the circuit, and a switch is provided for varying the number of sections in the circuit. In one arrangement, the impedance coil is of the construction described in Specification, No. 21,236, of 1896, and its sections are connected to the contacts of a switch. In a modified arrangement adapted to be operated by clockwork or otherwise for advertising purposes, a rotary drum fitted with contacts rubs on circularly-disposed contacts. 1 claim.

4,764. "Improved process and apparatus for tanning by the aid of electricity." N. P. Anderson, J. Westengaard, and H. T. Zerener. Dated February 26th, 1898. Relates to an electrical tanning process in which the skins are slowly rotated in a plane at right angles to the direction of the current, which is reversed at frequent intervals by a commutator. The skins are held by hooks carried by five bars supported by spiders upon the shaft. Rotation is effected by a worm and wheel driven by bevel gearing from the main shaft. At each end of the tank is an electrode parallel to the plane of the skins. When treating the hides with thin liquors it is unnecessary to rotate the supporting frame. 3 claims.

4,812. "Improvements in or connected with alternating current electric motors." A. Heyland. Dated February 26th, 1898. Relates to motors in which the speed of rotation can be varied by changing the number of poles. For this purpose, the winding of the inducing element is divided into two parts, and these are connected to a switch, so that the direction of current through one of them may be reversed at will. The winding may be further divided to obtain a larger number of poles. The short circuited rotating element has its winding in two or more sections, connected to the short-circuiting rings in parallel. In one arrangement the induced currents in the two sections flow in the same direction in a two-pole field and in opposite directions in a four-pole field. Sections of the winding may overlap one another at an angle. In another arrangement the sections of the winding are connected together through starting resistances. 3 claims.

4,819. "A method of electrically heating materials in closed chambers and apparatus for that purpose." Electric Reduction Company, Limited. (W. T. Gibbs, Canada.) Dated February 26th, 1898. A closed furnace is provided with one or more rods, supported above the materials to be heated by blocks of carbon or other material and made incandescent by the passage of current through them. Plugged openings and a tube are provided for the introduction of materials and removal of products. The materials are thus heated by radiation only, for fusing, volatilising, decomposing, or otherwise acting on them. 2 claims.

4,829. "Improvements in or relating to electric railway conduits and conductors." A. J. Boult. (R. Sayers, Belgium.) Dated February 28th, 1898. The conductor is made in lengths, and carried in a trough of paper pulp and bitumen, or other insulating material. The trough and a steel section are carried near another section by cross-bearers in a sheet metal casing through which water drains away. A cover-plate affords access to the casing. The section may be a rail, as shown, or may contain an insulating trough for a second conductor. Current is collected from the conductor by wheels held up by spring levers on a trolley carried by rails which may be insulated and used as return conductors. The trolley carries a conducting vertical blade, enclosed in insulating material in a steel casing, which projects between the sections and is connected by cords with the car. Where conduits cross, the insulating troughs and conductors are interrupted by slots only. At points the insulating trough, conductor, and trolley rails, are placed in a sheet metal casing, slotted at the top and movable laterally below the slotted top of the outer fixed casing about a pivot at one end. In order to give room for this, the trolley rails are lower at the points, short inclines being provided at the ends of such parts. 5 claims.

5,766. "Improvements in a method of and means for making connection between an underground conductor and a vehicle motor." H. L. Butler. Dated March 9th, 1898. Relates to electric railways and tramways on a road contact system with switches thrown by magnets on the vehicle, and more especially to conductors, switches, and collectors. Reference is made to Specification No. 1,493, A.D 1898. The switches are contained in segmental boxes pivoted in frames secured to the rails, &c. These boxes are preferably made in two halves, and the lead from the main is brought in at the pivot. The circuit is completed when the box is lifted by a weighted flexible strip, which is connected to a block or to side projecting lugs from which current is taken by the collector. A second protecting casing may be provided inside the box. If an insulated return is to be used, the switch arrangements are duplicated into the positions shown simultaneously with the engagement of lateral pins with guide bars, which thus automatically tip and discharge the bucket. 6 claims.

5,823. "Improvements in and in connection with underground conduit electric railways." E. Heyl-Dia. Dated March 9th, 1898. Relates to electric railways and tramways on a conduit system with insulated contacts and mechanically operated switches. A long collector or slipper travelling in the conduit depresses the end of the lever and completes the circuit at the spring contacts to the main conductor. A spring or weight returns the lever which is pivoted, and passes through a flexible water-tight diaphragm. In a modification, the lever is arranged to work horizontally. 3 claims.

6,022. "Improvements in primary voltaic or galvanic batteries." P. Lalargue and E. Drouet. Dated March 11th, 1898. The plates or electrodes consist of a split tube of zinc having a metallic strip fixed to it and a perforated carbon tube having a central perforated diaphragm. The tube is fitted axially in a porous cell by means of a ring. The lower part of the tube and the space between it and the porous vessel is packed with fragments of gas-retort carbon. In the upper part of the tube is a carbon plate which is held in place by a wedge, and in this same part is placed a quantity of potassium chlorate. The electrolyes are sulphuric and nitric acid respectively, the latter being used in the porous cell and the former in the space surrounding the zinc. In a modification the carbon electrode is in the form of a rectangular block having on each side of it carbon rods, and all held in place by a ring. The space between the carbon and the porous cell is packed with crushed or granulated carbon. Holes are made through the upper part of the block and serve for the introduction of the potassium chlorate and nitric acid. When the cell is in use, one of the holes may be closed and a fine glass tube serving as a gas exit may be placed in the other hole. 1 claim.

6,024. "Improvements in and relating to conduits for electric cables." W. Sykes. Dated March 11th, 1898. Conduits are formed of earthenware, &c., sections in which a number of circular tubes are formed parallel. The sections fit by spigot-and-socket joints on to and into which have been cast linings, preferably of bituminous material. The casting is done by means of steel dies with centring projections. When the tubes are fitted without previously formed joint liners, a centring mandrel is employed and the joint is made good with cement. In a further modification the ducts may be in the form of troughs which are filled with bituminous material and covered with flat lids after the cables have been laid. The lining composition preferred consists of gas tar, pitch, sulphur, and ground limestone boiled together. 3 claims.

6,025. "Improvements in and relating to draw and junction boxes for electric mains." W. Sykes. Dated March 11th, 1898. Junction boxes for use with conduits or armoured conductors are formed in sections which may be built up in position. One form is described in which a bottom tray is formed with a central cavity for the junctions or other necessary apparatus, a water or drainage ring, and an outer flange. The flanges and sides of the cavity are grooved to receive the cables, and the lower part of the body is grooved to fit over the cables. The upper part of the body is provided with a lid fitting by means of bitumen screws and a washer as described in Specification No. 7,498, A.D. 1893. The lid may have a metal surface and key recesses in a surrounding protective collar. One or more branch connections may be formed. The shape of the tray may be modified, and the whole bottom part may form a conduit section, or the part may be built on to an open conduit section when adapted for drawing through. In the case of service boxes, the bottom section may be plain and a screw lid without the metal surface employed. 8 claims.

6,058. "Apparatus for transmitting motion to a distance by means of electrical energy." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated March 11th, 1898. Relates to improvements upon the apparatus for transmitting motion to a distance described in Specification No. 8,041, A.D. 1897. Instead of the transmitter and receiver being alike, the desired differences in phase or amplitude may be produced at the distant point by suitable means at the transmitting point, such as the inclusion or exclusion of coils in a transformer. One arrangement for a three-phase current system consists of a generator, the transmitter and the transformer. The coils of the transformer are divided into sections, and these are connected to contacts similarly lettered on the transmitter. The transmitter has six radial arms rubbing over six rings connected to the coils of the receivers. Under these conditions any movement of the transmitter which requires very little energy will be repeated by the receiver. In modifications, the transformer may have a secondary winding which is connected to a distant point, or the transformer may be arranged for other than three-phase currents, and may be adapted to produce a rectilinear motion. 1 claim.

6,125. "Improvements in electric incandescence lamps." W. Nernst. Dated March 12th, 1898. Relates to incandescent lamps. Rods or filaments which become conductive only when heated by auxiliary means before they can be rendered incandescent electrically, as described in Specifications Nos. 19,424 and 3,470, A.D. 1897, are now made of an oxide such as zirconia, magnesia, or thoria mixed with a large or small proportion of an other oxide or other substance, yttrium, cerium, erbium, and didymium oxides, boric acid, calcium chloride, and tungstic acid be ing mentioned for this purpose. It is stated that such bodies can be heated by a match flame sufficiently to become incandescent with 100 volts. 3 claims.

6,145. "Process for hardening and rendering tenacious the active mass of electric accumulators." R. von Barby. Dated March 12th, 1898. Secondary batteries.—The active material is hardened and rendered tenacious by mixing it, *i.e.*, red lead, with pure water, half drying the mixture, and then exposing it to the vapours of indigotin, acetic acid, phenol, alizarin, pyroracemic acid, or other organic substance capable of forming compounds with the lead oxide. 1 claim.

6,350. "Improvements in or connected with the manufacture of carbons for electric arc lamps." J. J. Waddington. Dated March 15th, 1898. Relates to arc lamps. Carbons are provided with cores of plaster of Paris, or of a mixture of this with strontia and carbon dust, or with soda, or of other materials, to increase and colour the light produced, and so render it more suitable for certain photographic purposes, or more capable of penetrating fog when used as a search light. The material may be made into a paste with water and rammed into holes bored in the carbons. 1 claim.

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THE

ELECTRICAL REVIEW.

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THE

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1900

Edition

NOW IN PREPARATION.

H. ALABASTER, GATEHOUSE & CO.,

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THE ELECTRICAL OUTLOOK.

WITH the present issue of the ELECTRICAL REVIEW we are enabled to place in the hands of our readers a list showing, more or less clearly, the present position of the electric traction section of electrical development within the United Kingdom. The statistics and other information there published are as complete and accurate as circumstances have permitted us to make them. We have to express our thanks to the engineers and others having a controlling hand in these undertakings, for their readiness in lending us their valuable co-operation, and we hope that in future issues of this list the columns now of necessity left blank will be filled in with figures which will not only be interesting, but will at the same time show what splendid results it is possible to obtain by working tramways electrically. The figures showing cost per car-mile and ratio of expenses to receipts are, as everybody knows, not easily obtainable. Where they are accessible we have included them, but in a number of cases it will be observed that the accounts for a complete year are not yet made up, as the systems have not been long in operation. Next year, and in future years, we may hope that not only will there be at hand the working costs, &c., of tramway systems, but what will be even more important to some minds, viz, the figures showing the results attending the practical operation of municipal combined lighting and traction stations in full working.

It is, of course, understood that, above and beyond the systems which are now particularised, there are a host of towns in the country which have passed municipal electric tramway schemes; these are now being planned, and will shortly be in course of construction, but they have not reached that stage at which any particular details are available, or at any rate of especial value. The same remark also naturally applies to numerous schemes which are in the promotion, and even perhaps the construction, stage, in the hands of private companies.

We need hardly indulge here in fancy dreams of what the future has in store for the electrical engineering industry, and, in consequence, for electrical engineers personally. This was sufficiently marked out in Mr. Philip Dawson's interesting article in our last issue, the reading of which must have given young engineers a very rosy view of the land of promise, and made them feel glad that they were born.

That the promise of the future is very largely wrapped up in electric traction is again proved, if any further proof were necessary, by the very numerous and important applications which are now being made to Parliament and the Board of Trade for sanction. In another part of this issue, we have brought together, so far as is possible at the time of writing, a few general notes denoting something of the character and extent of the various schemes. The list is not complete, but a study of

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it is interesting as conveying a general idea of some points which will be raised in connection with electrical legislation during the session. Tramway and light railway applications are very plentiful; more so, we imagine, than electric lighting schemes. Private enterprise claims a very large share of the lighting schemes, and this is only what might be anticipated now that the larger boroughs have their installations working. With the smaller districts we can think of nothing better than that where possible several of them should be under the control of one company, and supplied from the same generating station, unless municipalities can make equitable arrangements for furnishing current on a similar system. This latter is a source of profitable and convenient supply, to which a number of towns are directing their attention, as is evidenced by several of the applications referred to. The question will, doubtless, be controverted somewhat, particularly as the country is now pretty well studded with proposals brought forward by private companies, but the result will be favourable to municipalisation if Parliament adheres to its policy of municipal protection and favouritism.

The large electric power distribution schemes have increased in number, and the supply of electricity in bulk, with the compulsory purchase of land, laying mains through other districts, together with the question of private and municipal competition in electricity supply, are among the matters which will require serious consideration. The very important question of municipal trading will be re-introduced, for there are numerous clauses in which powers are sought for the manufacture, supply, &c., of electrical fittings and apparatus. For the best interests of the industry, we hope that the proposals will meet with a dismissal as summary as was given to some scores of such applications last session.

In electric railway traction we find, among others, the scheme of the Mersey Railway Company to adopt electrical working. This proposal has been on the cards for a long time now, and at the present moment the board has relegated it to the care of Sir W. H. Preece and Major Cardew as advisers. Although nothing may be immediately accomplished, we imagine that some practical scheme will not be long delayed. Then there is the "lightning express" railway scheme for Manchester and Liverpool.

The City of London Electric Lighting Company is promoting a Bill to provide for the new generating stations which its daily increasing business renders compulsory in the immediate future; and its prospective competitor, the Charing Cross Company, seeks various powers in connection with its proposed West Ham station, from which current will be supplied for its City business, when it gets to work.

These few remarks may serve to show that matters of surpassing interest are on the agenda for settlement. The experience of previous years inclines us to fear that a number of the applications may never get beyond the paper stage; but allowing for a good percentage of failures, the outlook indicates a continuation and even an accentuation of the prevailing activity in every branch of the electrical profession. Assuming the readiness and fitness of works to cope speedily with large contracts, and the absence of labour troubles, the next few years ought to be very satisfactory from every point of view

Physical Society Meeting.

THE attendance on Friday was very small—altogether disproportionate to the value of the papers, and a sorry contrast to the numbers that attended the Dinner the previous week. Dr. C. H. Lees presented two papers, the second being the complement of the first (1) "On the Conductivities of Certain Heterogeneous Media for a Steady Flux having a Potential;" (2) "On the Thermal Conductivities of Mixtures and of their Constituents." In a few "brief but well-chosen words," he explained the results of what is really a hard piece of mathematical work, of wide application, and of practical importance. The papers were not read in full, but from the short account of them given by Dr. Lees we gather that they deal with the general case of conduction through a medium constituted of a mixture of definite proportions of substances whose individual conductivities are known. In the particular instance chosen by Dr. Lees, the problem is to determine the conductivity, for heat or for electricity, of a liquid mixture of two constituents present in fixed proportions. With a few exceptions, which must be disregarded, the conductivity may be taken to lie somewhere between the conductivities of the constituents. As the result of certain experiments, Dr. Lees finds that in a particular case if k is the conductivity of a mixture, whose constituents have conductivities k_1, k_2 in the proportion p_1, p_2 where $p_1 + p_2 = 1$, the equation $k = p_1 k_1 + p_2 k_2$ gives too low a result; and the equation

$$\frac{1}{k} = \frac{p_1}{k_1} + \frac{p_2}{k_2}$$

gives a result too high. This means that a mixture can neither be represented by alternate parallel layers of the two substances, nor by a chequer-board arrangement of conductors, passing from one potential face to the other. In other words, it is represented neither by a "series" nor by a "parallel" network. Dr. Lees next considers the case of conduction through a structure of small cubes, each set diagonally to the stream-lines, one half of each cube on one side of a diagonal, being of one substance, the second half of the cube being of the second substance. The integration for the conductivity in such a case is a very pretty problem, and leads to the equation $k = \sqrt{k_1 k_2}$, or more generally, $k = k_1^{p_1} k_2^{p_2}$; this agrees much more closely with the experimental results than do the other formulæ. As we have not yet had an opportunity of seeing the paper, we are not in a position to criticise the argument. It appears to us, however, that the case taken by Dr. Lees is again only an approximation, an approximation which might have been arrived at almost *a priori*. For since the arithmetic mean of two unequal positive quantities, their positive geometrical mean, and their harmonic mean, are always in descending order of magnitude, it is evident that when the arithmetic mean gives a result too low, and the harmonic mean a result too high, the geometric mean will be a closer approximation than either. The discussion elicited a point of interest to electricians, *i.e.*, that the formulæ were of direct application both as regards "capacity" and "dielectric resistance" to mixtures of two or more dielectrics. If $p_1 + p_2 + p_3 + \ldots = 1$, the most useful form of the equation is of course

$$\log. k = p_1 \log. k_1 + p_2 \log. k_2 + p_3 \log. k_3 + \ldots.$$

Train Electric Lighting.—A New York exchange says that the Atchinson, Topeka and Santa Fé Railway will be lighted by electricity generated from dynamos on the car axles, and the locomotive headlights will be supplied from the same source. Each car will have a separate plant, consisting of a dynamo and storage batteries, and the full train will have electrical equipment equal to over 4,900 C.P., exclusive of the locomotive headlight. These trains, it is said, will be the longest solid axle-light ones in the world, and will be the first to carry so large a lighting service derived exclusively from the car axles.

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SOME NOTES ON ROTARY CONVERTERS, WITH SPECIAL REFERENCE TO THE EXTENSION PLANT OF THE CHICAGO EDISON COMPANY.

By A. C. EBORALL.

(*Continued from page* 830.)

Another disadvantage connected with the employment of this method of starting from the polyphase side is, that the machine is just as likely to synchronise at the wrong pole as not. As the direct current sides of each rotary have to be put in parallel, it follows that all machines must have a definite polarity, which must always remain the same. It is therefore necessary, when starting up in this manner, to have a pole-indicator on each direct current panel of the switchboard, and if this indicates that the machine has come up to synchronism at the wrong pole, the rotary will have to be re-started, and the direct current side left open until the polarity is right.

In order to reduce the starting currents taken by rotary converters when starting from the polyphase side, an auxiliary polyphase induction motor can be arranged to bring the main unit up to speed. This motor must have an output of about 7½ per cent. of that of the rotary, and is preferably mounted on a bracket with its armature built-up on an extension of the shaft of the rotary converter. The stator of this auxiliary motor must be wound to have fewer poles than there are on the rotary, in order that the latter may be brought somewhat above synchronous speed by the direct-coupled motor. The rotary would be started by connecting the motor to the low pressure polyphase bus bars, allowing it to bring the rotary above synchronous speed, then exciting the latter from its own direct current side, or from the direct current bus bars if other machines are running, which would cause the speed to drop somewhat, and which, if not sufficient, could be still further diminished by means of a friction brake on the shaft, or by loading the direct current side. The rotary converter would then have to be synchronised, and then switched in. This method of starting also requires the employment of pole indicators in case the sub-station had to be wholly shut down and re-started again, but is far better than the method described above, the principal objections to it being the increased first cost, and increased complication to an already complicated business.

It appears to the writer that in sub-stations in which two or more rotaries are at work, the best means of starting is to employ this method in conjunction with a small accumulator battery. One or more of the rotaries (but not all of them) would be provided with auxiliary induction motors, in order to start the sub-station plant initially, and the remaining rotaries would be started up from the direct current bus bars as they were required, the accumulators being charged from these bus bars at convenient times. The capacity of the battery would not need to be greater than 10 per cent. of the output of the largest rotary, at the outside, and the lighting and ventilating of the sub-station could be done from it if desired.

From the above remarks, it will be seen that if it is laid down that the converting plant shall be capable of starting from either side—an absolute necessity in nearly every case—this can only be attained when rotary converters are used, by the employment of complicated switch gear and experienced operators.

The next question to consider is that of parallel running, and it is one of the most important connected with the employment of rotary converters. Satisfactory parallel running of these machines depends almost entirely on the design of the generator engines, and to a much greater extent than is the case with ordinary alternators. It may be said at once, that if the engines are unsuitable for the purpose, there is bound to be trouble in the sub-stations, due to hunting of the converters, and to the consequent interchange of current between the different units. In order to minimise this hunting, it is standard practice to put "damping coils" (amortisseurs) on the field poles of the converters. These coils take the form of massive copper bands, either imbedded in the pole-pieces or else wound round them, and short-circuited individually, and their action is to damp down or kill the pulsations due to want of uniformity of the main driving power. The damping effect is caused by the magnetic field produced by the currents induced in the short-circuited coils by the pulsations of the field strength, and it may be remarked here that within limits these coils are very effectual, and are, in fact, an integral portion of the design of the rotary. But if the engines are unsuitable, satisfactory parallel running is impossible, even with the assistance of the damping coils.

In this connection, a suitable engine may be defined as one in which the angular velocity during one revolution does not vary more than ¼ per cent. at constant load.

The parallel running of rotary converters is also affected by the amount of self-induction between the various units, by the pressure drop in the transmission lines, and by the adjustment of the field excitation, but only to a comparatively small extent.

Switchboards to control a number of rotary converter units working together in a sub-station are unavoidably of a very complicated nature, as a little consideration will show. In addition to the switch gear required by the two sides of each rotary, there must be provided switch gear for the transformers, synchronising apparatus, extra starting apparatus, and boosting or pressure regulating devices, and, as a consequence of this, the sub-station switchboards become very costly, and take up considerable space.

It is practically only with regard to the important points of efficiency and power-factor that the rotary converter scores over the motor-generator to any extent, and with regard to overload capacity. The efficiency of a rotary converter plant is certainly higher than that of a motor-generator plant by 4 to 5 per cent. This is, of course, owing to the higher efficiency of the stationary transformers compared with the asynchronous induction motors; the figure obtained at full load with large plants will be not less than 94 per cent. With regard to the power-factor, this will be approximately 100 per cent. at full load, because the excitation is so adjusted that the armature current neither lags nor leads, rotary converters behaving in this respect in exactly the same manner as synchronous motors. It may be said here that the high power factor of rotary converters is perhaps their greatest advantage—there being no idle current, copper is saved in the mains, alternator armatures, and transformers, and, moreover, excellent pressure regulation over the whole of the system is easily obtained.

The overload capacity of rotary converters is considerably greater than that of motor-generators. As the reactions of the synchronous polyphase motor approximately equalise those of the direct current generator, there is practically no sparking at any load with well-designed rotaries, and the output is limited by the heating. So that it is safe to say, that, as a general rule, a rotary converter will carry a 50 per cent. overload for an hour or two without doing itself harm, and, as a matter of fact, it is found in practice that short overloads of 80 to 100 per cent. can be allowed with safety. This is naturally a great advantage in connection with the use of rotaries for railway work.

As stated already, a disadvantage connected with rotary converters is that the design is not flexible. The frequency determines the number of field poles and the speed. In order to keep the latter within reasonable limits, either the frequency has to be reduced to a very low value, or the number of poles has to be very large. If the former course is adopted, it means that generators and transformers are needlessly heavy, and that the polyphase mains are useless for anything but power work. If the frequency is allowed to be normal, say, from 40 to 60 cycles, then the number of field-poles becomes so large that proper commutation is rendered very difficult, and the diameter of the rotary becomes so great compared with its breadth that the employment of steel fields has to be abandoned, and everything has to be done to increase the stability of the machine. For these reasons, it has been found necessary to compromise in practice. The frequency is arranged as a rule to be between 20 and 30 cycles per second, and the speeds of the rotaries are made as high as possible. But it may be remarked here that if direct current dynamos were designed to have as many poles as the corresponding rotaries at the same speed and output, sparkless collection of the current would be impossible.

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It is only because the effects of armature reaction are neutralised with rotary converters, that it has been found to be possible to run such machines satisfactorily, in spite of the excessive number of field poles.

The want of flexibility in the design of rotary converters shows itself in another way. As the ratio of the volts on the slip-rings to the volts on the direct current side is constant, being independent of the field strength and armature current, it becomes impossible to compound or over-compound the direct current side by usual methods. As over-compounding is invariably wanted for power work, it has to be done by special devices, outside the converter proper. There are three principle ways of compounding a rotary, all of which are used in practice. The first is by regulating the pressure supplied to the slip-rings by altering the secondary windings of the polyphase transformers, a multiple contact switch operated by hand cutting in or out secondary turns, as the case may be, and thus varying the pressure on the direct current side. The second method, very suitable for rotaries above 300 KW. output, is by means of a direct-coupled booster, which is mounted on an end bracket, and has an output of about 5 per cent. of the output of the rotary for the usual value of over-compounding required, namely, 10 per cent. The remaining method consists in using a compound winding on the field magnets, and choking coils inserted between the slip rings and the low pressure polyphase bus bars. A little consideration of the latter method will show that if the field current is so adjusted at a particular load, that there is neither lag nor lead on the polyphase side, in spite of the presence of the choking coils, then if the load diminishes, the field is weakened, owing to the smaller current in the series winding, and the polyphase current will lag; if the load increases, strengthening the fields, then it will lead. A lag means a reduction of pressure, and a lead an increase of pressure, on the polyphase side, thus diminishing or increasing the direct current pressure in accordance with the requirements of the load.

The last two methods described are perfectly automatic, although outside the rotaries. Of course, the good working of the last arrangement depends on the adjustments of the choking coils and of the field windings.

On account of the armature coils of a rotary converter forming a single winding, great care has to be taken not to inter-connect the direct current sides of different machines if the polyphase sides are inter-connected, or *vice-versâ*. Thus, for instance, if two rotary converters have to have their direct current sides joined in series for the purpose of feeding a three-wire network, the polyphase sides of the rotaries must not be connected together at the transformers. Either two sets of transformers must be used, or else one set having each phase arranged with two equal secondary windings. Otherwise a very complicated short-circuit would result.

The size of sub-station required for a given output at the same speed is about 30 per cent. smaller with rotary converters than with motor-generators. Naturally, the difference in the amount of floor space required by the two types is much greater than this, if the running machinery only is considered. But the rotaries require extra space for the transformers, and much larger switchboard, so that the actual difference in the size of sub-station works out approximately as above.

A summary can now be made of those points in which rotary converters come out better than motor-generators.

SUMMARY II.

1. Smaller floor space required.
2. Greater overload capacity.
3. Higher efficiency.
4. Higher power-factor.

(*To be continued.*)

Scholarship.—Mr. F. H. Nicholson has been nominated by the Council of the City and Guilds Central Technical College, Exhibition Road, to the free pupil Scholarship offered every three years by the Brush Electrical Engineering Company, Limited, to that Institution. The nomination has been duly accepted by the board of the Brush Company.

THE COST OF STEAM RAISING.

THE best way of proving the value of a fuel is to find the cost per 1,000 gallons of water evaporated. This is the line taken by Mr. Holliday in his paper read at the Electrical Engineers' Institution on November 23rd. The formula for finding cost is as follows:—Where C is the cost per 1,000 gallons in shillings, P the price per ton of coal, also in shillings, and W is the rate of evaporation per pound of coal,

$$C = \frac{P \times 10{,}000}{W \times 2{,}240} = \frac{4{\cdot}464\ P}{W}$$

We think, however, that Mr. Holliday is entirely in error in assuming that the price of coals varies exactly with the amount of heat they will evolve. Probably the price is more nearly related to the amount of heat they will evolve per unit area of grate in unit time. The formula considers only the cost of the fuel, not the incidental cost of labour, which is usually increased with poor fuel. Nor does it include the disposal of waste. However, Mr. Holliday simply proves what we have long contended, that the fuels of least cost in the market will usually produce most steam per shilling of cost.

With dust coke at 5s., Welsh dust at 10s., and large Welsh at 22s., evaporating respectively 6 lbs., 8 lbs., and 9 lbs. of water, the evaporation of 1,000 gallons will be 8s. 8d., 5s. 3d., and 10s. 11d.

Against the economy of the cheap fuels are several disadvantages, says the author. One is that more fuel must be burned in the same time. He should rather have said more material must be put upon the fires, for in actual fuel there is not much difference in the weight of combustible. The difference is usually ash, clinker and water. Though the cheap fuels are far cheaper per calorific capacity, they do not fetch a price equal to this capacity, because it is more difficult to use them, and it may cost a great deal to secure furnace capacity to deal with a fuel of inferior price. Hence the economy of forced draught, even if more wasteful than a less energetic draught, for with a reduction to one-third in the cost of evaporation, there is a margin to throw away by adopting a draught intensity which will enable the old furnace area to still maintain steam.

The author rightly sounds a note of warning against the practice of buying apparatus on a basis of fuel saved, for any new furnace ought to show an improvement on old half worn-out plant, and while the seller makes all the saving, the user is saddled with all the extra incidentals, such, for example, we may point out, as fan driving or wages in clinkering. The author cites a certain plant of nine Lancashire boilers using some Perret's furnaces with coke breeze and other ordinary bars with Martin's doors. He is not at liberty to give their owners' names, but from his description we think we know these boilers, or some under very similar conditions, using coke breeze at 3s. 6d. per ton, says Mr. Holliday. This fuel contains 22 to 25 per cent. of incombustible, an amount that might be prohibitive in some cases, but which is not always costly or difficult to remove. The above Lancashire boilers, all about 7 feet × 28 feet, return 170 H.P. at 20 lbs. of steam per H.P.-hour. This is about half of what such boilers ought to turn out, and points to one disadvantage of low quality fuels. It also points to the necessity for larger grate surfaces, and obviously to underfiring, for no larger grates can be got into Lancashire boilers than the furnace diameters allow of. The Perret furnace uses a fan draught of about 1·1 inch of water under the fire bars, and this was produced for the three boilers so fitted by a 36-inch fan.

In 1895 Welsh coal was chiefly used at this works in the six hand-fired boilers, and it cost 14s. 6d. per ton, and had a 10 per cent. content of ash, &c., and evaporated 9½ lbs. water. The cost per 1,000 gallons was thus 6s. 9¾d., a result so much above the 2s. 8¼d. found for the breeze as to be very striking. The rate of evaporation was 3,800 lbs. per hour per boiler of 190 H.P., an advance of 11·7 per cent. beyond the results of the cheap fuel. The Perret furnaces, however, cost a great deal to clean out. The flues become filled with dust, and more is paid for clearing them out. More is paid also for cartage of all this dirt. The four

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natural draught boilers cost 16s. 6d. per week for refuse removal, and 4s. 6d. for each boiler cleaned is also paid, whereas the forced draught boilers cost 40s. per week for refuse removal and 11s. 6d. for the amount removed from each boiler. It appears that of the water evaporated, 7 per cent. was used by the fan engine, but this is hardly fair to the fan principle in the absence of any statement as to the economy of the small fan engine.

Taking into consideration all the costs in each case, including insurances of all kinds, interest on plant and buildings, depreciation on same, due proportion of chief engineer's salary and of the cost of the spare plant, it appears that the cost of evaporation per 1,000 gallons comes out as follows:—For the forced draught boilers, 7s. 3½d.; for the natural draught boilers, 9s. 2d. The spare boilers cost 15s. 5¾d., and the cost for all boilers was 8s. 6¾d. There is thus a distinct saving from the use of cheap fuel with such appliances as were necessary to enable it to be used. In fuel cost alone the economy was considerably over 50 per cent., or 3s. 1·84d. against 6s. 8·47d. This ratio is, however, reversed in the items of wages, cartage, &c., and stores being 1s. 8·65d. against 0s. 11·9d. Maintenance and interest and all other items are heavier against the forced draught, and the net economy is brought to barely 2s. per 1,000 gallons, a sufficient economy, however, to warrant the outlay. The question of using a fan in place of a chimney is one that is rather coming forward at present. There may perhaps be less economy in capital expenditure between a fan and its motor and the chimney, and the fan, of course, requires to be driven.

But it must not be overlooked that, quite apart from the elasticity given to the system by the use of fan draught in case of fog or gloom, there is the possibility of using a much cheaper fuel. Mr. Holliday's paper is an excellent and practical paper, for he has endeavoured to take all points into estimate, and presented as unfavourably as possible the claims of the cheap fuel, but the advantage still remains with the cheap fuel. We may assume that the saving due to cheap fuel is practically about 2s. per 1,000 gallons less than the apparent saving per 1,000 gallons calculated on fuel cost only. This is for the very worst fuel—coke breeze—which Mr. Holliday finds to cost about 1s. 10d. extra to burn it, as compared with Welsh at the price named. Fuels better than breeze will no doubt involve less expense in incidentals and, though dearer than breeze, will still save considerably over the more costly fuels. Perhaps, indeed, the really cheapest fuel would be found low down in the scale of price, though not the lowest, and where the question of smoke has been solved, it is probable that a very smoky coal, abnormally cheap because of this quality, might prove very efficient.

In estimating the advantages of a fuel, regard must be had to situation, a river frontage and cheap barging of refuse being all in favour of the dirtier fuels. In many large works also there is an outlet for clinker for purposes of mortar or concrete for extensions and foundations, and it is said of a certain Cheshire salt works that nothing is ever taken off the ground, and yet this never succeeds in keeping itself many inches above water level, so constant is the subsidence due to brine pumping. As the price of Portland cement is now fully 30s. or even 40s. per ton, and hard boiler clinker has only cost a few shillings per ton to bring on to the ground, and would cost another shilling or so to remove it off the ground, it would be waste of time and money to carefully examine the coarse residue of the more coarsely ground cements with any idea of finding traces of boiler clinker therein.

INFLUENCE OF CHEAP FUELS ON THE COST OF ELECTRICAL ENERGY.

For years we have pointed out that the cheapest fuel that could be used for steam raising was, at usual market prices, that fuel which could be burned in sufficient quantity on the available grate area to do the work required. In other words, the price of fuel is not governed by its calorific capacity, but by the size of its particles. Large fuel can be burned at higher rates per square foot of grate than can small fuel. These facts, and their corollaries, have been proved for years. Apparently high rates of combustion should result in economy. Practical reasons often cause better results to be obtained from comparatively slow combustion. Small fuel can only be quickly burned by means of some kind of forced draught, but it is very difficult to apply forced draught to small fuel, for small fuel must be laid on a thin fire, and thin fires soon burn into holes, and can only be kept right by two means. One of these is constant agitation of the bars, and this is not practicable, because it causes so much waste through the bars. The other means is mechanical stoking on the sprinkling system. Doubtless a steeply sloped step grate, with the feed accelerated by gravity towards the foot of the slope, would deal well with small fuel, for this cannot fall through a step grate that receives all its air horizontally.

Mr. Crompton's inquiries have led him to discover that coal of inferior quality can be had at the pit's mouth for 2s. 6d. per ton, or perhaps, at this day of prosperity, at 3s. 6d., and that such coal, while excellent within a radius of 50 or 60 miles of the pit, because its total cost is only 5s. 4d. to 6s. 4d., is not so excellent at Chelmsford, where its total cost will be rarely under 14s.

As regards small bituminous coal, Mr. Crompton has rediscovered the fact that even in a coking stoking machine, where the fuel will coke to a mass, and so will not fall through the bars, it is difficult to get it pushed forward regularly.

This is a fault which causes loss by reason of the excess of air admitted at the grates, and is one reason why such grates are made with such very narrow air spaces. It is also difficult to get rid of clinker. A coking stoker with a steeply inclined grate would, of course, get rid of this trouble, and it is so got rid of in America, where practically all boilers are underfired, and all the room required can be had under the boiler—an unfortunate impossibility with Lancashire boilers. We have pointed out frequently that inferior fuels were not to be dealt with by means of increased heating surface. The duty of a boiler remaining the same, no difference of heating surface is necessary for different qualities of fuel—merely differences of grate surface to suit the rates of combustion per square foot necessary to burn the weight of fuel necessary for the given duty.

Obviously, the externally fired boiler presents an easier solution of the problem than can the internal furnace, and Mr. Crompton suggests the use of a furnace so arranged that one portion performs the duty of igniting and caking the fuel at comparatively low temperatures. He advocates, in fact, the brick lined—or partially lined—furnace, which for years we have insisted upon as necessary for the smokeless combustion of bituminous fuels. Bituminous fuels cannot, except under exceptional circumstances—one of which is a right sort of engineer in charge—be burned smokelessly even in Lancashire boilers which have furnaces of the correct *form* for perfect combustion. It is because of its correct *form* that the Lancashire boiler is so good as it is, but its material is wrong. It is ridiculous, of course, to carry on a chemical process of a kind requiring high temperature in a crucible chilled to 350° or less. Yet this is what is attempted. In externally fired boilers the furnace sides can be made of brick, though the roof is of cold tubes. In the Scotch furnace of the Babcock boiler, even the cold roof is partly covered by fire tiles, and, so far, is thereby improved. Mr. Crompton has evidently had the opportunity of seeing a Juckes grate at work. We have repeatedly referred to this form of external furnace carried on a wheeled truck and fitted with a chain grate. We have seen scores of these Juckes grates at work, particularly in Yorkshire, and are glad to find the common knowledge of the North has filtered down so far as Chelmsford, where Mr. Crompton, by means of refractory lined combustion chambers and sufficiently reduced air excess, has succeeded in manufacturing a furnace product containing 11 per cent. CO_2.

He has tried regenerative tiles in Lancashire boilers in the form of a long arched bridge with pendant fins. We imagine the arch rather than its fin trimmings is the chief factor in the good results obtained. This bridge he places over the ignition area of the fuel. With Juckes furnaces we have seen a plain brick arch over the front end of the grate—and possibly used primarily to protect the front end plate rivets to shell plates—liquefy like treacle with the high temperature. The most refractory

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brick must be employed. Probably it should be thin and cellular so as to expose a portion of the plates it protects, and thus somewhat the temperature reduce.

It appears that the revolving grate has been adopted by the Babcock & Wilcox Company, apparently from Mr. Crompton's description, almost as we know it under the name of Juckes, but with a back doctor plate of cast-iron to clear off the clinker and ash as the grate turns over the back end roller.

At Chelmsford, coal has been costing 17s. 5d. per ton. This amounts to 64 per cent. of the total cost per unit of the current delivered to the tool motors. The plant is of 250 KW. capacity, but averages only about 120 KW. of output for 54 hours and about 50 KW. during the 62 hours of night work. If the day rate had been maintained the fuel cost would have been about 76 per cent. of the total cost per unit, which would then stand at ·63d. With coal at 5s. 4d. per ton the coal cost would be 35 and 42 per cent. of the total in place of the above figures of 64 and 76 per cent.

The figures which Mr. Crompton gives in the table attached to his paper may be compared with others.

Mr. Crompton is always so very optimistic as to the cost of electrical energy, and we cannot think that his table accurately represents the cost as it would have to be set down in any public station, for example, Manchester, where coal, we may be certain, does not cost 17s. 5d. per ton, probably not 7s. 5d.; yet the fuel cost at Manchester is ·41; stores cost, ·16; labour, ·22, and repairs, ·31, or a total of 1·10 works' costs for nearly 5 million units. According to one set of calculations, the lowest total in England appears to be the ·87 of Bradford, where coal costs ·33d. per unit, and we know of those who have bought the best steam coal at Bradford for 6s., and very excellent coal for 5s. There is one lower, namely, Leeds, with ·78, of which coal accounts for ·25. We fear Mr. Crompton has underrated the cost per unit. According to his figures, Bradford and Leeds should not show more than ·30 or ·43 total costs. Assuming his fuel figures to be the more properly correct, it is evident that the cheaper fuel is the less costly, if its cheapness consists in the fact that it is small in size rather than small in calorific capacity, and that it can be utilised by simply increased grate area—not by increased total boiler plant. If a given boiler will perform certain work with round coal, it is folly to employ two such boilers with slack coal. This is, however, usual practice. In order to secure a larger grate surface, steam users practically use double the amount of steel plates, double the amount of brick seatings, steam pipes, dampers, and all accessories, where they could simply provide increased grate area alone.

Apropos of the whole question of bituminous coals, which are only at this late date receiving Mr. Crompton's tardy recognition, we would once again refer to the Wigan coal trials of the Manchester Steam Users' Association. It is many years since these trials of highly bituminous coals were made, and they proved the possibility of smokeless combustion in the furnaces of Lancashire boilers. Recognising the difficulty of securing the same skilled attendance as was, of course, obtained for the Wigan trials, we have always advocated some form of refractory furnace, so that the extremely critical conditions of combustion in water-cooled furnaces might be overcome and replaced by conditions of more certainty. The whole question of smoke is one of air admixture and temperature, and we think that if the extremely militant Smoke Prevention Committee, headed by Sir W. Richmond, wished to rid London of smoke, they would be better advised than they at present appear to be, if they would employ their funds in putting to work a boiler of some ordinary type, and showing how it might be made both smokeless and economical by some furnace construction which should embody the conditions we have so long advocated.

The country cannot afford to shut out of use its bituminous fuels, nor can it act on the dictum of one engineer who went so far as to state that the hydrogens of bituminous fuels must necessarily be all wasted, and, therefore, the calorific capacity of bituminous fuels was at most that of their fixed carbon constituents alone. We are, therefore, glad to see that Mr. Crompton has had at last the courage to emerge from the all-Welsh sect which has hitherto dominated south country electrical practice—not to its economic benefit.

ELECTRICAL SCHEMES TO COME BEFORE PARLIAMENT.

THE following is a list of some applications which will come before the next Parliamentary Session, as gleaned from the formal notices registered in the last few copies of the *London Gazette*. The list is not yet complete, but any further applications will be notified in a future issue. We have divided them off into three sections, viz., (*a*) electric lighting; (*b*) electric traction (tramways, light railways, and railways); and (*c*) miscellaneous:—

(*a*) ELECTRIC LIGHTING.

Name of place or town.	Description of powers.	Authority promoting.
Allerton, Much Woolton, Little Woolton, Cheldwall, and Garston	Revocation, alteration, or amendment of a certain provisional order, 1896, Electric Lighting Acts, &c.	Liverpool District Lighting Company
Alverstoke	... ...	Council
Banbury	... ...	Electrical Power Distribution Company
Barnet	... ...	Urban District Council
Barnstaple	... ...	Corporation
Battersea (St. Mary) ...	... ...	County of London and Brush Provincial Company
Berwick-upon-Tweed ...	... ...	Urban Electric Supply Company
Birkenhead	Extension of area of supply to Bidston-cum-Ford and Noctorum	Corporation
Bishop Auckland	... ...	County of Durham Electrical Power Distribution Company
Bishop Auckland ...	... ...	Urban Electric Supply Company
Bonchurch	... ...	Ventnor Electric Light and Power Co.
Boston	... ...	Corporation
Bredbury and Romiley ...	... ...	Urban District Council
Bridlington	Provisional order; manufacture & supply electrical apparatus	Corporation
Brierley Hill	... ...	Urban District Council
Caterham and Warlingham	... ...	Urban Electric Supply Company
Cheadle and Gatley ...	... ...	Urban District Council
Cheltenham	Extension of electric lighting to outside districts, Charlton Kings, Leckhampton, Prestbury, &c.	Corporation
Chester-le-Street ...	... ...	County of Durham Electrical Power Distribution Company
Cleckheaton	... ...	Urban District Council
Clecthorpes-with-Thruncoe	... ...	Council
Cowpen (Northumberland)	... ...	Northern Counties Electricity Supply Co.
Dartmouth	... ...	Urban Electric Supply Company
Egremont	... ...	Urban District Council

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(*a*) ELECTRIC LIGHTING —(*continued.*)

Name of place or town.	Description of powers.	Authority promoting.
Eiland	... ...	Council
Enfield	... ...	Urban Electric Supply Company
Erdington	... ...	Urban District Council
Exmouth	... ...	Council
Farnham	... ...	Urban District Council
Felixtowe and Walton ...	... ...	Urban Council
Festiniog (North Wales) ...	... ...	Urban District Council
Garston	Provisional order, and extension of 1896 Allerton, Woolton, Childwell and Garston electric lighting order	Liverpool District Lighting Company
Glastonbury and Street ...	Various powers *re* gas supply, and as to electrical energy ...	Glastonbury Gas and Coke Company
Gosforth	Various powers and amendment of 1893 order	Newcastle-upon-Tyne Electric Supply Co.
Gosport	... ...	Council
Grantham	... ...	Urban Electric Supply Company
Harrow-on-the-Hill ...	... ...	Urban District Council
Heaton Norris ...	Transfer to Manchester Corporation	Urban District Council
Hebburn	... ...	Urban District Council
Heston and Isleworth ...	... ...	District Council
Hyde	... ...	Corporation
Hythe	... ...	Corporation
Jarrow and Hebburn ...	... ...	Walker & Wallsend Union Gas Company
Jarrow, Hebburn & Felling	... ...	County of Durham Electrical Power Distribution Company
Kendal	... ...	Corporation
Kingston-upon-Thames ...	Various powers, including electric lighting	Gas Company
Lambeth (part of) ...	... ...	S. London Electric Supply Corporation
Leek	... ...	Urban District Council
Limehouse	Provisional order, make and sell electrical apparatus ...	Board of Works
Littleborough (Lancaster)	... ...	Urban District Council
Liversedge	Provisional order & powers to manufacture & sell electrical apparatus	Urban District Council
London	Compulsory purchase of lands, establish generating stations, lay mains beyond districts of supply, &c.	County of London and Brush Provincial Electric Lighting Company
London	Compulsory purchase of lands in St. Saviour's Parish, new generating stations, and various powers, including as to depreciation account and reserve funds	City of London Electric Lighting Company, Limited
London	Powers for generating station at West Ham, connecting mains, &c., to City of London and other areas of supply; supply in bulk to authorities, &c.	Charing Cross and Strand Electricity Supply Corporation
London: Mile End Old Town	... ...	Vestry of the Hamlet
London (St. George's in-the-East)	... ...	Vestry
Lymington	Construction of electrical works, &c.	Corporation
Lytham	... ...	Urban District Council
Malton (Yorkshire) ...	... ...	Northern Counties Electricity Supply Co.
Marylebone	... ...	Marylebone Electric Supply Company (19, Carnaby Street, Golden Square)
Maryport	... ...	Urban District Council
Neath, Briton Ferry and Aberavon	... ...	Electrical Power Distribution Company
Morley	Additional electrical powers, including supply of electricity to other authorities within or beyond the borough, dealing in electrical apparatus, alteration of date of electricity accounts	Corporation
Nantwich	... ...	Urban District Council
Newark	Prov. order and powers to manufacture and sell electrical apparatus	Corporation
Newcastle-upon-Tyne Electric Supply Company	Powers regarding Walker, Wallsend, Long Benton; transfer of Walker 1899 order; supply of electricity to Long Benton, &c.	
Newhaven	... ...	Company to be formed
Nuneaton & Chilvers Coton	To purchase undertaking of Nuneaton Electric Company (revocation of 1898 order)	District Council
Penrith	... ...	Urban District Council
Prestwich	... ...	Urban Council
Ramsgate	... ...	Corporation
Redruth	... ...	Urban Electric Supply Company
Romford	... ...	Urban District Council
Royal Leamington Spa ...	... ...	Midland Electric Light & Power Co.
St. Helens (I.O.W.) ...	... ...	E. Ironside Bax and others
Salford	Supply electricity to districts adjacent to the borough, supply electric motors	Corporation
Sandgate	... ...	Urban District Council
Seaford	... ...	Company to be formed
Seaham Harbour ...	... ...	County of Durham Electrical Power Distribution Company
Sevenoaks	... ...	Electrical Power Distribution Company
Sheerness	Electric lighting powers, transfer of undertaking to another company	Electrical Power Distribution Company
Sleaford	... ...	Urban District Council
South Blyth	... ...	Northern Counties Electricity Supply Co.
Southwold	Electric lighting powers, including manufacture, sale, &c., of electrical apparatus	Corporation
Sowerby Bridge ...	... ...	Council
Spennymoor (Durham) ...	... ...	Northern Counties Electricity Supply Co.
Staines, Egham & Chertsey	.. ..	Electrical Power Distribution Company
Stamford	... ...	Urban Electric Supply Company
Sudbury	... ...	Corporation
Teddington & Twickenham	... ...	Richmond (Surrey) Electric Light and Power Company
Thirsk	... ...	Northern Counties Electricity Supply Co., 13, Mosley Street, Newcastle-on-Tyne, Sir T. Richardson, C. W. Fairweather, C. S. Vesey-Brown, and others
Totnes	... ...	Electricity Supply Company
Tottenham	... ...	Urban District Council
Tunstall	... ...	Urban District Council
Twickenham & Teddington	... ...	Twickenham and Teddington Electric Supply Company

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(*a*) ELECTRIC LIGHTING.—(*continued.*)

Name of place or town.	Description of powers.	Authority promoting.
Uxbridge and District ...	... ...	Urban District Council
Wallington	... ...	County of Surrey Electrical Power Distribution Company
Wellingborough ...	... ...	Electrical Power Distribution Company
Weybridge	... ...	Urban Electric Supply Company
Whitefield	... ...	Urban District Council
Whitney	... ...	Electric Supply Company
Woking	Application for provisional order, powers to manufacture and supply fittings, &c.	Electric Supply Company

(*b*) ELECTRIC TRACTION (Tramways, Railways and Light Railways).

Aston Manor	... ...	Urban District Council
Baker Street and Waterloo Railway Company	Various powers for underground railways, subways, agreements, &c., electrical working, 4 feet 8½ inches gauge	
Barnsley	... ...	Corporation
Barnsley and District (extensions)	Light railways, Worsborough district, West Riding ...	British Electric Traction Company.
Batley	Construct and alter tramways, electrical powers, &c. ...	Corporation
Bedford	Construct and work electric tramways...	Corporation
Blackpool and Garstang (Light Railway)	... ...	Blackpool and Garstang Electrical Railway Co.
Blackpool, St. Anne's, and Lytham	Construction of tramways, doubling existing track, supply of electricity in Lytham, dissolution of company, and formation of new one, &c.	Tramways Company
Blyth and District ...	Light railway powers for Cowper and South Blyth ...	British Electric Traction Company
Bournemouth... ...	Various tramway powers, electrical working	Corporation
Bradford Corporation ...	Tramways construction and electrical working in Bradford, Farsley, Hunsworth, Birkenshaw, Clayton, and Queensbury; and various other powers	Corporation
Bredbury and Romiley ...	Construction and electrical working	Urban District Council
Brighton	Construction of tramways, generating station at Southwick, for electrical working; to alter date for making up electric lighting accounts, &c.	Corporation
Brompton and Piccadilly Circus Railway	Extension of time and other powers	Company
Burnley	Abandonment, reconstruction, and construction of tramways, increase of speed, electrical working, extension of electric lighting area, &c.	Corporation
Cardiff	Extension of borough boundaries, new tramways within and without existing area to be worked electrically, generating station, &c.	Corporation
Cambridge	Construct and work electric tramways in Chesterton and Cherry-hinton	Corporation
Charing Cross, Euston and Hampstead Railway Co.	Extension of time	
Christchurch, Bournemouth and Winton	Various electric tramway powers	Poole and District Electric Traction Company
City of Bath	Light railways	Corporation
City and South London Railway	Amendment of 1893 Act *re* tunnel for the station under City Road, Islington	Company
Croydon	Leasing line to B.E.T. Co.	Council
Devonport	Construct and work tramways, electrical power, transfer of electric lighting powers of East Stonehouse Urban District Council, and various other powers	Corporation
Ealing	Construction of lines, electrical working, current for lighting station	Urban District Council
Farnworth	New tramways, electrical working, electric lighting, further powers including supply of electric motors and apparatus	Urban District Council
Folkstone, Sandgate and Hythe	Electric tramways. New Romney to Folkstone, dissolution of Sandgate and Hythe Electric Company, &c.	Sandgate and Hythe Electric Company
Great Grimsby Street Tramways Company	Construction and working of tramways; power to enter into agreements with Corporation for supply of power to tramways	
Halifax	Construction of lines in and outside borough electrical working, &c.	Corporation
Hastings	Construction of tramways, underground cable to connect with Hastings, Bexhill, and District Light Railway, supply of electricity in bulk to other bodies; transfer to company of Hastings, Bexhill, and District Light Railways (Electric) Co., Ltd., undertaking	Company to be formed
Hemel Hempstead ...	... ...	British Electric Traction Company
Houghton-le-Spring and District	Construction and electrical working of tramways, &c. ...	United Kingdom Tramway, Light Railway and Electrical Syndicate
Huddersfield	Construct tramways, and use of electrical power; erect poles, &c., for trolley working	Corporation
Hurst	... ...	Urban District Council
Ipswich	Construction of tramways, agreements with tramway company, electrical powers, extension of electric lighting powers	Corporation
Kingston, Surbiton and District (Light Railway)	... ...	Greenwood and Batley
Kingston-upon-Thames ...	Tramways, electrical powers, supply of electricity, sell electric apparatus, &c.	Corporation
Knott End Railway Company	New railway acquisition and electrical working of Garstang and Knott End Railway Company; agreements for supply of electricity	
Knott End Railway Company	New railways in county of Palatine of Lancaster; acquisition of Garstang and Knott End Railway Company; powers to work both lines electrically; agreements as to supply of electricity, &c.	
Lancaster and Morecambe	Tramways purchase, working, constructing, use of electrical power, and supply of electricity to adjoining districts	Corporations
L.C.C. (Light Railways)...	Highgate; Clapham, Wandsworth, Putney, Battersea; Deptford, Shooters' Hill, Woolwich; New Cross, Lewisham, and Eltham	
Leamington and Warwick	Tramways, electrical equipment of new and existing, &c. ...	Leamington and Warwick Tramways and Omnibus Company

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(*b*) ELECTRIC TRACTION (Tramways, Railways, and Light Railways)—(*continued*).

Name of place or town.	Description of powers.	Authority promoting.
Lincoln	Tramways to be electrically worked, and various incidental powers	Corporation
Liverpool	Construction and working of electrical tramways, and other powers	Corporation
Liverpool Overhead Railway Company	Construction of new lines, widening lift, further capital powers, &c.	
Liverpool	Various powers, including alteration and equipment of tramways	Corporation
London	Powers to use electric traction on tramways, re-construct lines for electrical working, erect posts, wires, &c.	L.C.C.
London	New tramways and electrical powers for Hampstead, St. Pancras, Islington, Poplar, Bromley, Camberwell, Newington, and various other districts	London County Council
London, Barnes, and Richmond	Construction and working electrical lines, power *re* sale and purchase of electrical energy, &c.	Company to be formed
London United Tramways Company.	New tramways, road alteration, compulsory purchase of land, extension of time, agreements with Councils, &c.	
Loughborough and District	Light railways, Parishes of Hathern, Dishley-with-Thorpe Acre, Garendon, Knightthorpe, Loughborough, Woodthorpe, Quorndon, and Mountsorrel, all in Leicester County	Loughborough and District Electric Traction Syndicate, 49, Queen Victoria Street, E.C.
Manchester	Tramways; Manchester and Salford electrical working, supply of electricity to other authorities, and transfer of electrical powers, &c.	Corporation
Manchester and Liverpool	Electrical express railway, generating station, &c.	Company to be formed
Mersey Railway Company	Powers as to working of railways of the company and Mersey and Wirral Joint Committee and Wirral Railway Co. and portions of railways of the Birkenhead Joint Railways of the London and North-Western and Great Western Railway Companies by electrical power; lands for generating stations	
Metropolitan District Railway	Various powers *re* land for generating stations, provisions as to electrical working of Metropolitan and Metropolitan District	
Middleton	Tramways to be worked by gas or electricity	Corporation
Morley and District ...	Electric tramways, Morley and Bradford, Drighlington, Gildersome, and West Ardsley	British Electric Traction Company
Newcastle-on-Tyne ...	*Re* leasing of lines to company	Corporation
Newport	Construct tramways and work electrically	Corporation
Nottingham	Various powers, including fixing brackets to buildings for tramway working	Corporation
Oldham	Road widening for tramways, fixing brackets to houses, &c., for electrical working	Corporation
Oldham, Ashton-under-Lyne, Hyde, and District	Light railway extensions in Ashton, Denton, Hyde and Dukinfield	Company
Peterboro' and District ...	Light railways	British Electric Traction Co.
Plymouth, Stonehouse and Devonport	Additional lines, electrical powers, &c.	Plymouth, Stonehouse and Devonport Tramways Co.
Portsmouth	Construction of tramways and working by electricity ...	Corporation
Preston	New tramways in Preston, Walton-le-Dale, and Fulwood; electrical powers, lighting of public streets and Corporation property by electricity, &c.	Corporation
Rawmarsh	Construction of tramways, electrical power, supply of electrical energy and electric fittings	Urban District Council
Reading	Construct and work electric tramways...	Corporation
Redditch	Construction of tramways, electrical powers	Urban District Council
Rochdale	New tramways; electrical working; agreements with local authorities for supply of electrical energy, &c.	Corporation
Rotherham	New tramways, electrical powers, generating stations, extension of borough and of electric lighting area, &c.	Corporation
Scarborough	General tramway powers and electrical working	Corporation
Sheffield	Construction of additional tramways, electrical working, &c. ...	Corporation
South Lancashire ...	Tramways, electrical powers, &c, in St. Helens, Bolton, Leigh, Eccles, Abram, and a number of other places in the borough of St. Helens, Bolton, Leigh, Eccles, and various other urban districts in the county of Lancaster. Generating station at Leigh	Company to be formed
South-Eastern Metropolitan Tramways	New lines in Counties of London, Kent, and Surrey; electrical powers, &c.	Company
Southport	Construction and working of electrical lines; agreements with companies; alteration of date for making up electricity accounts, &c.	Corporation
Southport and Lytham ...	Tramways, electrical powers, &c.	Southport District Tramroad Company
South Staffordshire ...	Sell, transfer, and adapt tramways for electrical power, &c. ...	Tramways Company
Spen Valley	Light railway extensions in Bradford, Dewsbury, Batley, Cleckheaton, Liversedge, Gomersal, Birkenshaw, Hunsworth, Heckmondwike, and Thornhill (West Riding). Purchase of lands in Dewsbury	British Electric Traction Company
Stockport	Construct and work tramways, use electrical power, supply electrical energy	Corporation
Tickhill	Light railways	W. M. Mackey and G. H. Newborn
Vale of Rheidol (Light Railway)	Power to work authorised lines by electrical energy instead of steam, to enter into agreements for the supply of energy	Company
Walsall	Construction and electrical working of tramways, supply electrical fittings, and other powers	Corporation
Walthamstow ...	... ...	Urban District Council
Wellingborough & District	Tramways construction, generating stations, and electrical powers	British Electric Traction Company
West Bromwich ...	Tramways, electrical powers, supply of electricity outside borough, and of electrical fittings, &c.	Corporation
West Ham	Construction of tramways, electrical working	Corporation
Weston-super-Mare ...	Construct and work tramways, electrical power, &c. ...	Weston-super-Mare and District Electric Supply Company
Whitechapel and Bow Railway	Various powers; extension of time, capital, agreements with other companies, &c.	Company
Wigan	Light railways in Pemberton, Ashton-in-Makerfield, Abram and Ince-in-Makerfield	Wigan and District Tramways Company
Windermere and District Light Railways	Light electric railways in Bowness-on-Windermere, Windermere, Ambleside, Troutbeck, and South Westmorland.	British Electric Traction Company
Wirral Railway ...	Powers for electrical working, agreements with the Mersey Railway Company	
Withington	New tramways; electrical powers	Urban District Council

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(c) MISCELLANEOUS.

Name of place.	Description of powers.	Authority promoting.
County of Durham Electric Supply Company	Incorporate company, generate and supply electrical energy in bulk to lighting authorities, companies, &c., in part of the county of Durham, compulsory purchase of lands, &c.	
Coventry	To authorise regulations in regard to electrical fitting in houses and buildings, power to supply fittings, alteration of date of annual accounts.	Corporation
Lancashire Electric Power	To establish generating stations and supply electrical energy in the county of Lancaster.	Company to be formed
L. B. & S. C. Railway ...	Power to contribute toward cost of constructing City and South London Subway between their railway and London Bridge Station.	
Midland Electric Power Distribution & Lighting	Extension of area of supply authorised in 1898 and 1899 orders, to include additional districts and parishes in Stafford and Worcester	Midland Electric Corporation for Power Distribution
North Metropolitan Electric Power Supply Company	Incorporate company, generate and supply electrical energy in bulk to local authorities and companies in Middlesex, Hertford and Essex, compulsory purchase of lands, break up streets, &c.	
South Wales Electrical Power Distribution Co.	Supply of electricity in bulk. (See page 842 ELECTRICAL REVIEW, November 24th.)	
Tyneside Electric Power Company	Incorporation of company, supply of electricity in Northumberland and Durham, &c.	

RECENT LEGISLATION IN CONNECTION WITH ELECTRIC LIGHTING AND POWER STATIONS.

A DILIGENT search through the statute books for the last few years does not reveal any very striking development of the laws which regulate the institution and management of electric lighting and power stations. The Act of 1888 modified the rules of purchase by the local authority, gave the Board of Trade power by provisional order to vary the terms of purchase, and afforded protection to the public from open electric wires. It also enabled the Postmaster-General to require that supplies of electricity should be continued only in accordance with conditions and regulations made by him for the protection of telegraphic communication. Since this important statute no Act has been passed until the present year which directly affected the interests of the electrical world, although many of the public general Acts, such, for instance, as the Factory Act, 1895, and the Workmen's Compensation Act, 1897, are of much more than passing interest to those whose business involves the employment of large numbers of working men. To these it will not be necessary to refer at any length.

The last session of Parliament, however, saw placed upon the Statute Book two Acts which are, or may be, of considerable importance to those who provide the electric current for lighting and power. The first of these, the "Electric Lighting (Clauses) Act (1899)," which came into operation on October 1st, comprises an important schedule which is to become part of every provisional order made in respect of every district outside the administrative County of London. It applies, moreover, whether the local authority is or is not the undertaker. The text of the schedule (an abstract of which was published in the ELECTRICAL REVIEW for September 15th, 1899) differs in no material respect from the form of provisional order which may be found in the latter part of "The Law of Electric Lighting," (1890) by W. Shiress Will, Esq., Q.C., which was generally made use of when the undertakers were a company or person.

The passing of this Act has necessitated the issue of a new edition of the "Rules Made by the Board of Trade with Respect to Applications for Licenses and Provisional Orders, &c.," which last appeared in 1890. The one alteration made by these rules refers to the draft license, six copies of which must be deposited with the memorial. [See Rule VIII., Board of Trade Rules, 1890.] Formerly the draft was bound to contain [*inter alia*]—

1. The address and description of the applicants.
2. A description of the proposed area of supply.
3. A statement of the purposes for which a supply is to be given, viz., any or all of the public or private purposes specified in Section 3 of the Electric Lighting Act, 1882.
4. Provisions concerning the breaking up of streets, railways, and tramways, where powers are sought to be obtained by the license or order for those purposes. [See Sections 15—17 of the Schedule to the Electric Lighting (Clauses) Act, 1899.]

Conditions of supply. [See Sections 10 and 27—30 of the Schedule to the Electric Lighting (Clauses) Act, 1899.]

6. Provisions for securing the safety of the consumer and of the public from injury by shock, fire, or otherwise. [See Section 38 of the Schedule to the Electric Lighting (Clauses) Act, 1899.]
7. Provisions for enforcing the performance by the undertakers of their duties in relation to the supply of electricity, and for the revocation of the license or order where the undertakers fail to perform such duties. [See Sections 63—68 of the Schedule to the Electric Lighting Act, 1899.]

The particulars referred to in paragraphs 3—7 above must not now be set out at length in draft orders, but must be provided for by the incorporation of the Electric Lighting (Clauses) Act of 1899. [See Board of Trade Rules, September, 1899, *note*.] We have pointed out the various sections of the Schedule to the Act which have reference to the matters dealt with in the above rules.

In addition to the well-known power of compulsory purchase, which is vested in the *local authorities*, it is important to recollect that by virtue of Sec. I. of the Electric Lighting Act, 1888, no provisional order authorising the supply of electricity by any undertakers within the district of any local authority can be granted by the Board of Trade, except with the consent of such local authority, unless the Board of Trade are of opinion that such consent ought to be dispensed with, in which case they must make a special report, stating the grounds upon which they have dispensed with such consent. Moreover, there is nothing to prevent the granting of a licence or provisional order to the local authority, although a grant of authority to undertakers may have been previously made in the same area. The consent which must formerly have been obtained from the Vestry or certain district council, must be obtained from the new municipalities which may be constituted in accordance with the provisions of the London Government Act of 1899.

This leads us to examine the London Local Government Act of 1899.

"Within the limits of 35 sections," says Mr. Hunt in the preface to his work upon this Act, "none of them unduly long, and three short schedules, provision is made for the abolition of some 78 elected vestries, consisting of over 4,000 members, 12 district boards, consisting of nearly 600 members, one local board, consisting of 21 members, and one urban district council, and for the creation in their place of 28 borough councils, each of which is to consist of a mayor and not more than 60 councillors and 10 aldermen, or a possible grand total of 1,988 members. Women will not be eligible to serve on these borough councils."

The theory of the Act is simple. The unit of local government ceases to be the parish, although the parish is retained as the unit for rating purposes, and the administrative County of London outside the City is divided into 28 areas, each of which is to be a borough, and for each of which a borough council is to be formed; 16 of these areas are single parishes.

The following list serves to show at a glance the proposed re-arrangement of Greater London:—

PROPOSED BOROUGHS.

1. Battersea.
2. Bethnal Green.
3. Camberwell.
4. Chelsea.
5. Fulham.
6. Hackney.
7. Hammersmith.
8. Hampstead.
9. Islington.
10. Kensington.
11. Lambeth.
12. Paddington.
13. Marylebone.
14. St. Pancras.
15. Shoreditch.
16. Stepney. [Aldgate, Christchurch, Spitalfields, Limehouse, Mile End New Town, Mile End Old Town, Norton Folgate, Old Artillery Ground, Ratcliffe, St. George-in-the-East, Shadwell, Wapping, St. Botolph-without-Aldgate, and Whitechapel and Tower of London.]
17. Poplar. [Bow, Bromley and Poplar.]
18. Wandsworth. [Clapham, Mitcham (det.,) Putney, Streatham, Tooting Graveney, and Wandsworth.]
19. Southwark. [Christchurch, Newington, St. George-the-Martyr, and St. Saviour.]
20. Bermondsey. [Bermondsey, Horselydown, Rotherhithe, and St. Olave and St. Thomas.]
21. Holborn. [Farnival's Inn, Gray's Inn, Lincoln's Inn, Saffron Hill, St. Andrew, and St. George, and Staple Inn.]
22. Clerkenwell. [Charterhouse, Clerkenwell, Glasshouse Yard, St. Luke, and St. Sepulchre.]
23. Deptford.
24. Greenwich. [Charlton, Deptford St. Nicholas, Greenwich, and Kidbrooke.]
25. Lewisham. [Lewisham and Lee.]

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26. Woolwich. [Eltham, Plumstead, and Woolwich.]
27. Westminster. [St. Anne, Westminster, St. Clement Danes, St. George, Hanover Square, St. James, Westminster, St. Margaret and St. John, St. Martin-in-the-Fields, St. Mary-le-Strand, St. Paul, Covent Garden, St. Peter, Westminster, Liberty of the Rolls, and Savoy.]
28. Stoke Newington. [South Hornsey and Stoke Newington.]

The Borough Council will be a local authority for the supply of electricity under the Electric Lighting Acts, 1882 to 1888. [See Hunt, "London Local Government," Vol. ii. pp. 797 to 809,] and may borrow money for the purpose of supplying electricity in all areas where the Borough Council is authorised to supply electricity. Another most important provision is that which enables the Local Government Board, in cases where the Borough Council is unable to purchase land, to empower that Council to put the compulsory provisions of the Lands Clauses Consolidation Acts into force.

By Section 4 (1) of the Act, on the appointed day (*e.g.*, the day fixed by Order in Council), every elective vestry and district board in the county of London shall cease to exist, and, subject to the provisions of the Act and of any scheme made thereunder, their powers and duties, including those under any local Act shall, as from that day, be transferred to the Council for the borough comprising the area within which those powers are exercised, and their property and liabilities shall be transferred to that Council, and that Council shall be their successors, and the clerk of the Council shall be called the town clerk, and shall be the town clerk within the meaning of the Acts relating to the registration of electors.

As we have pointed out, the Act does not come into force until a special order of the Queen in Council. No immediate changes need, therefore, be expected.

WATER SOFTENING.

In the treatment of feed water a great change of the conditions to be met has taken place during the last few years. This change is dependent upon increase of pressure. With higher pressures the temperature of a boiler is also higher, and where the scale-producing material is carbonate of lime, experience points to the fact that in entering a boiler which is at a high temperature the carbonate of lime is much more quickly separated out of the water and deposited in the immediate vicinity of the feed inlet. Probably this is because of the more rapid driving away of the carbonic acid gas which keeps the bicarbonate of lime in solution, and the loss of which at once permits the salt to deposit as mono-carbonate.

As regards sulphate of lime, there is considerable doubt as to the solubility of this salt. It is said to render water permanently hard, and not to be deposited by heating the water up to boiling point. It is also said to deposit if the water is raised to 400°, but few boilers attain to this high temperature, and lime sulphate should thus not form scale unless it becomes concentrated by evaporation. But whether this be so or not, there is a form of incrustation which is of a peculiarly adhesive quality. We refer to the deposit of its contents of each molecule of water converted into steam at the surface of the plate. The water goes off as steam, and the freed molecule in a peculiarly fit state for the purpose adheres promptly to the plate. Sulphate scale is thus much more adhesive than carbonate scale, as well as less satisfactory to deal with by preliminary treatment.

Seeing that carbonate scale is so very quick to deposit in a hot boiler, we wonder that more is not done in the way of feeding the water at a high point in a boiler into the upper of a series of trays so arranged as to permit the water to settle and overflow from tray to tray, depositing its lime salts on ribs or oyster shells placed as surfaces for adhesion. Excepting where soluble salts concentrate in a boiler, we should like to see the time when the blow out tap is not required to regular use; for we have very little belief in its action as a remover of loose scale or mud, and we believe such impurities, even if not deposited before the water enters a boiler, should be deposited in trays within the boiler, not upon the plates of the boiler itself. Various scale prevention apparatus depend for their action on the heating of the feed by live steam in some vessel outside the boiler. This system supposes frequently that the feed is supplied cold. Any live steam heating ought, obviously, to come after an economiser. Unless an economiser adds a more than usual amount of temperature to the feed, the lime will not be deposited until the boiler is worked, but where deposit takes place in the economiser, it can be bored out from time to time. Of course, we would place no system before that of the primary treatment of the water before it even enters the economiser. But even the most approved of water-softening systems may be reduced to minimum dimension and cost where the feed is taken from a surface condenser. Any other system of working bears the stamp of inferiority excepting under exceptional circumstances.

With surface condensation the making up water required is small, and can be treated for scale at small outlay. Indeed, in many cases it will produce so small an amount of scale as to admit of being used untreated, for when only supplied with a small amount of scale-forming matter, the natural tendency of the boiler to rid itself of scale may be sufficient to overcome the tendency to form additional scale. With water from a surface condenser there is also a considerable scale-detaching effect, and it is rarely desirable to have the inside of a boiler absolutely free from scale, as they are when supplied with water from most moorland districts.

CORRESPONDENCE.

High and Low Speed Motors.

Referring to the letter in your issue of November 17th, under the above heading, signed by "Lente," I should have replied to this sooner but for my absence from town.

"Lente," on the one hand, advocates extremely slow speed motors for power purposes, and contends that he can buy them at a cheaper figure than given in the leading article of the ELECTRICAL REVIEW of October 13th, and thus make it worth while to a user of motors to substitute slow-running ones for the ordinary quick-running ones.

In a subsequent article communicated by the present writer, it is pointed out that the figures and contentions contained in the original article of October 13th on this subject are substantially correct, and agree with the present writer's experience on the subject.

"Lente" begs to differ, and offers to bet £10 that a user of motors can buy a first-class motor, giving 4 B H.P. at 300 revolutions per minute, for £67, or thereabouts, whereas the price quoted by the ELECTRICAL REVIEW is about £112.

If a man were to come to one and offer to bet you £10 that he could buy a first-class felt hat for 1s., one would be liable to think there was a catch in it, and instead of taking the bet, would offer to put business in that man's way, provided he could supply a hat for 1s. to a specification which would warrant its excellence.

As a matter of fact, the prices of a motor, capable of doing about this output, as taken from the catalogues of Crompton's, Siemens's, Parker's, and the Electric Construction Company, appear to vary somewhere between about £90 and £110, depending upon the exact size of the motor, as the standard sizes do not in every case come out at 4 B H P. exactly.

I think it can be said that these four firms know as much about continuous current machinery—and have made as many motors for power work as anyone in the country, and, consequently, their prices for a first-class article may be looked upon as representative.

It is just possible that as soon as multipolar machines are made in any quantity for these smaller sizes, the prices may come down a little for the same speeds, but the above prices are based on the ordinary two-pole machine, which represents the present practice in this country.

If, therefore, "Lente" can go a step better, and obtain the size of machine in question (at retail prices), at the price he names, as well as other sizes of motors at corresponding speeds and prices, to the following specification, which will guarantee a good article, I feel confident that the readers of the ELECTRICAL REVIEW, as well as the present writer, would like to know about it, and that business would be likely to result therefrom to "Lente's" advantage.

SPECIFICATION.

Motor to be of the ordinary open type, and to be capable of developing 4 B.H.P. at 300 revolutions per minute for a period of six hours, with a maximum temperature rise at any part of 70° F. above the surrounding atmosphere.

Bearings, two in number, of the ordinary self-lubricating type.

Armature, drum wound, and fitted with carbon brushes.

Efficiency, after six hours' run at full load not to be less than 75 per cent.

Finish and Workmanship of the best.

Note.—The prices to be subject to the ordinary full trade discounts.

I think I am fairly conversant with what is and can be done in the continuous current line in this country, and I need only add that if machines of the same excellence can be purchased 25 per cent. below the market price, it would be very interesting and useful to know about them.

The Writer of the Communicated Article.

London, *November 28th*, 1899.

Electric Wiring.

Prof. Silvanus Thompson in his Presidential Address refers to the question of electric wiring and the importance of keeping down its first cost, and you also refer to the matter in this week's issue of your paper. Prof. Thompson is of opinion that this reduction in cost is to be effected by adopting an uninsulated return wire.

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As I patented a system on these lines some seven years ago, and have continuously adopted it in all installations which I have carried out since then, the publication of the experience gained during this period may perhaps be of advantage at the present time.

The system was first introduced by me in the lighting of Hollycombe for Mr. J. C. Harkshaw in 1892, after having obtained the sanction of Mr. Tarrant, inspector of the Sun Fire Office. The installation was at first only for some 250 lights, but has since been extended to over 600. Mr. Tarrant himself made an exhaustive inspection, and subsequently expressed his approval in the strongest manner. Fortified by this opinion, I have never had any objection raised by any insurance company, although some 200 houses have now been wired by this system. At Fort William, also, where some 5,000 to 6,000 lamps have been wired by the same method, the result has been entirely satisfactory.

Major Cardew, when inspector to the Board of Trade, made an examination, and after taking sundry tests, also gave his approval, and passed the arrangements adopted.

I was curious at the time to know what form these tests would take, and Major Cardew explained to me that the question concerning which he wished to satisfy himself, related to the possible existence of a difference of pressure between the earthed electric conductor and other neighbouring earths, such as gas or water pipes, which difference of pressure, if present, might cause trouble from electrolysis.

On testing, however, no such effect could be detected to any appreciable extent, and all objection on this score was removed.

I think, therefore, that having been found satisfactory, and passed by the Board of Trade and the insurance companies, and having also endured the test of years, I may claim that my earthed water-tight system may now be adopted with confidence.

With regard to the saving of cost, experience shows that on an average this may be taken from 4s. to 5s. per lamp wired. There are other subsidiary advantages which I need not dilate on now, such as a decrease in the time required to carry out the work of wiring, and the absence of damage to walls, ceilings, and decorations.

Prof. Thompson would like the cost of wiring to be reduced to that of putting in gas pipes. This is, no doubt, desirable, but at the same time the comparison is hardly a fair one. It must be remembered that the electric wiring of houses is far more complete than the usual system of laying gas pipes. For instance, numerous switches are placed in convenient positions, and fuses and main switchboards have also to be provided.

If these conveniences and safety appliances were omitted, and the wires taken straight off the mains, then the cost of wiring would not greatly exceed that of fixing pipes for gas. On the other hand, if this plan were adopted the advantages and safety ensured by the adoption of the electric light would be greatly minimised.

R. Frederick Yorke.

212, West George Street, Glasgow.
November 28th, 1899.

Tested Lamps.

I fully expected some able reader to make some remarks on a paragraph headed as above in your issue of November 17th, 1899.

It was most unfortunate that the names of those English makers of the lamps which the "Tested Lamp Company" publish cannot be given, as it would have afforded an opportunity for them to defend themselves, or at least some explanation.

I have tested a number of lamps at various times, my results appear somewhat different.

Does it appear likely for a moment that there is so great a difference between English-made lamps? You may find a difference of 15 per cent. in life, if all have the same candle-power, same efficiency and at the same E.M.F. if about a dozen of each maker are tried, but not one lamp, as you may get hold of a particularly good or bad one.

The information in this test is so very vague, and not at all what you might expect expert lamp testers to put before the readers of a highly technical journal.

1. A 200-volt 16-C.P. lamp is tested at 3 watts per candle. The photometered result is at 200 volts 19 C.P. at 3 watts per candle-power, after burning at 200 volts (I suppose) it becomes 200-volt 9-C.P. at 6·5 watts per candle-power, this means that after "running" the period mentioned, the current increases ·017 ampere, a considerable amount in a 200-volt 16-C.P. lamp.

2. A marked 100-volt 16-C.P. lamp.

Photometered result gives 100-volt 12-C.P. at 4·5 watts per candle, after burning 336 hours, it becomes 100-volt 9-C.P. at 6 6 watts per candle, this means after 336 hours the current increases ·0836, this, too, is an enormous amount.

Now, it is a well-known fact, that the less the sectional area a filament has, the lower should be the efficiency to obtain the same life, then how comes it that the 200/16 volt having about ·005 mm. sectional area is given at 3 watts per candle-power, and a 100/16, having about ·02 mm. section, is tested at 4·5 watts per candle.

Again, to me it is new to find a lamp consuming more current at the end of its life than at the start, these matters want a little more explanation before I can quite swallow all that.

My experience has been that as a lamp burns, the resistance of the filament goes up, and at the same voltage the current naturally drops proportionately, it being due to the volatilising of the carbon and disposition on the bulb sides; of course, the more efficient the filament the quicker the change in resistance.

I would inform the Tested Lamp Company that about ·75 watt per candle-power more should be allowed a 200/16 lamp than a 100/16, and a further ·5 watt per candle-power for a 100/16 than a 50/16, to procure the same hours of life with an approximately parallel curve.

See Mr. Preece's test of lamps; a study of these will give an immense amount of information.

Is it an agency for an "American" or "Continental" lamp that is showing? If so, let us be straight about the matter. But really such absurd statements cannot go unpassed, or to the uninitiated some damage may be done, and also to our English lamp trade.

English Electric Engineer.

Street Box Explosions.

My attention having been directed to accidents reported in the ELECTRICAL REVIEW of October 20th, 1899, as occurring in the Strand, London, and at Carlisle, from gas which had accumulated in the conduits, I beg respectfully to state that by the introduction of my patent junction box in main's circuit there would be no possibility of explosions.

I have pleasure in enclosing a copy of my completed specification for your information.

While there may be an objection to the box being over the street or road level, it need not in any sense be regarded as offering a street obstruction, no more than a Post Office pillar box; any little inconvenience from such a cause would be more than compensated for by the advantages gained; the present surface boxes should, from my point of view, be a thing of the past; if my box were adopted, there will be no more explosions.

F. D. Black.

[The specification to which Mr. Black refers is No. 29,676 of 1897.—EDS. ELEC. REV.]

Why not Sir Joseph?

It has now become fairly recognised as an unwritten law that the presidents of the great Institutions should receive the honour of knighthood, either during or at the expiration of their term of office.

The presidents of the Institutions of Civil Engineers, Mechanical Engineers, and Marine Engineers are all so honoured, and justly so.

But why should the president of the Institution of Electrical Engineers be omitted, and especially when he happens to have rendered such brilliant service to the cause of science and of practical engineering as our late president has done?

The honour conferred upon the presidents of the other

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Institutions is, as most of us understand, for a twofold reason.

It is a recognition by Her Majesty, as representing the nation, of the status and usefulness of the Institution as a whole. It is also a recognition of the position which the president himself occupies in the world of science and engineering generally, the world in which he moves, and to the betterment of which he has devoted himself.

It is for exactly the same reason that a judge is knighted. It is a recognition by Her Majesty, as representing the nation, of the importance of the judicial office, and of the legal fraternity as a whole.

It is also a recognition of the man himself and of the work he has done. And similarly with the great medical and surgical bodies.

Surely on both accounts our late president is entitled to knighthood.

Surely the importance of the Institution of Electrical Engineers is now sufficiently established to warrant their being recognised by Her Majesty equally with the other great Institutions. One obstacle we very probably foresee in the matter. Our late president is, as we know, an exceedingly modest man, who would prefer not to be troubled with honours and rewards.

We know, too, that as plain Joseph Wilson Swan, he is greater than any title can make him, and that his name will go down to posterity as one, and not the least, of the brilliant band of able men who have made the Electrical Age.

After all,

> The rank is but the guinea stamp;
> The man's the gold for a' that and a' that.

But I think most of us would claim that, in this case, our late president should make one more sacrifice for the industry for which he has done so much and submit to the knightly stroke.

Engineers of to-day hold the position that knights and military leaders did in days gone by; and it is our right that our leader should receive the badge of knighthood.

Sydney F. Walker.

Bath.

A Tender Point.

With reference to the paragraph in ELECTRICAL REVIEW of this day's date on "A Tender Point," I beg to inform you that I am not entitled to any credit attaching to the plan of printing the schedules of specification in copying ink and arranging for their being readily detached in the manner indicated in the article referred to.

The point is, perhaps, a small one, but the article is wrong in stating that the plan is due to me. With your well-known reputation for accuracy, I feel sure you will be glad to avail yourself of a correction on even such a minor matter as this.

F. Baylay,
Capt. R.E.

War Office, S.W.,
November 23rd, 1899.

An Electricity Supply Question.

Possibly some of your readers may be able to give me some information as to the obligation which a supply company is under as regards applicants who have their own plant for lighting their premises, but who wish to have the company to fall back upon in case of a breakdown, or to take current from them when it may be convenient.

It is not reasonable that the company should have the expense of putting down extra plant in order to be prepared for such contingencies without any prospect of making any profit, and if the question has not been settled by a court of law, it is important to consider what is a safe attitude for supply companies and corporations to take up, and it will be interesting to know how such cases are dealt with in different places.

Supply Company.

Norwich, *November 28th*, 1899.

Signalling without Contact.

I have been greatly interested in the reprint of Mr. W. S. Boult's British Association paper on "Signalling without Contact," in Mr. James Swinburne's report, and in the subsequent correspondence in your columns. Mr. Boult's system is most comprehensive, as regards signalling, and the apparatus is ingenious without being complex. Given construction on engineering lines, as distinguished from electrical, there seems to be no reason why it should not be perfectly satisfactory as regards the exhibition of signals to the engine driver. Some of the points made—apart from the operation of the contacts magnetically—are especially valuable.

There is, however, one point with regard to such signalling which does not seem to be noted or provided for in the paper, or referred to in Mr. Swinburne's report. From fig. 20, particularly, and from the paper and report generally, I gather that Mr. Boult's system is entirely independent of the ordinary semaphore signals, and, whilst it may be superposed on the latter form, there is, really, no need for further signals of any kind such as are in use at present.

The levers of the present semaphore signals are, in order to prevent mistakes on the part of the signalman, interlocked with those of the points, so that only the signals relating to the points set can be lowered for the passage of a train. Mr. Boult's apparatus, used as a complete system, would abolish such control, and I do not see that any substitute for this most important safety device is suggested.

Unless something of the kind is provided, at least as efficient as the present mechanical interlocking, it would be possible to set the points for one line, and the signals for another with, under certain conditions, disastrous results.

J. Pigg.

There is nothing ridiculous or funny in the statement contained in my letter which appeared in your issue of the 10th ult., as to what a driver assumes in a fog. That statement is quite correct. It can be verified by reference to the rules of any railway company party to the Clearing House system.

I do not understand Mr. Boult's apparent objection to the quotation from Sir George Findlay, seeing that the quotation appears in his (Mr. Boult's) original paper. So many hard things are being said of the present fog signalling system, that the opinion of so eminent a railway man respecting it, cannot be too well known, and more especially so seeing the great improvements in that system that of late have taken place.

I regret that I did not make myself clear about the man I suggested would be required by the driver of an express. The man would be required to watch the working of the indicators, to calculate the road numbers ($M_2 + 2 =$ Branch No. 4, &c.), and watch the duplicate spots. Would it be fair to the driver to expect him to keep a look out along the line and watch these indicators also? A driver has something to look for besides signals, which, be it remarked, he does not implicitly rely upon. If he has to watch Mr. Boult's indicators, there will be a possibility of his not noticing some obstruction he otherwise would. I submit, therefore, that the question of the number of indications and road numbers a driver may receive in one minute is important, and if Mr. Boult will not admit 30 it would be interesting to know what he considers would be the maximum. I believe my estimate to be rather under than over the possible maximum.

I am still of opinion that it is not good railway signalling to have an indicator corresponding to a "stop" signal showing "off" on an engine when inside the Distant, if that "stop" signal is "on." There must necessarily be a liability of the indicator being misread.

In speaking of a wrong road number being given, I did not intend to refer to a mistake in the switching in the signal-box, but to a failure of one or other of the electro-magnets on the road, owing to which, although the switching was right, you might get on the engine, say, M_2 only, instead of $M_2 + 2$.

Until single-line signalling is seriously tackled by Mr. Boult, his system cannot be complete. If only electro-magnets are used Mr. Boult's *danger* signal is open to one of the very objections he raises against the *danger* signal of

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other systems, as his medium on the road for operating the *danger* signal is then a varying one, the magnetic field not being permanent. Moreover, how can the switches that would be required for throwing these electro-magnets "in" and "out" be safely and efficiently controlled?

On the whole, perhaps, the *nursery* method is to be preferred to putting engine drivers to solve Mr. Boult's simple equations.

C. M. J.

"Earthing the Middle Wire."

Under the above heading you have in your last week's issue a paragraph (which you state is brought to your notice by Mr. Musgrave Heaphy) showing a possibility to-day of fire-risk in electric wiring as usually carried out with two insulated conductors installed on a three-wire main system in which the neutral is "earthed."

I venture to suggest that a note of interrogation should have been placed after your heading, or that the instance given could have been better described under the heading "Imperfect" earthing of the middle wire, for if the earthing "principle" was consistently carried out in the wiring of *houses* as well as in the streets, and any concentric system adopted in which one conductor completely surrounds the other, the possibility instanced could not occur.

It appears to me that Mr. Heaphy has unwittingly (or perhaps designedly) brought forward an instance which shows the fallacy of the present method of wiring—flourishing under existing insurance regulations.

From my point of view I would like to ask Mr. Heaphy what fire-risk possibility he can discover in a system of wiring in which two ordinary insulated wires forming the outers are installed in a steel armoured insulating conduit, of which the outer mechanical armouring or iron pipe forms the neutral and uninsulated earthed return?

Further, if such practice was generally adopted, it is obvious that the cost of wiring per light with steel armoured insulating conduit would immediately become *reduced one-half*, for, in other words, the present carrying capacity of the insulated wires would be virtually doubled by balancing the return current on to the pipe. The supplemental insulation on the inside of the pipe would effectually prevent "leakage," and, in the event of any fault occurring, rather invite a "short circuit" that would remove itself harmlessly.

Undoubtedly this question of consistently "earthing the neutral," involving as it does a general and complete adoption of the principle of permanently "earthing" one side of a circuit, is a very important matter, and the commercial exigencies of to-day will continue to bring the subject more and more prominently before the profession.

A discussion dealing with the question of "earthing" from all points of view would directly benefit many branches of the electrical trade. Your "Correspondence" column, however, could not be so burdened, and I must at present content myself with stating my belief that "earthing" does offer the *ultimate solution* to the question of providing thoroughly efficient and permanent electric wiring, at a price that would effectually check the further growth of gas-piping, and thereby secure the full field for electric lighting.

I also suggest that the practical efficacy and success of the principle of "earthing" depends mainly upon the *completeness* with which it is adopted, and the question of the present is how far existing lighting plants could be readily and economically changed over or adapted to meet the necessary requirements?

Fred. Bathurst.

63, Queen Victoria Street, E.C.,
November 29th, 1899.

Single-Phase Motors.

It is difficult to discuss with Mr. C. E. L. Brown. He continually argues points which are outside the question, and then exclaims with confidence, Am I not right! Under such circumstances further writing is of no value, and I'll therefore stop from the discourse.

Alexander Heyland.

The Dublin Cable Contract.

We have received from Mr. Wm. M. Murphy, chairman of the Dublin United Tramways Company, Limited, a long letter dealing with the matter of the Dublin cable contract, but in view of the letter from Messrs. Renshaw, Kekewich and Smith, which appeared in our last issue, we refrain from publishing it, as we assume that the matter is now *sub judice*.—Eds. Elec. Rev.

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The first subject to be discussed by the Institution of Electrical Engineers this session is the appropriate one of "the cost of steam raising"; it possessed a more than usual interest for many of those present on Thursday evening of last week owing to the phenomenal rise in the price of smokeless coal, and the positively astounding prices asked for even low grade coals. "The cost of steam raising" at a time when many stations are short of steam ought to elicit some useful and instructive remarks; no doubt, at the adjourned discussion, those who have felt the pinch will have something to say. Mr. John Holliday read his paper, and was followed by Mr. Crompton on the "Influence of Cheap Fuels on the Cost of Electrical Energy."

Mr. Ferranti opened the discussion by expressing the interest which attached to the two papers dealing with a most difficult problem, particularly so at this time of the year. Not only must steam be generated economically throughout the year, but in large cities fogs and sudden loads had to be faced. At the present time there was another difficulty due to the large quantities of coal required by the Government, and the demand was so great that there was little smokeless or Welsh coal to be had. In his own works at Hollinwood, an economy had resulted from the use of cheap fuels, but when an attempt was made to utilise any particular class of fuel which was cheap but not in demand, the supply of that fuel became exhausted or the price was raised and the economy hoped for was lost. One of the wants in some boilers was a large combustion chamber, and Mr. Crompton's large combustion chamber must and would give a large economy. When the temperature in a furnace was very high, due to forced draught or the use of highly calorific fuel, the condition became very like that in a blast furnace and great trouble was found in maintaining the brickwork, so the cost of renewal might be considerable. Those who had to deal with steam raising knew the value of an efficient and sufficient proportion of spare boilers, and a substantial spare was necessary for economy at the worst time of the year. Unless this were provided the deposit inside the boilers, and the deposit from the coal outside led to a reduced evaporation; to work boilers economically one had to be able to clean them systematically and thoroughly at all times of the year.

Mr. Stromeyer thought that Mr. Holliday's paper was especially valuable because of the very complete figures given. He referred to the objection to cheap coal owing to the amount of refuse produced and the cost of removing it, and that the large proportion of refuse made the effective thermal units less than were given theoretically. He found it convenient to state the cost of coal in pence for evaporating a ton of water, and showed that the value of coal was reduced to about a quarter if it gave 30 per cent. of ashes, as compared with what would be given if there were no ashes at all. He cited the attempts made to use shale oil as a cheap fuel, but the price increased, and it became uneconomical to use it. The statement by Mr. Crompton that 25 per cent. of heat was carried off with the products of combustion in one test of a boiler of the water-tube type at Glasgow, was characterised as absurd, but Mr. Crompton interposed the remark that the test was not his but one of Mr. Longridge's. Mr. Stromeyer thought there must be an error in the sampling of the gases. He further criticised the results obtained by analysis of flue gases, owing to the difference in composition in different parts of the flue. Externally fired boilers had always been unsatisfactory, and manufacturers did not like water-tube boilers, because with such boilers, when any

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leakage occurred, one did not feel inclined to go on, but the boiler had to be stopped all of a sudden. He commended the dry-back boiler.

Mr. Dugald Clerk thought it quite a mistake that a gas-producer was going to do any good with a steam boiler; all attempts to do this had failed. The reason was that the carbon had to be converted into CO and then into CO_2; the result was that little more than 70 per cent. of the heat in the coal was used. The only way to avoid this was to have the whole producer in the boiler. He quite agreed that the water-tube type of boiler is not satisfactory to the ordinary manufacturer, but it has a very great advantage compared with the Lancashire boiler as it can be got into difficult inaccessible spaces and used with very high pressures, although in some cases it would pay better to stick to lower pressures and more economical boilers. The chief loss of economy is attributable to the radiation from the fire-brick furnace. When the fire was put into the centre of the water there are no such radiation losses, and the best results are obtained when combustion is not quite complete in a Lancashire boiler.

Mr. H. W. Miller mentioned some experiments he had carried out with special smoke-consuming fire-bridges. It was well known that in the ordinary standard pattern of Babcock-Wilcox boiler there was no real combustion chamber at all. By pyrometer tests the temperature of the flue gases is 800° to 1,000°, much too low to complete combustion. After fixing the fire-bridge of extended pattern the temperature rose to 1,200° to 1,600°.

Mr. Bertram Blount spoke on the chemical questions involved: many impossible figures were given, and the amount of CO_2 exceeded the total product of the combustion of the carbon burnt and the oxygen supplied. It was usually supposed by a great number of steam users that imperfect combustion led to a great loss: they may relieve their minds of that, to discover CO in the flue gases is most unusual. The neighbourhood might be ruined but their pockets will be safe. Again, on the question of gas producers, no one in his senses would use a gas producer for a steam boiler, he would use the gas in a gas engine.

Mr. G. L. Addenbrooke thought that electrical engineers were most interested in the comparative cost of raising steam in large and small plants. Three or four years ago he went into the question very largely, and it astonished him to find great difficulty in getting reliable figures. One of the troubles with cheap fuel was the oxidation which took place on exposure to the air, and its ready absorption of water.

The discussion was adjourned, and will be resumed at the next ordinary meeting.

THE HARGREAVES-BIRD ELECTROLYTIC ALKALI PROCESS.

By JOHN B. C. KERSHAW, F.I.C.

As a result of the criticism made upon the reports of Prof. Ramsay and Messrs. Cross and Bevan in last week's issue of the ELECTRICAL REVIEW, the writer has received from Mr. C. C. Connor, one of the directors of the General Electrolytic Parent Company, the appended figures relative to the average working efficiency of the Hargreaves-Bird electrolytic cell over a long period of time. Mr. Connor states that in the prospectus of the new company, which is to be issued to the public in the course of the present week, a current efficiency of 90 per cent. has been made the basis of the estimates. The figures given below confirm the opinion expressed by the writer, that the efficiency of 97·28 per cent. given in the reports of the experts was a *maximum* rather than an *average* efficiency, and it is satisfactory to learn that it has not been used in framing the estimates upon which the statements in the prospectus are based.

With reference to the suggested possibility that purification of the brine might be necessary before it could be used in the electrolytic cells, Mr. Connor states that in the recent experiments at Farnworth, brine prepared by dissolving rock salt in water has been employed without any purification, and that no difficulties have been met with since this method of preparing the brine was adopted.

The works will have a capacity equal to the production of 27,000 tons alkali and bleach per annum.

Days.	Amperes.	Volts at cell terminals.	Current efficiency.
360	(Av.) 2,048	(Av.) 3·926	(Av.) 93·405

Number of days	360 days.
Na Cl decomposed per 24 hours	220·097 lbs.
" " 360 days	79,229·0 "

	tons.	cwt.	qrs.	lbs.
Na Cl decomposed per 360 days	35	7	1	17
Production as ash (Na_2CO_3) = (Na Cl × 9) ...	31	16	2	18
" soda crystals = (×2·444)	86	8	3	15
" of 37 per cent. bleach (×1·558) ...	55	2	0	14
" as bicarbonate (×1·435)	50	15	0	13

E.H.P. at cell ... ... 10·778 E.H.P.
Lbs. Na Cl decomposed E.H.P.-day ... ... 20·42 lbs.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending Nov. 22nd, 1898.	
Adelaide	Value £73
Amsterdam	61
Bombay	140
Boston	45
Brussels	30
Buenos Ayres	100
" Teleg. mat.	704
Calcutta	500
" Teleg. wire	329
Cape Town	54
Christiania	460
Colombo	81
Copenhagen	84
Durban	2,246
East London	151
Gothenburg	103
Hamburg	110
Hong Kong	122
Launceston	90
Madras	38
Malta	157
Melbourne	75
Ostend	10
Penang. Teleg. mat.	118
Port Elizabeth	73
Quebec	100
Rio de Janeiro	32
Rockhampton	393
Rotterdam. Teleg. mat.	107
Senegal. 55 knots teleg. cable	107
Shanghai	93
" Teleg. mat.	1,087
Singapore. Teleph. mat.	58
Stockholm. Teleg. mat.	189
Sydney	1,023
Tientsin. Teleg. mat.	79
Vera Cruz. Teleg. mat.	33
Wellington	82
" Teleph. mat.	381
Yokohama	434
Total	£9,905

Week ending Nov. 21st, 1899.	
Adelaide	Value £42
Alexandria	709
Amsterdam	442
" Teleg. mat.	45
" Telephones	50
Antwerp. Elec. fuses	801
Barcelona. Teleg. cable	117
Bombay	271
" Teleg. wire	29
Brisbane. Teleg. wire	25
Buenos Ayres	225
" Teleg. mat.	135
Calcutta	122
Cape Town	310
Colombo	294
" Teleg. appts.	58
Copenhagen	26
" Teleg. wire	297
Demerara. Telephones	30
Durban. Teleg. mat.	1,575
East London	263
" Elec. tramcars	472
Gibraltar	174
Gothenburg	67
" Teleg. wire	19
Halifax. Teleg. cable	49,000
Hamburg	10
" Teleg. mat.	230
Hong Kong	183
Malta	96
" Teleg. mat.	566
Melbourne	10
" Teleg. mat.	110
Nelson	26
Ostend	62
Otago	22
Perth	65
Port Elizabeth	114
Rio Janeiro. Teleg. mat.	775
Santos	310
" Teleg. mat.	70
Shanghai	87
Singapore. Teleg. mat.	60
Stockholm. Teleg. mat.	136
Sydney	317
Wellington	67
Total	£58,314

Foreign Goods Transhipped.

Toronto. Teleph. mat. Value £49

Electrical Wares Exported.

Week ending Nov. 29th, 1898.	
Adelaide. Teleg. mat.	Value £103
Alexandria	106
" Sub. cable	150
Antwerp	85
Brisbane. Teleg. mat.	101
Buenos Ayres	1,421
Calcutta	1,743
Cape Town	229
Christiania	84
" Teleg. cable	185
Colombo	105
Copenhagen	20
Durban	189
" Teleg. mat.	12
East London	108
Hamburg	110
Hong Kong	171
Kobe. Teleg. cable	65
Malaga	70
Melbourne	82
" Teleg. mat.	854
Port Elizabeth	26
Rio Janeiro. Teleg. mat.	5,196
Santos. Teleg. mat.	156
" Teleph. mat.	75
Senegal. 55 knots sub. teleg. cable	—
Shanghai	110
Singapore. Elec. detonators	243
Stockholm	1,700
" Teleg. mat.	85
Sydney	1,097
Valparaiso. Teleg. mat.	1,186
Venice	230
Yokohama	474
Total	£10,974

Week ending Nov. 28th, 1899.	
Adelaide	Value £75
Alexandria	284
Amsterdam	25
Barbadoes	20
Buenos Ayres. Teleg. mat.	742
Calcutta	236
" Teleg. wire	201
Cape Town	310
Christiania. Teleg. wire	31
Colombo	217
Copenhagen. Teleg. wire	49
Durban	169
East London	74
Genoa. Teleg. wire	70
Hong Kong	145
" Teleg. mat.	8
Lyttleton. Teleg. mat.	2,910
Madeira	80
Madras	88
Melbourne	141
" Teleg. wire	1,001
New York	24
Ostend	116
Otago	14
Port Chalmers	210
" Teleg. mat.	2,710
Port Elizabeth	377
Rio Janeiro	27
St. Helena. Teleg. cable	136,000
Shanghai. Teleg. wire	137
Singapore	45
Stockholm. Teleg. mat.	45
Sydney	459
" Teleg. wire	648
Tokio	90
" Teleph. cable	1,412
Trinidad	98
Wellington	41
" Teleg. mat.	473
Total	£149,580

Foreign Goods Transhipped.

Alexandria	220
Amsterdam	35
Bombay	25
Progresso. Teleg. mat.	188
Total	£468

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Bankruptcy.—The creditors of J. C. Howell, electrical engineer, late of Queen Victoria Street, E.C., met last week at the London Bankruptcy Court. A statement of affairs was submitted, showing gross liabilities £19,120 (unsecured £10,348), and assets valued at £11,433, or sufficient to show a surplus of over £1,000 after meeting all liabilities. The debtor has been interested in numerous electrical companies, among the number being John Charles Howell, Limited; B. Howell & Son, Limited; Crompton-Howell Electrical Storage, Limited; Porous Accumulator Company, Limited; John Charles Howell (No. 2) Company, Limited; Epicycle Company, Limited; Epicycle Manufacturing Company, Limited, and Pontypool Electric Light and Power Company, Limited. He ascribes his position to the severance of his connection with the Crompton Company, and to the liquidation of John Charles Howell, Limited. In the absence of any offer, the creditors resolved to administer the estate in bankruptcy.

At the Lincoln Bankruptcy Court on 28th ult., W. H. F. Bowman, photographer and electrical engineer, Gainsborough, was up for public examination. The debtor attributed his failure to putting an electric light installation in the Albert Theatre, and never being paid for it.

A receiving order has been made on a creditor's petition against W. Rowbotham, electrical engineer, Teddington.

Liquidations, Dissolutions, &c.—The Electric Light Insurance and Maintenance Company has decided upon reconstruction and is winding up for that purpose, Mr. G. Bunbury, of Little Gadcombe Leigh, Reigate, being liquidator. The new company to be registered will have the same name.

Round's Accumulator Company, Limited, and the Power Accumulator Syndicate, are winding up voluntarily, with Mr. A. Pigram, of 70—71, Bishopsgate Street, E.C., as liquidator.

The Milver Portable Electric Battery Syndicate has resolved to wind up voluntarily, Mr. R. W. Palk, 105, Colmore Row, Birmingham, being appointed liquidator.

Books Received.—Kalender für Elektrotechniker, von F. Uppenborn, Siebzehnter Jahrgang 1900. München: R. Oldenbourg. 5 marks.

"The *Mechanical World* Pocket Diary and Year-Book for 1900." Manchester: Emmott & Co., Limited. 6d. (net.)

"Therapeutic Electricity," by W. S. Hedley. London: J. & A. Churchill. 1899. 8s. 6d.

Brown v. Laing, Wharton & Down, Limited.—In the Chancery Division of the High Court of Justice on Saturday, the 25th ult., the above matter (Brown *v.* Messrs. Laing, Wharton and Down, Limited,) was mentioned before Mr. Justice North on a motion for judgment. Counsel for the plaintiff said the action was brought by a second debenture holder, and the first debenture holders were not parties to the action at all. Minutes had been prepared which, according to the view of plaintiff's advisers, were sufficient. His Lordship said he should like to know what the inquirers said. A time might come when he (the judge) would sell the property. He thought the matter should stand over for inquiry, with leave to apply in Chambers for realisation. Counsel was granted permission to amend the writ which set forth that the plaintiff sued on behalf of himself "and all other debenture holders," whereas he was only a second debenture holder, and amendment was therefore necessary. There was another point: a receiver and manager had been appointed by Mr. Justice Darling in Vacation, the receiver without any limit of time and the manager until January 4th next. But there were a number of pending contracts which would not be completed until considerably after that date. His Lordship continued the appointment of receiver and manager without limit as to time.

Catalogues and Lists.—From the Thunderbolt Patent Governor Company, Limited, of Glasgow, we have received an illustrated circular particularising, with illustrations, the Thunderbolt governor, which has been already described in the ELECTRICAL REVIEW. An electric governor regulator is shown for controlling engines driving lighting or power generators. It is employed in combination with the air compressors and throttling cylinder, in order to vary the speed of the engine with a varying load and so maintain a steady voltage. A patent electric governor for small installations is also noticed. It is actuated by the electrical energy of the circuit, being arranged to act directly on the throttle valve of steam or gas engines in a manner described in the list before us.

Messrs. Polland & Co., of Newcastle-on-Tyne, have brought out a new price list of their "Bees" pocket volt and ampere-meters, which, we understand, are much in demand, both among large firms at home and the colonies, and have also been supplied to various Governmental departments for telegraphs, telephones, &c. The list has some comments regarding the application of the instruments to testing igniting apparatus in benzine and petroleum motor cars.

From Messrs. J. H. Holmes & Co. there comes to hand a copy of a newly issued catalogue of Lundell motors. This list is naturally of great interest and importance at the moment to all taking part in the development of electrical power transmission in factories, &c., for the Lundell motors are very widely used, and we understand that the demand is continually increasing both for home and foreign use. The demand is particularly marked from India and the East for the Senior type of ceiling ventilating fan motor which we find described. Some idea of the business being done by Messrs. Holmes may be gathered from the fact that of the two-pole and six-pole types of motors they have during the last three years supplied about 3,200 with an aggregate of 9,000 B H P. The motor has achieved great fame in America, the place of its birth, and the list before us is arranged in that beautiful manner which we have frequently mentioned as characteristic of American catalogues. The illustrations are worthy of the highest praise, and the neat way in which the matter and blocks are arranged, together with first-class paper and excellent printing, make the catalogue as good as anything of the kind that we have recently seen. Examining the contents more closely we find that the list opens with a general description of the motor, and there follows a table showing the intermediate powers for which the bipolar motors may be wound. Another table gives details of standard speeds, powers, &c., for multipolar types, and motors of various types are shown driving fans, emery grinders, dental outfits, lathes, pumps, linotype machines, wood-working and other tools, &c., and for organ blowing. Notes on motor parts, efficiency curves, and connection diagrams, are also interesting features of this excellent list.

The Electric Construction Company, Limited, have issued a revised list of their continuous current dynamos and motors. The list is capitally printed and has first class illustrations. A specification of E.C.C. standard two-pole dynamos is followed with tabulated details and prices of shunt and compound wound machines of various capacities. Direct current motors, and the Bushbury enclosed motors, also starting switches, resistances and regulators are described.

Mr. James Dickson, of Gray's Inn Road, W.C., sends us his latest lists of carbon brushes for dynamos and motors, the "Tieciton" dynamo brush, and the "Ideal" electric lamp guard.

From Messrs. Krupka & Jacoby, of Watling Street, E.C., we have received a catalogue of the Strela open and enclosed arc lamps. These lamps are made by the Stralsund Arc Lamp Factory, Limited, of Stralsund, for whom Messrs. Krupka are sole agents for this country and the colonies. The lamps as supplied for direct and alternating currents, for stage purposes as projectors, and arc lamp accessories, are described and illustrated.

We have received from the Fabrique d'Appareils Electriques Société Anonyme, Aarbourg, Switzerland, several neatly illustrated lists (October 1899) in which they describe and price their rheostats, regulators, switches for high and low pressure currents, and other specialities.

The Sparkless-Cleanser Company, of Nottingham, send us a circular of their "sparkless cleanser" for dynamo and motor users, for reducing wear and tear.

The Electrical Transmission Company, Limited, of Hammersmith, have issued some excellently printed and illustrated lists of the "Albert" knife switches and arc lamps and accessories.

Mr. W. Middlemiss has issued a new revised price list of switch blocks.

Messrs. Estler Bros., of Leadenhall Street, E.C., have issued a catalogue of high class mirrors, lenses, ship's lanterns, &c. In another list to hand from Messrs. Estler Bros., we find cuts and a few particulars of Ambroin trolley line material for which they are sole vendors for Great Britain and "Ireland." With "ambroin" it is claimed that fewer repairs are necessitated and an improved insulation is obtained; it possesses "high insulating qualities, resists heat, and is non-hygroscopic," claim the makers. This insulating material is composed of fossil copal and silicates, the silicates being saturated and mixed with the copal by a patent process, and after being subjected to a very great pressure, a strong, firm and uniform material is said to be produced. By varying the proportions of the component parts different qualities are obtained for different purposes. A glance through the list before us shows that line insulators of various shapes, large and small strain insulators, bracket arm hangers, sound dampers, arc lamp hangers, overhead frogs, trolley ears, wheels, harps, stretchers, turnbuckles and other things are made of this material at the Ambroin Works, Berlin-Pankow.

Changes of Address.—The Dalston Electrical Company have removed from 18, Ball's Pond Road, to 60, Stoke Newington Road, N.

Mr. F. J. Jones, electrical engineer, Princess Street Works, Chester, has removed to more commodious premises in Seller Street.

Dividend.—Die Fabrik Isolirter Drähte zer Electrischen Zwecken Gesellschaft, of Berlin, is declaring a dividend of 12 per cent. for the past financial year.

Dynamo Brushes.—We have received from Mr. C. Ford, 27, Clement's Lane, E.C., samples of his patent copper foil dynamo brushes. These are made of pure electrolytic copper sheet 0·0025 inch thick, doubled back and forwards to form laminated sheets 0·0025 inch, which are laid together to any desired thickness, and soldered together at one end. For these the advantages of high conductivity and small wear of commutator are claimed. We have received also samples of metal-paper for show cards, reflectors, &c., which are remarkable for their extremely brilliant colours and high polish.

Falcon Works Engineering Society.—The Falcon Works Engineering Society held their inaugural meeting of the present session on Wednesday evening, the 22nd ult., when Mr. R. Percy Sellon delivered the presidential address to a large attendance of members. Mr. Sellon passed in review the chief events of interest in electrical engineering during the past year and pointed out the tendencies of demand for electrical plant in their relation to the manufacturing industry. He laid stress on the necessity for specialising and standardising lines of manufacture to enable the British manufacturer to meet competition from the United States, Germany and Switzerland. Mr. Sellon concluded by explaining in detail the nature and objects of the additional buildings, plant and tools in course of erection, and further extensions which are in contemplation at the Falcon Works of the Brush Electrical Engineering Company.

Gutta-Percha Corporation, Limited.—Last week Mr. Justice North, in the Chancery Division, appointed a receiver and manager in a debenture holder's action against this corporation.

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The Herzog Fairy Annunciator. — The apparatus which we illustrate below is a radical improvement in electric bell indicators or annunciators. It is new in principle and is adapted to replace any magnetic annunciator—or ordinary push button circuit—with ordinary open battery. Everyone is well acquainted with the cost and great space occupied by the ordinary indicator now in general use. Too often it is, in addition to the drawback of occupying a large space, an unsightly object in a very prominent position. The present invention is claimed to be anything but unsightly, to occupy a very small space, and to cost less than any indicator board now in use. The principle of operation is that the current passes from the push button to a corresponding positive disc connected thereto and immersed in a solution, then through the solution to a negative ter-

minal also immersed in the solution, the action of the current instantly decomposes chemicals in the solution and thereby causes the platinum disc to change colour. A twelve point indicator of this pattern will not occupy more space than a No. 2 Leclanché cell, is said to be most reliable in action, and can be adapted to replace any magnetic annunciator in any push button circuit. The inventors claim for it:—

1st.—Automatic restoration of the indications, which may be arranged to disappear independently of one another after any time within from 30 seconds to five minutes, according to adjustment, or by special provisions after a longer period if desired, thus making it unnecessary to reset the annunciator after every call, thereby avoiding the confusion which results when ordinary annunciators are used, and the attendant does not know from whence a call comes, because several drops are down owing to their not being previously replaced.

2nd.—The relative time when each call was made is clearly indicated.

3rd.—Visibility of all indications, because as the annunciator is so small, its entire face is within the field of vision at the first glance.

4th.—Compactness, simplicity, durability, and low cost.

The Hotel Great Central, Great Central Railway Terminus, Marylebone Road, and Hotel Russell, Russell Square, have been fitted throughout with "telesemes" on this principle by Messrs. Maple and Co, Limited. Messrs. C. F. Quicke & Co., 301—303, Euston Road, N.W., are agents for the apparatus.

In re River Plate Electric Light and Traction Company, Limited.—On Friday last, in the Chancery Division of the High Court of Justice, the above matter (Guinness and another *v.* the River Plate Electric Light and Traction Company, Limited,) was before Mr. Justice North. It was stated by Mr. Vernon, Q.C., that there were two plaintiffs in this suit—Mr. Herbert Frederick Guinness, acting in his own behalf and that of all other holders of the company's debenture stock, and Mr. Michael Bowden Snell, proceeding in his own behalf and all other holders of first and second debenture stock, he (the second plaintiff) being entitled to both sets of debentures. Counsel said that the company had issued first debenture stock to the amount of £150,000, and second debenture stock to that of £50,000; and the principal and interest had not yet become payable. Plaintiffs, however, were desirous of enforcing the debentures, and he (Mr. Vernon) now moved for the appointment of a receiver and manager, on the ground that the creditors of the company were pressing for payment and that the security for the debentures was in jeopardy. The company, the learned counsel further stated, had no funds wherewith to pay its debts or meet the current expenses of carrying on business, and it was impossible for it to obtain such funds. Therefore, Mr. Vernon submitted, a receiver and manager should be appointed in the interests of both sets of debenture holders. Mr. Cassel, who appeared for the company, did not oppose the application, which His Lordship said he should grant, but direct, however, that the receiver and manager should not act for more than four months without the leave of the Court. The receiver and manager would be at liberty to act at once upon the plaintiff's undertaking to be answerable for his security and upon his (the receiver's) own undertaking to complete his security forthwith.

Lead Poisoning.—As the result of an inquest touching the death of Robert Band, an employé of the Electrical Storage Syndicate, Clifton Junction, the jury returned the following verdict:—"That deceased on November 14th died from blood poisoning, arising from an ischiorectal abscess, and that such abscess was set up or induced by the anæmic condition of deceased, caused by lead poisoning."

Milver Portable Electric Battery Syndicate, Limited.—On Wednesday, November 29th, in the Companies Winding-up Court, Mr. Justice Wright, sitting as an additional judge of the Chancery Division, had again before him the matter of the Milver Portable Electric Battery Syndicate, Limited, on the petition of G. Trenam. This was a creditor's petition, and it stood over from the sitting of the Court on November 15th.—Counsel now informed the Court that the defendant had been paid, together with a sum for costs. There were no other creditors, and he (counsel) asked to be allowed to withdraw the petition.—His Lordship: You do so at your own risk.—Counsel: Certainly.—The petition was then withdrawn.

New Large Power Schemes.—The Tyneside Electric Power Company, Limited, are promoting a Bill in Parliament next session, empowering them to supply electric energy throughout the whole manufacturing district on both sides of the Tyne from Blaydon and Newburn on the West, to Tynemouth and South Shields on the East. The company propose to generate electric energy on a very large scale, and to supply it both in bulk to local authorities for distribution, and also for motive power purposes to works, shipyards and manufactories. Among the directors of the Tyneside company are the Hon. C. A. Parsons, F.R.S., and Mr. A. A. Campbell Swinton.

Press Directory.—*Street's Newspaper Directory* for 1899 is, as usual, a very useful index to the newspaper press of this country, and a few casual references which we have made have inclined us to describe it as accurate in its material and convenient in its arrangement. For the commercial man the book is the right thing, for it is a directory pure and simple, and does not attempt to import into it literary matter which will interest the literary man and nobody else. Such details as addresses, trades, date of publication, latest time for advertisements, are placed straight before the eye, and with the aid of a concise "contents" are always ready for reference.

Reduction of Capital.—The petition for reducing the capital of Hick, Hargreaves & Co., Limited and Reduced, will be heard before Mr. Justice Kekewich on December 2nd.

The Salignac Boiler.—At the time when this boiler was first brought out we drew attention to it in our columns. We have just received from Messrs. Salignac, Grille & Cie, of 67, Rue de la Victorie, Paris, a catalogue of their boiler, which is now made in various forms. This catalogue is a small treatise on evaporation. It may be remembered that the Salignac boiler is based on a principle which, if not new—for it was tried 50 years ago—is yet possible to-day, because of the excellence of the stout steel pipes now procurable. The principle of action is "never to introduce into the tubes more water than can be continuously evaporated." In this way the tubes are never gorged with water. Their receiving ends are restricted to the taking in of the quantity of necessary water that can be evaporated. It is claimed that a great reduction of heating surface can thus be effected, as much as two-thirds from ordinary practice. Circulation is active, and as much as 40 to 50 kilos. of steam can be produced per square metre of surface, or about nine to 11 lbs. per square foot = three times as much as ordinarily obtained. An ordinary form of boiler consists of an upper drum of water and steam space, containing a vertical pipe delivering steam near its upper part. This pipe springs from the top of a chamber placed below the drum. This chamber receives at its upper edge one set of ends and at its lower edge the lower set of ends of a series of long U tubes with their limbs nearly horizontal. The lower part of this chamber is connected by a pipe with the lower part of the upper drum. Water enters at the ends of the lower leg of the U pipes, is converted into steam in its passage through the pipes, and escapes to the upper drum by the vertical escape pipe, up which it also carries any water supplied by the down course pipe in excess of evaporation. Thus, as soon as the water reaches the level of the steam escape pipe, a mixed current of steam and water rises to the top drum, and in starting a boiler from rest the whole of the water contents are thus rapidly circulated and heated to improve temperature. The principle of the boiler appears good, and we should say it has a future.

Search Lights in the German Navy.—All the vessels of the German navy are equipped with the Schuckert searchlight projectors. The Royal yacht *Hohenzollern*, the man-of-war *Kaiser Friedrich III.*, and the gunboat *Hela*, which accompanied the German Emperor on his visit to this country, are, of course, included.

Sentence.—S. S. Clarke has been sentenced at Westminster to four months' hard labour for stealing moneys of the Safety Concentric Wiring Company.

Strike at a Chemical Works.—The shift men at the Castner-Kellner Electrolytic Chemical Works came out on strike last week. With these there also struck a number of other labourers, bringing the total up to about 100. The number employed at the works is about 400, and those in disagreement with the masters are employed in what is known as the "cell room," where chlorine gas is manufactured in oscillating cells of mercury, kept in motion by electrical power. Each man has the oversight of one row of these cells, and it was proposed that each man should overlook a row and a half in future, and that his wages should be reduced by 2s. 3d. per week. The men resisted this proposal by leaving their work. The

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managers declined to treat with the men unless they resumed work, and a large portion of the employés did so. The men held a conference with the masters' representatives, with the result that they have agreed to work for a month under present conditions; the whole matter will then be reconsidered.

Smoke Nuisance.—At the Altrincham (Cheshire) Petty Sessions last week, the Altrincham Electric Supply, Limited, was summoned for not complying with a magistrate's order to abate the black smoke nuisance at their works. The Bench said the order must be complied with, but recognising the difficulties with which the company had to contend, inflicted the mitigated penalty of 10s., and costs, 9s. 6d., on one information only.

Trade Announcements.—In consequence of Messrs. W. Tasker & Sons, Limited, giving up their electrical branch at 39, Victoria Street, S.W., Mr. Manley has made arrangements whereby he has taken same over and will continue the business in its same form. The "Moto" soldering iron, which has been giving great satisfaction, will be embodied in the business taken over by Mr. Manley, who will continue the sale of same under the same conditions.

Messrs. Edwards & Shaw, consulting electrical and mechanical engineers, of Birmingham, announce that they have purchased the interest of Mr. Cerrito in their late partnership business, and that their address for the future will be 105, Colmore Row. They will, as hitherto, confine themselves strictly to consulting work.

English Industrials, Limited, whose head office is at 55, Market Street, Manchester, has now opened an office at 82, Victoria Street, Westminster, S.W., for the extension of the various schemes and projects which are in hand.

Messrs. Worth & Handcock, boiler, &c., manufacturers, say that their works at Britannia Works, Cleveland Street, Birkenhead, are now completed, and most of the machinery is fixed and working, and that they are now ready for orders.

The registered offices of Sax, Slatter & Co., Limited, have been removed from 54, to 48, Gresham Street, E.C.

ELECTRIC LIGHTING NOTES.

Aberdeen.—The Electric Lighting Committee has instructed Mr. Bell, the electrical engineer, to prepare a report on the extensions and alterations likely to be required to cope with the increasing demand for electricity.

Backbarrow.—An electric lighting installation has been carried out in the Lancashire Ultramarine Company's mills by the Windermere and District Electric Lighting Company, Limited. Power is derived from a turbine driven by water from the River Severn.

Bala.—The Urban District Council has received the report of Mr. Peers on the electric lighting scheme, in which it is stated that a suitable outfit to supply 2,000 8-c.p. lamps and 40 20-c.p. street lamps would cost about £2,870. A ratepayers' meeting was called last week to discuss the report, when it was decided to defer the matter for 12 months.

Ballycastle.—A public meeting of the ratepayers was held on the 24th ult. to consider the proposed lighting of the town and quay. At present the town is supplied with gas, but the streets are not lighted. It was stated that the electric light could be installed at a cost of £1,500.

Barnstaple.—Mr. F. W. Chanter has been appointed electrical engineer to the Town Council, and is preparing a scheme for lighting the principal streets.

Battersea.—The Vestry last week resolved to oppose the application of the County of London and Brush Provincial Electric Lighting Company for a provisional order for Battersea. It was also decided to allow the contract with the Hart Accumulator Company for the supply of batteries to be so amended as to include certain clauses referring to the maintenance of the batteries as requested by the company.

Bognor.—Subject to an agreement being approved, the Urban District Council has accepted the offer of Edmundson's Electricity Corporation, Limited, to take over the Council's provisional order at cost price, and establish works for the supply of electricity in the district. Energy for public lighting will be charged for at 3d. per unit, for other purposes at 7d. and 4d. per unit on the Wright system; the Council may purchase the undertaking after 14 years for the capital expended + 33⅓ per cent.

Bury.—On Thursday, last week, Mr. E. A. Sandford Fawcett, on behalf of the Local Government Board, held a public inquiry into the application of the Town Council for sanction to borrow £800 for purposes of electric lighting. There was no opposition.

Carmarthen.—The Town Council last week decided to ask the South Wales Electrical Power Distribution Company for a statement of their terms for the supply of electricity for public lighting.

Cleethorpes.—The Urban District Council has received the report of Mr. C. S. Vesey-Brown on the question of electric lighting. The report recommends three-wire distribution at 230 volts, with street lighting by arc lamps on the tramway poles. The plant required would include steam dynamos of 120 kw. capacity, and a battery of accumulators, with a probable annual output of 147,000 units. The capital cost would be about £15,719. Electrical energy would be sold to private consumers at 5d. or 6d. per unit, and for public lighting at 3½d. The estimated total cost of the Cleethorpes electric lighting scheme is about £16,000, and the probable annual cost is given at £2,070. This, it is estimated, would enable the District Council to supply electricity to the public at from 5d. to 6d. per unit.

Cowes.—The Board of Trade has granted a further extension of the electric lighting order for six months.

Dublin.—The Corporation has concluded an agreement with Mr. R. Hammond, M.I.C.E., under which his appointment as consulting electrical engineer is settled. The extensions of the electric lighting scheme are to cost £120,000.

Edinburgh.—The Secretary for Scotland has sanctioned the borrowing of £210,000 by the Town Council for extensions of the electricity works.

Heylake.—The District Council has accepted tenders, amounting to £20,660, for electric lighting buildings and plant. A Local Government Board inquiry is to be held shortly with reference to the application of the Council to borrow £26,000 for electrical purposes.

Italy.—A company has been formed in Naples with a capital of £120,000, to be known as La Società Napoletana per Imprese Elettrichi, to establish and operate central electric lighting stations in Naples.

Largs.—The Burgh Commission is considering the question of adopting electric lighting, and has obtained a favourable opinion on the subject from Lord Kelvin, at Netherhall, Largs.

Leatherhead.—The Urban District Council has received an application from Messrs. Handcock & Dykes, on behalf of a client, to purchase the Council's provisional order. The Council is prepared to consider any favourable offer.

Lowestoft.—Encouraged by a record season, the Corporation has decided to adopt electric lighting early next year as a municipal undertaking at a cost of £30,000.

Maidstone.—The Urban District Council has accepted tenders, amounting in the aggregate to £14,292 9s. 8d. (£3,000 less than the engineer's estimate), for the supply of plant for the electric light installation.

Morecambe.—A Local Government Board inquiry was held last week regarding an application by the Morecambe Council to borrow £25,390 for the extension of the electric light installation.

Northumberland.—Mr. A. A. Campbell Swinton has been instructed to report to the committee of the Northumberland County Lunatic Asylum upon the proposed electric lighting of the Asylum.

Poplar.—The Board of Works has accepted the tender of the British Insulated Wire Company, Limited, for supplying and laying cables; the necessary excavations and repaving will be carried out by direct labour.

Ruislip.—A local syndicate has been formed to promote an electricity supply undertaking in Northwood. The Parish Council has resolved to support the scheme in preference to that of the Uxbridge and District Development Syndicate, Limited.

St. Annes-on-the-Sea.—Colonel Durnford held a public inquiry, on Thursday last week, into the application of the St. Annes Council to borrow £18,000 for electric lighting. The assessable value of the district was given as £42,000, and loans already sanctioned, £46,000. Thirty years were asked for repayment of the loan, with the first two years' grace. The engineer estimated a gross revenue of £2,226, and a surplus, after the first year, of £274. There was no opposition.

St. Helens (I.O.W.).—The District Council has assented to the introduction of electric lighting in the district by the St. Helens Electric Supply Company, subject to purchase clauses being inserted in the order.

Sevenoaks.—The Electrical Power Distribution Company, Limited, has proposed an electric lighting scheme to the Urban District Council, involving a capital expenditure of about £20,000. The Council has appointed Mr. Hawtayne to advise on the subject.

Sheffield.—Last Friday Colonel W. Langton Coke, M.I.C.E., held an inquiry on behalf of the Local Government Board into an application by the Sheffield Corporation for sanction to borrow £100,000 for the purposes of the electric lighting undertaking. The town clerk informed the inspector that the electric lighting undertaking was purchased last year from the Sheffield Electric Light and Power Company by the Corporation, who entered into possession on January 1st this year. The undertaking was a large one, and was purchased at a largely enhanced value. The Corporation had practically no capital to work upon, and this was the first application for any loan in connection with the undertaking. At the time the Council took over the works the company had in hand the erection of certain buildings, extensions of their premises. These had been completed by the Corporation, who also needed money to purchase machinery, to lay street mains, and to do other work rendered necessary by the greatly increased demand for electric

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light. Of the £100,000 a sum of £35,000 was for machinery, some portion of which was ordered before the Corporation became owners, and the remainder of which was either on order or would be wanted in the next few months. There was £20,000 for underground mains, and of this £10,000 would be expended during the year ending December 31st next. This was entirely for private lighting. There was a sum of £7,600 for public street lighting, but this was anticipatory. Nothing had been done yet in this matter, but it was anticipated that something would be done, and it was suggested that some of the principal streets should be lighted with large electric lamps placed on the standards of the electric tramway. There was £3,700 for extensions of buildings, some already carried out and some to be done; £7,000 for transformers and meters; £16,000 for boilers, and other appliances and other smaller items, with £5,000 for contingencies. Of the total sum £51,201 was the amount the Corporation had already spent, or were committed to, and £48,799 was for future works.

Sleaford.—The Urban District Council of Sleaford has given notice of its intention to apply to the Board of Trade for an electric lighting provisional order.

Swansea.—The Town Council has accepted the tender of Mr. David Jenkins for buildings for electricity works (£17,000). A Leeds firm is to be engaged to equip them at a figure of about £8,000. It is understood that it will take about six months to have the station completed, and it is expected that by next summer Swansea will have both the electric light and electric tramcars.

Train Lighting.—According to the *Echo* it has been decided to light all the carriages of the London, Chatham and Dover Railway by electricity.

Uckfield.—The Rural District Council has decided to make application for a provisional order enabling the Council to supply electricity in the parishes of Rotherfield, Mayfield, and Buxted.

Wellingborough.—The Urban District Council has approved of the terms of the provisional order to be applied for by the Electrical Power Distribution Company for supplying the town with electricity for lighting and other uses.

Winchester.—The Board of Guardians has decided to light a new laundry which has been added to the Workhouse by electricity, and has accepted the tender of Messrs. Dicks & Son, Winchester. It is probable that when the present contract for lighting the whole of the house expires, electricity will be substituted for gas throughout.

Wrexham.—The Town Council has received the sanction of the Local Government Board to borrow £20,000 for electric lighting purposes, to be repayable in 25 years.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Barnes and Richmond.—The New General Traction Company has withdrawn its proposals to construct an electric tramway through Barnes and Mortlake to Richmond. It was part of the proposals that the Richmond Corporation should lend the company £60,000, but the Town Council was not satisfied what return it would get, and on the Council deciding to oppose the scheme the promoters took no further steps.

Bradford and Leeds.—The Board of Trade has recently confirmed an order authorising the construction of a light railway in the West Riding of the county of York from Bradford to Leeds.

Cinque Ports.—Among the schemes to come before Parliament is the Cinque Ports Light Railway, which will be a single line, 3 feet 6 inches gauge, and worked on the overhead electric system. The scheme is a very extensive one, and will provide convenient communication at a part of the country where such is sadly lacking at present. It is proposed to run from Ramsgate, forming a junction there with the Isle of Thanet Light Railways, which go to Westgate, Margate, and Broadstairs. It will run partly over private property, but chiefly along the road through Sandwich, Deal, Walmer, Kingsdown, and St. Margaret's. There will be a branch from St. Margaret's Bay to Martin Mill Station, thus putting St. Margaret's Bay and the adjacent country in direct communication with the London, Chatham and Dover Railway. From St. Margaret's the railway will run across fields, touching several farmsteads, until it joins the main road above Castle Hill, down which it will run, making junction with the Dover tramways in the Market Square. The *Dover Standard* says that negotiations are to be opened with the Dover Corporation for running powers over their line to Maxton. From Maxton it will run along the main road through Folkestone, Cheriton, Shorncliffe Camp and Sandbrooke to Hythe, making junction with the South-Eastern Railway Company's tramway to Sandgate. From Hythe the line will run along the sea-front road through Dymchurch to New Romney. From New Romney the route runs through Lydd across the Marsh to Rye. From Rye the railway will run through Winchelsea to Hastings, and it is proposed to form connection with the proposed Hastings and Bexhill lines.

Darlington.—The Imperial Tramway Company has notified to the Darlington Town Council its desire to restrict the proposed tramways, omitting Eastbourne, Victoria Road, Grange Road, Greenbank, Haughton, &c. This restriction of the scheme will be shortly considered by the Town Council.

Falkirk.—A proposal is on foot to lay down electric tramways in Falkirk on the overhead trolley system. The Town Council has favourably received the proposition.

France.—A company has just been formed in Paris with a capital of £120,000, to be known as La Compagnie des Tramways Electriques de Vanves à Paris et Extensions, to construct and work an electric tramway between Vanves and Paris. The line, which is already in hand, is to be on the Diatto system.

Garston.—Notice has been given to the Urban District Council by the Garston Electric Lighting Company of its intention to apply for Parliamentary sanction to the construction of electric tramways from Aigburth Vale to Garston. The Council decided to oppose the application.

Glasgow.—At a meeting of the Tramways Committee of the Corporation held last week, the tenders for the two auxiliary engines required for the electric power station at Port Dundas were under consideration. The highest offer, which was by an English firm, amounted to £29,350; while the lowest offer, which amounted to £7,858, was by an American firm. The latter did not, however, comply with the specification, and it was agreed to recommend acceptance of the second lowest offer, which amounts to £7 870 10s, and is by Messrs. Duncan Stewart & Co, Limited, London Road Ironworks. It was also agreed to recommend that the offer of the Westinghouse Electric Company, Limited, London, to supply the switchboards required at the Port Dundas electric power station and at the sub-stations throughout the city be accepted. The contract amounts to £33,593.

Gravesend.—The Town Council has received notice that application is to be made to the Board of Trade for its approval to the transfer of the undertaking of the Gravesend, Rosherville, and Northfleet Tramways Company, Limited, to the Drake & Gorham Electric Power and Traction Company, Limited, of 66, Victoria Street, E.C., in consideration of £7,750.

Mersey and Wirral Railways.—Major Cardew has been engaged by the Mersey Tunnel Railway, and Mr. S. B. Cottrell, manager of the Liverpool Overhead Railway, by the Wirral Railway Company, for the purpose of preparing plans for the electrical equipment of the above railways.

Newcastle.—The New Tramways Committee last Friday decided to recommend the Council to accept the following tenders for plant:—Dick, Kerr & Co., 5,000 tons 45-foot steel rails at £8 7s. 6d. per ton; ditto, fish plates, at £9 17s. 6d.; Patent Nut and Bolt Company, Limited, 250 tons of patent nuts and bolts, &c., at £18 10s.

Portsmouth.—At a meeting of the Town Council on Tuesday the Tramways Committee presented a report recommending the adoption of a separate power station. Mr. H. Kimber, chairman of the Committee, in moving the adoption of the report, said the figures had been carefully examined, and the Committee felt that a separate power station would be best for the interests of the borough, and that as it would be a separate commercial undertaking it should stand on its own merits. There would be no additional outlay in the case of a separate power station, as the same outlay would have to be made by the Electric Light Committee if the Council decided that the current should be supplied from the electric light station. The figures had been very carefully prepared by the tramways engineer (Mr. Rotter), and they felt that they could produce the current more cheaply than the Electric Light Committee. Mr. Alderman Ellis, chairman of the Electric Light Committee, advocated the supply of the power from the existing station, but, after a long debate, the Committee's recommendation was adopted by 31 to 9.

Stirling.—The proposals of the British Electric Traction Company to take over the Stirling and Bridge of Allan Tramways and to extend the line to Tillicoultry, have been finally broken off. The points in dispute were the terms for street wayleaves and the sum to be paid the Council for the privilege of running the tramways.

Stourbridge.—An electric tramcar last week ran into a cartload of carboys of vitriol in the early morning before daybreak. The carman was seriously injured by the vitriol, and the motorman broke his leg. The car also was much damaged.

Warrington.—The Town Council on Tuesday resolved that application be made to the Board of Trade for a provisional order authorising the Council to construct and work tramways in the principal thoroughfares of the borough. The scheme embraces 11 tramways with four main lines. It was stated that no doubt the motive power would be electricity. The estimated cost of the scheme is £170,000.

Whitehaven.—The *Whitehaven News* is informed that a proposal has been made to the Corporation by a substantial company seeking to acquire powers to run a tramway through the borough on the overhead wire system. The line would pass from Cleator Moor, through Whitehaven, to Distington.

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TELEGRAPH AND TELEPHONE NOTES.

Constantinople.—In view of the increase of telegraphic correspondence between Constantinople and Syria, and the delay in the transmission of messages, the Sublime Porte has, says an exchange, instructed the Administration of Ports and Telegraphs to double the wire between Constantinople and Damascus.

Edinburgh and the Telephone Service.—The town clerk has issued a report to the members of the Lord Provost's Committee of the Town Council relating to the public telephone service within the city. The report deals at length with the present position of the telephones within the city, of which the National Telephone Company has a practical monopoly. Among other questions the report considers the question which has arisen as to the interference with the streets involved in an underground system, the opinion being expressed that an adequate and efficient telephone service can only be had through an underground system with twin wires. The Town Council attaches the utmost importance to maintaining the control of the streets. They hold that the power of the Postmaster-General, with the consent of the Town Council or upon appeal, to lay underground wires in the streets was only intended to be used when necessary for Post Office purposes, and that it remains to be determined whether the Postmaster-General is within his legal rights or has exceeded them, in coming to the aid of the company in that matter. The report further discusses in detail, as possible alternatives to the present system, Government or municipal services, and it embodies a proposed agreement between the Corporation of Edinburgh and the National Telephone Company in the meantime. The main points of that agreement are given as follows in the *Glasgow Herald*:—

The Corporation shall retain control of the streets; they will lay underground wires between the points desired by the company, but the particular line of route will be in the discretion of the Corporation, who may from time to time alter the position as they find desirable. The company undertakes to give telephone service to all persons within the city on equal terms, irrespective of their distance from an exchange, and to maintain an adequate and efficient service; the Corporation reserve all their rights in the streets; the maximum rate of subscription charged for service will be in the subscriber's option at one of the following rates:—(*a*) Unlimited service at £10 per annum; (*b*) a fixed charge of £8 10s. per annum, with an addition of 1d. per call, without any charge for messages received—the latter "toll" system would probably bring the telephone within reach of many citizens who do not take it at present; the company is to pay a yearly rent of not less than £750 to the Corporation for the use of the streets; on December 31st, 1911, or within six months thereafter, the Corporation will have the option either to call upon the company to remove the tubes, &c., in the streets, or to take these over from the company at a valuation by arbitration. The agreement, which is subject to the approval of the Town Council within two months, it is pointed out, does not prevent or interfere with the Government or Post Office taking up the telephone service at any time. It does not interfere with the municipality obtaining a license and starting an independent service at any time, on the statutory conditions which would be applicable if there was no agreement. Moreover, it has the positive advantage, in the event of the municipality establishing a competing service, that it would have the effect of preventing the company from unduly reducing its rates for the purpose of driving off the municipality, as it might do if there was no agreement. It retains to the Corporation control of the streets, and it secures adequate and efficient service to subscribers, on terms which will allow the use of the telephone to become more general than hitherto, and it produces a substantial yearly rent to the Corporation which would otherwise not be had.

French Cable Schemes.—A Paris despatch says that at the meeting of the Cabinet there on Tuesday, the Ministers considered a proposal by M. Henrique, President of the Colonial Council, to facilitate the laying of a system of submarine cables by French enterprise. M. Millerand, Minister of Commerce, was instructed to draft a Bill in conformity with the views of the Colonial Council. The Bill will probably be laid before the Chamber during the first or second week in December. It is estimated that the cables cannot be laid in less than five years.

The Interruption to South African Cables.—Mr. Chamberlain pointed out to a deputation which waited on him in support of the claims of the Eastern group of cable companies, that when trouble occurred in South Africa, some of their cables had a habit of breaking down. We have had two examples of the correctness of this opinion during this last month. The cable from Delagoa Bay to Mozambique (an unduplicated section) broke down on November 15th. The cable between Aden and Zanzibar, also unduplicated, broke down on the 25th. In giving evidence *re* the Pacific cable, the Marquis of Tweeddale and his colleagues pointed out the necessity of duplication, saying, "We have gone on that principle of spending our surplus revenue in triplication and duplication." The cases to which we refer along the East Coast of Africa appear not to have been present to the minds of these gentlemen when giving evidence.

The Pacific Cable.—The *Sydney Daily Telegraph*, after having printed an article evidently inspired by the advocates of the Cape-Australia cable, and in which article the usual misrepresentations appear, corrects itself as follows:—

In regard to what appeared in yesterday's issue as to an agreement come to between the Postmasters-General of Victoria and New South Wales, the Postmaster-General assures us that the information on which the article was written was erroneous, and that the facts are as follow:—Since the present Government came into power, an advisory board has been appointed, representing Great Britain, Canada, New South Wales, Victoria, New Zealand, and Queensland. This board is to consider the whole matter of the Pacific cable, and advise the interested parties as to the result of its deliberations. The board meets in London early next month, and until the Postmaster-General receives its report, he points out it would be ridiculous for him to come to any decision on the proposals of the Eastern Extension Company. The Eastern Extension Company submitted certain proposals to the Colonies concerned, and all that has been done, so far, has been for the Postmasters-General of Victoria and New South Wales to ask the agent of the company if the company were prepared to vary those proposals in certain particulars, so that they might have all the information required before them when the report of the advisory board was received.

Reported Fast Speed Telegraphy.—It is telegraphed from New York that the Pollak-Virag system of rapid telegraphy has been tested between Chicago and Buffalo, and 90,000 words an hour were transmitted. Between Chicago and Milwaukee 140,000 words were sent in the hour. The distance from Chicago to Buffalo is 1,062 miles. Herr Virag superintended the experiments.

The South African Cables.—The Eastern Telegraph Company notified that the first section of the new cable between South Africa and England (Cape Town-St. Helena) was completed and opened for traffic on Sunday. The ship conveying the second portion of the new cable (viz., the section between St. Helena and Ascension) was due at St. Vincent on 28th ult., and it is expected that the section will be laid and open for traffic in December.

It has been since announced that another breakdown in the telegraphic connection with South Africa has occurred, the Aden-Zanzibar cable being now interrupted. This implies that telegrams from the seat of war will be again subject to delay, as all news will have to be transmitted by the West Coast cable. It is hoped, however, that the broken cable will be speedily repaired. The West Coast cable, it is understood, is at present working well, and, so far, with little delay.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies:—		
Jamaica-Colon	June 30, 1899 ...	...
Trinidad-Demerara (1871 original)	Oct. 20, 1899 }	Nov. 9, 1899.
Do. do. (1891 duplicate)	Oct. 6, 1899 }	one cable restored.
Do. do. (both cables)	Nov. 22, 1899 ...	Nov. 23, 1899
South African:—		
Zanzibar-Mombasa	Oct. 27, 1899 ...	...
Aden-Zanzibar	Nov. 27, 1899 ...	...
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Latakia-Cyprus	June 20, 1899 ...	...
Landlines.		
West Indies:—		
Cuban Government lines... ...	Oct. 30, 1899 ...	...
Communication with Les Cayes (Haiti)	Nov. 22, 1899 ...	...
South African:—		
Communication with Mafeking...	Oct. 13, 1899 ...	...
Communication with all offices beyond Orange River	Oct. 18, 1899 ...	...
Communication beyond Burghersdorp, Cape of Good Hope, and Estcourt, Natal...	Nov. 7, 1899 ...	...
Communication with north of Mooi River (Natal)	Oct. 21, 1899 ...	...
Colombian Government lines to Bogota	Oct. 21, 1899 ...	...
Communication with interior of Colombia, excepting Amalfi, Ambalema, Buga, Cartago, Ibagua, Manizales, Medellin, Palmire, Pasto, Popoyans, Reimedos, Sonson, and Santo Domingo... ...	Nov. 6, 1899 ...	...
Communication with Valentia (Venezuela)	Nov. 18, 1899 ...	...
Saigon-Bangkok	Nov. 23, 1899 ...	Nov. 25, 1899
Majunga-Tananarive	Nov. 25, 1899 ...	...

The Telephone Service.—The Hammersmith Vestry has been considering plans with notices and schedules in connection with the proposal of the Post Office authorities to break up the roadways and footways in various thoroughfares in the parish for the purpose of laying conduits with multiple ducts, or cast-iron pipes, also for the provision of manholes, &c., for the new telephone system for London, which the Postmaster-General has undertaken to provide. It was agreed that permission be given upon certain conditions as approved by the Vestry.

Wireless Telegraphy.—It is stated by an evening paper that the staff of H.M.S. *Vernon*, at Portsmouth, are engaged on experiments which it is understood will, if successful, precede the introduction into the British Navy of wireless telegraphy for signalling purposes. A torpedo gunboat is to be sent to sea with instructions to keep in touch with a receiving station established on the battleship *Hector*.

The Vulnerability of Cables in War Time.—A correspondence on the above subject between the Marquis of Tweeddale and Sir Edward Sassoon has been going on in the *Times*, and as it may be of interest to our readers, we produce here the two last letters which have appeared.

Referring to Sir Edward Sassoon's letter which appeared in your issue of the 18th, permit me to point out that I never made the statement he ascribes to me—namely, "that the Cuban telegraph cables were not interfered with during the Spanish-American war." My statement to the Chancellor of the Exchequer was that "cable communication with Cuba was maintained up to the last few days of the war," and at the half-yearly meeting of the Eastern Extension Company that "as a matter of fact the interruption of cable communication between Cuba and the United States was never effected." These statements were made by me on the strength of the seventh paragraph in the report of the Cuba Submarine Telegraph Company, dated November 9th, which contained the following passage:—"Notwithstanding these interruptions, the directors are glad to state that through communication has been continuously maintained, the staff remaining at their posts under very trying circumstances."

Sir Edward will, I feel sure, admit that my "persistence" was not altogether without warrant. TWEEDDALE.

I have just read Lord Tweeddale's letter. There appears to exist some mental confusion, to remove which I beg the further hospitality of your columns. In criticising Sir C. Dilke's remark that the experience of the

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Spanish-American war has confirmed what all military and naval authorities had already made up their minds to—viz., "that all telegraphic communication is likely to be destroyed in time of war," Lord Tweeddale said, "But the recent war afforded no such experience." Immediately afterwards he went on to say, "It is true that the cable between Hong Kong and Manila was interrupted." He might have added that the American Admiral cut the cables between Manila and Iloilo on May 23rd, 1898.

The Hong Kong and Manila cable, which was laid some 20 years ago and has not been duplicated, is the only cable to the Philippines, and it was cut by Admiral Dewey on May 2nd, 1898. This surely does afford one "such experience":

As regards the Cuban cables, I have not in any of my speeches or letters asserted that all cable communication between Cuba and the rest of the world was interrupted, but I gave chapter and verse concerning the cutting of the two important Cuban cables as proof that wires "are likely to be, and can easily be, severed in time of war." I quite admit that although in the case of Manila "all" communication was sundered, in Cuba this was not the case; but, Sir, in addition to the typical incident which I cited, there is the cable between Santiago and Guantanamo, which was cut by the U.S. steamer *St. Louis* on May 18th. Then the Jucaro to Tunas cable was cut by the U.S. steamer *Wilmington* on July 21st, 1898. Another instance is that reported in the Press at the time concerning the French cable between Guantanamo and Hayti as having been cut and buoyed by Rear-Admiral Sampson early in June, 1898, and afterwards restored by him, probably to avoid international complications. Then the severing of "all" cable communication between Cuba and the rest of the world, it should be remembered, would have entailed cutting the English cable to Jamaica and the French cable to Hayti—the Key West cable being in the hands of the Americans. That these international cables were not cut was doubtless due to what you, Sir, at the time aptly termed "a tenderness for the rights of neutrals." Lord Tweeddale would fain have it that the whole point at issue should turn on the word "all," which appears to me a narrow way of treating the general question of the vulnerability of cables in war time.

When addressing the Folkestone Chamber of Commerce on the 7th inst. I observed, "How critical the state of affairs is in South Africa it is needless to say, and yet, just when most required, the cable from Delagoa Bay to Mozambique—the solitary cable—breaks down, and we must now rely for news of the most vital importance upon the long landline which runs through Natal to Cape Town." Commenting on this remark, Lord Tweeddale, addressing his shareholders on the following day, said:—"I judge that the lecturer meant to convey the impression that we are cut off from the Transvaal and Natal because the cables are interrupted—that is the only interpretation that can be put upon it."

Sir, I leave the fairness of this construction to all dispassionate and fair-minded readers, and can only say that his multifarious occupations must have prevented Lord Tweeddale from reading the address which he did me the honour to criticise. It is obvious that my protest was directed to the fact that this 25-year old cable had not been duplicated by its proprietors, who had received £1,300,000 in State subsidies, and there is not the shadow of a shade of suggestion that we were entirely cut off from receiving news from the Transvaal and Natal by the long land route. I am glad that the disabled cable has now at last been repaired.

EDWARD SASSOON.

CONTRACTS OPEN AND CLOSED.

OPEN.

Battersea.—December 4th. The Vestry wants tenders for arc lamps and posts. See "Official Notices" November 17th.

Birkenhead.—December 12th. The Corporation wants tenders for the supply of condensing plant, overhead crane, and feeder mains for the electric tramway works and scheme. See "Official Notices" December 1st.

Blackburn.—December 23rd. The Corporation wants tenders for overhead trolley line equipment. See "Official Notices" December 1st.

Blackpool.—December 15th. The Corporation wants for the electricity works four boilers and accessorial steam plant; two 600-KW. steam alternators (or one 1,200-KW.), switchboard, mains, transformers, and battery. See "Official Notices" Dec. 1st.

Denmark.—December 28th. The Corporation of Aarhus is inviting tenders for water-tube boiler plant, steam dynamos, switchboard, and accumulators for electricity works. From our "Official Notices," November 3rd, further particulars may be obtained.

Gloucester.—December 28th. The Electricity Committee wants tenders for extension plant including Lancashire boiler, &c., one 300-KW. steam dynamo, switchboard work, condensing plant. See "Official Notices" December 1st.

Hackney.—December 12th. The Vestry Electric Lighting Committee is inviting tenders for refuse destructors to deal with the whole of the refuse of the parish. Specification, &c., may be obtained at the offices of Mr. Robert Hammond, M.Inst.C.E.

Hackney.—January 2nd, 1900. The Vestry wants tenders for the supply of accumulators. See "Official Notices" to-day.

Harrow.—December 4th. The Electric Light and Power Company wants tenders for a 150 KW. steam dynamo and switchboard extension. See "Official Notices" November 17th.

Lambeth.—December 6th. The Vestry is prepared to receive tenders for 25 arc lamps and posts. For particulars, see "Official Notices" November 10th.

Manchester.—December 2nd. The Tramways Committee wants tenders for 5,000 tons of steel girder rails and 250 tons of steel fish-plates. See "Official Notices" November 17th.

Manchester.—December 16th. The Corporation Tramways Committee wants tenders for steel tie-bars, bolts and nuts for permanent way work. See "Official Notices" this week.

The Midland Corporation.—December 18th. From an "Official Notice" Dec. 1st, particulars may be obtained of certain plant and machinery and conductors, for 10,000 B.H.P. output, required for the new power house to be erected by the Midland Electric Corporation for Power Distribution, Limited. There will be 16 water-tube boilers, six sets of Corliss engines and three-phase generators, transformers, switchboards, mains, batteries, &c.

Mistretta (Sicily).—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Palermo, stating that tenders are invited by the Municipality of Mistretta, not later than December 31st next, for the establishment of a service of electric lighting in that town. Such particulars as have been received may be examined on personal application at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 5 p.m.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

Plymouth.—December 8th. The Corporation wants tenders for tramcars, trucks, motors, trolley arms, &c. See "Official Notices" November 17th.

Rathmines and Rathgar.—December 13th. The Council is inviting tenders for additional feeding and distributing mains, including trenching, cables, joint boxes and house services. See "Official Notices" December 1st.

Roumania.—December 8th. The Roumanian State Railway authorities in Bucharest are inviting tenders until December 8th for the supply of 11,320 porcelain insulators and 10 tons of ingot lead.

St. Pancras.—December 12th. The Vestry wants tenders for (*a*) two dry back marine boilers; (*b*) condensing plant, feed water heaters, steam and feed pipes. See "Official Notices" this week.

Trimdon Grange (Durham).—The owners of East Hetton Trimdon and Trimdon Grange Collieries want tenders for 12 months supply of iron and steel castings, gas and steam piping, and a variety of other sundries including electric light fittings. Specifications from the Storekeeper, Trimdon Grange Colliery Company.

Weybridge.—December 4th. The Oatlands Park Hotel Company, Limited, wants tenders for wiring and fittings for 423 lamps at their hotel. See "Official Notices" December 1st.

York.—December 4th. The Corporation invites tenders for the electric wiring and fitting of the Guildhall, municipal offices and Mansion House. See two "Official Notices" December 1st.

CLOSED.

Hammersmith.—The name of Allen & Co. given as tenderers last week for electric wiring at Hammersmith should read E. P. Allam & Co.

France.—The French Posts and Telegraph authorities have placed a contract for 10 kilometres of iron pipes, 80 mm. diameter, for pneumatic pipe lines with La Société Française pour La Fabrication des Tubes, of Louvroil, at 7 francs 95 cents per metre.

Leeds.—The City Council has accepted the tender of Messrs. Schofield, Son & Co. for buildings, amounting to £2 298; that of the British Insulated Wire Company for cables, at £17,310, and laying *pro rata*; and that of the British Electrical Company for transformers and electrical equipment, at £5,734. These contracts are in connection with the extensions to which we recently referred.

Maidstone.—The following tenders have been accepted by the Corporation for electric lighting, subject to the sanction of the Local Government Board:—

		£	s.	d.
Section A.	—Steam dynamos: Messrs. Thomas Parker, Limited ..	4,818	0	0
„ B.	—Boilers: Messrs. Davey, Paxman & Co.	1,818	0	0
„ C.	—Condensers: Messrs. Mirrlees Watson and Yaryan Company	883	0	0
„ D.	—Switchboards: James White, Glasgow	808	0	0
„ E.	—Accumulators: Not decided.			
„ F.	—Travelling crane: Messrs. Carrick & Ritchie	245	0	0
„ G.	—Mains: Messrs. Callender's Cable and Construction Company	4,128	0	0
„ H.	—Arc Lighting: Messrs. Callender's Cable and Construction Company	851	0	0
„ I.	—Electricity meters: Messrs. The General Electric Company	590	5	0

Newington.—The Vestry has accepted the tender of Messrs. Johnson & Phillips for supplying and erecting engine, generator, and continuous current transformers for £5,030.

Poplar.—The following contracts have been placed for the engineering works now being carried out for the Poplar Union to Mr. Warden-Stevens' specifications:—

		£	s.	d.
Section H.	—Two Lancashire boilers: Tinkers, Limited	945	0	0
„ K.	—Water pressure drums and tanks: John Fraser & Sons	1,256	0	0
„ L.	—Steam jet plant.—Three ejector condensers, two steam jet pumps, two injectors: Korting Bros.	112	10	0
„ M.	—Auxiliary pumping plant.—One steam air compressor, (direct acting), one three-throw feed pump, one air compressor (three-throw), two centrifugal pumps, one three-throw hot water pump: Clay, Henriques Co.	281	10	0

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The list of contracts previously placed are:—

	£	s.	d.
Section A.—Two steam turbines and dynamos, direct coupled: Greenwood & Batley	630	0	0
„ B.—Electric motors.—One 12-B.H.P., one 8-B.H.P.: General Electric Company	231	0	0
„ C.—Battery of accumulators, maintenance for eight years at £22 per annum: Hart Accumulator Company	456	8	8
„ D.—Electric wiring and fittings: Speedy, Eynon & Co.	1,975	0	0
„ E.—Main switchboard and distribution boards: Veritys, Limited	523	0	0
„ F.—Engine and dynamo (enclosed high speed): Thames Ironworks Company	827	0	0
„ G.—Electric motors.—One enclosed 14 B.H.P., one partially enclosed 20-B.H.P., one partially enclosed 7-B.H.P.: Fuller-Wenstrom Manufacturing Company	419	0	0
„ J.—Economiser: James Carter & Sons	99	10	0
Deep wells and pumping machinery; Harvey & Williams, Limited	1,600	0	0

FORTHCOMING EVENTS.

Tuesday, December 5th.—At 8 p.m. Northern Society of Electrical Engineers, Grand Hotel, Aytoun Street, Manchester. Paper on "Methods of Suppressing Arcing at Switch and Fuse Contacts," by E. K. Scott.

At 8 p.m.—The Institution of Civil Engineers. Papers to be further discussed:—"The Waterloo and City Railway, and its Electrical Equipment," by Messrs. Dalrymple-Hay and Jenkin; "Combined Refuse-Destructors and Power Plants," by C. Newton Russell, A.M.I.C.E.

Wednesday, December 6th.—Institution of Electrical Engineers' annual dinner, Grand Hall, Hotel Cecil.

Thursday December 7th.—At 8 p.m. The Institution of Electrical Engineers. "The Cost of Steam Raising," by John Holliday, A.M.I.C.E; "Influence of Cheap Fuels on the Cost of Electrical Energy," by R. E. Crompton, Past President (adjourned discussion).

Friday, December 8th.—At 2.30 p.m. Institution of Civil Engineers. Students' visit to the works of the Baker Street-Waterloo Railway.

At 5 p.m.—Physical Society meeting in the physical laboratory of the City and Guilds' Technical College, Leonard Street, Finsbury. "Cylindrical Lenses," by Prof. Silvanus Thompson, F.R.S.; "Exact Formulæ for Lenses," by Mr. T. H. Blakesley; "On an Organic Compound of great Double-Refraction," by Prof. Silvanus Thompson, F.R.S.

At 8 p.m.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W. "A Continuous Mean-pressure Indicator for Steam Engines," by Prof. W. Ripper.

NOTES.

Trades Union Tyranny.—We have just had brought to our notice the case of a man who has been deprived of nearly half his wages by the tyranny of a Trades Union. He was found capable, though only a labourer nominally, of doing certain work better than other men who were styled fitters. He was, therefore, put on to this work and paid 9d. per hour—a rate higher than the Union rate in the particular locality. When the Union heard of it, they complained, and to avoid a strike the man had to be put off, and set back to his old work and pay at 5d. per hour only. If he has sense, he will probably obtain a certificate from his employers and proceed to America and obtain the rate of pay for the work he has been proved capable of performing. In the meantime, our workshops are behind time for lack of labour of every kind, except the worthless product of the far too numerous incapables who seem to be so prominent when a sober labourer has to be crushed.

Acetylene Lighting of a Town.—Tata Tovaros, Hungary, is the first town to have the distinction of inaugurating a public lighting system of acetylene gas. One of the most notable features about the system apparently is the small space taken up by the generating plant, and though it is proposed to do a considerable amount of public lighting, in addition to house lighting, only two men are required to operate the whole of the plant. The pipe system is laid as for an ordinary gas supply system, and no special precautions are apparently necessary at joints. Curiously enough, there are no local electricity works capable of producing calcium carbide, and this has to be obtained either from France or Switzerland.

Hammersmith Extensions.—Since we described these works, some few months ago, additions have been made to the plant in the shape of a new 300 KW. alternator of the Ferranti type, coupled to a Robey engine. This brings the plant up to three 125-KW. and three 300-KW. machines. We have often pointed out in these columns the importance of anticipating the demand for lighting; it may be difficult to forecast, and it wants a certain amount of courage to propose a scheme involving considerable outlay, but judging by the condition of most of the metropolitan and suburban lighting systems, it is quite apparent that the demand for electric lighting has been underrated. At Hammersmith it is proposed to lay down plant which will meet all possible requirements for the next two or three years. In order to do this, extensive additions to the existing buildings are being erected, which comprise a large boiler house capable of taking three 500-H.P. boilers, and an engine house, which is a great deal larger than the present one, and will afford accommodation for three 600-KW. sets. The end of the engine house is permanently raised, and is on a level with the street, and this will give great facilities when it is necessary to bring in the plant. There is on order at the present moment, under the extension scheme, two 600-KW. plants, which will consist of Robey engines and Siemens alternators. The main principles of these engines will be similar to the 300 KW. sets, which we have previously described. Three water-tube boilers are being put up, each of which will have a capacity of 500 H.P. Some notable changes are to be introduced in the price of current, and the charge will be based on 6d. per unit for the first hour and 3d. afterwards, this being a considerable reduction on the former method of 6d. for the first two hours and 4d. afterwards. The lighting authorities of Hammersmith are especially fortunate in having ample room for extensions, and we suppose there is hardly a station in the vicinity of London which is better provided for in this respect. Unlike many other alternating current systems, distinct encouragement is given to the use of motors on the circuits, and at the present moment there is an aggregate of 50 H.P. made up of small motors. This branch of supply has been so satisfactory that it is fully expected there will be considerable accession to the present motor load.

The Institution of Electrical Engineers at the Paris Exhibition.—It is proposed to hold a meeting of the Institution of Electrical Engineers in Paris immediately before the opening of the International Electrical Congress, and probably on August 16th, or 16th and 17th, 1900. It is further hoped that a joint meeting with the American Institute of Electrical Engineers may be arranged at that time. In order that a preliminary estimate may be formed of the number of members of all classes who will take part, the Council would be glad to receive at an early date the names of those who think it likely that they may attend.

The Cost of Electric Haulage in Mining.—The difficulty of obtaining precise data as to the economy effected by electric driving in mining work, is as great as it is in other industrial operations. It is, however, possible to obtain isolated instances which show how great the saving may be when electricity is substituted for ordinary methods of haulage. The Berwind-White Coal Mining Company, at Windber-Pa., who are the owners of extensive mines in the district which produces high grade fuel, some time ago adopted in place of the ordinary methods of haulage, electric locomotives, of the Baldwin-Westinghouse type. One mine, in particular, was formerly worked by mule haulage, combined with an ordinary rope hoist in the main heading, having a dip of 2½ per cent. over a length of some 3,000 feet. Under the old *régime*, with eight mules and eight drivers, in addition to the hoist, the output of coal per day was 200 tons, which cost to raise over £4, or 5d. per ton. Substituting, however, one Baldwin-Westinghouse locomotive, weighing about 26,000 lbs., and abandoning the hoist and mules, the output of coal was increased to 480 tons of coal, as well as a good deal of rock, and the cost per ton was actually reduced to ½d. per ton. This is a significant instance of what electricity will do under some conditions.

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The Civil Engineers' Presidential Address.—The recent initial address of the new president, Sir Douglas Fox, contains very little pertaining to electrical engineering, and generally the address was an example of the difficulty which every president must feel in preparing anything much more than a series of historical statements and comparisons. Telephone practice, we are informed, is much behind that of other countries, and, we would add, is likely to be while present exorbitant charges and indifferent service are maintained; and he foreshadows more metallic returns and automatic exchanges, and more numerous trunks, as well as proper subways for these and other mains, not omitting, we may hope, traction mains when the London County Council wakes up. Electric buried railways are not keeping pace with increase of population and traffic owing to difficulty in raising capital. The backward condition of both electric light and traction is attributed to the obstruction of vested interests and of county, district, and even parish councils. Reference is made to the fact that in New York and Brooklyn—cities of a combined population about one-third that of London—about 880 millions of people are carried annually, and decreases are only found on the non-electric overhead railways. The above is practically all that the president of the Institution of Civil Engineers could find to say on electricity and its applications. This is not his fault, but the fault of others. We omitted above any reference to one of his expressed hopes, namely, that the conduit system may be proved in the near future to be capable of being brought into practical and economical use. Clearly Sir Douglas is of opinion that what he calls the unsightly overhead system is at present the one which is practical; and we may venture to think that so practical an engineer as Sir Douglas would not have committed himself to the task of putting back the hands of the clock for London traction so many years in order to load the overburdened ratepayers with a system that he could only hope would some day be capable of being brought to a successful issue. The overhead system is successful. It may not be so nice as a successful conduit would be, but it would enable five to six million of Londoners to travel, and would put a stop on the overbearing insolence of the steam railway companies, which have been given longer life by a pseudo-socialistic County Council.

Gas-Driven Electricity Works.—Notwithstanding the theoretical advantages that would seem to be gained by the use of gas engines for electric lighting, it cannot be said that they are making much headway as regards public works. One of the most important examples in this country of gas engines for dynamo driving is that of Leyton; and though we have no authentic details as to the manner in which the plant has performed, we do not think there is any immediate likelihood of the gas engine principle being extended. Yet it must not be forgotten that the cost of fuel at Leyton per unit is one of the lowest in London. If, however, there is not any marked tendency on the part of public lighting works to adopt gas engines, it must not be overlooked that for private work they are being adopted on a somewhat large scale. Indeed, we think we are not incorrect in stating that at the famous works of the Brunner-Mond Company, gas engines of 1,000 H.P. each are being erected to drive dynamo electrical machinery; and there is an additional interest in this installation because producer gas is to be employed. One of our American contemporaries recently published a short account of an interesting gas-driven station in the town of Oerlikon; and though this instance may be familiar to some of our readers, it is worth repeating that the installation at present includes one gas-driven engine of 200 H.P., and two of 100 H.P. The current from these works is utilised for the purpose of a local tramway service. A producer gas is employed which is washed and passed through coke scrubbers and sawdust, and apparently there is no noticeable smell. The gas engines and the generators have been made by the Machinen Fabrik Deutz, the dynamos being compound four-pole continuous current machines, which generate current at 500 volts when running at 180 revolutions per minute. A battery of 280 Tudor cells is connected in parallel to the dynamos, the regulating cells being charged by a motor generator. It is stated that the coal consumption per effective horse-power is 1·4 lbs., and the cost of operating the electric line per car-mile is given as 84·6 centimes.

Coal Smoke Abatement.—We were obliged some twelve months ago to pass some strictures on the well-meaning efforts of Sir W. B. Richmond and a few other busybodies, who had taken on themselves the task of getting up prosecutions for smoke abatement. It now appears from another letter in the *Times*, following just about a year after that on which we commented, that the self-constituted society made, by means of one inspector, 1,000 observations in six parishes. They reported 530 nuisances and persuaded the Vestries to prosecute in 60 cases. They are now asking the general public to subscribe in order to secure an annual income. So far all efforts appear to have been confined to the West End, where dwell chiefly, one may suppose, the various titled and other members. The *Times* devotes a leading article to the subject, wherein some doubt is thrown on the wisdom of a committee whose zeal possibly has outrun its discretion. If some people had their way there would be no sort of manufacture possible in this country. Sir William's committee calmly intermeddle in a question of technical chemistry of great difficulty, and can do little except by the brutal method of prosecution. Smoke is a nuisance, and no one wishes it to continue, but the fires of West End drawing rooms make more smoke in the aggregate, and of a less pleasant type, than do West End manufactories. We hold that smoke inspectors ought to be duly qualified experts, able to know if the steps taken to reduce smoke are really correct. Smoke can be prevented in very many cases, but we repeat that it is the domestic fire that is the chief offender.

The Traction Experiments on the Underground Railway.—Although we do not think it the intention of either the consulting engineers or the contractors to make a secret of what is being done at the present moment on the Underground Railway in the shape of traction experiments, there has been for some reason or other a certain amount of mystery shrouding the important work that is being carried on. Travellers of an observant nature must have, for some months past, noticed the four additional rails that are to do duty as conductors for the double track between Earl's Court and High Street, Kensington, stations. To avoid, as far as possible, disturbance of the track, it has been necessary to use separate conductors for the out-going and return current; these consist of heavy channel iron rails, supported on porcelain insulators, of somewhat heavy character. Armoured cables are carried in trenches underneath the rails, and make connection at different points with the channel iron conductors. At crossings the rail is broken, and we presume connection is made underneath the rails. A temporary power house has been erected some few yards away from the platforms of the Earl's Court stations, but the entire plant is not of very considerable dimensions. Some days ago the first trial trip was made, and as far as we can ascertain, the experiment was a pronounced success. We believe, at any rate, that many of the railway officials are inclined to be enthusiastic with the results.

Give It Up?—A contemporary is responsible for the following conundrum, picked up in the tea-room of the Institution by Meteor, after the presidential address. The riddle may be propounded thus: Meteor affirms that Phodyne imagines that A declares that B denies that C asserts that D is a liar. A speaks truth once in three times, B, twice out of five times, and C three times in seven. What price D's veracity? Phodyne's specific veracity may be measured by the statement of Meteor that Phodyne says the problem is easy. Meteor's veracity is, then, the only doubtful factor in the problem. Meteor thinks the question indeterminate, owing to the variety of solutions. That's the worst of those tea-rooms!

Appointments Vacant.—The Llandudno Council wants an assistant electrical engineer for the electricity works. The Rochdale Workhouse authorities want a clerk of works (afterwards engineer-in-charge) for electric lighting plant. See "Official Notices" this week.

The Eccles Corporation invites applications for the appointment of borough electrical engineer at £200 per annum. See "Official Notices" this week.

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The Effect of Thames Water in Boilers.—Mr. C. E. Stromeyer, the chief engineer of the Manchester Steam Users' Association, writes to a contemporary saying that last year the long-continued drought was the cause of many boiler furnace collapses, as many of the feed-water supplies had become heavily charged with mineral salts. He adds:—

According to recent information, a somewhat similar experience is being passed through by those London steam users who draw their feed water from the river Thames, and I would strongly urge them to have their boiler water tested daily with a salinometer; or, better still, they should use town's water.

Formerly the drinking water which was taken from the Thames and its London tributaries, after being contaminated with sewage, but not with sea water, was again discharged into the river, not much below London, and thus kept back the sea water. Now that the sewage is being carried further away it mixes at once with sea water, and does not exert the same influence as before. As a consequence, the Thames water, even above London, is much more brackish than formerly, and boilers which for years past have been fed with Thames water without giving trouble, are all of a sudden suffering from collapsed furnaces and excessive corrosion traceable to an excess of sea salts in the water.

The American Mechanicals.—Next week, from 5th to 8th inst., the American Society of Mechanical Engineers holds its convention in New York City. Admiral G. W. Melville will deliver his presidential address. Among the papers to be read are the following:—

"The Steam Engine at the end of the Nineteenth Century," by R. H. Thurston.
"New Graphic Method of Constructing the Entropy-Temperature Diagram of a Gas or Oil Engine," by H. T. Eddy.
"Education of Machinists, Foremen, and Mechanical Engineers," by M. P. Higgins.
"Friction of Steam Packings," by C. H. Benjamin.
"Note on Fly-wheel Design," by A. J. Frith.
"A Broken Fly-wheel, and how it was Repaired," by James McBride.
"Efficiency Test of a 125-H.P. Gas Engine," by C. H. Robertson.
"The Southern Terminal at Boston," by H. J. Conant.
"The Value of a Horse-power," by G. I. Rockwood.

Personal.—At a meeting of the Bradford Corporation Electricity Committee last Friday it was decided to appoint Mr. Gibbings, the present engineer, as consultative electrical engineer at a salary of £350 a year, and to advertise for a manager at £350 a year. This action has been taken to meet the wishes of Mr. Gibbings, who has an important consultative practice.

The staff of the Wakefield Corporation Electricity Department recently presented Mr. J. K. Brydges, chief engineer, with a silver mounted dinner gong, on the occasion of his leaving Wakefield to take up an appointment at Eastbourne.

Mr. J. F. Taylor, manager of the Hartlepool Electric Tramways Company, was lately presented with a silver card salver, and Mrs. Taylor with a lady's companion, by the staff, on the occasion of Mr. Taylor's appointment as general manager of the Madras Tramways.

The new Tramways Committee of the Corporation of Newcastle-on-Tyne has appointed Mr. A. E. Rossignol, at present under the Corporation of Glasgow, to be resident engineer of the Newcastle tramways. Mr. A. W. Wheildon, engineer-in-chief of various power stations for the British Thomson-Houston Company, was next on the list.

The West Ham Council on Tuesday, the 28th ult., unanimously appointed Mr. James K. Bock borough electrical engineer.

Northern Society of Electrical Engineers.—Members have been invited to send in their nominations for seats on the Council.

The British Association.—The proposal was brought forward at Dover, and has now been urged at the Society of Arts in London, that in 1903 or 1904 the B.A. should hold its meeting at Colombo, Ceylon. We question whether many practical electrical scientists from this side would be able to spare so large a slice out of the year as this would occasion—not that their absence would greatly affect the total number of visitors present!

Cool!—A Liverpool paper says that a trust has been formed of the principal electrical fan makers in the United States. Its joint capital is $25,000,000.

Searchlights for the New York Fire Department.—The New York Fire Department is about to add a complete portable electric searchlight plant to its apparatus. The searchlight wagon will go to fires with the engines, &c., and it is believed it will add greatly to the efficiency of the force, both in saving life and property. A note in the *Scientific American* says that it resembles a fire engine in general appearance, but instead of a pump it has an engine and dynamo. There are two searchlights, each with an 18-inch lens. These will be carried on a platform behind the driver's seat. They can be used either from the platform or removed and carried to any desirable point of vantage, all communication with the generator being kept up by means of flexible cables which are insulated with rubber. The lights are provided with devices for quick regulation, so that the light may be spread out over a wide area or confined and directed to any particular point. The purpose of the apparatus will be to light up dark parts of the street and aid the firemen in laying the hose, setting ladders, &c., also to light up the front of buildings where people may be in danger, and to project light into the buildings themselves. This seems to be a step to which the British fire authorities would do well to devote attention.

The Institution Dinner.—Our readers are reminded that the annual dinner of the Institution of Electrical Engineers will be held at the Hotel Cecil on Wednesday next, December 6th, and that applications for tickets not yet submitted should be sent in at once.

Electricity in Agriculture.—*Commercial Intelligence* quotes from the *Eleckt. Zeits.* that an association of farmers in the district of Ochsenfurt (Bavaria) is erecting large electrical works near the village of Bütthard, in Lower Franconia, which will be entirely devoted to agricultural uses. The current is produced close to the village of Schäftersheim, a distance of 11 kilometres, requiring for its creation a force of about 150 H.P., which is supplied partly by steam and partly by water, and conducted as current of 5,000 volts to the villages of Bütthard, Laudenbach and others, where it finds the most varied use. Movable electromotors for driving thrashing machines, chaff cutters, bruising mills, &c., are supplied, and connecting boards for the conducting wires are placed at every farm. The motors are of very simple construction, and can be easily handled by any of the farm hands. The electric light will be widely used in all the villages named, and on account of greater security with regard to fire in the lighting of agricultural buildings it is daily increasing in use among farmers.

Electric Power for Working Dredges.—We read in the *New Zealand Mines Record* that Messrs. J. Marshall and J. Solomon, who proposes to provide electric power for working dredges in Central Otago, have been circularising the principal dredge owners bringing their scheme to notice. They propose to work the dredges on the Clutha, Kawarau, and Molyneux rivers, and they are seeking support so as to enable the scheme to take practical shape. The circular says:—

In order that the success of the scheme may be made certain, there are two initial requirements: (1) that the dredges now being built should undertake to avail of the power proposed to be created; and (2) that the projectors of the scheme should be in a position to assure the supply of same when required. These requirements in a measure somewhat hamper the flotation of a company to provide the necessary capital, but the projectors deem it absolutely essential to test the feeling of those likely to avail of the power before committing themselves to any large expense.

The promoters hold the first right to 40 Government heads of water from the Roaring Meg—the finest water-right in New Zealand—taken in at such a point as will furnish 1,200 feet vertical pressure. It is proposed to pipe the water to a site near the foot of the Meg, and there to erect electrical works; thence the power to be distributed by the usual method. Although not in a position to furnish details of cost, or price of power supplied, the promoters are assured that a large reduction can be made on the present expensive system of steam—besides, in the case of new dredges, saving a large initial cost in the way of machinery. They are in communication with electrical engineers, and on receipt of particulars of cost, &c., matters will assume a definite shape.

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Gas v. Steam Engines.—The *Mechanical World* quotes the following discussion of the relative economy of the gas and steam engine from a recent trade publication of a large manufacturer of both types. A correct answer to the question, "What is the comparative cost of operating a gas engine and a steam engine of equal power?" is stated to involve a special solution for each individual case. "Considered solely as a machine for converting the total energy of the fuel into mechanical work, the gas engine is by far the more efficient. There are gas engines in operation which transform over 25 per cent. of the heat in the fuel into useful work, while in the very best recorded performance of the steam engine barely 14 per cent. of the energy in the coal burned has been thus accounted for, and in the average steam engine plant it does not exceed 5 per cent. There are many small plants, consisting of common slide-valve engines, with uneconomical types of boilers, in which less than 2 per cent. of the energy in the coal burned is converted into mechanical work. At the same time it must be remembered that a given number of heat units in the form of fuel suitable for use in a gas engine costs more than an equal number in the shape of coal or other ordinary fuel suitable for burning in a common boiler furnace. As a general proposition it may be assumed that in a plant which operates continuously, the item of fuel alone will be somewhat greater for the gas engine than for an approved type of modern steam engine, except possibly in the case of an engine running on producer gas. Where the service is of an intermittent nature, or the power is required only for a comparatively short time each day, this difference in favour of the steam engine becomes less, and may even become a balance in favour of the gas engine, for the reason that in the gas engine plant there are no 'stand-by losses'—*i.e.*, radiation and leakage when standing idle under full steam pressure, and coal burned in banking fires and raising steam. With the gas engine the fuel expense starts and stops with the engine. But the fuel cost is only one item in the cost of producing power. One must consider the value of the additional space and buildings required for a boiler plant; the cost of a stack; labour of handling coal and ashes; cost of attendance, oil, and water; depreciation, repairs, and insurance on a boiler plant. The gas engine has a field of its own which cannot be occupied by the steam engine, and there is no immediate prospect of the gas engine seriously encroaching on the legitimate field of the steam engine." Some important considerations are here set forth very clearly and concisely.

Electric Shock Fatality.—At Messrs. Isaac Holden and Sons' Alston Works, Bradford, on Monday, last week, Edward Driver, aged 22, employed by Messrs. Collinson Bros., electricians, Aldermanbury, Bradford, was accidentally killed. The firm were fitting up a new electric installation at Messrs. Holden's, and Driver while at work on a trestle missed his footing. To save himself he seized portion of a large electric arc lamp. At the same time he apparently made a "contact" with his feet on an iron grating, and the shock which he received instantly killed him. At the inquest on Wednesday, Dr. Lodge said there was a discoloration of the right hand, but no burning. He had not known of such a case before. Mr. Gibbings, electrical engineer to the Bradford Corporation, said the highest voltage that the deceased could have received was 225, whereas, according to the Board of Trade, 500 was considered low and not dangerous. Persons had been known to receive 2,500 voltage without a fatal result, but in electricity there were latent powers concerning which they knew little. In this case the deceased's wet boots and freely perspiring body led to his being in a favourable condition for a severe shock. A verdict of "Accidental death" was returned.

The War.—Messrs. Raphael Tuck & Sons, Limited, are publishing a photogravure, after the original painting by Harry Payne, of "Sons of the Empire," for the benefit of the Mansion House Transvaal War Fund for Widows and Orphans, at prices ranging from 5s. to £5 5s. each. The entire profits on the first year's sales will be placed to the fund. The list is dedicated (by permission) to Field Marshal the Right Hon. Viscount Wolseley.

NEW COMPANIES REGISTERED.

Garston and District Tramways Company, Limited (64,238).—This company was registered on November 21st, with a capital of £5,000 in £1 shares, to apply for any Acts of Parliament, provisional orders of the Board of Trade, or other authority for the construction, maintenance, and working, with or without the use of steam, electricity, or other power, of any tramways, and to carry on the business of tramway proprietors, electricians, electrical and general engineers, manufacturers of wires, cables, lines, &c. The first subscribers (each with one share) are:—Jacob Atherton, Hurst House, Huyton, Lancs., manufacturer; George H. Nesbitt, Ashfield, Huyton, Lancs., electrical engineer; Albert E. Haptie, 5, Darham Road, Seaforth, near Liverpool, manager; Charles O. Grindrod, 11, Knowsley Road, Rock Ferry, Cheshire, gentleman; Frederick W Lintern, 22, Beaumont Street, Liverpool, book-keeper; Allen Buckley, 8, York Road, Seacombe, Cheshire, book-keeper; and H. Russell, 25, Demesne Street, Seacombe, Cheshire, book-keeper. The number of directors is not to be less than two nor more than seven; the subscribers are to appoint the first; qualification, £200; remuneration as fixed by the company.

English Electric Manufacturing Company, Limited (64,247).—This company was registered on November 21st, with a capital of £385,000 in £5 shares (37,000 preference), to carry on the business of electrical and mechanical engineers, electricians, generators, distributors, and suppliers of electricity for the purposes of light, heat and motive power, manufacturers of electrical apparatus and machinery, &c. The first subscribers (each with one share) are:—Richard H. Prestwich, 13, Marsden Square, Manchester, cotton spinner; B. Sykes, 33, Winckley Square, Preston; T. D. Lingard, 10, Booth Street, Piccadilly, Manchester, solicitor; S. H. Short, 110, Cannon Street, E.C., electrical engineer; T. S. Turnbull, 13, Spring Gardens, Manchester, solicitor; G. Flett, 110, Cannon Street, E.C., contractor; and F. O. Mott, 110, Cannon Street, E.C., clerk. The number of directors is not to be less than three nor more than seven. The first are George Flett, John Kerr, Thomas D. Lingard, Richard H. Prestwich, George Richardson, and Sidney H. Short; qualification, £1,000; remuneration, £1,250 per annum, divisible. Registered office, 13, Spring Gardens, Manchester.

SUPPLY STATION ACCOUNTS.

The Accounts of the Cheltenham Corporation.
Public lighting and private supply.

Electricity supply undertaking shows a slightly better state of affairs than in 1897, but there is still a loss on the year's working of over £1,000 after allowing for interest and sinking fund. The gross profit was over £2,100, but the sinking fund and interest payments amounted to £3,700 odd, showing a difference of over £1,100 as compared with £1,400 the previous year. The gross profit in 1897 was £1,200, and the sinking fund and interest taken together over £2,600. Thus the net loss is less by £300, the difference between an increase of £900 in gross profit and of £600 in repayments, &c.

General Statement.

	1897.	1898.	Increase.
Total capital expenditure ...	£55,691	£75,125	£19,434
Number of units sold	248,516	375,834	127,318
Number of lamps connected ...	16,140	19,000	2,860
Gross revenue	£4,010	£6,113	£2,103
Gross profit	£1,262	£2,148	£886
Average price per unit sold ...	3·84d.	3·83d.	−·01d.

The sales of current is spread over 302 consumers, while the public lighting is represented by 134 arc lamps and 13 incandescent lamps. The maximum demanded supply was 360 kw. The proportion of units is shown below:—

Units generated.	Units to street lamps.	Units to private supply.
507,830	192,712	183,122

The price per unit sold has remained practically unaltered; a slight increase is due to the greater number of sundry goods sold.

Revenue Statement.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current ..	£3,978	3·84d.	£6,007	3·83d.	−·01d.
Meter rents	2	·00d.	2	·00d.	·00d.
Supply of sundry goods	30	·03d.	104	·07d.	+·04d.
Sundry	...	...	...	...	...
Gross revenue	£4,010	3·87d.	£6,113	3·90d.	+·03d.

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The figures certainly indicate that the price charged for street lighting is abnormally low. The receipts per unit under this head amount to about 2¾d., or only about ¼d. over total works' cost. The private supply charges are 6d., 5d., 4d., and 3d., and out of a total of over £4,000 (excluding rebates) over £3,500 is obtained from the 6d. units. It is evident, therefore, that as more than half the units sold are taken by the public lighting, the loss in working is really due to the low price fixed for the street lighting.

We now turn to the costs of production. These are very moderate indeed. For a town of the size and situation of Cheltenham a works' cost of just over 2d. may be regarded as satisfactory. Coal and fuel shows an increase of nearly the fifth of a 1d., due probably to the enhanced cost of coal all over the country. Works' costs, however, have slightly fallen, and total costs have gone down by about the eighth of a 1d.

COST OF PRODUCTION.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal	£704	·68d.	£1,322	·84d.	+·16d.
Oil, waste, water, and engine room stores.	185	·18d.	269	·17d.	−·01d.
Salaries and wages incurred in generation and distribution.	1,136	1·10d.	1,316	·84d.	−·26d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	280	·27d.	528	·34d.	+·07d.
Works' cost	£2,305	2·23d.	£3,435	2·19d.	−·04d.
Rent, rates and taxes ..	93	·09d.	152	·10d.	+·01d.
Management and expenses, salaries of managing engineer, secretary, clerks, &c.	208	·20d.	236	·15d.	−·05d.
General establishment charges, stationery and printing, law charges and insurance	142	·14d.	142	·09d.	−·05d.
Other expenses	...	...	...	...	...
Total costs ...	£2,748	2·66d.	£3,965	2·53d.	−·13d.

PROFIT STATEMENT.

	1897.	1898.
Interest on loans	£1,074	£1,650
Sinking fund for repayments	1,606	1,617
Net profit carried forward	−1,418	−1,119
Gross profit	£1,262	£2,148

CITY NOTES.

Aron Electricity Meter, Limited.

THE report of the directors reads:—"The directors have the pleasure to submit the first accounts of the company, duly audited, for the term of one year and nine months ending September 30th, 1899. The balance to credit of profit and loss amounts to £26,107 9s. 2d., out of which the sum of £9,829 19s. 5d. (less £2,316 1s. 11d. cost of establishing the Schweidnitz Factory), amounting to £7,513 17s. 6d., representing the net profit for the nine months prior to the formation of the company, will be put to a reserve account. This leaves a balance of £16,277 9s. 9d., out of which the interim dividend on the preference shares was paid, amounting to £2,509 18s. 8d., leaving the sum of £13,767 11s. 1d. The directors are much encouraged by the result of their work, as shown in the profit and loss account of the last nine months, the period during which they have been in actual charge of the company. The small decrease of profits during the first part of 1898 is explained principally by the necessity of having had to change over from the supply of the old type to the new type meter, which caused a temporary decrease in sales. The directors propose to deal with the available profits as follows:—To pay a dividend at the rate of 6 per cent. per annum on the preference shares for the six months ending September 30th, 1899, absorbing £3,750; and further, to pay a dividend at the rate of 6 per cent. per annum for the year ending September 30th last on the ordinary shares, absorbing £7,500, leaving a balance to be put to reserve of £2,517 11s. 1d. The prospects of the company's business are very bright, and the meter is gaining in favour both in Great Britain and on the Continent. To meet this growing demand, steps are being taken by the board to considerably increase the output of the factories. The directors' anticipations as to the value of patents in foreign countries have so far been realised, that they have effected the sale of the American patents on satisfactory terms. The London Stock Exchange require alteration in Section 78 of the Articles of Association, and a resolution will be submitted to give effect to this. Messrs. Price, Waterhouse & Co., who have acted hitherto as auditors of the company, offer themselves for election."

SIR JAMES PENDER, Bart., M.P., presided on Thursday last week at Winchester House, over the second ordinary general meeting of the shareholders of the above company.

In moving the adoption of the report, the CHAIRMAN said that it required a few words of comment on his part, because it was the first meeting they had had since the formation of the company, and the accounts covered a period of 21 months. He thought they had every reason to congratulate themselves on the result of the working of the business up to date. In the prospectus the statement was made that the highest profits ever made by the company were in 1897, and they were given as £18,550, exclusive of any allowance to Dr. Aron. In dealing with the profit and loss account of 1898, the profit was nearly at the same rate, viz., £17,731, and the slight check to the business was easily accounted for by the charges which necessarily had to occur with the transference of the business from a private concern to a company. Another fact was that up to the beginning of 1898, the bulk of the profits derived by Dr. Aron were made out of the old type clockwork meter, and when the new type meter was brought to the front, Continental engineers suddenly stopped ordering the old type meter in large quantities, and gave orders for samples of the new type, and that for some time caused a decrease in the returns of the German business, which the rapid increase in the English and Austrian business could not quite balance. With regard to the profit and loss account for the past nine months, during which period the directors had been responsible for the working of the business, it proved the business to be an unqualified success. They had, in those nine months, made a trade profit of £18,391, which practically meant an increase of 25 per cent. on the very best year mentioned in the prospectus, and this profit would probably have been much greater but for some difficulties which they had encountered. To meet the growing demand for the new type meter they had had to considerably increase their staff and tools and stock. Their efforts had been so far successful, as was proved by the figures of the past few months. But the coming year would, of course, reap the bulk of the benefit of this re-organisation. He was glad to say that at the present moment the rate of taking orders was progressing from month to month, and they had not lost a single central station that had taken their meters, while they were getting new ones every day from every part of Europe. Owing to the arrangements they had made, in the next 12 months they would not only be able to cope with new orders, but also to execute orders in arrears. It would be seen by the accounts that a good sum had been placed to reserve, and further, they would see that arrangements had been made for the sale of the American patents, which would increase their assets by about £9,000 in cash and £33,000 in shares. They considered the business in America to be important, not only on account of the profit-earning capacity there, but also on account of the novel effect which it would have in their favour if they competed successfully with the present American meters in their own home. It was hoped that they would be equally successful in due course in disposing of their patents in other countries, and thus create a large reserve, without unduly trenching on their trading profits.

Mr. R. W. WALLACE, Q.C., seconded the resolution, and in doing so, said that very often difficulties arose in the formation of companies by the exaggerated statements of the vendors, but in the case of that company they had met with unqualified support from Dr. Aron and Mr. Guthrie and the statements these gentlemen had made were not exaggerated in the slightest degree. Dr. Aron was not neglecting the business now he had sold it, but with his great intelligence and skill was endeavouring to add to the value of the property. With regard to the question of why they manufactured these things so much abroad, he might say that it was very difficult to get clockwork made in England, and Schwerdmeis was the best seat of manufacture of the particular kind of works they required.

Replying to Mr. HOWARD, the CHAIRMAN said that if the American company was a great success their interest in it would be much more valuable than now appeared. The contract had been actually signed. The board were considering the question of what could be done to work the patent in France.

The motion was then carried, and a dividend at the rate of 6 per cent. on the ordinary shares was agreed to.

An extraordinary meeting was then held to make a slight alteration in the articles of association.

The Blackheath and Greenwich District Electric Light Company, Limited.

THE third ordinary general meeting of this company, held at Cannon Street Hotel on Friday last, was presided over by Sir John Wilcox, M.P.

The CHAIRMAN said that the document before them covered a period from May 11th, 1896, to September 30th, 1899. That was the period during which the company had been in existence, but the present board had been controlling the company's affairs for little more than a year during that time. They had endeavoured to carry out the Parliamentary rights for Blackheath and Greenwich districts, and he hoped the shareholders would see that they had lost little time in the prosecution of the work. It was not wise to unduly hurry engineering works and cable-laying operations of this kind. They aimed rather at making progress with discretion, and securing a substantial and reliable installation. The expenditure reached an aggregate of £84,000, the great part of which had been expended upon buildings, plant, land, and the works generally, which are now nearly completed. He thought they might claim unprecedented rapidity of work, in that within a year of the beginning of construction work they had actually commenced the supply of current. It had been a borrowed light, and he was afraid, from what they heard, it had not in all respects been as satisfactory as they would wish, but he hoped that the blame of a flickering and unsteady light would not be imputed to the Blackheath and Greenwich Company. It was not their failure, and he hoped their consumers would not judge them by present experience, but

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have a little more patience. He thought they would be able to show that they had established a system at once reliable and efficient. He referred at some length to the constitution of the board, and the special qualifications of several of the directors, one being connected with one of the most successful London supply companies, and another, the chairman of a municipal committee, which has the credit of establishing one of the very best and most successful electrical installations within the metropolitan area. Another director had acted with a large West End electricity company, and had had a very large experience in the administrative and practical departments of this business. Those three gentlemen had placed their knowledge freely at the service of the board, and their assistance, support, and guidance had been such as fees could not themselves have secured from practical consulting engineers. He attributed the rapid progress made in the completion of the works to that cause. The works, both as regards productive power of the plant and efficiency of the distributing media of the cables and connecting wires, would be efficient and stable. He could not fix upon a date when the generating station would be in operation. The machinery was, to a large extent, already completed, but some parts had not yet been tried. In a very short time they would be supplying current from their own works. It would be an assurance of substantial and continuing business to know that up to October 31st last practically 7,000 lamps of 8 C.P. had been ordered, and that nearly half that number had actually been connected with the company's mains. Since then there had been a further increase of applications, and the little hesitation that now obtains in the district will at once disappear when possible users discover that they can obtain a good and efficient supply of light. There were several applications for motor power, which promised to be especially advantageous to the company, from the fact that it would give employment to the plant in the day time, when the machinery is not wanted for lighting. In addition to the 40 H.P. applied for, they were negotiating with other applicants representing at least double that amount already. The company was formed for supplying Blackheath and Greenwich, and it was regarded as being of a substantial and hopeful character, but they had since applied to Parliament for an extension of area, with the result that they now had a considerably larger area than they originally possessed. Some parts of the new district were not at present covered very densely with population, but the possibilities of extension in London, especially with an expanding system of locomotion, there was every assurance that that district, now sparsely peopled, would become very populous, and therefore very profitable to the company. He hoped this would prove profitable to the investors hereafter. They had also succeeded in excluding poachers from their district. Two attempts to invade their territory had been resisted. Not that they would have feared competition, but competition should be avoided in works of this kind, if it could be. It was thought by some that the meeting had been unduly postponed, but the board had little to report while the works were in progress, and there was little use in holding meetings until they had arrived at a definite stage in their work. He moved that the report be adopted.

Mr. Ernest Hill seconded the adoption of the report, and thought the directors had taken high fees (£1,409) for a company with a £100,000 capital, especially considering that the chance of getting dividends was somewhat remote.

Mr. Horace Boot, borough electrical engineer at Tunbridge Wells, proceeded to make a lengthy criticism of the report and the undertaking in general, but he said that his remarks were intended to improve, and if possible, to help the company in the future; and he asked them to accept them as such. He was not in any way anxious to "upset the show." He felt that they had a valuable area asset, and they ought to make the best of it, but if they were going to water it or play with it, no company under the sun could be anything less than a failure. Mr. Boot said he was more or less of an expert understanding the matters to which he referred. He asked, firstly, the number of free-wire consumers, as against the ordinary consumers; secondly, he found that the lamps applied and connected differed very considerably, and half the revenue that they might have earned was apparently lost, and he would like some explanation. Would the chairman kindly tell him the capacity of the proposed generating plant in kilowatts, as it was only stated as so many 8-C.P. lamps? He was anxious to get this statement for the purpose of verifying Messrs. Kincaid, Waller & Manville's report, where it was worked out at £97 10s. per kilowatt installed. He asked the price paid by the company for the temporary supply of current and the price paid to them by consumers. He would rather give no supply at all than a bad one. It would harm and ruin the company's interests for the next five years. It was generally known in the Blackheath district that they were obtaining a temporary supply from a company whose pressure every night gave consumers not more than red-hot hairpins. A circular ought to be sent to their consumers explaining the matter. As to the extension of area, he congratulated the board, and he also said that it was their duty to promote or supply light railways worked electrically. That part of a business was more profitable than the lighting branch, if prices were arranged correctly. As to the motors applied for (40 H.P.), he said that motors were by no means a blessing to a company, and the smaller the company the bigger the curse they were. They upset the pressure of supply, and necessitated running a very large engine during the day to keep the pressure steady, which meant a great waste of coal for perhaps only 40 H.P. That might right itself, but he did not look upon 40 H.P. as of any good whatever as a revenue-earning capacity. After referring to what he considered the high directors' fees, £288 per director, and suggesting that they each, for the present, take £50, he remarked that he believed that the resident engineer, who was responsible for doing the whole of their work, was receiving less salary than each of the directors. In regard to capital outlay, they, at Tunbridge Wells, had made more or less of a record, and their magnificent buildings, offices, engine room, boiler house, &c., cost something like £6,000, and up to date they had a revenue of £9,000 to £10,000. The Blackheath Company, so far, had spent £17,818 upon buildings, and he compared the two figures which made those of the company appear to him as very excessive. Were there any engineers' certificates still to be passed under that head? Why were alterations to the new offices necessary at the cost of £100? Directors' names ought to be submitted to the shareholders before there were elected. Could they not get some approximate date as to supply? He asked the directors in future reports to give more working details. He was particularly interested in those details, because it enabled him to put his finger upon the weak points, and he was anxious to see his shares at a high price, and he was anxious to eradicate the weak points.

Mr. Snape (a large original shareholder) said Mr. Boot was somewhat pessimistic—he would not say hypercritical—in his criticisms. He was the engineer at Tunbridge Wells, he believed, and it might be that "two of a trade did not agree." His objection to the report that instead of stating in kilowatts, the statement had been made in candle-power only, was hypercritical, because he could easily make a simple calculation. He did not know whether it would have been policy for the company to have refused to give temporary supply of light until the works were finished. They were not to blame if the light was a bad one. He would emphasise the necessity of considering the desirability of supplying, not merely the large consumers, but the multitude. Had the board considered the effect of third class passengers on railway revenues, and the working class on gas consumption. If not, they would be astounded by the results obtained by catering for the multitude. They were better than catering for the large consumer. Was there sufficient space in the buildings for enlargement of plant when the increased demand from the new areas came along? If the resident engineer was not being paid sufficiently well, pay him better. He must see that the work was going on as well as the consulting engineer had planned it. Would the chairman give an approximate date for supply, so that they might be able to tell when they are likely to be paying dividends? He considered that the hard work of the board was at the initial stage when the business and works were being established, and they were not justified in complaining at the amount charged for fees.

The Chairman said the board did not resent criticism, but, on the other hand, he thought that the points raised would be found to be not weak points at all, but really strong points in their favour. No doubt there was a disparity between the lamps connected and the lamps ordered, but there was no urgent need for connecting them until the mains were in a position to supply light, and Mr. Boot's own argument was their best justification that they should not put in lamps to houses, while they had an uncertain and inefficient supply. The present plant in kilowatts which they are now providing will represent about 750 KW., including spare. On the question of buildings, it was hardly fair to compare work of this kind, necessarily expensive, with the works adapted to a place like Tunbridge Wells, which would be to a large extent fixed and the requirements known. They had set up plant sufficient for present needs, and had also spent a considerable sum in providing larger premises than would otherwise be immediately required, and the chimney would serve a generating station of double the size. For the temporary supply they paid 4d. and received 6d. per unit. The board realised the importance of the income from a day-time power supply. After further remarks showing that the small consumer was being well catered for, he said he thought they might be able to commence supply within a month. The knowledge and work which had been brought to bear upon the business by the directors quite warranted the fees charged, but whether the fees were adequate or the reverse they were fixed by the articles.

The resolution was carried unanimously.

Messrs. Chalmers, Wade & Co. were elected auditors, and the usual vote of thanks closed the meeting.

Renewable Electric Lamp Company.

The statutory meeting of this company was held on 22nd ult. at the offices, 11, Charing Cross Road, W.C., Mr. Jacob Atherton, presiding. No notice of the meeting seems to have been given to ourselves or to other electrical journals, therefore we have to depend upon reports appearing in the financial papers for the following particulars of the proceedings:—

The Chairman described the nature of the operations that have taken place during the last four months. The directors took into serious consideration the question of the location of the works. Works for a business of this nature are indispensable. First of all, they must be able to produce a first-class article, as that article had to be dealt with so many times over; that is to say, a lamp made under the company's patents has to be renewed time after time, and from that point of view it is absolutely necessary to make a first-class article. The directors took considerable trouble in finding a suitable site, but at last found one at Brunswick Place, City Road, Shoreditch. They took the advice of an expert lamp maker, a man who had been connected with this business for the greater portion of his lifetime, and he confirmed the impression made on their minds that this was the most suitable place for the works, and expressed the opinion that they were capable of taking in machinery for the supply of about 10,000 lamps per day. They had taken the buildings on a very favourable lease, having 50 years to run, at a moderate rent, and had the option of buying the ground rent any time during the first seven years at a price of £4,000. The directors would have to decide later as to the expediency of buying it. They had appointed a first-class lamp maker to take charge of the works on moderate terms. They had appointed a general manager to look after the commercial side of the question, and he has gone so far as to lay out the works

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for equipment with the most modern machinery for producing lamps, so that they were in every sense of the word, an up-to-date lamp manufacturing company. They had the benefit of the experience of their managing director, who has been connected with the electrical industry for a great many years, and, perhaps, with one of the most successful supplying stations in London. Their expert advised them that they would be in a position to turn out lamps in fairly large quantities within three months from the present time. In the meantime they had made an engagement with a friendly English lamp manufacturing company to supply 2,000 lamps per week, in order that they might furnish the various supply stations, companies, hotels, clubs, and very large consumers of lamps with small parcels, in order to give them some practical experience pending the time that the lamp works are fully equipped at Shoreditch. Important large contracts have been entered into with large public bodies in various parts of the country and in London. They had, in fact, more orders than they could execute at the present time, and many large buyers are waiting for the time when they could give deliveries. The chairman said: "It is now customary for supply companies to include our lamp in the price of their supply of current, and in the near future it is expected that our business will be done with these public companies, who are anxiously looking forward to an efficient lamp at a moderate price, and one that can be renewed over and over again. In other words, it is intended that this company shall do for electric consumers what the Welsbach mantle has done for gas consumers. I do not think I can say anything further." When our annual meeting takes place we shall be able to present a fair and satisfactory report.

Prospectus.

In our advertisement pages to-day will be found the prospectus of the Electrolytic Alkali Company, Limited ("Hargreaves-Bird" process.) An article regarding the process will be found in our issue for last week and also that for August 5th, 1898, and some further notes by Mr. Kershaw appear on another page this week. The list of subscriptions opens on Tuesday next, December 5th, and closes on Thursday, 7th. The capital is £300,000, divided into 200,000 7 per cent. cumulative preference £1 shares and 300,000 £1 ordinary shares. The present issue is for £300,000, of which £200,000 will be available for the purchase of land and erection of works and plant, and for working capital, &c.; 50,000 ordinary shares are reserved as part of the consideration to be paid to the parent company, and £100,000 preference and £150,000 ordinary are offered to the public. The prospectus gives copies of reports by chemical and patent experts and accountants. The parent company, who are the promoters, receive £100,000 in cash and shares for the United Kingdom patents, and for the land, &c., at Middlewich £15,000 in cash is payable. Applications may be obtained from the secretary (*pro tem.*) of the company, Mr. James Barron, Farnworth, Widnes, Lancs., and from the bankers, solicitors, and auditors.

Stock Exchange Notices.—The Stock Exchange Committee have (1) appointed special settling days as under:—Wednesday, December 6th—Metropolitan Electric Supply Company, Limited—125,000 3½ per cent. mortgage debenture stock. And (2) ordered the undermentioned securities to be quoted in the Official List:—County of London and Brush Provincial Electric Lighting Company, Limited—£200,000 4½ per cent. debenture stock in lieu of the provisional certificates now quoted; Metropolitan Electric Supply Company, Limited—£125,000 3½ per cent. mortgage debenture stock.

Electrical Undertakings, Limited.—Another meeting of this company was held on Tuesday at Winchester House, E.C., and our representative was again refused admission, as the proceedings were stated to be private.

Meeting.—A meeting of the Cape Electric Tramways Company was held yesterday afternoon. A report will appear next week.

TRAFFIC RECEIPTS.

The Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending November 25th, 1899, were £159 19s. 7d.; November 25th, 1898, £139 14s. 7d.; aggregate for half-year to date, £19,575 17s. 0d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending November 24th, 1899, were £2,650 5s. 9d.; corresponding period, 1898, £2,454 17s. 6d.; increase, £195 8s. 3d.

The City and South London Railway Company.—The receipts for the week ending November 26th, 1899, were £1,085; November 27th, 1898, £1,114; decrease £79. Total receipts for half-year, 1899, £21,488; total receipts corresponding period, 1898, £21,518; decrease, £30. Miles open, 3¼.

The Dover Corporation Tramways.—The receipts for the week ending November 25th, 1899, were £158 4s. 0d.; November 26th, 1898, £133 14s. 1d.; increase, £24 9s. 11d. Total receipts to date, 1899, £9,308 8s. 11d.; corresponding period, 1898, £7,786 7s. 10d.; increase, £1,521 16s. 1d. Miles of track open, 1899, 3; 1898, 2. Car miles run, 1899, 4,791; 1898, 4,371. Number of cars, 1899, 11; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, November 24th, 1899, were as follows:—D. U. T. Co., horse cars, £169 19s. 2d.; ditto, electric cars, £2,726 14s. 8d.; D. S. D. Co., electric cars, £674 9s. 2d.; total, £3,571 3s. 0d.; corresponding week last year—D. U. T. Co., horse cars, £2,042 5s. 11d.; ditto, electric cars, £432 1s. 10d.; D. S. D. Co., electric cars, £572 2s. 2d.; total, £3,036 9s. 11d.; increase, £534 13s. 1d. Aggregate to date, £89,241 13s. 10d.; aggregate to date last year, £85,249 1s. 8d.; increase to date, £3,992 12s. 2d. Worked:—The mileage open is 39 miles electrically, 5 miles by horses, as against 16 miles electrically, and 26 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending November 26th, 1899, were £575; November 30th, 1898, £309; Increase, £266. Number of cars, 1899, 28; 1898, 10. Total receipts to date, from April 1st, 1899, £20,620; 1898, from June 29th, 1898, £5,881. Miles of track open, 12; 1898, 3¼.

The Liverpool Overhead Railway Company.—The receipts for the week ending November 26th, 1899, amounted to £1,477; corresponding week last year, £1,317; increase, £160 Total receipts for half-year ending November 26th, 1899, £35,789; corresponding period last year, £34,355; increase, £1,388.

The South Staffordshire Tramways Company.—The receipts for week ending November 24th, 1899, were £529 5s. 7d.; November 25th, 1898, £559 13s. 1d.; aggregate receipts for 47 weeks £31,279 2s. 4d.; 1898, £29,739 2s. 1d.

STOCKS AND SHARES.

Wednesday Evening.

The Stock Exchange has been in one of its pessimistic moods for the past week, and prices in every department have suffered more or less. The principal cause of the trouble has been, and still is, the stringency existing in the money market. As we have remarked in an earlier issue, investors will not buy securities which only return them 4 per cent. or thereabouts, at a time when money can be lent upon excellent security to the Stock Exchange at 6 or even 7 per cent. This week has seen a slight decline in prices of the Electrical Supply section; Westminsters and St. James's are the principal losers, but Metropolitans have also weakened. The late action of the company at Willesden is the subject of a good deal of market comment, but the irritation is not likely to impress itself on anybody's mind. The old shares and the new are now the same price, and both can be bought at about 15. Charing Cross new are 10 middle.

Some attention is being directed to the marvellous progress which Germany is making with regard to electrical work, and suggestions are in the air as to the advisability of one of the principal British Companies opening a branch in the Fatherland, but no step has yet been made in this direction.

The telegraph market is quiet. Easterns are scarcely moving, nor did the price change at the announcement of the company's having successfully completed and opened a section of its third cable to South Africa on Monday last. Communication with the Cape and Natal has again been delayed owing to the now familiar "breakdown on the line," and the two incidents neutralised each other so far as the Stock Exchange is concerned. Anglo-American varieties present very little alteration, but Submarine Cables Trust stock is down 2 per cent. This, of course, is due to the new issue which is to be made, particulars of which we gave a week ago. Brasilian Submarines are considered a good investment in the market. The price is now 15½, at which a purchaser gets 4 per cent. and a trifle more, upon his money, assuming that the usual 7 per cent. dividend is maintained. We must say, however, that the outlook for Brasil herself during the next few years is not particularly encouraging, and the prosperity of the Brasilian Submarine is naturally largely dependent upon the state of affairs in "the land where the nuts come from."

Prices of electrical railway stocks are in no way affected by the columns of Parliamentary Bills relating to this branch of traction which are to be presented next session. Among the notices are several applications for an extension of time for building, as in the case of the Brompton and Piccadilly, the Charing Cross and Euston, and the Baker Street and Waterloo lines. This will no doubt occasion some little disappointment to those financially interested in the various schemes, but that an extension would be inevitable has been patent now for some considerable time. There are several ambitious projects for electric railways in different parts of the kingdom, and it seems probable that the idea will be hugely developed in the new century. One of the lines talked about is that which, it is said, Mr. Carnegie and a syndicate are going to build from Croydon to Brighton. These are, of course, early days to express any kind of opinion as to the likelihood of such a line being successful, but the idea is not a new one, by any means. London and Brighton stock has been weak upon fears that the contemplated electric railway will be a severe competitor, but such anticipations are more premature than intelligent.

British Electric Traction do not move, but the market is not a very good one. The old Preference have shed another ¼ for the reasons connected with the new issue to which we referred last week.

Henley's have recovered their former position in the Official List, both Ordinary and Preference reappearing. The former are 13¼, while the Preference hover around about 5½.

National Telephone issues are harder, and already dividend forecasts are being whispered. The ordinary shares are ⅛ better, and the Third Preference have also been bought. Business in them, however, is very quiet.

From New York comes intelligence of a gigantic Trust that has been formed of the United States electrical fanmakers. The new combine, it is said, will start with a share capital of five millions sterling. We should have thought that after her recent experiences in this direction, America would have eschewed "Trusts" for some considerable time.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Nov. 22nd.	Closing Quotation, Nov. 29th.	Business done during week ended Nov. 29th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	66 — 69	66 — 69	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	117 —118	117 —118	117⅞	116¾
3,047,220£	Do. do. Deferred	Stock	...	...	18s. %	17⅜— 18¼	17½— 18	18⅛	17⅝
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15½— 15¾	15 — 15½	15½	15⅜
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	198 —202	198 —202	...	...
1,262,528£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	103 —105	103 —105	104½	...
224,250	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20 xd	19 — 20	...	...
12,961	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
20,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½ %	3½ %	12 — 12½	11⅝— 12¼	12	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101 —104	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½ %	7 %	7 %	158 —163	156 —161	162	158
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	99 —102	99 —102	100½	99½
89,900	Do. 5 % Debs., repayable August, 1899	100	5 %	5 %	...	... ...	... ...	...	...
1,422,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	117 —122	117 —122	...	...
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	15½— 16	15½— 16	16	15 13/16
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,040, 3,976—4,336	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,337—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
350,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	118 —123	118 —123	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,800£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—3,000	25	4 %	...	...	101—104% xd	101 —104%	101	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5½ %	11¼— 11⅝	11¼— 11⅝	11⅛	11⅛
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15½— 16	15½— 16	15 3/16	15 1/16
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	10 %	...	81 — 83	81 — 83	...	...
89,500	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,900, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	48½	48
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000	1	...	...	...	¼— ⅜	¼— ⅜	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	5 — 5½	5 — 5½	5 7/16	5⅛
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5½	5¼— 5½	...	...
1,289,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —102	100 —102	...	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	¾— 1	¾— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	...	103 —106	103 —106	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
8,261	Submarine Cables Trust	Cert.	...	...	...	130 —135	128 —133	130	...
88,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5½	4¾— 5½	...	...
151,788£	Do. do. 5 % Debs.	Stock	...	..	...	105 —108	105 —108	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	%	...	99 —102	99 —102	...	...
20,008	West Coast of America, Nos. 1—20,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	103 —105	103 —105	...	...
389,531	Western and Brazilian Telegraph 4 % Deb. Stock Red.	Stock	...	...	...	104 —107	104 —107	...	...
88,321	West India and Panama Telegraph	10	1 %	%	...	1 — 1½	1 — 1½	1⅛	1
84,868	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	10½— 10⅝	10 — 10⅛	...	...
4,689	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	9 — 10	8 — 9	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,600	100	5 %	5 %	...	105 —108	106 —109	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7½— 8½	7½— 8½	...	...
12,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	...	9 — 10	9 — 10	...	...
30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	10 — 11	10⅜	10⅜
20,000	Do. do. do. do. Nos. 30,001—50,000	5	...	...	...	...	9½— 10½	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅜— 6¼	5⅜— 6¼	...	...
84,000	*Chelsea Electricity Supply, Ord.,	5	5 %	6 %	6 %	8 — 9	8 — 9	8¼	8⅛
100,000	Do. do. do. % Deb. Stock Red.	Stock	4½ %	4½ %	...	111 —113	111 —113	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000	10	7 %	10 %	6 %	11½— 12⅛	11½— 12	12¼	11⅞
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 14	13 — 14	13⅝	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	126½	126
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10½— 11½	10½— 11½	11	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	13½	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	...	111 —114	111 — 114	112¾	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5½	5 — 5½	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	3 — 3½	2½— 3½	3 7/16	3 1/16
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6 — 6½	6 — 6½	6⅜	6 1/16
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	105½	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	15 — 16	14½— 15½	15⅝	15
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14½— 15½	14½— 15½	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½— 16½	15½— 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	16 — 17	15½— 16½	16½	16
30,000	Do. do. 7 % Pref., 20,061 to 40,060	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord., £4 paid	5	...	...	...	3½— 3¾	3½— 3¾	3 5/16	3½
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	9 %	12 %	12 %	14½—15½	14 — 15	14½	14

* Subject to Founder's Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

† Quotations on Liverpool Stock Exchange.
‖ Dividends paid in deferred share warrants, profits being used as capital

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Nov. 22nd.	Closing Quotation Nov. 29th.	Business done during week ended Nov. 29th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2⅜— 3¼	2⅜— 3¼	3	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
80,000	British Electric Traction	10	...	...	6 %	16½— 17	16½— 17	17	...
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13½— 13⅝	13 — 13⅛	13⅜	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11½— 12½	11½— 12½	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6⅝	6½— 6⅝	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅞— 2⅛	1⅞— 2⅛	1⅞	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	2 5/16	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —115	110 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13 — 14	13 — 14	...	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	...	5½— 6	5 1/16	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	113 —116	113 —116	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10⅛— 10⅜	10⅛— 10⅜	10⅜	10⅜
178,308	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,083	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5½	4⅜— 5½	5	..
71,447	Do. do. Def. do.	5	...	...	...	5½— 5⅝	5½— 5⅝	5 7/16	5⅝
630,000£	City and South London Railway	Stock	1 1/16 %	1⅛ %	2⅛ %	63 — 66	63 — 66	64	63
37,000	Do. do. Ord. shares, Nos. 22,501 to 60,000	4½	...	...	...	...	3½— 4½	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4½	3½— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5½ %	6 %	6 %	2 — 2⅛	2 — 2⅛	...	...
17,189	Do. do. do. "A" Shares, 01—017,189	5	5½ %	6 %	6 %	3½— 4½	3½— 4½	4⅛	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2 — 2¼	2 — 2¼	2 3/16	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	3 — 3½	2⅞— 3⅛	3	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	104 —107	104 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	½— ½	½ — ½	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	10 %	12 %	14 %	...	13 — 14	...	...
6,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	7 %	...	5½— 5⅝	5⅝	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	...	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3½ %	3½ %	9 — 9½	8⅝— 9	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½— 13⅝	13½— 13⅝	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	37 — 41	...	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9½— 9⅝	9 — 10	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	101 —104	...	...

† Quotations on Liverpool Stock Exchange. ‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10
Brompton and Kensington, 4½% Debentures of £100, 105—108.
National Electric Free Wiring, 10s. paid, 5s.—7s.
Oldham, Ashton, and Hyde Electric, Ord., 19—19½.
Do. do. Pref., 10⅞—10⅞.
Smithfield Market Electric, 1—3.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6%, £5 (fully paid), 7½—7¾. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
Kidderminster and District Electric, Pref., 6—6½ x d.
*T. Parker, £10 (fully paid), 18⅜.

* From Birmingham Share List.

Bank rate of discount 5 per cent. (October 5th, 1899).

MARKET QUOTATIONS, Wednesday, November 29th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	32/-	32/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) .. per ton	£29	£29	..
a „ „ .. .. per ton	£27	£27	..
a Bleaching powder .. .. per ton	£6 10	£6 1	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25 10	£25 10	..
a Lead, Nitrate .. .. .. per ton	£25	£25	..
a „ White Sugar .. .. per ton	£31	£31	..
a „ Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks .. per lb.	3¼d.	3¼d.	..
a „ Caustic (75/80 %) .. per ton	£34	£34	..
a „ Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£8	£6	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
Crystals .. .. .. per ton	£8	£8	..
a „ Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£224	£224	..
b „ Sheet, in ton lots .. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 3" to 15") basis per lb.	8½d.	8½d.	..
c „ Tube (brazed) .. .. per lb.	10d.	10d.	..
c „ Wire, basis .. .. per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	3/-	3/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£85	£85	..
g „ Wire (basis price) .. per lb.	10½d.	10½d.	..
g „ Sheet .. .. .. per ton	£85	£85	..
g „ Rod .. .. .. per ton	£85	£85	..
m German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	7/-	7/-	..
h India-rubber, Para fine .. per lb.	4/6½ to 4/7½	4/5 to 4/7	inc.
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) per ton	69/1½	69/10d.	8½d. dec.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£14 5	£14 5	..
g Lead, English Ingot .. .. per ton	£17 12 6	£17 12 6	..
g „ „ Sheet .. .. per ton	£18 16	£18 16	..
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£9 10	£9 10	..
d Mica (in original cases), small per lb.	2d. to 8d.	2d. to 8d.	..
d „ „ „ medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large per lb.	3/6 to 7/6	3/6 to 7/6	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd str'p & sheet per lb.	From 1/2½	From 1/2¾	..
o Platinum .. .. per oz.	£8 11	£8 11	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/1	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£59	£58	..
g Tin, block .. .. per ton	1 9 1)	£132 10	£3 dec.
g „ foil .. .. per lb.	1/6	1/6	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/11	1/11	..
p White Anti-friction Metals—			
"White Ant" brand .. per ton	£40 to £70	£40 to £70	..
f Yarns, Cotton, Single 10lb. bundles per lb	7¾d.	7¾d.	..
f „ Best Flax, 6 lea. .. per lb.	5d.	5d.	..
f „ Hemp, 8 ply 10 lbs. .. per lb.	3¾d.	3¾d.	..
f „ „ Russian, 10 lbs. per lb	4¾d.	4¾d.	..
f „ Jute, 180 lbs. rove .. per ton	£14	£14	..
k Zinc, Sheet (Vielle Montagne bnd.) p.s	£26	£26	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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INSTITUTION OF ELECTRICAL ENGINEERS.

PRESIDENTIAL ADDRESS

By Prof. Silvanus P. Thompson, D.Sc., F.R.S., President.

(*Delivered Thursday, November 16th.*)

(*Concluded from page* 833.)

Passing from the generation of current to its utilisation for electric traction, the most notable evolution now in progress is that of the application of electric power to heavy railways. The application to street railroads—in other words to mere tramways—has been an accomplished fact for ten years on the other side of the Atlantic, where there are now thousands of miles of electric tramways, mostly operated from overhead lines from which the current is taken by a contact trolley wheel. If in this country the development of electric tramways has been slower, we have at least the advantage that our cities are not disfigured by networks of overhead trolley lines. No such objections hold good for rural districts, and slowly but surely both the industrial and agricultural districts of England are being furnished with electric intercommunication with its many attendant advantages. It may come as a surprise to many who think England behindhand in this respect, when they learn that while the total subscribed capital invested in this country in 1899 for public electric supply is about £17,800,000, no less than £20,800,000 is already invested in electric traction. Of the effect of the introduction of electric traction as a social and economic factor I have spoken elsewhere. There can be no question of the immense social benefit, particularly to the artisan population, afforded by this means. But the electrical engineer is now engaged on the still greater problem of operating heavy railways, and the development in this branch is being watched with keen interest. The two deep level railways in London, the City and South London Railway and the Waterloo and City Railway, both of which have amply justified their promoters, are shortly to be supplemented by the Central London Electric Railway, an undertaking of much greater magnitude, while several other similar schemes are either under construction or authorised. In the City and South London Railway the rolling stock is designed for separate electric locomotives, each drawing three passenger cars. The gauge is 4 feet 8½ inches. On the Waterloo and City line the trains consist each of four cars, of which the two end ones are fitted with motors, four motors on each terminal car, so that the train can be driven by either set of four motors. Each train can carry 204 passengers. The gauge is 4 feet 8½ inches, but owing to the size of the tunnel, ordinary railway rolling stock could not be used. In the Central London line the gauge is also 4 feet 8½ inches. The locomotives, each with four gearless motors, weigh 35 tons each. Each will draw a train of seven cars, with a seating capacity of 336 persons per train. The total length, including sidings and cross-over lines, exceeds 8 miles of double track.

In all three of these railways the current is taken from a third rail on the surface, and the return circuit is through the ordinary rails, which, for this purpose, are bonded with copper bonds. All these lines are operated by continuous currents at 400 to 500 volts. In the case of the Central London line, part of the feeding is effected through rotatory converters which receive three-phase currents from step-down transformers.

In sharp contrast to these three London undertakings is the Burgdorf-Thun railway in Switzerland, which was opened in July last. It is in every sense of the word a full-gauge railway. Not only is its rolling stock full gauge (the full gauge of Switzerland is 4 feet 8½ inches), but the railway admits of use by ordinary steam locomotives, drawing ordinary trains. The electric rolling stock is of two kinds—automobile cars carrying 66 passengers each, for use singly or in pairs, and locomotives of 300 H.P. each, for drawing trains of ordinary carriages or goods wagons. This railway is worked by alternating currents supplied in three phases, at 750 volts, the feeding being effected through stationary transformers at 16,000 volts. The currents are taken from two overhead conducting wires, the rails serving as the third conductor. The length of line thus electrically equipped is 40 kilometres, or 26 miles. The arrangements were designed, and the electrical equipment constructed, by Messrs. Brown, Boveri & Co., of Baden, who were the first to apply three-phase currents to traction. In the Lugano tramways as a commencement, then in the steep mountain light railways of Engelberg, of the Gornergrat, and lastly of the Jungfrau, they gained experience in this method, which now stands triumphantly demonstrated in its adaptability to the service of heavy lines. In the United States heavy railways have been, to a very limited extent, operated by electric locomotives. Some built for the Baltimore and Ohio Railroad, weighing about 90 tons, are employed to draw ordinary trains over a short line around part of the city of Baltimore. They work with continuous currents from overhead trolley lines.

There can be little doubt, however, that to Switzerland rather than to America we must look when desiring guidance as to the future development of this problem. All necessary data now exist for the exact working out of the necessary equipment of any given line, actual or projected. No experiments are needed to enable the constructor to proceed, so soon as it shall have been determined which kind of current is to be used. Already it has been found in the designing of the Central London line that continuous current methods, however suitable for light and short railways, and for tramways where frequent stoppages occur, fail when the current has to be supplied from a distance of several miles, alternating currents being brought in because of their greater economy in transmission. The extraordinary thing is, that this having been so far grasped, the whole of the rest of the equipment was not designed to match with three-phase motors, instead of introducing the complication of rotatory converters to work continuous current motors. Time alone can show how the mixed system adopted will work in practice. To me the choice of the mixed system appears of doubtful wisdom. Perhaps the distinguished engineers who are understood to be spending £30,000 on experiments for the Metropolitan Railway to enable them to recommend the best system for our inner circle underground line will shortly be able to report whether a simple three-phase system throughout is, or is not, more economical than either a continuous current system throughout or than a mixed system with converters. If they do not settle this question, which is to-day the one important question in electric railway work not yet settled, we must regard the expenditure as pure waste.

Returning to the question of electric tramways, the problem of the hour is the equipment of busy city thoroughfares, where, for obvious reasons, overhead wires are inadmissible. To all the three possible methods that dispense with overhead construction, viz, by accumulators carried on the car, by use of slot conduits in the road, and by use of surface contacts, objections are not wanting. Accumulators are found too heavy and too short-lived to be satisfactory. Conduit constructions are objected to as too costly, and as interfering too much with the roadway, while to surface contacts there is brought the terrible indictment—worse than any against the conduit—that nobody has had experience of them. You are aware that in this question of surface contact systems of tramways I am an interested party, and cannot be expected, even in a presidential address, to speak dispassionately. Yet you have never expected your president to banish from his inaugural address the topics to which he has devoted his thoughts, his energies, his time, or his resources. And with the examples before me of other presidents who have spoken of their own work, I take the liberty of speaking of mine. A paper dealing with some aspects of surface contact working was read by me at the Bristol meeting of the British Association, and in January last you listened here to a paper on some other points by Mr. Miles Walker, my former assistant, and partner in this matter. We have, indeed, worked out several different systems, of which the earlier only have yet been publicly described. We are at work on modified plans, the result of our experience gained on our short experimental line at Willesden; and before long we expect to demonstrate the advances we have in hand. Meantime we are not alone in the field. Since the time when the late Dr. Hopkinson proposed his original plan, many others, including Mr. Wynne, Mr. Holroyd Smith, Mr. Esmond, and Messrs. Johnson and Lundell, have suggested various new methods. Three years ago Dr. Hopkinson wrote of one of these methods that he "would not hesitate to approve its adoption in any town in which overhead conductors were inadmissible"; adding that he had "not the least doubt that it would work thoroughly, effectively, and safely." A good deal has happened since then, and much experience has been gained. But there remains not only in London, but in many provincial cities, crowded thoroughfares where overhead construction is absolutely out of the question, and where a slot-conduit would be almost equally objectionable. It is some years since Mr. J. Love equipped slot-conduit lines in Washington and Chicago. It is now most significant that in three great capitals—New York, Berlin, and Paris—the electric tramways are being largely extended without overhead wires. New York and Berlin are putting down slot-conduits; New York, most expensively, as if the object were to put as much cast-iron as possible into the roads; and the conduit at every 15 feet is furnished with pairs of hand-holes, the covers of which interfere with the surface quite as much as any surface-contact system, to say nothing of the interference of the central slot or of trouble about drainage. In Paris, on the other hand, where a tentative surface-contact system has for about a couple of years been tried with moderate success, no fewer than 63 kilometres—about 48 miles—are now being equipped by Mr. Diatto on his surface-contact plan which has been in successful operation on a small scale at Tours. Surely, then, if a method of surface contact can be shown which is at once simple, safe, and not too expensive, there is every reason to urge its adoption on engineers and municipal authorities. Thanks to the criticisms — some of them passed in this place—with respect to possible difficulties likely to arise from the use of underground coils, from mercury switches, and from surface leakage around the contact studs, improvements have been worked out which largely, if not wholly, remove the fears that have been expressed on these grounds. As contrasted with the conduit, a surface-contact system has the advantages of much lower prime cost, of less interference with the roadway, and of not requiring any drainage arrangements. On long lines that run out into the country it can be operated with the same cars that carry trolley poles for use in the suburban part of the track. Those cities and towns which, like London, Birmingham, and Cambridge, have waited before erecting overhead lines, will have justified their waiting attitude when they can point to examples of the successful surface-contact roads at Monaco, at Tours, and, lastly, at Paris.

Time forbids me to dwell further upon this topic; it precludes me likewise from entering upon a number of other topics of great interest, such as the development of the single-phase motor; the establishment of electric time services by synchronised dials throughout buildings, blocks of offices, or whole municipalities; the use of prepayment meters; the recent developments of electro-metallurgy; the revolution in chemical manufactures by the use of electric methods; the use of aluminium wires in place of copper wires as conductors; and last, but not least, seeing that Atlantic liners can now signal their presence when 50 miles from port, the progress of telegraphy without communicating wires. In all these many directions there may be noted pronounced tendencies toward development along distinct lines of progress, and some of these topics will doubtless form the subjects of discussion at our meetings during the session now beginning. I venture also to express the hope that the question of

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the distribution of electric energy on the large scale may be brought before our members for discussion. Nothing can be more helpful to the industry generally, just at present, than the free discussion of a topic which is likely again to engage the attention of Parliament, and which ought to be discussed from the standpoint, not of restricted parochial or municipal interests, but of its bearing on the wider interests of national and public economics, and of the industry at large.

In commemoration of the centenary of the discovery of the pile, by Alessandro Volta in 1799, the city of Como, his birthplace, has this year held high festival. Beyond contest this discovery of a means of generating chemically a steady electric current constitutes the starting point of the entire modern development of the science of electricity. Though that modern development turns upon the subsequent discoveries and inventions of others—the discovery of the magnetic properties of the current by Oarsted, the invention of the soft iron electro-magnet by Sturgeon, the discovery by Faraday of the fundamental principles underlying the dynamo and the transformer, together with many others of lesser moment—it still remains true that to the genius of Volta we owe the initial impulse. His memorable letter of June, 1800, to Sir Joseph Banks, first describing the pile, marks the opening of a new epoch in the history of civilisation. Without that discovery we now possess, neither telegraph nor telephone, neither electric light nor electric power, electrotyping and electroplating, would not exist. Commerce, diplomacy, warfare, and journalism would have remained in a totally different stage of development from that in which they are to-day. In brief, we should—with the modifying circumstances of the steam engine existing for power, and the gas jet for light—be still living in the stage of civilisation of the 18th century.

The Volta centenary was commemorated at Como by the erection of an exhibition and the holding of a series of celebrations. Unfortunately the exhibition was destroyed on July 9th by a calamitous fire, in which not only a fine collection of modern electrical machinery was destroyed, but a number of Volta's original manuscripts, and a considerable part of his historical apparatus perished. Happily the original pile and numerous other relics were saved, and are now enshrined in the Civic Museum of Como. Nothing daunted, the citizens of Como reconstructed their exhibition, which was re-opened in 42 days. Amongst the Como celebrations were held two congresses; one a congress of telegraphists, in June; the other a congress of electricians, in September. No invitation to send delegates to the former was received by this Institution, and neither it nor the British Post Office was officially represented. Four English telegraphists, none of them members of this Institution, were reported as having been present. This congress, having been convened by the Italian Minister of Posts and Telegraphs, and being attended by official delegates of various European Administrations, many of them telegraph engineers of the highest distinction in their various countries, it is extraordinary, to say the least, that the English Postmaster-General was not represented on the occasion. The congress of electricians was organised by the co-operation of the Physical Society of Italy, of which Prof. Rôiti, of Florence, is president, and of the Italian Association of Electrical Engineers, which has branches in Milan, Turin, Genoa, Rome, Naples, and Palermo, and of which Prof. the Hon. Giuseppe Colombo is president.

At this congress, at which distinguished electricians from France, Germany, Holland, Switzerland, and Finland were present, this Institution was represented by Prof. Ayrton, Past President, and by myself. The Italian physicists and electrical engineers attended in great force. The proceedings of the congress were carried on with great vivacity; and many matters of the highest scientific and technical importance were discussed in its various sessions. After the sittings were concluded, two days were devoted to visits to the large generating stations at Paderno and at Vizzola; the former taking power from the river Adda (which flows out of the Lago di Como), and supplying electric current for transmission at high voltage to the city of Milan; the latter, not yet quite completed, taking water from the river Ticino, which drains the Lago Maggiore, and distributing its currents to the industrial towns of Gallarate, Legnano, and Somma Lombardo, within a radius of some 25 miles. Alike from the point of view of electrical and hydraulic engineers these stations are of the highest interest, presenting as they do special features different from those of almost all other kindred enterprises. Our Italian brethren may well be proud of the engineers who have found the solutions for these special problems of construction, and carried those solutions to practical success.

This year is also marked by the establishment, with a Government grant, of the National Physical Laboratory for the standardising and certification of scientific instruments, and for physical research on well-defined lines. Though thus commenced on a modest scale, the circumstance marks an event of national importance.

I cannot forbear to direct your attention to another matter of public interest, and one which exercises an influence on all attempts at developing new enterprises. It is only too notorious that the whole question of financial development of new inventions is in this country in a most unsatisfactory state. The promotion of joint-stock companies under the Limited Liability Acts has become a public scandal. In the eighties a heavy blow was given to the real progress of electric lighting by the reckless promotion of bubble companies with inflated capital, causing the loss of millions of money upon foolish and worthless schemes. In the year 1882 no less a total than £23,000,000 of nominal capital was registered in electrical company schemes alone. In the nineties a similar reckless speculation has been witnessed over bicycles and automobiles. Happily electric traction has largely escaped this curse; and it will be an evil day for any of the newer developments of electrical engineering if a like craze should overtake them. There is something amiss in our economic machinery when such scandals can recur. Nothing is more familiar to those who have to deal with new inventions, or to those who, as consulting engineers, have to advise and report upon them than the ever-recurring difficulty of getting them financed on a sound basis. Suppose that there is an invention of a thoroughly sound character, properly protected by patents, but requiring time and money to establish itself commercially. Suppose that there is required a capital of from £10,000 to £25,000 to put it upon a commercial basis. In the present state of public finance in this country the inventor finds himself in this difficulty—he must either raise the necessary capital privately by personal effort amongst his own friends, or he must put it into the hands of a promoter, who will want to bring it out with a capital of at least £100,000. In other words, it is almost impossible to find a middle course between a purely private affair and an over-capitalised swindle. We have, unfortunately, in this country no organisation corresponding to the Industrial Banks of Germany, to the enlightened management of which the financing of sound schemes on a moderate scale can be entrusted. Much more might be said on this topic. It is one which affects not our industry alone, but it affects ours perhaps more than any other industry, because the glamour which is attached in the public mind to everything and anything electrical is made use of by the unscrupulous financier to the detriment of honest promotion.

I have already alluded to the sums of money which have been invested in this country in the supply of electricity for lighting and power, and in electric traction. According to Mr. Garcke's invaluable "Manual of Electrical Undertakings," from which I derive my figures, the aggregate subscribed capital in shares and debentures at the present date stands as follows:—

Telegraphs	£34,284,957
Telephones	7,729,626
Electric supply (companies)	9,265,793
" " (municipalities)	8,531,167
Electric traction	20,808,959
Electric manufacturing	16,799,152
Electro-chemical and miscellaneous concerns ...	8,558,065
Total	£105,997,716

This hundred millions of subscribed capital is much less, it is true, than that represented by the total capital invested in railways or in many other domains of British industry. But it is this electrical industry and the scientific and professional elements associated with it which our Institution represents to-day. Competing as we have to do not only in foreign and colonial markets, but even in our own home markets, with the manufacturers and engineers of other countries, it behoves us to do all we can to make our Institution of use to our members of all grades, and particularly to our younger members. One great duty which we owe to them is to furnish them with the latest information as to the progress of electrical development, the development not only of industrial undertakings, of new machinery, of new materials, and of new inventions, but also of pure science, upon which all technical developments are in truth based. From the very first year of our existence—1872—we have always issued, in our *Journal of Proceedings*, abstracts and extracts of scientific and technical papers published at home or abroad. Two years ago we joined with our colleagues of the Physical Society in bringing out in the monthly numbers of *Science Abstracts* a far more complete digest of electrical progress than we were previously in a position to produce. To carry on this publication both we and the Physical Society have had to devote considerable sums, and, indeed, one of the reasons why we had a year ago to raise the fees paid by our students was avowedly to meet the financial burden which we had thus assumed for the purpose of disseminating knowledge. I venture to think that every penny thus spent has been a most wise outlay, and one of which we are already beginning to reap the fruits. Our members all over the country and in distant lands are thus kept informed month by month of the progress of the science, and they increasingly appreciate their connection with the Institution. I know of no means better calculated to keep our younger men abreast of the times than by putting into the hands of everyone of them this admirable compilation.

But the needs of our Institution do not end with the effort to keep our members informed of the progress of science. We have other demands upon our funds of a very pressing character. The Benevolent Fund, established a few years ago upon an independent basis, has, though small, been available for helping necessitous members. In this connection every member of the Institution will rejoice to learn of a great and generous offer which has just been made to us. One of our honorary members, Mr. Henry Wilde—a name memorable as that of the pioneer in the sixties of the early forms of dynamo machine, both continuous and alternating, and of their application to lighting, to deposition of copper, and to the transmission of power—has offered to the Institution, and the Council has accepted, a sum of £1,500 for the purpose of constituting a Benevolent Fund. I need only mention this to secure your cordial acknowledgment of the great generosity of Mr. Wilde, whom two years ago we elected an honorary member in recognition of his claims on the electrical community.

From the very beginning we have been accorded by our generous hosts, the Institution of Civil Engineers, the privilege and advantage of holding our meetings in this hall. If some of us feel that with the rapid growth of our own body the time is coming when we ought to be taking active steps toward providing ourselves with a home of our own, it is not because we are not deeply grateful for that privilege. Nay, rather the circumstance that our growth compels us to contemplate this step is a perpetual reminder of the courteous generosity which has itself been no small factor in promoting our welfare and our increase. The founding of our Building Fund six years ago was due largely to the foresight and fostering care of our then treasurer and vice-president, Sir David Salomons. At his instigation we have

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annually set aside such sums as we could spare from our surplus income, and our nucleus of a Building Fund stands this autumn at £5,000 so accumulated. The Council has for some months been quietly prosecuting inquiries for a suitable site; and it has recently decided to issue a circular drawing attention to the building fund, and suggesting to members of all grades the expediency of subscribing for the next few years an annual contribution thereto. If by this means we can treble or quadruple our present fund, we shall be ready at least to begin to build when a suitable site shall have been found. And it is most earnestly to be hoped that the generous example of Mr. Wilde will stimulate others of our wealthy members to rival his gift by valuable donations to the building fund.

Finally, I would speak of the growth of the Institution itself. From a total membership of 110 in 1871, we have increased to a total of 3,254 at midsummer, 1899, and statistics show clearly that the rate of increase is itself increasing. In the establishment of the new class of associate member we think we have secured a new element of strength. With the growth of total membership has come a new movement for the grouping of our provincial members in local branches. The Council has appointed a committee to organise these; and already preparations are on foot for constituting two local centres in the North, and another in Ireland; while our South African members have already constituted themselves informally into a local branch, holding meetings in Cape Town, which will shortly be officially recognised under our new articles of association. All these are signs of active progress. The novel departure made last summer, when the council sanctioned the suggestion of an official visit to Switzerland, has already borne fruit in many ways. The Swiss tour brought together many of those who, though active members of the profession, cannot often attend the ordinary meetings in London. It not only enabled us to see what Swiss engineers are doing; it brought us into the most pleasant personal touch with our able and courteous Swiss *confrères*, and it procured for us an invitation to pay a similar visit to Germany at a date in the near future. But, best of all, it has, I think, enabled some of us to realise more fully than we did before the value of our connection with our own Institution of Electrical Engineers; it has taught us what the power and usefulness of our Institution may be; and it has knit us together and inspired us to do what we can to promote its prosperity and the prosperity of the great industry which it represents. In this spirit, and with the note of progress sounding in our ears, let us carry on the work of the session now opened.

THE COST OF STEAM RAISING.

By John Holliday, A.M.I.C.E.

(*Paper read November 23rd, 1899.*)

(*Concluded from page* 835.)

For the other six boilers various fuels have been used at different times at prices varying with the state of the fuel market; in 1895, however, most of the work was done with a South Wales coal, consisting of about 30 per cent. large, the rest fine, which was delivered at the boiler at the price of 14s. 6d. per ton; this fuel contained about 10 per cent. of incombustible, and under the existing conditions evaporated about 9·5 lbs. of water per pound of fuel. Taking the cost of evaporating 1,000 gallons of water with this fuel, as was done above for the breeze, we have

$$C = \frac{P}{w} \times 4{\cdot}464$$

$$= \frac{14{\cdot}5}{9{\cdot}5} \times 4{\cdot}464$$

$$= 6{\cdot}81 = 6s.\ 9\tfrac{3}{4}d.$$

which is in remarkable contrast to the 2s. 8½d. found to be the cost of the breeze to do the same work. In these boilers evaporation is at the rate of about 3,800 lbs. of water per hour per boiler, equivalent to 190 H.P. at 20 lbs. of steam per horse-power per hour, or 11·7 per

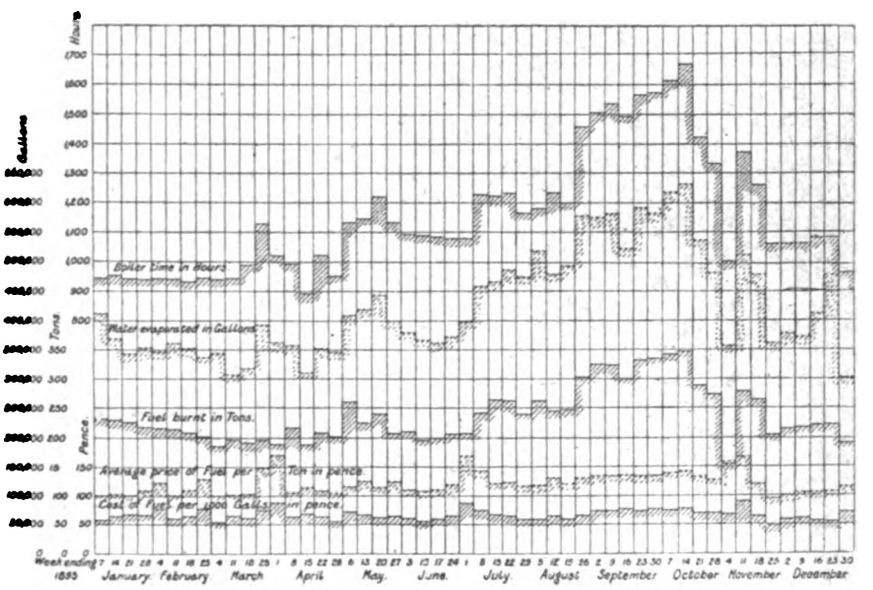
Gallons
Tons
Pence
Boiler Time in Hours.
Water evaporated in Gallons.
Fuel burnt in Tons.
Average price of Fuel per Ton in pence.
Cost of Fuel per 1000 Gallons in pence.
Week ending
1899 January February March April May June July August September October November December

Diagram 3.

cent. more power per boiler than in the case of the boilers fired with breeze.

We have, therefore, two ranges of boilers, one using a cheap fuel and producing steam at a cost for fuel of 2s. 8½d. per 1,000 gallons evaporated at a rate equivalent to 170 H.P. per boiler, and the other producing steam at a cost for fuel of 6s. 9¾d. per 1,000 gallons evaporated at a rate equivalent to 190 H.P. per boiler.

We have now to consider the other items already mentioned, which go to make up the full cost of steam raising. The most important of these is working expenses, and in this labour is the heaviest. Under normal conditions seven boilers are under steam, viz., Nos. 1, 2 and 3 fired with breeze, and four of the other six fired with Welsh coal. As the boilers are worked continuously the firemen are divided into three shifts, of which the two day shifts work three spells of three hours each between 6 o'clock a.m. and 10 p.m., and the night shift one spell of eight hours; thus for two hours in the day both sets of the day men are in the house together, and in this time some of the necessary cleaning, &c., is done. There are generally three men per shift, the two leading men taking three and four boilers each, and the third man assisting each of them as required. Taking the amount burned in 24 hours as 15 tons of breeze and 18 tons of the Welsh coal, the total amount fired per day is 33 tons by the nine men, or an average of 3·67 tons per man per day, not an excessive quantity when compared with the new Board of Trade rule for ships which allows one stoker for every 4½ tons

Table IV.—Sparks Boilers. Nos. 10, 11, 12, and 13.

Boiler.		Fuel.		Feed water.			Cost of fuel.	Working expenses.															
								Wages.			Fuel weighing and distribution.			Removal of refuse.			Light.			Water.			Stores.			Total.		
Date.	Time.	Coal.	Price per ton.	Refuse.	Evaporated.	Per hour per boiler.																						
1895.	Boiler hours.	Tons.	s. d.	Tons.	Gallons.	Gals.	£ s. d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.	£	s.	d.
Jan. ...	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Feb. ...	53	25	13 0	2·3	33,600	634	16 5 0	0	10	9	0	1	11	0	4	7	0	3	7	0	11	3	0	0	9	1	12	10
March	87	23	13 0	2·1	30,912	355	14 19 0	0	18	2	0	1	11	0	4	2	0	3	0	0	10	3	0	6	9	2	4	3
April ...	34	10	13 0	1·0	13,440	395	6 10 0	0	7	1	0	1	2	0	2	0	0	1	7	0	4	6	0	0	10	0	17	2
May ...	188	58	13 0	5·3	77,952	415	37 14 0	1	19	2	0	6	8	0	10	8	0	7	0	1	6	0	0	3	8	4	12	11
June ...	265	65	13 0	6·0	87,360	330	42 5 0	2	15	3	0	4	6	0	12	0	0	4	0	1	9	1	0	4	7	5	9	5
July ...	251	67	13 1	6·1	90,048	359	43 14 6	2	12	4	0	7	5	0	12	2	0	3	10	1	10	0	0	3	3	5	9	0
Aug. ...	683	188	13 0	17·3	252,672	370	122 4 0	7	2	5	0	19	5	1	14	8	0	11	10	4	4	3	0	2	6	14	15	1
Sept. ...	1,203	327	13 0	30·1	439,488	365	212 11 0	12	10	8	0	19	8	3	0	1	1	1	8	7	6	6	0	12	2	25	10	4
Oct. ...	1,115	284	13 0	26·5	387,072	347	187 16 4	11	12	4	1	10	4	2	13	0	0	18	8	6	9	0	1	7	11	24	11	3
Nov. ...	446	112	13 0¾	10·3	150,528	337	73 0 2	4	12	11	4	18	5	1	0	8	0	11	3	2	10	2	0	14	7	14	8	0
Dec. ..	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
Aver'ges and Totals.	4,325	1,163	13 0½	107·0	1,563,072	361	756 9 0	45	1	1	9	10	9	10	14	0	4	6	5	26	1	0	3	17	0	99	10	3

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TABLE V.—COSTS OF STEAM RAISING.

	Forced draught boilers. Water evaporated, 6,665,960 gallons.			Natural draught boilers. Water evaporated, 13,594,140 gallons.			Spare boilers. Water evaporated, 1,563,070 gallons.			All boilers. Water evaporated, 21,823,170 gallons.		
	—	Costs per annum.	Costs per 1,000 gals.	—	Costs per annum.	Costs per 1,000 gals.	—	Costs per annum.	Costs per 1,000 gals.	Costs per annum.		Costs per 1,000 gals.
	£ s. d.	£ s. d. Per cent.	s. d.	£ s. d.	£ s. d. Per cent.	s. d.	£ s. d.	£ s. d. Per cent.	s. d.	£ s. d.	Per cent.	s. d.
Fuel bill	...	1,051 6 0 43·22	3 1·84	...	4,557 19 6 73·05	6 8·47	...	706 10 0 58·10	9 0·46	6,315 15 6	67·81	5 9·43
Other working expenses—												
Wages of stokers, &c.	277 7 6	... ...	...	288 12 6	... ...	...	45 1 1	... ...	...	...	...	...
Fuel receipt	23 8 2	... ...	...	38 19 4	... ...	...	9 10 9	... ...	...	..	...	...
Removal of refuse	120 6 0	... ...	...	79 6 0	... ...	...	10 14 0	... ...	...	...	...	...
Water	119 3 6	... ...	...	226 7 8	... ...	...	26 1 0	... ...	...	...	...	...
Light	16 6 10	... ...	...	27 7 2	... ...	...	4 6 5	... ...	...	...	...	...
Stores	16 19 2	573 11 2 23·58	1 8·65	13 11 6	674 4 2 10·79	0 11·90	3 17 0	99 10 3 8 18	1 3·28	1,347 5 7	14·44	1 2·82
Maintenances—												
Boilers and mountings	24 16 1	... ...	...	23 14 0	... ...	...	...	... ...	...	...	...	...
Furnaces and brickwork	21 7 0	... ...	...	36 7 6	... ...	...	...	... ...	...	...	...	...
Feed water heaters	4 9 11	... ...	...	8 9 8	... ...	...	...	... ...	...	...	...	...
Feed pumps	10 2 3	... ...	...	19 3 0	... ...	...	...	... ...	...	...	...	...
Fan and engine	3 7 9	... ...	...	...	... ...	...	...	... ...	...	...	...	...
Steam and feed mains	7 11 0	... ...	...	14 10 0	... ...	...	...	... ...	...	...	...	...
Non-conducting coverings	13 4 9	... ...	...	27 16 0	... ...	...	...	... ...	...	...	...	...
Sundries	4 1 0	88 19 9 3·66	0 3·20	7 14 11	137 5 1 2·20	0 2·42	...	30 15 9 2·52	0 3·84	257 0 7	2·76	0 2·82
Insurance—												
Boiler (explosion)	7 17 6	... ...	...	15 15 0	... ...	...	11 10 0	... ...	...	...	...	...
Boiler house and contents (Fire)	4 19 4	12 16 10 0·53	0 0·46	9 18 8	25 13 8 0·41	0 0·46	1 8 0	12 18 0 1·06	0 1·99	51 8 6	0·55	0 0·56
Interest on—												
First cost of boilers and machinery	113 0 0	... ...	...	149 0 0	... ...	...	100 0 0	... ...	...	...	...	...
First cost of boiler house and chimney	52 10 0	165 10 0 6·80	0 5·95	95 0 0	244 0 0 3·91	0 4·31	75 0 0	175 0 0 14·39	2 2·87	584 10 0	6·27	0 6·43
Depreciation—												
Boilers and machinery	113 0 0	... ...	...	149 0 0	... ...	...	100 0 0	... ...	...	...	...	...
Boiler house and contents	26 5 0	139 5 0 5·73	0 5·02	47 10 0	196 10 0 3·15	0 3·47	37 10 0	137 10 0 11·31	1 9 11	473 5 0	5·08	0 5·20
Ground rent	...	12 10 0 0·51	0 0·44	...	24 0 0 0 38	0 0·42	...	16 10 0 1·36	0 2 53	53 0 0	0·57	0 0 58
Rates and taxes	...	20 0 0 0 82	0 0·72	...	38 0 0 0·61	0 0·67	...	26 13 0 2·19	0 4 09	84 13 0	0 91	0 0 92
Superintendence	...	45 15 0 1·88	0 1 64	...	93 8 9 1·50	0 1·64	...	10 16 3 0·89	0 1·66	150 0 0	1·61	0 2 04
Share of cost of spare	...	322 14 11 13 27	0 11·62	...	249 4 6 4·00	0 4·40	...	... ...	...	...	...	...
Totals	...	2,432 8 8 100·00	7 3·54	...	6,240 5 8 100·00	9 2·12	...	1,216 3 3 100 00	15 5·83	9,316 18 2	100 00	8 6 80

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burned per day; but the low quality of the fuel used on the Parret furnaces adds greatly to the labour of firing them, each of the six having to be cleaned out once in three hours or oftener. The firemen are paid at an average rate of 23s. per week, those working at night getting a shilling extra whilst doing so; they are under the charge of a foreman, who, however, has other duties to perform, so that a portion only of his time is charged against the boilers. A charge at the rate of £150 per annum is also made for the time which the engineer in charge devotes to this portion of his work. A boy is also employed for a portion of the day in the boiler house in sweeping the tops of the boilers, &c. The expense of weighing the coal, and any incidentals connected with its receipt over and above the price paid for it per ton delivered, is included in the working expenses; these being the same per ton for all qualities of fuels, constitute a heavier expense per 1,000 gallons of water evaporated by the inferior as compared with the better-class fuels.

During 16 hours, between 6 o'clock a.m. and 10 o'clock p.m., which constitute the only light portion of the week's work, two boilers are kept under easy steam, the fires in the other being cleaned quite out in the morning and started again at night. The firing during Sunday is done by three men working, two of them five hours and one six hours, for which they are allowed time and a half; whilst a second fireman works two or three hours in the evening as required, in order to re-start the boilers that have been at rest during the day.

Flue sweeping and boiler cleaning is the item next in importance. The boilers using the inferior fuel are very thoroughly cleaned out at the end of each 11 or 12 weeks' run, during which time they have generally steamed from 1,600 to 1,700 hours each, and have deposited in their flues a very large amount of dust which, but for the forced draught, would require to be removed much more frequently; as it is, there is certainly a falling off in the amount of water evaporated both per boiler and per pound of fuel burned, but not to such an extent as would justify the shutting down and cleaning of these three boilers five times a year instead of four as at present. This cleaning is performed not by the firemen, but by some of the general labourers attached to the concern; two men are able thoroughly to sweep and clean one boiler in four days, and in addition to their regular wages they are paid a gratuity of 12s. per boiler. In addition to the actual cleaning and removal of dust some expense is incurred in taking out fire bars, disconnecting air pipes, cleaning bars, &c., all of which are carefully overhauled at each periodic cleaning.

The natural draught boilers, fired with better-class coal, run for about the same length of time between cleanings as the forced draught ones, but as there are generally two of these idle, each boiler is cleaned only from three to four times a year; two men can finish a boiler in two days, and in addition to their wages of 5½d. per hour they earn between them the gratuity of 12s. for the job. Each cleaner is provided with a suit of overalls, which seldom serves for more than four boilers at the most. The expenses of cleaning out one of the natural draught boilers is far less than that of one of the forced draught boilers fired with inferior fuel.

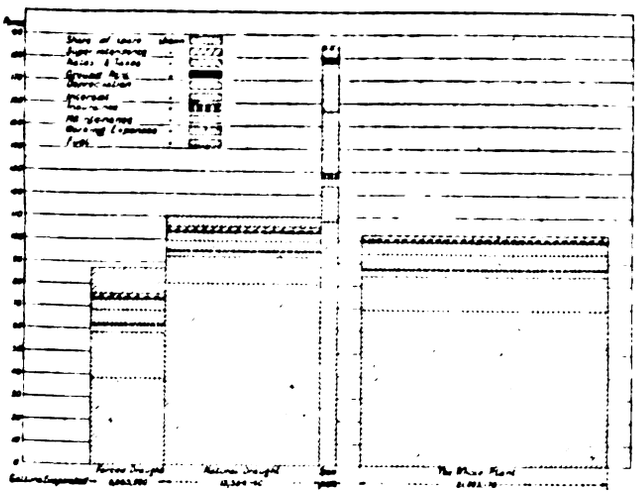

Diagram 4.

The removal of refuse, viz., clinkers and ashes taken from the furnaces in the ordinary way of firing, and the dust removed from the flues during sooting out, amounts to a considerable sum during the year; the bulk of it is removed from the premises by a contractor at a fixed rate per load, but since an intermediate handling is necessary, the removal of an average week's refuse from the forced draught boilers during work costs about £2, and the amount removed from the flues at each cleaning about 11s. 6d. per boiler; whilst that from the natural draught boilers is removed for 16s. 6d. per week whilst in full work, and 4s. 6d. per boiler cleaned.

The feed heaters being common to both groups of boilers, the cost of cleaning them and the feed pumps is taken according to the quantity of water evaporated in each group. The water used is taken from the town main, through meters, the cost being 4d. per 1,000 gallons; and as it is very pure, there is no expense incurred in treating it except for the addition of a small quantity of soda ash which is necessary to prevent corrosion.

The cost of illumination is divided amongst the boilers according to the number of boiler hours worked; gas and electric light are both used—the annual cost is about £50. In the same way also the cost of the steam used to drive the boiler feed pumps is divided according to the quantity pumped, but in the case of the forced draught boiler a further charge has to be made for the steam used by the fan engine in producing the forced draught. The quantity of fuel to be charged against feeding the boilers is, however, very small, as a very large portion of the heat in the exhaust steam is recovered by passing the exhaust into the low pressure main by which the feed water is heated. Some experiments have shown that by utilising the exhaust steam from the feed pumps to heat the feed water an economy of 1½ per cent. in fuel can be realised. There are two quadruple acting steam feed pumps, each capable of delivering one gallon per revolution, which also act as water meters, for which purpose they are fitted with counters which are read daily, whilst the pumps are calibrated periodically against a tank of known capacity to ensure correctness in the results; it is generally found that they deliver about 5 per cent. less than their full charge. A certain quantity of stores are of course used, such as shovels, firing-tools, barrows, soap, oil, waste, which in the course of a year amount to an appreciable sum.

The maintenance charges are somewhat more difficult to set out precisely for any given period than are the working expenses, as these vary from time to time, and a year is quite too short a period to ensure every item being fairly treated; some parts will come out too high or too low as repairs of any considerable extent happen to fall within or without the period under consideration. The figures given are those ascertained for the year 1895, and include somewhat heavy repairs to the pumps, and heavy items for renewals of non-conducting coverings of tops of boilers and steam mains; but in order to avoid errors the costs have been compared with those of previous years, and though the details differ, the totals agree very closely. The figures for maintenance are considerably less than they were expected to be when the investigation was taken up, but as the work was mostly done by the company's own workmen, only charges for labour and material are included; had the work been done by an outside firm, the figures must have been much higher, and the average cost of maintenance would probably have been 5 per cent. of the total, instead of less than 3 per cent. as they stand in Table IV.

The fixed charges include the insurance of the boilers against explosions at £2 12s. 6d. per boiler per annum, and it is worthy of remark what a very small proportion the cost of this excellent safeguard bears to the total cost of the steam made.

In calculating the interest on the first cost of the plant and buildings, it was found impossible to ascertain the actual figures, so a careful estimate was prepared on the basis of present prices, on which the interest has been taken at 5 per cent. per annum.

Depreciation of boilers and machinery has been taken at 5 per cent. per annum, and of buildings, including chimneys, at 2½ per cent.; ground rent, rates and taxes having been approximated to local conditions as far as possible, and superintendences in proportion to the amount of the steam made.

The question of spare plant is one of extreme difficulty, and the practice varies with each different case. In some instances, where an occasional stoppage is permissible, the amount of spare required may be *nil*; again, in cases where the boilers are worked by day only a small spare is allowable, because the interval between two days' work admits of minor repairs being carried out or temporary expedients resorted to. Where sufficient spare must be always available and the demand for steam small, then the spare plant must be fully equal to that in ordinary use; in other cases where the amount of steam made requires the use of several boilers, there is a point at which it is no longer necessary to maintain a full spare plant. In the case under notice it has been found that a spare plant of one boiler to every three in work is sufficient for all emergencies. This, of course, is based on the maximum and not on the average output of steam, consequently the spare plant has been comparatively very little used, but, as it exists, it has had to be kept in order, and it is a recognised fact that a boiler idle may deteriorate as fast as one in work; it has been kept in complete working order, and worked occasionally. Of course, the cost of steam produced by these independent boilers is much greater in almost every way, than that made in the main boiler house, as the statement in Table V. will show. The extra expenses of making this steam over and above those of that made in each of the two groups in the main boiler house have, in order to determine the full cost of the steam made in each, to be added to the ascertained expenses of those groups. It is, in the first place, difficult to decide what share of the expenses of the spare plant should be debited to each group of boilers in the main house, but, since the forced draught boilers were always worked when possible to their full fuel capacity, and had no self-contained spare as did the natural draught boilers, it has been considered right, in spite of their much smaller output of steam, to charge half of the extra cost of the spare to them, and the other half to the natural draught boilers.

The figures charged in Table V. as share of spare against the forced and natural draught boilers respectively have been determined thus: the quantity of water evaporated by the spare boilers is 1,563,000 gallons, at a cost of 15s. 5·8d. per 1,000 gallons; the difference in the cost of evaporating one-half of this, viz., 781,500 gallons at 15s. 5 8d., and the same quantity at 7s. 3 3d., the cost of the steam made in the forced draught boilers, amounts to £322 14s. 11d. or 11·62d. per 1,000 gallons on the quantity evaporated in the forced draught boilers. Similarly the difference in cost of evaporating 781,500 gallons at 15s. 5 8d. and the same quantity at provisionally 9s. 2 75d. amounts to £249 4s. 6d., or 4·4d. per 1,000 gallons on the quantity evaporated in the natural draught boilers. Even if this distribution of the extra cost of the steam made by the spare boilers be heavier than it should be on the forced draught boilers, the figures will, all the same, show that a too large spare plant may prove an expensive luxury, quite apart from the fact that, unless kept in good working

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order and tried from time to time, it may fail in more ways than one when most required.

The author regrets that circumstances have compelled him to confine his observations to a type of boilers not so universal as was the case a few years ago, and which work at a pressure much below that now commonly used, but he ventures to hope that the figures may be of some use as a basis of comparison, and may, perhaps, elicit a more complete return from a thoroughly up-to-date plant.

In conclusion, the author would express his thanks to the officials of the company who have allowed him to use the figures, but who have expressed the wish that their names should not be made public.

INFLUENCE OF CHEAP FUELS ON THE COST OF ELECTRICAL ENERGY.

By R. E. Crompton, Past President.

(Paper read November 23rd, 1899.)

The problems involved in this subject are worthy of the careful thought and consideration of members of this Institution.

As water-power is only available in the United Kingdom to a very limited extent, the bulk of our experience in generating, transmitting and distributing power on a large scale is certain to be based on power stations put down in the best positions where we can either raise steam or work gas engines by means of our cheap fuels.

Mr. Holliday in his paper deals very exhaustively with several of the problems involved in dealing with inferior cokes or coals of the anthracitic description. My present paper must be taken as a suggestive one of other important problems connected with this subject, in the hope that the matter will be carried further by those of our members who are working as engineers-in-charge of electrical power stations, and who are therefore likely to have already directed their thoughts in this direction. Perhaps the first and most important point that we ought to consider is the extent of our available supplies of cheap fuel. I do not think that this most important point has been sufficiently looked into. I am told that in certain districts where fuel of very considerable calorific value could be had almost for nothing at the pit's mouth, solely because the difficulties in burning it were so considerable that no one had thought it worth while to put down proper appliances, immediately appliances were set to work to deal with this fuel on a large scale the price doubled itself. It is of considerable importance to take this into consideration, and then to fix on a price which is likely to hold good for a sufficient period. To enable us to discuss the problem I have put myself into communication with several colliery proprietors, and have ascertained that in the Midland district, Nottinghamshire, Derbyshire, and Yorkshire, there are supplies of slack coals available, the average price of which during the last 10 years has been about 2s. 6d. per ton at the pits, so that it could be delivered by railway carriage, including wagon hire, within an average radius of 50 miles for about 5s. 4d. per ton. At the present time, owing to exceptional demand, the present price is 1s. per ton higher than this, but I am informed that this higher price is not likely to be maintained, and that it would be fair to base my calculations on the assumption that a large supply of this coal would be available at the above price.

Whilst on this subject I must point out that railway rates and wagon hire are the same for inferior as for the best quality of fuels, so that this inferior fuel cannot be delivered to distant parts of the United Kingdom, such as in the case of our own works at Chelmsford, under 14s., so that it appears probable that it will rarely pay us to deal with these cheap fuels at an average radius in excess of 50 miles from the colliery.

Where a system of canal transport is available, as in the Birmingham district, these conditions will, of course, be modified, on account of the much lower rate for carriage and barge hire. From inquiries I have made, it is probable that the Cannock Chase class of slack may be delivered within an average radius of 50 miles from the colliery at about 5s. 6d.

There are three distinct classes of cheap fuels available for generating electrical energy. The first are those in which the calorific value is chiefly in the contained carbon. These include the anthracite and small Welsh coals, and the refuse coke fuels dealt with by Mr. Holliday. The difficulties in burning these fuels are not great. They are cheap, because they are friable, easily broken up by carriage into powder, and thus there is always loss in transit; such powdered fuel is liable to fall through the bars, or be carried forward in the form of dust into the flues and chimney. All easily pulverised fuel is also likely to have additional earthy matter mixed with it, as whenever a heap of it is shovelled over, the earthy bottom gets mixed with it, and thus its liability to form clinker is increased.

The second class of cheap fuel is the free-burning small coals of the Midland districts. In this class I include all the small and earthy coals which are only slightly bituminous, and which therefore have slight tendency to cake.

The third class is the small and dirty or earthy bituminous coals of the North. These last are the most difficult to deal with, but as they possess high calorific value the problem of dealing with them successfully is the most interesting of all.

The first group of fuels have been dealt with, with considerable success, by several forms of furnaces in addition to those described by Mr. Holliday. In this class it is all-important to reduce as far as possible the loss of unburnt fuel by its falling through the fire bars or being carried forward into the flues in an unconsumed condition. So far, probably, the best method of dealing with the clinker from this class is the provision of large water ash pans, the steam rising from which appears to have the effect of preventing the clinker from clinging to the bars. A great portion of it separates as it forms into small drops of melted matter and falls through the bars into the water instead of forming large cakes which hinder the air admission.

Up to the present the attempts to satisfactorily deal with the second and third classes of fuels have been chiefly connected with the use of automatic appliances for distributing the fuel over the bars, breaking up and getting rid of the clinker, and providing sufficient admixture of air at various points in the furnace to insure satisfactory combustion of the gases. These last difficulties are at their greatest where a great portion of the calorific value of the fuel lies in its volatilisable products.

I think that most of those who have had experience in the use of automatic stokers will agree with me that, although in some cases where a large range of boilers has been automatically fired, economies in labour have undoubtedly followed, yet the cost of clinkering the grates and afterwards removing the clinker from the boiler room and the cost of maintenance of the grates and furnaces has been so considerable, and these difficulties and costs increase so rapidly with the amount of ash present in the fuel, that in most cases even with these automatic stokers it has been advisable not to use the very cheapest class.

With the third, or highly bituminous class, coking stokers have been used with more or less success. Most of these operate on the principle of spreading the coal on the front end of the grate, allowing it sufficient time to form itself into coke, and then by means of moving bars to break up and move this coke forward over the bars to the point where intense combustion and radiation is required. This method is correct in theory, but it has not worked out well in practice. The moving bars do not move the caked material forward with sufficient regularity, so that openings occur in the fire, and thus excess of air is allowed to dilute the gaseous heated products of combustion, and their temperature is thereby reduced. Clinker is seldom automatically got rid of, and in most cases a considerable amount of hand labour has to be expended on its loosening and removal.

From the above remarks it will be seen that one great difficulty in burning cheap fuels at a small cost for labour and maintenance is that of getting rid of the clinker. What we require is that the fuel should be tipped from the railway trucks or barges into conveyers, and thence distributed to the furnaces without being touched by the firemen, and that after passing through the furnace the clinker and ashes should also be automatically taken away from the back of the furnaces and delivered into a railway truck without any hand labour being necessary.

There are two distinct methods of dealing with the cheap fuels which contain much volatilisable matter. The first is that described very fully in a paper read on March 16th, 1897, by Mr. Humphrey (*vide Min. Proc. Inst. C.E.*, Vol. cxxix., p. 190) before the Institution of Civil Engineers, on the "Mond Gas Producer." With this system the fuel is gasified in separate gas producers, and the gas then burnt under boilers or used in gas engines. I do not propose to deal with this system, although it may well be a most satisfactory way of utilising cheap fuels, as it has been most thoroughly described by Mr. H. A. Humphrey in his paper. He showed that by this method 90 lbs. of sulphate of ammonia, which is about 70 per cent. of the total nitrogen in the fuel, may be recovered from it, and that the gas from each ton of coal is then capable, under ordinary boilers, of evaporating not less than 7 tons of water. The repairs and upkeep of the system appear to be satisfactorily low.

I propose for the present to confine my remarks to suggestions as to the form of furnace which may be attached direct to the boilers to burn these inferior fuels so as to evaporate the water at the least cost.

Mr. Holliday has called our attention to the fact that in considering such furnaces and the boilers best suited to them, the use of cheap fuel has undoubtedly, up to the present, necessitated the use of larger furnaces and larger boiler plant, so that there has been considerable increase in the capital cost, and hence in the maintenance charges, which are a percentage of that cost, and this, of course, increases the real cost per 1,000 gallons of water evaporated. I think, however, that in the case of externally fired boilers, at any rate, arrangements may be suggested by which the grate area only need be increased, the size of the boiler remaining the same as for the best fuel; for if we so arrange our grate that those portions of it in which the preliminary work of igniting and caking the fuel is performed are at a comparatively low temperature, this portion of the grate or furnace may be exterior to the boiler, and it follows that that portion of the furnace in which advanced combustion is carried on would be no larger than would be the case if we were burning the very best Welsh coal; but it is only fair to say that in the case of bituminous fuels where it is necessary to prevent newly formed volatilisable products from coming into contact with the cold boiler surfaces considerable additional space will have to be provided exterior to the boiler itself, as it is evident that in this case, in order to produce perfect combustion of these products, some form of combustion chamber which contains a large surface of highly incandescent material must be provided. Again, however carefully we may provide for the disposal of the clinker, portions of it are certain to adhere to the bars and lining of the furnace or combustion chambers, and in order that these parts may be made easily accessible for cleaning, the whole furnace ought to be easily removable from the boiler—in other words, it should be built on a frame mounted on wheels running on rails.

Probably the simplest and most efficient method that has yet been contrived of continuously firing a large grate with cheap fuel is by the old Juckes revolving grate, which has been in use for upwards of 30 years, and wherever it has been properly installed and well mounted has given satisfactory results. I remember seeing one of these grates in use in Messrs. Fowler's works at Leeds in 1871—that is to say, 28 years ago—and I am told that the performance has been so continuously satisfactory that Messrs. Fowler are still using this form of grate.

It appears probable that all the conditions I have above noticed

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could be satisfactorily filled up by a revolving grate mounted on a movable frame running on rails. In these days of electric motors there is no difficulty in providing power for working this grate. It can easily be constructed to deliver the clinker and ashes continuously into a transverse channel at the back end of the grate, from whence it could be removed by a conveyer to suitable trucks. Immediately above that part of the grate on which the fuel is ignited I propose to provide a combustion chamber in the form of a long bridge made of a special quality of fire brick. I have found by experiment that a good way of arranging this apparatus is in the form of an extended fire brick arch, each arch-shaped brick having a fin-like projection hanging down from its lower surface into the path of the gases. I have already used this form of combustion chamber for Lancashire boilers at our works at Chelmsford with satisfactory results. The extended surface of fire brick acts extremely well as a reservoir of heat even under the difficult circumstances of firing a Lancashire boiler, the fire door of which must be frequently opened, but it is evident that this form of bridge will work much more efficiently in an automatically, and hence continuously, fired boiler where no necessity exists for so often opening the door and hence admitting cold air. As I have pointed out above, for burning the first group of cheap fuels this regenerative apparatus may be dispensed with. It is somewhat more necessary in the case of the second group, but it is absolutely necessary in the case of the bituminous smoky fuels of the third group.

Up to the present the weak point of smoke-consuming apparatus has been that it has generally stopped short at supplying additional air so as to obtain more perfect combustion of the fuel, and although this has resulted in a larger proportion of the CO being converted into CO_2, yet as this has been effected by passing a considerable excess of air through the furnace, the heated products have been so diluted and cooled that not only is the output of the boiler diminished, but also its efficiency greatly reduced. The only satisfactory method of dealing with the question is to provide the combustion chamber I have above described. I need hardly remind those who are accustomed to boiler tests that the efficiency of a boiler is largely proportionate to the proportion of CO_2 present in the gases as they leave the furnace. On tests we always try to get this proportion as high as possible. In my experiments at Chelmsford, I have been able when my combustion chambers were worked successfully, and when using highly bituminous fuel, to bring the proportion of CO_2 up to 11 per cent., which is sufficient proof that a very small excess of air was passing, and that the products were consequently undiluted.

How important it is that the excess of air should be kept down is shown by the following table:—

	Test of water-tube boiler at St. Pancras.		Test of water-tube boiler at Glasgow.		Result of the Glasgow test if excess of air had been prevented.	
	B.T.U.	Per cent.	B.T.U.	Per cent.	B.T.U.	Per cent.
Heat transferred to water	10,463	72·6	8,228	68	9,960	83
Heat carried off with products of combustion and excess air	1,792	12·4	2,939	24·25	1,440	12
Heat in unburnt fuel mixed with ashes	316	2·2	417	3·45	240	2
Heat radiated and otherwise unaccounted for	1,829	12·7	390	3·22	360	3
B.T.U. in fuel ...	14,400	100	12,012	100	12,000	100

In column 1 I give the figures of an often-quoted test made with a water-tube boiler using the best Welsh coal, hand-fired. In this case only about 12·5 per cent. of the heat was carried off with the products of combustion and excess air. Owing probably to considerable radiation losses the efficiency of the boiler in this case was not extremely high, being under 73 per cent. In column 2 I give the results of a test made at Glasgow with a water-tube boiler, coal having a calorific value of 12,000 B.T.U., being fired by automatic stoking apparatus. From the inefficient working of this apparatus it was found difficult to keep the bars properly and evenly covered, so that what otherwise would have been an extremely good result was spoilt, as the heat losses due to heat carried off with the products of combustion and by excess air were over 25 per cent., so that the total efficiency therefore worked out at only 68 per cent. In column 3 I give the results that ought to have been obtained at this test with automatic stoking of this class of fuel if this excess of air had been properly controlled.

Since I commenced the preparation of this paper I have learnt that the Babcock & Wilcox Company, who have already done so much to reduce the cost of steam raising, have actually perfected and brought into practical use a form of furnace which combines a considerable number of the requirements that I have laid down in this paper as necessary for the satisfactory and economical burning of cheap fuels. In the Babcock & Wilcox new revolving grate, illustrations of which I am able to put before you on the screen, it will be seen that they provide a modern revolving grate which performs the duties of feeding the fuel on to the front of the grate and delivering the ashes and clinker at the back of the grate in a most satisfactory manner. The whole grate is mounted on a removable frame running on rails, so that it can be removed from the furnace and ready access given to the parts for examination, renewal, or repair. The difficulty of getting rid of the clinker and ashes at the back of the grate without admitting air at this point was a matter in which the old Jackes grate was defective. This is got over by means of a very heavy cast-iron flap which rests on the revolving bars at their back end. The bars have to move forward under this flap, and as it has a sharp edge the clinker and ashes are removed from the bars, slide over its inclined surface, and are delivered into an air-tight receptacle at the back from whence they can be removed by a conveyer or other convenient means. It is probable that this revolving furnace is a great step in advance, and probably the only addition that is required to perfect it is the addition of the combustion chamber which I have described.

In order to show the proportion the cost of fuel bears to the total cost of generating energy in a modern power station of moderate size I have extracted figures from the log book of the power station of our new Chelmsford works, from which I have prepared the accompanying table, which shows that under the actual conditions of working the plant during the last 49 weeks, and at an average price of 17s. 5d. per ton of coal (which was Nottinghamshire steam hard of the best quality), the cost of the fuel was 64 per cent. of the total cost of 0·77d. per B.O.T. unit delivered to the tools. The plant is of moderate size; including spares its maximum rate of output at present is about 250 kw. It is not easy to give the average rate at which it is worked, but it is probable that this is at the rate of about 120 kw. during 54 hours per week and 50 kw. during the night shift during 62 hours per week. If the plant had been worked at the higher rate throughout the night as well as the day shift, the output would have been increased from 368,000 B.O.T. units to 680,000 B.O.T. units, and the cost prices would have been modified as shown in the second column—that is to say, that the cost of coal would then have been about 76 per cent. of the total cost, which would stand at 0·63d. per unit. If, however, this plant were put to work within the radius of 50 miles from collieries, where cheap coal at 5s. 4d. per ton could be supplied, and the furnaces of the boilers modified to suit this fuel in the manner I have indicated, the figures in the third column would be obtained at the rate of output in column 1, and those in the fourth column at the rate of output in column 2, and it must be observed that in these two columns I have not reduced the cost of labour to the extent that might fairly be claimed by the saving in stokers' wages.

It is needless for me to point out to you that increasing the size of this plant would largely reduce the labour charge, so that it is probable that (exclusive of interest and depreciation) the total cost price of ¼d. per unit would be reached in many cases, providing that the coal obtainable at 5s. 4d. per ton is burnt in a satisfactory manner. The fact that such figures are now easily within reach ought to be a powerful stimulus to the investment of capital in power distribution works.

Table Showing the Proportion which the Cost of Fuel Bears to the Total Cost in Chelmsford New Works Power Station.

	(1) Actual cost per B.O.T. unit at output of 368,000 units in 49 weeks	(2) Calculated cost if full night shift be worked, giving 680,000 units in same period.	(3) Cost as in col. 1 if coal 5s. 4d. per ton were available.	(4) Cost as in col. 2 if coal at 5s. 4d. per ton were available.
	d.	d.	d.	d.
Coal at 17s. 5d. per ton delivered at boilers	0·488	0·480	0·15	0·148
Stores	0·0293	0·016	0·0093	0·016
Labour, superintendence, two complete shifts, including fire and boiler cleaning	0·236	0·127	0·236	0·127
Repairs	0·016	0·009	0·016	0·009
Total	0·769	0·632	0·431	0·300
Coal to total cost ..	64 %	76 %	35 %	49 %

PHYSICAL SOCIETY.

Ordinary Meeting held November 24th, 1899.

Prof. G. Carey Foster, F.R.S., Vice-President, in the Chair.

A paper "On the Conductivities of Certain Heterogeneous Media for a Steady Flux having a Potential," was read by Dr. O. H. Lees.

Two formulæ have already been proposed to express the conductivity of a mixture in terms of the conductivities of its constituents. In the first formula the conductivity is represented as the

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sum of a number of terms, each one of which is the product of the conductivity of any constituent and the fractional part of the mixture which is made up of that constituent. In the second formula, the resistivity of a mixture is expressed in the same way with respect to the resistivities and percentages of its constituents. In general the first of these suppositions gives results which are above the experimental values, while the second gives results which are below. If we suppose that the mixture is made up of a series of columns of the separate parts stretching normally between two equipotential surfaces then the conductivity would be accurately represented by the first formula. If, however, we assume that the constituents are arranged in parallel layers then the second formula would apply. In the present paper the author has attacked the problem two-dimensionally and has investigated the relation which holds between the conductivities, when the constituents are arranged in the mixture, alternately like the squares on a draughtboard. Dealing first with two components it is easily shown that the problem reduces itself to finding the form of the equipotential curves and of the stream lines in a square which is divided by a diagonal into two parts of different material. By means of conformal representation Dr. Lees has referred the square under consideration to a kite-shaped quadrilateral with two opposite angles (right angles), and the other two so determined by the conductivities of the constituents as to give straight equipotential lines in the two portions of the figure which represent the two materials, and which are separated the one from the other by the axis of symmetry. The general relation which exists between the vector co-ordinates in the two systems has been proved by Love to consist of elliptic functions, but near the angular points of the figures a close approximation can be obtained by the use of a simple exponential expression. Taking the known solution to the problem in the case of the kite-shaped quadrilateral it is easy to calculate the result for the square under consideration. This leads to the conclusion that the conductivity of the square is the geometric mean of the conductivities of the constituents. Allowing the medium to become fine grained, and introducing new materials, it follows at once that the logarithm of the conductivity of a mixture is equal to the sum of a number of terms, each one of which is the product of the logarithm of the conductivity of any constituent, and the fractional part of the mixture which is made up of that constituent. By a superposition of fluxes the author has shown that the above law holds for flows in four directions, and he, therefore, considers that with the assumed structure the formula represents the conductivity for any flux.

DR. LEES then read a second paper "ON THE THERMAL CONDUCTIVITIES OF MIXTURES AND THEIR CONSTITUENTS."

In this paper the three formulæ considered in the preceding communication are applied to the known experimental results upon the conductivities of mixtures of liquids. The author finds that the least satisfactory formula is the first one, whereas the least unsatisfactory is the logarithmic one.

MR. APPLEYARD said that it was frequently of importance to be able to determine the resistance of a mixture of gutta-percha from the known resistances of component parts. He had attempted, without success, to do this by means of the old formulæ, and he would be interested to see whether Dr. Lees' logarithmic formula gave better results. In electrical work, Mr. Appleyard pointed out that the nature of the contacts affected the conductivity, the resistance of a sheet of rubber being different when measured between metal plates and mercury sheets.

MR. CAMPBELL said that the difference between the calculated and observed results might be due to the thermo-electric properties of the materials. Lord Rayleigh had observed that the high resistivity of alloys might be due to a back E.M.F. produced by the contact of dissimilar metals. Mr. Campbell said that he had measured the resistances of ferro-nickels, both with direct and alternating currents and found them the same in the two cases.

In reply, Dr. LEES said that all his experimental work on conductivity had been carried out with mercury contacts.

The Society then adjourned until December 8th, when, by the invitation of Prof. S. P. Thompson, the meeting will be held in the Physical Laboratory of the Finsbury Technical College.

CARE OF CAR EQUIPMENT.

AT the Chicago convention Mr. Vanderveer, of the Brooklyn Heights Railroad Company, gave his views on the care of car equipment. In the first place, only those equipments fitted with both oil and grease boxes will safely run over 40 days without thorough overhaul. For overhauling purposes, there should be extra trucks with motors mounted ready to be run under car bodies as these are lifted off their trucks. For this purpose four duplex chain hoists are necessary, or air hoists, with cross timbers and stirrup irons. This lifts a car body with little injury, the truck is run out, and the spare one substituted all in about one hour, for which time alone the service of the car body is lost. On opening the motor case, the armature should be removed to a rack for test and cleaning. The fields, also, must be tested for drop, and where this is present those fields and armatures should be used together, new and re-wound fields and armatures, also, being kept together with resulting durability and less risk of crippled cars on the road. Motor cases are cleaned with compressed air or washed with kerosene; grease is removed from the boxes and put into gear cases, and the grease boxes cleaned with kerosene. At the same time the whole truck is inspected. A car will run five days safely between general inspection, and one man will, in this way, take care of 20 to 25 cars per day. As regards the trolleys and poles, another man will look after all circuits, canopy switches, fuse boxes and arresters. A third will be fully occupied with the controllers, while the brakeman and assistant will keep the brakes in order on this number of cars.

Night work should be limited; three men by night are sufficient to take care of 100 cars, greasing motors, inspecting brushes, and doing small trolley repairs. All car washing should be day work, night cleaning being limited to dusting and sweeping out.

A shed of 100 cars requires one good carpenter, and no car that requires more than a day's work to repair it after a collision, &c., should be done out of the general repairs shop, to which every car should go at least once a year. It pays for companies to make their own electrical repairs, including making armature coils and renewing commutators, which is best done by sawing off lengths from bars of hard drawn copper. It is suggested to make the diameter as much bigger than manufacturers' sizes as the brush holders will permit. For controllers and canopy switches the parts can best be purchased and assembled.

Piecework has been found by the author to be applicable to body repairs, painting, armature winding, making commutators and coils. In a case known to him, cars were costing £24 to re-model on day work. They were then let out to four men to do for £22, and these four men did the work easily and earned 24s. per week upon their previous rate of 9s. per day. The price is now cut down to £16 per car, and the men are earning 10s. daily, but close inspection is necessary—we believe it; they must have been pretty bad skulkers in the old days, or they must now be very tired o'nights.

In discussing this paper, Mr. Conette, of Nashville, stated that he followed steam railroad methods, and ran a car 100 to 200 miles, and then into the shed, where it was cleaned and inspected ready to start next day. With limited equipment it is necessary to work by night, general overhaul being done by the day gangs. As regards spare cars, about 10 per cent. is an outside requirement for double motor equipment. Single motor equipments run higher than 10 per cent., and Mr. Foster, of Lynn, stated that it did not pay to run single equipment, while he found that an open 10-bench car, with a pair of G.E. 57 motors of 52 H.P. each, ran all summer at 120 miles per day without any repairs being necessary. He advises large motors to reduce repairs. Single motors, however, have been found in Nashville to require less power than double equipments, but are short of adhesion especially if run uphill with motor axle leading.

It would appear that roads should make their own trolley wheels, though one speaker dissented if wheels could be bought for 11½d. per pound, and sold for scrap at 8d. This man used a 5-inch wheel, weighing 3½ lbs. finished. Why do not various lines combine to run a small brass foundry on mutual terms? The dissenter, however, makes contracts for 5,000 wheels at once, to be delivered as needed, and the shop making them can always do so, as a filling-up job in time that otherwise might be partly wasted.

The same gentleman also believes that the power saved by single motor equipment is saved at great cost in repairs, for the energy used is one of the cheapest things put into a road. Even on his double-truck cars he now uses four motors, and by this can make rapid starts and good time. While such cars may consume 30 per cent. extra power, they are really the cheapest in the long run. The motors are G.E. 1,000, one on each axle. Flats are reduced to a minimum, and maintenance alone is reduced a fourth below that for two motors. The cars seat 44 passengers, and are 41 feet long overall. They average 8½ miles per hour, and run at long headways, but punctually. A car makes 160 to 170 miles daily as a minimum, and on interurban service as high as 380 miles. This is in Milwaukee, where rates of 50 miles an hour are run on portions of the line which are on private right of way.

Another speaker detailed how he had spliced his 16-feet car bodies and placed them upon double trucks, and on level track they run as fast as the old cars with the same 25 H.P. motors. It costs about £60 to £80 to splice a couple of cars. Trolley wheels average on one line 8,000 to 9,000 miles, though some roads get 16,000 miles. The 8,000 mile wheels are 86 per cent. copper, 8 to 9 of tin, and 4 to 5 of zinc. Steel wheels wear the trolley wire. On all points raised, especially as regards single and double equipment, and cars generally, there was great difference of opinion, as may be expected, from men on lines working under widely varying conditions. The impression conveyed as a whole is, that the car of the future will be one with double trucks, and, possibly, four motors.

STANDARDISING IN ENGINEERING CONSTRUCTION.

MUCH has been said as to the lowering effect on the workman of repetition work. Americans, of course, who have as manufacturers been so very successful as our competitors solely because they have worked along repetition and standardising lines to a very full extent, do not agree with the above, but then the American manufacturer is necessarily biassed in favour of the system, and may perhaps be excused if he sees none too clearly that what is to his profit may be to his workmen's injury. Our own observation in this country tends, however, to the same conclusion.

For many years the production of textile machinery has been conducted on the fullest lines of repetition, and there is a marked difference between the men employed in a machine shop and the men in large engine works; here repetition work is less pronounced, and

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there are wide differences between one engine and another and considerable scope for a more intelligent individuality. But even here may there not be a confusion of cause and effect? Possibly it may be that the better work has demanded better men, and that the inferior men have drifted naturally to the less intellectual work of the machine shops. The subject admits of endless *pro* and *con* arguments. Sir Benjamin C. Browne, who writes on standardising in the *Engineering Magazine*, denies the lowering effect of repetition work, but he adduces a very poor argument to support his contention, to wit, that greater intellect is required to *organise* an economical system of standard reproduction, to carry it on, &c., than is required to do an isolated piece of good work. His argument, however, is useless. It is not the man who is the repetition worker that does the organising, but one of superior intelligence, who has perhaps never even handled a tool, whereas the isolated pieces of good work are done by manual workers.

It is because the scheming of repetition work is done by superior intellects that the mere machine tending is so unintellectual a process. Let us take only one instance in such work, say, the rough turning of a spring barrel or some other part in a watch. The turner has supplied to him the pressed casing or stamping in the rough. He has to fix it in the lathe. For this purpose there is a chuck on the lathe spindle, and the machinist is not even called upon to use any intelligence in gripping the piece. The chuck does this for him, not only correctly as to position, but as to force of grip. The machinist may be a fool, but the chuck will not distort the piece, for it is only tightened up by a handwheel which has a slip motion and refuses to grip harder than it has been set by the superior intelligence of some foreman. The actual work of turning or boring is performed by tools that have been fixed by the superior intelligence, the machinist merely pulls handles and forces the tools to their work. He can only pull the handles as far as some stop piece, also fixed for him by the intelligence department. His own share consists of mere repetition work. If he be a man he can be equalled or surpassed by his son or daughter in rapidity, and though he may have to keep his wits about him, as Sir Benjamin says, we cannot think that this amounts to a particularly intellectual use of his wits.

Far be it from us to stamp the man himself as unintelligent. Thousands of men, by the stress of environment and the very fact that they possess intellectual faculties of a high order, useless to them for purposes of gain, are compelled to resort to the meanest of employments for the purpose of gaining food and clothing. Such men no doubt find employment for their intellects in apparently useless hobbies, and occasionally come to the surface as learned in some special point of geology or botany, and if the majority of machine workers could be educated to science there would be some set back to the demoralising effect of mere mechanical labour. This ameliorating influence is at present absent from American work. Hours are too long—far too long for closely applied drudgery, and must inevitably be shortened as soon as American workmen discover the better hours in England and Australasia and become more homogeneous where they are now divided into narrow circles of different nationalities. The only hope we see for the future worker is in the line of intellectual employment of leisure hours. As regards success in manufacturing, it is, of course, hardly necessary to insist that repetition and standardising are necessary to success in manufacture. But there may be a limit which it is not good to exceed in rapidity of production. American manufacturers have had but one end in front of them—rapidity of production. That this is so is more and more apparent every day. The tool maker rules the roost. He it is that makes out the calculations as to the rates of cutting and performance. He it is pickles castings to reduce their surface hardness and ease his tool, and it is to him that manufacturers of soft steel are indebted for the demand for this material, the absence of which, in Europe, so arouses his wrath. It is usually claimed to be a proof of American prowess, that in England American tools will not do the work they do regularly at home, but the truth is, that the difference is one of materials. Material suited to rapid machine work is good in very many directions, but more especially in small machinery. The wearing surfaces of a light sewing machine are so excessive as compared with the proportions of a steam engine, that soft materials do not show to disadvantage. But undue softness of material may be carried too far, and we think American manufacturers would be well advised to look into such matters otherwise than through the spectacles of the man who supplies, shall we say, for a good example, the machine on which they bore steam engine cylinders. The end and aim of a steam engine cylinder is not to be rushed through a boring mill. "As hard as can be bored" conveys a very different idea to an engine manufacturer in America from what it does in England. Perhaps too much stress is laid on durability in English work. Durability tempts the owner of a tool or other machine to continue it in use after it has been superseded by an improved tool. To scrap a tool as good as new is felt to be a waste. To read articles like this of Sir Benjamin Browne's is good for a man, because it opens up the lines of thought on which other men are working, but we observe that all these articles on competition assume that America has the monopoly of the system of standard and repetition work. Now this idea must be carefully guarded against.

We believe there is no shop in America where modern manufacture is carried out so perfectly as by Willans & Robinson, to name one well-known firm, while for the best work, despite all croakers, and we shall not cease to croak ourselves while so many abuses exist, England still leads. We have many things to remedy and abuses to correct, but these are excrescences merely. An engine building firm have informed us since the above was written that they are driving their machine tools to take heavier cuts, and generally to do more work than they can even get Americans to believe possible. Yet no one hears of this firm except as a maker of very good engines.

The whole question of modern conditions of manufacture cannot be dismissed by the off-hand assertions and claims of either the tool maker or the manufacturer. The workers have claims. It may not appeal to the employers to consider these, but it will be impossible to avoid doing so. For the present the just claims of labour have been so ground up with their unjust claims at the hands of selfish and unscrupulous leaders, that great harm has been done to everyone. Our own idea of manufacturing is that the function of machinery is to increase production, and to reduce the cost of everything, and to compel labour to put forth its energies under high pressure for short hours. At the moment America, which is using up the stamina of its people by high pressure and long hours, really stands as the principal obstacle to a more enlightened social system.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

22,597. "A locking device for electric incandescent lamps." G. W. Goldring. Dated November 13th.

22,615. "An improved safety device for starting switches of electric motors." A. J. Attersberg. Dated November 13th. (Complete.)

22,650. "A new or improved method of preventing or diminishing sparking on breaking electric circuits and apparatus therefor." L. W. Heath. Dated November 14th.

22,652. "An improved joint for troughs for electric cables." A. E. Tanner. Dated November 14th.

22,666. "A new or improved chemical generator of electricity." E. L. Anderson. Dated November 14th. (Complete.)

22,679. "Electro-magnetic appliances." J. L. Cutler. Dated November 14th. (Complete.)

22,702. "Improvements in or relating to electric motors." A. J. Boult. (O. Patin, France.) Dated November 14th.

22,707. "Improvements in the distribution of electricity." A. Sweet. Dated November 14th.

22,710. "Improvements in apparatus for the electrolytic extraction of zinc." H. H. Lake. (S. Stepanov, Russia.) Dated November 14th. (Complete.)

22,754. "Improvements in or connected with alternating arc lamps." W. J. Davy. Dated November 14th.

22,757. "Improvements in electro-magnetic reciprocating engines." W. H. Willson and M. S. Conly. Dated November 15th.

22,762. "Improvements in electrical switchboards." E. W. Cowan. Dated November 15th.

22,784. "Improvements in telephones." D. Macdonald. Dated November 15th.

22,785. "A tinted film covering an electric lamp." F. Round. Dated November 15th.

22,807. "Improved manufacture of lead peroxide and its application to electrical storage batteries." H. Beckmann. Dated November 15th.

22,809. "Improved manufacture of magnet cores with ventilating passages for transformers and the like." O. T. Blathy. Dated November 15th. (Complete.)

22,829. "A material or composition suitable for electric battery cases, insulating and other purposes and method of manufacturing the same." Pheip's Metal Limited. (C. J. Hubbell, United States.) Dated November 15th.

22,830. "Improvements in primary batteries." S. Robinson. (S. R. B. Robinson, United States.) Dated November 15th.

22,832. "Improvements in batteries for the generation of ozone and for like purposes." C. A. Sahlstrom. Dated November 15th.

22,853. "Improvements in electro-magnetic coils and magnets." J. Jones. Dated November 16th.

22,857. "A medicinal light-curative apparatus for the production of complete or partial baths of chemical and electrical rays of light." L. Cusow. Dated November 16th. (Complete.)

22,889. "Improvements in or relating to trolleys for electric tramways and the like." W. R. Ormandy and J. Unsworth. Dated November 16th.

22,900. "Improvements in magnetic cut-out apparatus." L. Andrews. Dated November 16th.

22,919. "Improvements in insulators for electrical purposes and method of making same." S. W. Johnson. Dated November 17th.

22,960. "Improvements in electric insulating devices." H. H. Lake. (L. McCarthy, United States.) Dated November 17th (Complete.)

22,964. "A new or improved electric automotor carriage." P. Hebert and E. Cannevel. Dated November 17th.

22,989. "Improvements in electric tramways or railways." F. Hewer. Dated November 18th.

23,009. "Improvements in automatic electric warning signals for railways and the like." J. H. Hollyer. Dated November 18th.

23,021. "Improvements in or relating to electric motor vehicles." H. Sefton-Jones (of the firm of W. P. Thompson & Co.). (Kölner Accumulatoren-Werke Gottfried Hagen, Germany.) Dated November 18th. (Complete.)

23,029. "Improvements in or relating to electrical traction, particularly applicable for tramways and railways." H. Lane. Dated November 18th.

23,033. "Improvements in secondary batteries." W. Scholthaeer. Dated November 18th.

23,040. "Improvements in or relating to apparatus for the electrolysis of alkali chloride solutions." A. J. Boult. (F. Stormer, Germany.) Dated November 18th. (Complete.)

23,047. "Improvements in radio-conductor tubes." E. Ducretet. Dated November 18th. (Complete.)

23,054. "Improvements in coupling appliances for the electrical conductors of electrical railway and tramway vehicles." Siemens Bros & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated November 18th.

23,055. "Improvements in current collecting apparatus for the underground conductors of electric railways and tramways." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated November 18th. (Complete.)

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ELECTRICAL PATENTS OF 1885 EXPIRING IN NOVEMBER AND DECEMBER, 1899.

We are informed by W. P. Thompson & Co. that about 180 applications for electrical patents were filed in November and December, 1885, of these some were never completed, and of those that were, only four have been maintained to run their full term, viz., 14 years; these being of considerable interest we give a short abstract of them below:—

13,287. "An improved manufacture of metal wire for electrical transmission and other purposes." E. Martin. Dated November 2nd, 1885. Relates to conductors. Compound wire for use as electric conductors is composed of two metals or alloys of different strength and conducting power enclosed one within the other and drawn down to the required gauge. 1 claim.

15,251. "Improved means for distributing electric energy." S. Z. de Ferranti. Dated December 11th, 1885. Relates to cables. In a special system of distributing electricity for lighting, the mains for conveying the current consist of two concentric metallic tubes with insulating material between. If the conductors are suspended from steel wires, they may be enclosed with the steel wire in a woven or other fibrous tube. 10 claims.

15,868. "Improvements in electric switches." S. M. Drake and J. M. Gorham. Dated December 19th, 1885. Switches are constructed with contact blocks of one or two or more concentric springs cut on one side to admit of the end of the lever. Bolts are employed to tighten the contacts when necessary. 4 claims.

15,888. "Improvements in the means of and apparatus for the extraction of metals from their ores; particularly in the treatment of 'blue stone' and similar complex ores, and for electrolytically refining copper and for the manufacture of sulphuric acid by electrolytic action." W. Elmore, A. S. Elmore, and H. Barrett. Dated December 29th, 1885. Relates to a method of treating complex ores, and the object is to extract and refine the metals and to manufacture sulphuric acid by electrolytic action. The finely ground ore is roasted in a reverberatory furnace and while hot stirred in a tank with water or other suitable solvent for dissolving zinc and copper. The solution is removed to a tank containing zinc to precipitate the copper and any silver present, and the precipitate is fused to form an anode in subsequent operation. The zinc left in solution is deposited by electrolysis, and the acid liquor obtained is passed over fresh ore. The residue, which may contain lead, gold, silver, &c., is smelted for lead, which alloys with the gold and silver and may be treated in the usual manner. The copper-silver alloy or other like alloy is refined as follows:—The alloy is made the anode of an electrolytic apparatus, consisting of a tank divided by a porous partition. Both cells are partially filled with a solution of cuprous chloride; the liquid in the cell containing the anode is kept at a lower level by means of an adjustable overflow. On passing a current through, part of the copper is deposited at the cathode, while the remainder, together with the silver, is dissolved. The solution is treated with an iodide to separate the silver, and then passed back to the tank to be re-charged. The sulphurous fumes given off in calcining are, together with steam, passed into a chamber, through which electric discharges pass between conductors, preferably of platinum combs; sulphuric acid is formed and condensed. 4 claims.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. THOMPSON and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

3,995. "Improvements in suspension devices for electric and other lamps." P. G. Pasquet. Dated February 16th, 1898. A yoke secured to a ceiling or wall has three projections supporting a hollow ball which carries a tube containing another sliding tube supporting an electric or other lamp or gas burner. The ball is held frictionally by a ring and springs of any kind. In modifications, the ring and springs are dispensed with, the yoke being made longer, and the tube extended above the ball to carry a counterweight, or the upper part of the ball made solid to serve as a counterweight. Gas may be supplied to the burner by flexible tubing. Electric current may be supplied by flexible conductors, controlled by a spring coiled on the tube, or a spring roller, or pulleys and weights; segmental rods may slide within corresponding conducting strips, within the tubes, or two parallel tubes may be used. 1 claim.

4,004. "Improvements in switches for altering the speed and direction of revolution of electric motors." W. R. Edwards and S. F. Beever. Dated February 17th, 1898. Relates to switches for altering the speed and direction of revolution of electric motors used for propelling boats or for other purposes, where the current is supplied from storage or other batteries. The arrangement may be such, for instance, as to enable a boat to be driven at full speed or half speed ahead, or at full speed or at half speed astern. For this purpose, the battery 14 divided into two halves, and the two speeds are obtained by connecting these in series or parallel, as the case may be, while the direction of revolution is changed by reversing the connections of the armature or field magnet. An auxiliary resistance switch is employed for preventing sparking at the contacts of the main switch. The main switch comprises, in addition to a central contact, two series of concentrically-arranged contacts which are cross-connected. Above these contacts is arranged a rotary switch arm carrying six spring brushes, connected together in three sets as shown in dotted lines. A resistance switch is interposed between the main switch and the field terminal of the motor. This comprises two quadrantal series of resistance contacts, an inner contact and a rotary bridge-piece shown in dotted lines. The two switches are geared together in such a manner that one complete revolution of the resistance switch causes the main switch arm to move from one of its five positions to the next. When the latter is in the highest position shown, the two parts of the battery are connected in series for full speed ahead, while in the next position the two parts are connected in parallel for half speed ahead. When it reaches the horizontal position, the current is cut off and the motor stopped. Further movement reverses the armature connections and puts the two halves of the battery first into parallel for half speed astern, and then into series for full speed motors. 4 claims.

4,048. "Improvements in or connected with the distribution of electricity on the three-wire system with the neutral wire at earth potential." A. B. Blackburn, W. L. Spence and E. S. W. Moore. Dated February 17th, 1898. Relates to a system of three-wire distribution for railways and other purposes, in which two or three wire circuit generators are arranged with balancing transformers so that the central point is earthed and the greatest difference between the feeding leads is double that between the lead and earth. The balancing transformers are preferably those of the variable ratio type described in Specifications No. 11,153 and No. 24,296, A.D. 1895, and may be controlled by an electric governor such as described in Specification No. 19,871, A.D. 1896, In a modification a triple commutator transformer may be employed, the whole of the branch network being taken by this one transformer. 3 claims.

4,075. "Improvements in methods and apparatus for electro-thermally treating materials, more particularly for the manufacture of calcium carbide and other carbides, and the reduction of ores." H. Maxim. Dated February 18th, 1898. A furnace for making calcium carbide, reducing ores, or other purposes, is provided with two or more parallel electrodes, which are covered with the materials. On starting they are connected by an incandescent conductor, and during an operation they are gradually withdrawn lengthways from the furnace, leaving a layer or layers of the product, which is removed as slabs after cooling, or in the fused state. The furnace may be movable on wheels, and the electrodes stationary. Adjacent pairs of electrodes may be supplied with separate currents, or multiphase alternating currents may be used. The starting conductor may be a carbon plate, grooved so as to be readily broken, or a line of broken carbon. The electrodes may be solid and be passed into the furnace through carbon tubes, electric connection being maintained by carbon powder: or hollow electrodes may be used, and coal dust fed through them. They may be cooled by water pipes. A pair of electrodes may be used to close a hole for discharging the product, which is kept fused near the hole by these electrodes. Several furnaces may be movable in an outer casing. The gaseous products of the furnaces, or other fuel, may be burnt with an air blast to heat the fresh materials, the air being heated by the products of combustion, or by burning some gas in it. The supply of material is controlled by two valves. 14 claims.

4,282. "Improvements in automatic cut-outs for arc electric lamps." C. Syng and A. E. Angold. Dated February 21st, 1898. Relates to a cut-out for the shunt coil of an arc lamp for protecting it from the full electromotive force of the circuit. A lever pivoted to the frame, and carrying a contact head, normally rests against a contact and closes a circuit through the shunt coil. A weight loosely mounted tends to hold the lever in position. It is fitted with a pin which projects into the path of an arm mounted on a spindle forming part of the regulating mechanism. The lever also carries a pin or tooth with which engages a pawl pivoted on the arm and having a small independent movement controlled by a pin working in a slot. When the carbons are burnt out the arm is thrown over against the contact, so cutting out the shunt coil. 2 claims.

4,368. "Improvements in electrodes for secondary batteries." P. W. Northey. Dated February 21st, 1898. The plate or grid is made up of a series of independent sections of short ribs supported at their ends by cross-bars. The ribs may be at any angle with the sides of the grid, and those in some sections may be at a different angle to those in other sections. A diagonal bar aids in the collection of the current. 3 claims.

4,441. "Improvements in or relating to electric motors." H. O. Duncan. Dated February 22nd, 1898. (Date claimed under Patents, &c., Act, 1883, Section 103, January 14th, 1898, being date of application in France.) Relates to electric steering propeller motors for pleasure boats and other vessels. The motor is mounted on four columns so that it may be raised and lowered by means of a screw passing through a frame or base. This frame is secured to two approximately vertical tubes, which terminate below in a water-tight casing in which is arranged the shaft of a screw propeller. These parts are detachably mounted on the stern of the vessel. The pulley on the motor shaft transmits motion to a second pulley on the screw propeller shaft by means of a belt or its equivalent, the tension of which can be varied by operating the screw so as to raise or lower the motor. To the frame is secured a bar terminating in a steering-handle, and covered by a tube through which pass the conducting wires. This handle can also be rotated so as, by a suitable arrangement of contacts, to reverse or stop the motor. A sheet-metal plate, acting as a rudder, is secured to the casing. 2 claims.

5,028. "Improvements in regulating apparatus for arc lamps." H. Leitner. Dated March 1st, 1898. Relates to arc lamps. An electromotor regulating apparatus is constructed as shown. The carbon holders are hung by cords on opposite sides of a horizontal shaft, or otherwise connected to this, and may be weighted so that they tend to move apart. The shaft carries an armature wound with fine wire and provided with a commutator and brushes by which it is connected in series with fine windings on a differently wound field magnet, this circuit being connected between the terminals of the lamp. The other winding of the magnet is in series with the carbons. The magnet is finely laminated, and the two coils on it may be connected together either in series or parallel to adapt the lamp for different currents. 1 claim.

5,084. "Improvements in non-synchronous electric motors." R. Belfield. (E. G. Lamme.) Dated March 1st, 1898. Relates to motors, alternating current. In a rotary field motor the primary member is provided with a distributed drum winding, which, when supplied with polyphase currents, will produce a rotating field closely approximating in effect to a single pole of uniform strength mechanically rotated. For this purpose each coil of the winding is made to embrace a circumferential core space, the width of which is either materially greater or materially less than that obtained by dividing the whole circumference by the number of poles. 2 claims.

5,086. "Improvements in electric switches." R. Belfield. (H. P. Davis). Dated March 1st, 1898. Electric switches. Contact is secured between the movable arm and the fixed contacts by means of curved and slotted metallic washers. In order to give a quick break a supplementary contact pivoted between plates and working between spring contacts may be provided. The head is held between the contacts until the switch arm is raised into the position shown in dotted lines, when the heel forces it out and the springs give a quick break. 2 claims.

5,123. "Improvements in electric lamp fittings." J. M. Heisman and H. C. Gover. Dated March 2nd, 1898. An electric incandescent lampholder is provided with a ring carrying a silvered or enamelled reflector and serving also to support an ordinary shade. A coloured or ornamental glass is supported by engaging its flanged edge with springs on the reflector. 1 claim.

5,172. "Improvements in telephone transmitter." J. V. Collingwood. Dated March 2nd, 1898. A microphone is formed of a carbon block having conical or other perforations in which are placed balls or their equivalent of compressed carbon or other suitable material. The balls rest against a carbon diaphragm and the front is provided with a mouthpiece and gauze protector. The apparatus may be reversed, the carbon diaphragm being behind but having an air space round it. The carbon block in this case is mounted on a pine diaphragm which is fixed in the metal casing by an india-rubber washer. 3 claims.

5,177. "Improvements in dynamo-electric machines." W. B. Sayers and Mayer and Cowlson, Limited. Dated March 2nd, 1898. Dynamo-electric machines. Comprises improvements on the invention described in Specification No. 27,209, A.D. 1896, according to which reversing poles are employed, in conjunction with commutator coils, for the purpose of enabling a fixed position of the brushes to be maintained without sparking. In one arrangement the reversing pole-pieces are supported in close proximity to the field magnet poles by a non-magnetic carrier, in such a manner that they can be adjusted relatively to the armature and the field magnet poles. The means for effecting this adjustment consist (1) of a pin and slot connection with the carrier, and (2) of set screws acting on the said carrier. According to another arrangement, the reversing pole-pieces are secured to the field magnet poles, or to extensions thereof, by means of screws, and are provided with distance pieces at one end and adjusting screws at the other. In some cases the air gap between the armature surface and the field magnet face is made to gradually increase in radial width towards the polar edge, which is strengthened by armature reaction, and the reversing pole-piece is arranged comparatively close to the armature. The reversing pole-piece may be made up of iron laminæ secured between side and end plates, and it may be attached to the field magnet pole, with one end bearing directly against the said pole. 3 claims.

5,566. "Improvements in microphones." A. H. Skold. Dated March 7th, 1898. Microphones.—Microphones are arranged with the granular carbon divided into cells formed by cross-pieces and rings of felt. The cells are faced on their lower surfaces by a central carbon block and two semi-annular blocks, all insulated from each other and mounted on the ebonite disc. The diaphragm has three pieces of tinfoil insulatingly mounted on its under surface and so arranged that the battery current has to pass through all five cells in series. 2 claims.

6,271. "Improvements relating to the driving of sewing machines by electricity." H. Lea. Dated March 15th, 1898. Relates to means whereby an electric motor can be readily applied to any existing sewing machine and its action controlled by a pedal switch. The motor is secured to a wooden base by means of screws passing through a slotted plate, so that its position relatively to the machine may be adjusted for the purpose of tightening the driving cord. Upon the motor spindle is a brake wheel, to which a brake shoe is applied by a lever acted on a spring. When the motor is started by depressing the pedal switch an electro-magnet connected in series with it attracts one end of the lever, and releases the brake; when, however, the motor circuit is broken, the brake is again applied by the action of the spring. The electric driving apparatus is attached to the machine by means of metallic tongues on the base of one fitting into mortices or sockets on the base of the other. 1 claim.

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THE

ELECTRICAL REVIEW.

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THE

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1900

Edition

NOW IN PREPARATION.

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ELECTRICAL FINANCE.

AMID the general prosperity which at present prevails in the electrical and allied industries, it would seem a gratuitous act to utter a discordant note, yet a careful survey of the whole of the conditions of electrical undertakings leads inevitably to the conclusion that there are some undesirable features connected with the financial side of the business. We do not say that the greater portion of the work being carried on is unsound, for this side of the question does not concern us so much as the fictitious value which is put upon electrical inventions and processes when they are brought before the investing public. In other words, the tendency among electrical companies is unmistakably towards over-capitalisation. This arises mainly from the overweening desires of promoters and vendors. No reasonable being grudges the due reward of inventors, but the demands of this sometimes useful class of persons are out of all proportion to those who help to bring the invention before the public. The ways of the average company promoter are as disagreeable as they are immoral. He not only seeks a high reward for himself, but he is wilfully extravagant.

In the initiation of a company, "preparing the way" seems to be an inseparable operation, and this when it takes the form of buying Press notices of a favourable character is apt to be a somewhat expensive process. We have recently had evidence that companies floated under the highest auspices are not free from this practice. While it may be said that the promotion of electrical companies has been comparatively free from many of the abuses that characterise joint stock enterprise, there has been undoubtedly a strong disposition on the part of vendors to place a high value on their services, and though large sums have been asked from the public it has frequently left inadequate working capital.

That it has been possible to successfully float some of the companies we have in mind, only shows with what extreme favour the public regard electrical affairs. Of the various branches of electrical enterprise, probably the one section that has been hitherto most free from the "promoting" element, is the supply undertakings; it is quite true that there have been in connection with it some remarkable instances of the enhanced value of founders' shares, but then these only became of value when the success of the concern was firmly established. Recently, however, there have been sundry enterprises started for the supply of electrical energy in various districts, where the demands of the vendors have been out of all proportion to the work they have conducted; the outlay of a few hundred pounds for a provisional order has been held good enough to demand 30 or 40 times that sum from the public. Probably, a well-conducted supply system might recover even from that rapacity, but when we witness the attempts made to float companies with a quarter

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or half a million for the working of mere processes, one may be pardoned for making close inquiries into the whole of the circumstances. There are many valuable electro-chemical and electro-mechanical devices which are the subject of patents, but how many are there which would justify the formation of a company with a quarter of a million capital. One of the most striking and remarkable features about present-day company flotation is, that large sums are asked for processes which have not been developed on a commercial scale. It is all very well to erect an experimental plant to prove the possibility of manufacturing certain materials, but even if the most conspicuous success is obtained under experimental conditions, there is absolutely no justification for asking the public to subscribe an enormous capital. In the commencement of new operations we believe in moderation, but, obviously, this is opposed to all the canons of the company promoter, and hence we see concerns brought out with share capital which would be farcical if it did not menace very seriously the future of the electrical industry. It is almost useless to recall the financial disasters of 1882, because they probably would not have much application to-day. Electrical apparatus and processes are in quite a different position; at the same time, the financial recklessness which characterises many latter-day promoters has much in common with the tactics of the period to which we have alluded. There is a rather remarkable feature in connection with the bringing out of electrical companies, that is, the most successful from a flotation point of view, are those which are looked upon by electrical men with suspicion; and, on the other hand, many sound concerns with moderate demands have met with little support from the investing public. Intrinsic worth, unfortunately, is not appreciated in the market, specious promises and exaggerated statements often receiving greater support. It is obvious that an era of prosperity in any industry brings in its train all sorts of impracticable, unsound, and uncommercial schemes, and we may take it for granted that the industry with which we are so intimately associated will not be wholly free from these evils. The financial press is a mighty power for good and for ill, but, with a few honourable exceptions, one cannot hope for its aid in the direction of sound finance. It is not necessary to dwell upon particular instances of over-capitalisation in electrical work; they, unfortunately, are to be found in most of the multifarious branches, though if one were to make an exception, it would be in favour of electric traction, which has probably suffered less from the promoter than the other applications of electricity. We are afraid that the watering of capital from which many organisations are suffering, is responsible for the somewhat unsound methods adopted in the making up of accounts; indeed, we may go so far as to say that there are but few industrial concerns in whose books the patents and goodwill do not figure at a highly fancy value. Moreover, one can hardly commend the manner in which depreciation is treated occasionally by electrical companies; there is too little suggestion of permanence, and though one might expect an electrical supply company, whose business is held only on a short lease, to adopt certain expediencies of book-keeping, there is no reason why a manufacturing concern should adopt methods that are foreign to a sound and growing business.

THE LIABILITY OF A SUPPLY COMPANY TO MEET THE DEMANDS OF CONSUMERS.

In our issue of last week one of our correspondents raised the question whether an electricity supply company is bound to provide current to applicants who have their own plant for lighting purposes, but who wish to have the company to fall back upon in case of a breakdown, or to take current from them when it may be convenient. In order to answer this question it is necessary to refer, in the first place, to the Electric Lighting Act of 1882. It is there provided by Section 19 that where a supply of electricity is provided in any part of an area for private purposes, then, except in so far as is otherwise provided by the terms of the license, order, or special Act authorising such supply, every company or person within that part of the area shall on application be entitled to a supply on the same terms on which any other company or person in such part of the area is entitled under similar circumstances to a corresponding supply. This section makes the supplying of electricity practically compulsory, but the provisions of the Electric Lighting (Clauses) Act of 1899, which are identical with the form of provisional order hitherto in common use, make certain regulations as to supply which ease the burden of the company.

By Clause 27 of the Schedule to the Act of 1899, which is now incorporated with every provisional order, undertakers (*e.g.*, the supply company) are bound, upon being required to do so by the owner or occupier of any premises situate within 50 yards from any distributing main of the undertakers . . . . to furnish and lay any electric lines that may be necessary for the purpose of supplying the maximum power to which the owner or occupier is entitled. The cost of any electric line to be used for conducting the current from the mains to the consumers' premises is to be borne by the supply company, if it is only 60 feet in length. The expense of providing additional wire shall, if the undertakers so require, be defrayed by the owner or occupier. The most important provision, from the undertaker's point of view, is contained in Clause 27 (2) (*b*), which provides that every owner or occupier of premises requiring a supply of energy, if required by the undertakers, must enter into a written contract with them to continue to receive and pay for a supply of energy for a period of *at least two years* of such an amount that the payment to be made for the supply, at the rate of charge for the time being charged by the undertakers . . . . . shall not be less than 20 per cent. per annum on the outlay incurred by the undertakers in providing any electric line required under the Section. The undertakers are also empowered (by Section 3) to demand security for the payment of all moneys to become due in respect of such supply, and in default of security being given, they may discontinue the supply of electricity. By Clause 27 (5) the undertakers are relieved from the obligation to provide any supply unless they are reasonably satisfied that the electric lines, &c., on the consumers' premises are in good order and condition. By Clause 30, the undertakers are made liable to a penalty not exceeding 40s. for each day on which they make default in supplying electricity. A glance at the above enactments will show the exact position of the supply company. Nothing is said in any statute which can be taken as excusing them from supplying to consumers who have their own plant.

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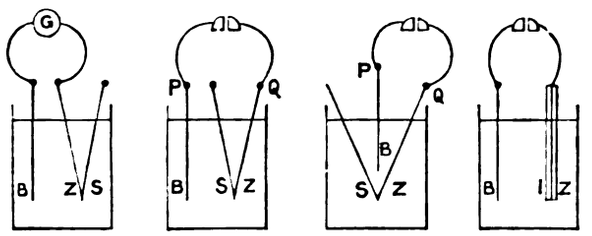
SOME EXPERIMENTS ON VOLTAIC CELLS WITH COMPOUND ELECTRODES.

By FREDERICK S. SPIERS, B.Sc.

1. The experiments about to be described here arose out of an investigation on the action of the zinc which is usually placed in boilers, and which is supposed to prevent, or at least diminish, the electrolytic corrosion of the steel plates or tubes.

2. In the course of some work on this subject, the author and Mr. M. Solomon happened to be experimenting with the voltaic combination shown in fig. 1. B was a plate of brass, Z a plate of zinc, and S one of steel; Z and S were in contact under the electrolyte, which was ordinary tap water, while B and Z were connected through a galvanometer which, when shunted, had a resistance of about 7 ohms. It was then noticed that the galvanometer deflection varied according to the positions of the zinc and steel plates relatively to the brass. When the zinc plate faced the brass, the deflection was considerably greater than when it was faced by the steel. (It should be mentioned that the internal resistance of the cell must have been very high compared with that of the outside circuit.)

This unexpected * phenomenon naturally suggested trying whether the P.D. between the terminals of the cell, as measured electrostatically, varied in the same peculiar manner with the varying positions of the plates. With the plates arranged as in fig. 2, the P.D. between the points, P and Q, as measured on a quadrant electrometer, was about 0·6 volt, which is approximately the E.M.F. of a brass-steel voltaic couple after immersion for an hour or so. When the compound electrode was reversed, so that the zinc faced



Figs. 1, 2, 3 and 4

the brass, the P.D. between the same points was about 0·9 volt, that is, somewhat less than the E.M.F. of a brass-zinc combination. In the intermediate position (fig. 3) the P.D. was about 0·75 volt. Moving the plates closer to one another had no apparent effect. It might be useful to give a rough idea of the dimensions of the cell. The plates were about 4 inches × 1½ inches, and were half immersed; the cell was a glass beaker of about 4 inches diameter.

3. The effect was observed in a still more striking fashion by binding together discs of iron and zinc and suspending the couple in the same cell (fig. 4). Different specimens of metal were used in this case. When the iron faced the brass, the voltage was 0·36. When the zinc faced the brass, the voltage was 0·48. When the edge of the disc faced the brass, it was 0·41. The effect was the same, whether the electrometer connection was made to the iron or to the zinc.

4. As regards the explanation of these experiments, it was first thought that the effects observed were analogous to those obtained in experiments on the "volta" effect. If the contact P.D. between two plates be measured in the ordinary way, the effect depends only on the physical state of those surfaces of the plates that face one another, and not at all on the state of the back surfaces. That the same state of affairs did not exist in these experiments was shown by electroplating with copper an iron rod, and then making a voltaic couple of this rod and a sheet of copper. When the iron was completely covered with copper, there was naturally no P.D. between the rod and sheet: but no sooner was a small speck of iron made visible by filing away the copper coating, than the P.D. rose to about 0·15 volt, *even when the iron speck was not facing the copper sheet.* As more iron became visible, the P.D. between the terminals of the cell continued to rise. The actual results are best shown diagrammatically. The shaded strip in fig. 5 represents the surface of iron visible.

(*a*) P.D. = 0·15 volt for all positions of the speck.
(*b*) 1. P.D. = 0·22 volt when the iron strip faced the copper sheet.
2. P.D. = 0·18 volt when the iron strip was turned away from the copper sheet.
(*c*) 1. P.D. = 0·24 volt, iron strip facing copper.
2. P.D. = 0·20 volt, iron strip turned away from copper.
(*d*) Half copper, half iron.
1. P.D. = 0·26 volt, iron facing copper.
2. P.D. = 0·31 volt, iron turned away from copper.
(*e*) All copper removed. P.D. = 0·42 volt.

These experiments, and particularly (*a*), show that the analogy to the "volta" experiment is not complete, for there no currents at all are flowing (excepting, of course, momentary displacement currents), while here, there is a local current flowing between the two dissimilar metals in contact. And it appears that it is this local current that

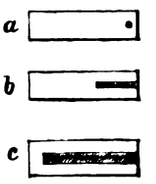


Fig. 5.

causes the curious phenomena recorded above, for what the quadrant electrometer really measures in all those cases is the E.M.F. of a voltaic couple as modified by the drop or rise of potential, as the case may be, due to the stream lines of the local current between the plates in contact.

5. Thus, consider again the simple case discussed at first (see fig. 6). The stream lines of the local current here flow from the zinc (Z) through the electrolyte to the iron (I). To find the P.D. between P and Q, where, to fix our ideas, we take P and Q as points on the copper conductors attached to the electrodes, as shown, we have to take a unit of positive electricity, by *any path whatever*, from P to Q, and determine how much work has been done in the process. If the unit is taken from Q through the *iron* plate to P, the P.D. is given by the *sum* of the E.M.F. of a brass-iron voltaic couple and the rise of potential along a *small* length of a

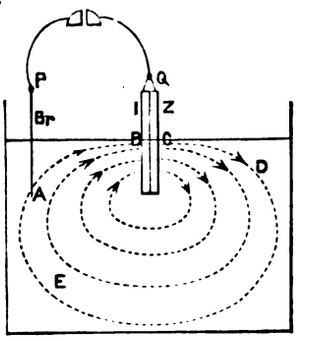


Fig. 6.

stream line, such as A B. If the unit is taken from Q through the zinc plate to the brass, the P.D. is the E.M.F. of a brass-zinc couple *lessened* by the drop of potential along a *long* length of a stream line, such as C D E. In both cases the resultant P.D. should work out the same. If, however, the iron-zinc couple is reversed, the P.D. between P and Q will be given by the *sum* of the E.M.F. of a brass iron couple and

D

* In an exceedingly interesting paper by Mr. A. P. Laurie, B.A., B.Sc., in the *Journal of the Chemical Society* for 1888, p. 104, I find the following statement:—"If, instead of a simple metal, a mixture of two metals is introduced into a voltaic cell, the E.M.F. of the cell is that of the more positive metal. . . . . Some experiments in a cuprous iodide cell, with plates of copper having pieces of zinc soldered on to them of about $\frac{1}{1000}$th of the whole area of the plate, showed this." [Op. § 5 (a)]. I confess my inability to reconcile this statement of Mr. Laurie with my own experimental results.

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the rise of potential along a *long* length of stream line, such as C D E, or, what comes to the same thing, the E.M.F. of a brass-zinc couple *lessened* by the drop of potential along a *short* length of stream line, such as A B. The resultant P.D. in this case is clearly greater than in the former case. In case (*a*) of the experiment described just above (Section 4, fig. 5), there is a great crowding of steam lines round the iron speck, and all are concentrated within quite a small volume (fig. 7), hence for all positions of the speck, the P.D. between P and Q is the same. As, however, the speck becomes enlarged, the stream lines spread out to some distance, and therefore the P.D. between P and Q depends on the relative position of the plate, Q, just as it did in the original experiments quoted.

(To be continued.)

THE ADVANTAGES OF LONG FILAMENTS IN INCANDESCENT LAMPS.*

When it was recognised by Edison and his co-workers some 20 years ago that the incandescent lamp was not suited for series work, but should be run on multiple constant-potential circuits, it was at once seen that these constant-potential circuits should be of as high a voltage as lamp construction would permit in order to make possible the distribution of the current over any reasonable distance from the dynamos. After considerable experimenting it was found possible to make lamps of a resistance high enough to withstand 100 volts, and this, with a margin of a few volts for full measure, making it 110 volts, came to be the standard recognised pressure of incandescent circuits.

During the 20 years since that time the incandescent lamp has been the object of as elaborate investigation and experimentation as any other one product of the mechanical arts, an enormous amount of time, money, and labour having been spent in its development, and with no mean results; but even at the present day, although lamps can be made for 240 volts, difficulties are encountered in making as good a lamp for the original standard pressure of 110 volts as can be made for lower pressure.

One of the difficulties in the way of raising the voltage of incandescent lamps may be illustrated as follows:—Assuming that the lamp is to be of 16 C.P. and of 3·5 watts per candle, its total consumption of power will be 16 × 3·5, or 56 watts. If burned on a circuit of about 56 volts this power will require 1 ampere, and the resistance of the lamp filament will have to be about 56 ohms. If, however, it is to burn on a circuit of 112 volts the power can only be kept down to 56 watts by cutting down the current to ½ ampere and the resistance of the lamp will have to be raised to 224 ohms. Thus it will be seen that doubling the voltage increases the necessary resistance four times, which is in accordance with a general law of purely resistive apparatus that the resistance must be varied as the square of the pressure to maintain the absorbed power constant. If the lamp is designed for a 220-volt circuit the current will have to be reduced to about ¼ of an ampere and the resistance will have to be raised to the extremely high value of practically 900 ohms to give the same economy of current. As the resistance of the carbon falls with increased temperature, the resistance cold is practically twice this, or, in the last case, 1,800 ohms.

The only way to obtain the high resistances of from 200 to 300 ohms necessary for lamps of 100 to 120-volt circuits is by using either a material of high specific resistance or of great length and fine diameter. Extended experiments in the direction of finding a suitable material of high specific resistance by means of incorporating more highly resistive substances with carbon, or otherwise, have uniformly proven in vain, the only material as yet found available being carbon in two of its allotropic forms. One of these is a variety similar to very dense charcoal, and formed by the carbonisation of the original cellulose thread of which practically all filaments nowadays are made. This form is known by lamp makers as "base" carbon. The other is a form of carbon closely resembling ordinary graphite.

All lamp filaments must contain as a foundation a central core of the former, or "base" carbon, filaments constituted wholly of graphite being impossible to make, since the graphite can only be obtained in the filament form by depositing it upon a skeleton structure of "base" carbon. This deposition is done by means of what is called the "flashing" or "treating" process. The carbonised cellulose thread is raised to high incandescence by electric current in a chamber through which is passed a current of gasolene vapour. The white-hot filament decomposes the hydrocarbon vapour, depositing the carbon as graphite upon its surface.

The "base" carbon has about six times the specific resistance of the graphitic carbon, so that filaments consisting wholly or largely of the former can be made much shorter and thicker for the same resistance than those containing a greater percentage of graphite. Unfortunately, however, the "base" carbon is much poorer in the qualities of economical light emission and life. This is not due, as many suppose, to any difference between the light-giving powers of graphite and charcoal; in fact, it is generally admitted that all substances, no matter what their colour, white, gray, or black, shine with the same intensity when raised to the same temperature of incandescence. But the graphite gives to the surface of the carbon a gray, metallic, steel-like appearance which can be plainly seen in all new lamps, and this gray surface, in conformity with a general law of physics, radiates much less heat when raised to a given temperature than does a dead black or sooty surface such as that of the "base" carbon or that of an old lamp in which

Fig. 1.

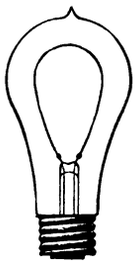
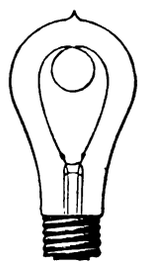


Fig. 2.



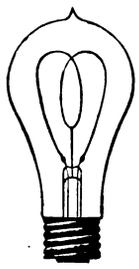


Fig. 3.

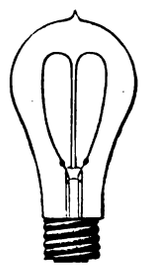


Fig. 4.

the surface of the graphite may have been reduced to the charcoal form. A filament, therefore, with a metallic gray surface requires less energy to supply this heat waste and raise it to the proper temperature of incandescence, such, for example, as to radiate 1 C.P. for every 3½ watts supplied, hence the superiority of the graphite for the economical emission of light.

Another superiority of the flashed or treated filament is mechanical. The graphite tube or sleeve which surrounds the "base" carbon is more dense and stiff than its central core, and hence holds the filament more rigidly against vibrations which tend to throw it against the glass, and also prevents it from sagging when the lamp is burned in a horizontal position. The graphite tube, deposited as it is at a high temperature, is a good resistant of the disintegrating effects of heat, and maintains the filament probably after the core of "base" carbon within it is broken down, thus greatly prolonging the life.

As stated above, the graphite is a good conductor of electricity as compared with "base" carbon, and hence if

* *American Electrician.*

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much of the cross section of the filament is graphite the diameter of the whole will have to be small and the length great, in order to obtain the necessary 200 or 300 ohms. The greater the amount of graphite and the less the amount of "base" carbon the better is the lamp for reasons pointed out above, and the general rule may be laid down that for a given voltage a lamp with a long filament is better than a lamp with a short filament, provided—and this is an important provision—the long filament is properly supported.

From the inception of the industry until a few years ago most incandescent lamps had filaments of the plain loop or horse-shoe type, such as is shown in fig. 1 of the accompanying cut. The filaments were thick and short, and little or no treatment was employed. As the superiority of the longer type became apparent the filament was given a loop or coil which allowed its length to be increased without enlarging the bulb, and its percentage of graphitic low resistance carbon to be increased with it, so that this filament took the familiar form shown in fig. 2. A variation upon it was the addition of more turns in the coil.

While this form is still made, it is largely giving way to another type developed by increasing the diameter of the coil and anchoring its lowermost point as illustrated in fig. 3, this being known as the oval anchored type. This allows a further increase of the length and percentage of low resistance graphite and is made in spite of several disadvantages. One of these is the impossibility of practically anchoring the filament during the process of flashing so that unsupported this process cannot be carried on at as high a heat as is desirable without badly warping the filament. The graphite deposited is more dense and stable with the higher temperatures of flashing, which cannot be obtained on the oval anchored filament. The cement used at the anchored point also causes trouble. This point being distant from the glass supporting the anchor wire and being heated in two directions and cooled in only one, rises to a high heat, throwing off gases within the bulb, which combine with the carbon on the surface of the filament to darken the latter, thereby tending to spoil the metallic gray finish which gives the lamp a high efficiency by reducing the amount of energy necessary to maintain the filament at the proper temperature, as pointed out above. In spite of these faults, however, the perfected oval anchored type is far superior to its predecessors, solely because a greater proportion of the filament's bulk is of the purer, denser form of carbon.

A further step in the support of long filaments is taken by making the filament in two pieces connected in series with each other, as shown in fig. 4, which illustrates what is commonly known as the double filament type. This double filament consists practically of two 8-C.P. 50 to 60-volt filaments connected in series with each other by means of a short piece of wire bedded in the glass and cemented at its two ends respectively to one end of each filament. In this lamp there is no oval coil to twist out of shape and short circuit on itself. The loop shape of the two filaments allows the deposit of graphitic carbon to be made at a higher temperature, making it dense and hard and durable.

For high voltage lamps, that is, those intended for 200 to 240-volt circuits, mechanical difficulties of course arise in making and supporting filaments of twice the length and half the cross section of those for 100 to 120-volt lamps. The result is that comparatively little or no "treatment" can be applied to such filaments without making their resistance too small, which accounts for their failure to equal 100 to 120-volt lamps in the qualities of efficiency and longevity. Still other expedients of support have to be used with these high voltage filaments such, for example, as anchoring two points, &c.

An idea of the proportions of graphitic to "base" carbon in modern 3·1-watt, 16-C.P., 100-volt lamps can be gained from the fact that lamps of the oval anchored type are treated down to approximately one-third of the original resistance of the base of the filament, whilst those of the double filament type are treated down to less than one-quarter of the original resistance, this reduction being accomplished by depositing a tube or sleeve of graphitic carbon with a thickness of about one-tenth of the diameter of the finished filament, thus making about one-third of its cross-section graphite, the inside four-fifths diameter, or two-thirds cross-section being "base" carbon.

RETURN FEEDERS FOR ELECTRIC RAILWAYS.

(*Continued from page* 223.)

By means of the graphic construction explained in the previous article, the sections of the cables can be readily determined for any given series of points of connection.

We shall discuss the method by the help of an example. Let the length of the line as in previous examples be 18 kilometres; the total current supplied 540 amperes, and the number of points at which the current is delivered, 18. Let the return cables be connected at 3, 9, 12, and 16 kilometres, and let there be also an end cable. The distribution of current under these circumstances is represented in fig. 4.

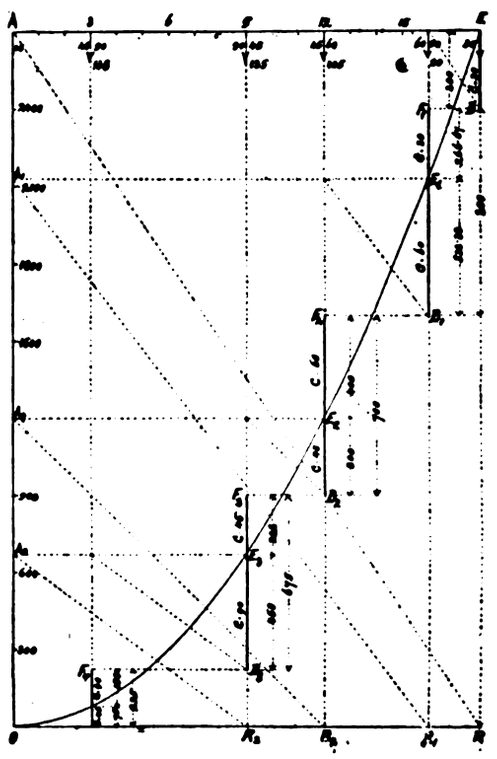

Fig. 4.

As has been already shown, the cross-section s_e of the end cable is proportional to its distance from the nearest intermediate cable, *i.e.*, $s_e : \Sigma(s) = 2 : 18$; and $s_e = 2{,}700 \times \frac{2}{18} = 300$ mm². We obtain this section by drawing from the connecting point, 16, on the diagram, a straight line parallel to the diagonal A R of the rectangle A E R O, till it cuts the side E R; the length E B cut off is the required section.

To obtain the section of the nearest intermediate cable, draw a perpendicular through the point 16 to cut the parabola in the point E_1. Assume for the moment that the line ends at 16 kilometres; then the total section required in this case is represented by the line $E_1 R_1$, and we obtain the section of the end cable by a construction similar to that given above, *i.e.*, draw from the point of intersection of the 12-kilometre line and the line $A_1 E_1$, a line parallel to the diagonal $A_1 B_1$. B_1 the point of intersection of this diagonal with the line $E_1 R_1$ gives the lower limit of the line, $F_1 B_1$ representing the section of the first intermediate cable. The lines representing the sections of the remaining cables are obtained by exactly similar constructions. The sections obtained for the end cable, and the 16, 12, 9, and 3 km. cables are 300, 800, 700, 675, and 225 mm² respectively.

It is now necessary to prove that the lengths $F_1 E_1$, $F_2 E_2$ ..... have the cross-sections required to draw off half the current in their respective sections of the line. Since currents which the cross-sections E B + $F_1 E_1$, $E_1 B_1$ + $F_2 E_2$ and so on, draw off are equal, the lines (E B) and (F E) must be proportional to the respective lengths of the cables. If we denote

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the total length of the line by L, and the length of the cable connected to the point next to the end by l; the equation to the parabola gives $l^2 = \frac{2 L K \Delta}{C} s$; hence $s = \frac{l^2 C}{2 L K \Delta}$, and since $\Sigma(s) = \frac{C L}{2 K \Delta}$, it follows that

$$s = \frac{l^2 \Sigma(s)}{L^2}.$$

Now, from the figure

$$E B + F_1 E_1 = \Sigma(s) - s$$
$$= \Sigma(s) \left\{ 1 - \frac{l^2}{L^2} \right\}$$
$$= \Sigma(s) \frac{L^2 - l^2}{L^2}.$$

But by construction

$$E B = \Sigma(s) \frac{L - l}{L}$$

Therefore

$$F_1 E_1 = \Sigma(s) \left\{ \frac{L^2 - l^2}{L^2} - \frac{L - l}{L} \right\}$$
$$= \Sigma(s) \left\{ \frac{(L + l)(L - l)}{L^2} - \frac{L - l}{L} \right\}$$
$$= \Sigma(s) \frac{L - l}{L} \left\{ \frac{L + 1}{L} - 1 \right\}$$
$$= \Sigma(s) \frac{L - l}{L} \cdot \frac{l}{L}$$

If now we find the ratio of $F_1 E_1$ to E B, it is

$$\frac{F_1 E_1}{E B} = \frac{l}{L}.$$

That is to say, the lines $F_1 E_1$ and E B on the diagram are in the ratio of the lengths of the cables which they represent.

A similar proof can be applied to the lines $F_2 E_2$, and $E_1 B_1$, and so on.

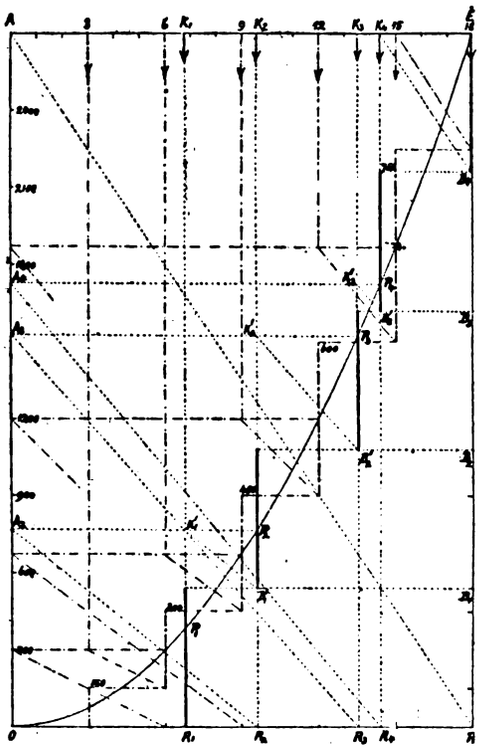

Fig. 5.

This demonstrates that the construction in fig. 4 gives the correct cross-section of each cable.

The construction just explained for finding the cross-sections of the cables when the points of connection to the line are given, may also be applied to solve the converse problem, namely, when the cross-sections of the cables are given, to find the points at which they should be connected to the line. The solution of this latter problem is of importance when commercial standard sections have to be used.

We shall show how to apply the construction to the case in which all the return cables have the same cross-section.

Let the total cross-section of the cables be, as before, 2,700 mm²; and let five return cables all of the same cross-section (540 mm²) be made use of. The line E B, fig. 5, is divided into five equal parts, at the points B_1, B_2, B_3, B_4.

Through the point B_4 a line $B_4 K_4$ is drawn parallel to the diagonal A B. K_4, the point of intersection with the line A, gives the point of connection (14·25 km.) of the first intermediate cable.

To obtain the point of intersection of the second cable, draw the line $K_4 B_4$ parallel to A O; through the point of intersection with the parabola P_4 draw the line $P_4 A_4$ parallel to A E, then project the length $B_4 B_3$ on to the line $K_4 B_4$. From B_3^1 draw a line parallel to the diagonal $A_4 B_4$ to intersect $A_4 P_4$ in K_3^1. The line $K_3 B_3$ drawn through K_3^1 parallel to E B gives the point of connection K_3 of the second intermediate cable. By continuing this construction the remaining points of connection K_2 and K_1 are found.

The unsymmetrical arrangement of the points of connection obtained, shows that it is not advisable to make use of return cables, all of the same cross-section. To get the most uniform distribution of the points of connection, the cross-sections of the intermediate cables should be made proportional to the lengths of the cables, the end cable being half the cross-section obtained by this rule.

This assumption is made in the second construction on fig. 5, and the cross-sections thus obtained are 150, 300, 450, 600, 750, and 900 × ½ = 2,700 mm²; the points of connection being at 3, 6, 9, 12, 15, and 18 km.

V.—The Influence of the Arrangement of the Points of Connection on the Volume of Copper Required.

We shall now proceed to determine whether, in the case of an unsymmetrical arrangement of the points of connection, a greater economy in copper is secured by crowding the points of connection towards the beginning or towards the end of the line.

Let us consider a line of length, L, to which currents are delivered at n places. To make the investigation as simple as possible, let us assume that there is an end cable and only one intermediate cable, which is connected to the line, at a distance of m currents in one case from the beginning of the line, and in the other case from the end of the line.

The distribution of the currents in the two cases are

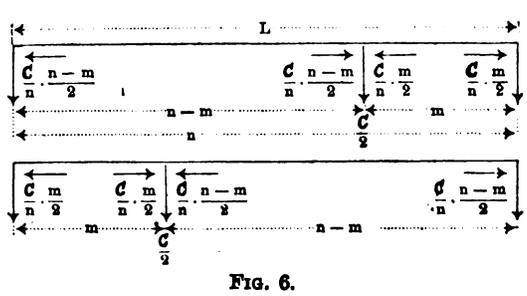

Fig. 6.

evident from the adjacent diagrams (fig. 6). In the first case the current which the intermediate cable takes off is :—

$$C_k = \frac{C}{n} \left\{ \frac{n - m}{2} + \frac{m}{2} \right\} = \frac{C}{2}.$$

The current in the end cable is

$$C_e = \frac{C}{n} \frac{m}{2}.$$

Since the lengths of the cables are $\frac{L}{n}(n - m)$ and L.

$$s_k = \frac{\frac{C}{2} \frac{L}{n} (n - m)}{K \Delta} = \frac{C L (n - m)}{2 n K \Delta}.$$

and

$$s_e = \frac{C L m}{2 n K \Delta}.$$

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From these we obtain the volume of copper:

$$v_1 = v_k + v_c = \frac{c\,L^2\,(n-m)^2}{2\,n^2\,K\,\Delta} + \frac{c\,L^2}{2\,n\,K\,\Delta}$$

$$= \frac{c\,L^2}{2\,n\,K\,\Delta}\left\{\frac{(n-m)^2}{n} + m\right\}.$$

In the second case the current which the intermediate cable draws off is,

$$c_k = \frac{c}{n}\left\{\frac{m}{2} + \frac{n-m}{2}\right\} = \frac{c}{2}.$$

The current in the end cable is

$$c_e = \frac{c}{n}\cdot\frac{n-m}{2}$$

Since the lengths of the cables are $\frac{L}{n}\,m$ and L_1 the cross-sections are

$$s_k = \frac{c\,L}{2\,n}\,\frac{m}{K\,\Delta} = \frac{c\,L\,m}{2\,n\,K\,\Delta} \text{ and}$$

$$s_e = \frac{c}{n}\,\frac{n-m}{2}\,\frac{L}{K\,\Delta} = \frac{c\,L\,(n-m)}{2\,n\,K\,\Delta}.$$

From these we obtain the volume of copper:

$$v_2 = v_k + v_e = \frac{c\,L^2\,m^2}{2\,n^2\,K\,\Delta} + \frac{c\,L^2\,(n-m)}{2\,n\,K\,\Delta}$$

$$= \frac{c\,L^2}{2\,n\,K\,\Delta}\left\{\frac{m^2}{n} + n - m\right\}.$$

An inspection of the expressions within brackets will show that $v_1 = v_2$.

It is therefore a matter of indifference, as far as economy of copper is concerned, whether cables are connected nearer the beginning or nearer the end of the line. It will be found, by similar reasoning that this result is quite general for any number of intermediate cables.

As an example, let us consider the 18-kilometre line discussed above. Let us assume that besides the end cable, there is an intermediate cable connected in the first place at 15 km., and in the second place at 3 km.

In the first case, the current passing through the intermediate cable will be

$$c_k = \frac{540-90}{2} + \frac{90}{2} = 270 \text{ amperes.}$$

The length of the cable is 15,000 m., and therefore the cross-section is

$$s_k = \frac{270\times 15{,}000}{60\times 30} = 2{,}250 \text{ mm.}^2.$$

The volume is $2{,}250\times 15 = 33{,}750$ dcm.^{3}.

In the end cable the current is $\frac{90}{2} = 45$ amperes, therefore the cross-section

$$s_e = \frac{45\times 18{,}000}{60\times 30} = 450 \text{ mm.}^2,$$

and the volume $450\times 18 = 8{,}100$ dcm.^{3}. The total volume is therefore 41,850 dcm.^{3}.

In the second case, the current in the intermediate cable is

$$c_k = \frac{90}{2} + \frac{540-90}{2} = 270 \text{ amperes;}$$

the length of the cable 3,000 m, and the cross-section is therefore

$$s_k = \frac{270\times 3{,}000}{60\times 30} = 450 \text{ mm.}^2.$$

The volume is $450\times 3 = 1{,}350$ dcm.^{3}.

In the end cable the current is

$$s_e = \frac{225\times 18{,}000}{60\times 30} = 2{,}250 \text{ mm.}^2,$$

and the volume $2{,}250\times 18 = 40{,}500$ dcm.^{3}.

The total volume is 41,850 dcm.^{3}, the same as in the first case.

The formula for the volume of copper obtained above, namely,

$$v = \frac{c\,L^2}{2\,n\,K\,\Delta}\left\{\frac{n^2}{n} + n - m\right\},$$

has a minimum when the expression within brackets is a minimum.

If we differentiate this expression with respect to m, and equate the differential coefficient to zero, we get

$$\frac{2\,n\,m}{n^2} - 1 = 0,$$

$$2\,m = n, \quad \text{or,} \quad m = \frac{n}{2}.$$

This means that the quantity of copper required is a minimum when the cable is connected to the middle of the line. In this case the intermediate cable takes a current of $\frac{c}{2} = 270$ amperes, and each end cable $\frac{c}{4} = 135$ amperes. The cross-sections are then

$$s_k = \frac{270\times 9{,}000}{60\times 30} = 1{,}350 \text{ mm.}^2, \text{ and}$$

$$s_e = \frac{135\times 18{,}000}{60\times 30} = 1{,}350 \text{ mm.}^2.$$

The total volume is

$$v = 1{,}350\times 90 + 1{,}350\times 18,$$

$$= 36{,}450 \text{ dcm.}^3,$$

that is, considerably smaller than in the unsymmetrical arrangements.

In the unsymmetrical arrangements the maximum potential difference in the rails is 8·4 volts, while when the cable is connected to the middle, it is only 3 volts.

(To be continued.)

BOARD OF TRADE REGULATIONS.

In a recent issue of an esteemed contemporary there appear some interesting notes on the above subject. The writer is of opinion that station engineers have no right to fix the "standard pressure" at the maximum pressure allowed by the Board of Trade. The regulations are perfectly clear upon this point. Regulation A1 states:—"The pressure of a supply delivered to any consumer shall not exceed 250 volts at any pair of terminals, except with the express approval of the Board of Trade, such approval will only be given for special purposes, &c." To this rule there is no exception, and the sooner station engineers learn to fix the standard pressure so as to allow of the 4 per cent. variation without exceeding the maximum, the less trouble they will have when the day of visitation by a Board of Trade inspector arrives. Another note deals with three-wire alternating distributing systems, and says that "Many engineers have considered that a 2 × 220-volt alternating current three-wire system comes within the category of high pressure supply." While, as the writer says, this applies to the distribution it cannot apply to two service cables, one connected to an outer and the other to the middle wire, provided the latter is earthed and that the other outer is not carried into the house.

In referring to Prof. Fleming's report to the Douglas Town Council, some adverse criticism of the Professor's opinions is given, and we are inclined to agree with the writer's remarks. That perfectly satisfactory high voltage incandescent lamps can now be obtained in open market of all reasonable candle-powers is well known, and we think that far too much importance is attached to the 5 C.P. lamp. How many people want these lamps even when they can obtain them? We believe station engineers will agree with us when we say that the demand is very small indeed, and when used they are frequently run two or three in series.

The much discussed question of fire risk and premiums is referred to in a further note. That all the insurance offices ought to reduce the premiums in case of electrically-lighted premises goes without saying, and although bad wiring has resulted in a few cases in an outbreak of fire, it is questionable whether any electric wiring has been half as bad as the gas pipes which are laid in the majority of houses. Small compo pipes kinked and badly jointed, run promiscuously under floors and behind plaster in positions where nails may be most readily driven through them, and are absolutely unpro-

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tected, cheap fittings with leaky cocks and badly cut screw threads, to say nothing of the highly dangerous waterseal chandeliers, and the thousand and one other oddments go to make up a system about as dangerous to life as it can well be.

There is no doubt that the ignorance of fire office inspectors in the early days must be held to be largely responsible for the present high rates for insurance. The majority knew little or nothing of the subject of electric lighting and were no doubt afraid of it.

Unfortunately all the chief offices are allied, and consequently to do as our contemporary advises, viz, to refuse to take out a policy with any office which will not make a reduction, would mean ignoring those offices which are financially sound, and possibly insuring in some office whose financial position is problematical. Now that the electric lighting of premises is so popular, we hope that the insurance companies will take the matter into serious consideration, and in common justice reduce the premiums for all properly wired electrically-lighted premises.

THE "LATENT DANGERS" OF ELECTRICITY.

By W. S. HEDLEY, M.D.

During an inquiry recently held before the Bradford city coroner, respecting a case of death from electric shock, the electrical engineer of the Bradford Corporation is reported * to have said that there are "latent dangers" (in electric lighting currents) "not yet fully realised." To me it appears that such a statement is calculated needlessly to alarm and seriously to mislead a certain section of the public. In point of fact the conditions under which electric lighting currents are likely to prove dangerous are fairly well understood; and from the occurrence of such conditions the ordinary user of electric light is securely and efficiently guarded. The witness in question preceded his very disquieting announcement by explaining that the deceased could not have received more than 225 volts, whilst the current was not generally fatal under 1,000 volts. It is not my present purpose to discuss the details of this case, nor to allude to a point which at once suggests itself, viz., that given a voltage of 225, and a three-wire system, and a leakage to earth on one of the outer wires (was this the "latent danger" darkly hinted at in the Bradford circuit?) it is possible to receive a shock at 450 volts.

Leaving this particular instance aside, it might be expected that in any such case an expert witness would explain that factors other than voltage, not less important and equally well understood, enter into the question. It is to intensity of current as measured in ampères rather than to mere voltage that attention may be usefully directed. Of course it is true that, other conditions remaining the same, danger to life increases in direct proportion to the electromotive force. But it is because these "other conditions" vary so widely that the effects of given voltages are so different. The duration of contact, the nature of the contact, its superficial area and position, the condition of the skin, the periodicity of the current, are amongst the chief factors to be reckoned with.

Kratter found that one short application of an alternating current at 1,500 volts did not always kill either rabbits or guinea-pigs. Yet much lower voltages have often proved fatal to man. It may be remembered that in one of the exhibitions at Kensington (the Fisheries?) a man was killed from a direct current Hochhausen machine, the voltage of which did not exceed 500; and the present writer has on former occasions quoted in the Electrical Review instances in which voltages considerably under 500 have caused death.

With reference to duration of contact, experiment has shown that currents easily borne by an animal when momentarily applied, were fatal when the application was prolonged to 5—10 seconds; and this is exactly what might be expected, for reasons both physical and physiological. It is obvious that the larger and better the contact, the greater the current. The condition of the skin with reference to moisture, or any breach in its continuity, comes to be a point of the highest importance, inasmuch as the epidermis is the great insulator of the body. The diminution of skin resistance (increase of current) by wetting is a familiar fact. This occurs (1) by water, a fairly good conductor, getting into the interstices of the skin; (2) by the formation of a good conducting joint due to a layer of water being interposed between the contact and the skin. The position of contact, *i.e.*, the points of entrance and exit of the current, in other words, the direction of the current's path through the body, is obviously of material consequence; for instance, does the heart lie in the line of greatest current density? Under such various conditions of contact it is not to be wondered at that, with a given E.M.F., the current received and the effects thereof must vary within a very wide range. It would indeed be remarkable were it otherwise.

In this connection it may be remembered that when, a few years ago, it was proposed to raise the limit of low pressure supply, a conference on the subject was held, under the auspices of the Board of Trade, and discussion was invited. On that occasion it was claimed by several of those present that they had received harmless shocks from what were then considered to be high pressure circuits. One gentleman asserted that he had felt no ill-effects from a 600-volt shock. The present writer, commenting upon this at the time, wrote as follows *:—

"In view of the fact that so much depends upon contact and the manner of taking a shock, and that little or no information was given on this point, it is difficult to form an opinion from such a statement. Did the gentleman in question touch one pole only of a 600-volt circuit? If so, what was the earth insulation of the other pole? Was his body in contact with the earth? Or, presuming that he simultaneously placed one hand on each pole of the 600-volt circuit—what was the surface area of skin contact, and what the condition of the skin? In the absence of information on such points, the statement referred to cannot be considered to have any real value. Had the surface area and condition of the skin been favourable for a low resistance contact, it is more than possible that the gentleman in question might ere this have been 'put to earth' in a sense other than an electrical one."

It is scarcely necessary to add that, had such a catastrophe unhappily occurred, its explanation might better have been sought in Ohm's law than in the shadowy hypothesis of "latent danger."

ACCUMULATORS AND VEHICLES.

The question must be very prominent in the minds of many as to whether electric accumulators are of the slightest use for the propulsion of vehicles. It is true that motor cars which depend upon accumulators make an occasional brave show in the streets of London; and one following in the wake speedily realises the difference betwen that and an oil car. But the prevailing notion is that accumulators are more or less experimental, and that we may have to wait some time before we obtain a really practicable electric motor vehicle. Although we cannot wholly coincide with such a view, there is, judging from recent experience, a certain amount of reason in that attitude. The performances of the London Electric Cab Company and the Electric Omnibus Company have done much harm to electrically-propelled vehicles of the self-contained type. The first-named concern was brought on to the market with a great blare of trumpets, and the public rapidly, if not eagerly, took up the venture. Electrically and commercially it was unsound, and the criticisms which were advanced at that time have been amply verified. It is quite true that an elaborate series of experiments were conducted by the engineers of the concern, and we firmly believe that a good deal of valuable information was thus obtained. But so far from the Cab Company benefitting from the experience which they obtained in this manner, and, selecting the best types of cell, they seemingly took up a cell which, according to their own tests, was quite inadequate to the needs of a cab service. Presumably, the

* *Westminster Gazette.*

* "Current from the Main," by W. S. Hedley, M.D., (Lewis).

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reasons that led the directors to adopt this accumulator were the somewhat handsome terms for maintenance offered by the accumulator company. Whatever the reasons may have been, it is said that the conditions of maintenance were not fulfilled, and with the absolute failure of the accumulators it was only a matter of time before the cabs were taken off the streets. An inquiry into the exact circumstances surrounding the flotation of this company would probably reveal some very disagreeable features. We do not for the moment propose to enter into such an investigation, but it should not be overlooked that this company paid for a form of gearing more or less valuable, practically £21,000, and on the top of that it entered into an agreement to pay a royalty of £4 per cab for the use of a controlling device. Without an accumulator all these patents, for which such handsome sums had been paid, were not able to be brought into practical operation. The Omnibus Company, which was formed to propel 'buses by electricity, had a protracted but inglorious existence, and it is doubtful if this concern, in the whole of its somewhat lengthy life, has left any data that can be of real value in future work. The disastrous results that have attended these schemes are likely to have very material influence upon future attempts to introduce electric cabs; and yet it would be exceedingly unfortunate both for the public and the electrical industry if any really sound concern were to meet with no support on account of former failures. The investing public, however, has a long memory, and it is certain that any scheme which pays heavily for patent rights, and is thus under the necessity of providing a large capital will meet with very little support. In Paris and America, particularly in the latter, a certain degree of success has attended the efforts to introduce a public service of electrically-propelled vehicles, and even within our own shores some of the most important and far-reaching results have been obtained in accumulator traction. We refer to the electric line at Birmingham, and though it is more or less an open secret that the maintenance figures obtained are most remarkable, there is, for some reason or other, a difficulty in persuading the owners of the system to publish actual results. This is particularly unfortunate, because this line is commonly credited with being the most expensive electric line in this country, or probably the world. Whatever may be the ultimate outcome of the New York electric cab service it seems that, financially and electrically, notable success has been achieved. Curiously enough, the commencement of the service in New York was almost contemporaneous with that of London. Probably the first efforts of the New York people were a little more modest than ours, for they started with 14 vehicles, and this has been gradually increased to 200 in actual operation. Later reports show that something like 2,000 vehicles are being constructed to operate in New York alone. Although one cannot attach much significance to financial operations, it is certainly worth mentioning that shares which cost £20 in 1897 now stand at £97. But what is of paramount importance to all interested in electrically-operated vehicles is the fact that a dividend of 8 per cent. has been paid on the preference, and a dividend of 2 per cent. on the ordinary shares. Surely if it is possible for an electric cab company to be electrically and financially successful in a city like New York, which is notoriously badly paved, how much better should such a service be in London. When we consider these figures one cannot help feeling indignant that there has been so much wasted effort in this country. It is extremely probable that attempts may be made in London during the next few months to start a new electric car service, and if that is the case, we would offer a word of advice to the promotors:—"Do not suggest anything that will involve a large capital outlay, keep down the vendor's price, and be sure of a satisfactory accumulator before making a start." Unless these conditions are met, we may be sure that any new attempt to start electric vehicles will receive but scant consideration.

GREENOCK ELECTRICITY WORKS.

THE new municipal station at Greenock was formally opened on Thursday last week, the current being switched on by Mrs. Cameron, wife of Bailie Cameron, convener of the Electricity Committee.

In an introductory speech, Bailie Cameron stated that the Corporation obtained a provisional order as early as 1883, but did nothing with it. A small committee was appointed about three years ago, urged on by the applications of two private companies for powers, but even then nothing was done until the Board of Trade threatened to admit a company.

About a year ago, acting on a report by Mr. Teague, of Paisley, the Corporation took proceedings towards erecting a supply station, and appointed Mr. S. E. Fedden, electrical engineer, who pressed on the work so rapidly that it was practically ready for the opening in seven months and ten days from the commencement of operations, a period said to be the shortest on record. Already applications for 3,000 glow lamps have been received, while there are 44 arc lamps in use for street lighting. The plant consists of two 60-KW. Silvertown dynamos coupled tandem to a Belliss two-crank compound engine, and one 180-KW. dynamo coupled to a three-crank engine, while a similar 180-KW. set is about to be put down. The boilers are of the Babcock-Wilcox type, two in number, with provision for four more, and there is a battery of 304 Tudor cells. The whole of the mains were laid by the Callender Cable and Construction Company, while the India-rubber, Gutta-percha and Telegraph Works Company were the principal contractors, and supplied the generating plant, switchboard, &c.

The Corporation has instituted an exhibition of electrical apparatus near the works, which was opened on the same day.

In the evening the Provost, Magistrates, Town Council, and a number of visitors were entertained at a dinner given by the contractors, at which Mr. W. E. Gray, of the Silvertown Works, presided. The usual toasts were honoured and a number of interesting speeches were delivered. Provost Wood, of Partick, described the difficulties with which his Council was contending in connection with the proposed electricity works; the trouble is due to the dust destructor with which the station is to be burdened *à la* Shoreditch. The Provost remarked that even if Partick is some day swallowed up by Glasgow, Mr. Chamen would be sure to want a generating station in Partick. In reply, Mr. Chamen raised no objection to inheriting the station if it was like the one at Greenock, which he most cordially approved of; but as for the destructor—words evidently failed him! He had been to Shoreditch, and seen the coal heaps in the boiler house, which he was informed were drawn upon every night. Even a dead donkey had been destroyed there, but this class of fuel could not be relied upon in Glasgow, though there were plenty of donkeys there who ought to be dead.

Mr. Bryson, of Leith, whose station was equipped by the same contractors, agreed with Mr. Chamen both with regard to the excellence of their work and on the subject of dust destructors.

In toasting the contractors, Bailie Cameron remarked that the fulfilment of the contracts exceeded the promises made, and the time originally fixed for opening the station had not yet arrived. There had been no disputes or misunderstandings whatever. Messrs. Gray and Callender feelingly acknowledged the compliments, the latter remarking that he was unaccustomed to them, while both expressed their admiration of Mr. Fedden's energy and skill. Mr. Best, who carried out the work for the Silvertown Company, came in for a good share of praise, which all who are acquainted with him know to be well merited. The company broke up at a late hour, after spending a most enjoyable evening.

CORRESPONDENCE.

Signalling Without Contact.

I must thank Mr. Pigg for his very kind and appreciative remarks, which, coming from a gentleman who has made so special a study of his subject as the author of "Railway Block Signalling," are particularly gratifying.

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Mr. Pigg's only adverse criticism is due to an extraordinary oversight in my paper, for pointing out which I am much obliged to him. The switch levers in the signal-box would necessarily have to be interlocked with each other and with the point levers, as all signal levers are now. All existing interlocking frames can be made use of without any alteration whatever; it is only necessary to fix suitable insulated contacts on the present levers, or, as was done at New Southgate, to actuate independent switches by the levers. This point is referred to in my letter in your issue of November 24th, and in an article on "The Fog Signalling Problem," that appeared in *Transport* on November 17th. For new work the interlocking might be either electrical or purely mechanical, as preferred.

"C. M. J." really is not fair; in his first letter he set forth numerous criticisms and questions with which I carefully dealt in my reply, and I asked in turn a few questions, to not one of which has he vouchsafed an answer. I, therefore, again ask: (1) In the absence of fogger and detonators, how does a driver discover that he is passing an invisible signal? (2) If he invariably knows when he is passing an invisible signal, of what use are the detonators? (3) If he cannot tell without the aid of the detonators what course is open to him but to go on moving until detonators are heard, or, as "C. M J." puts it, to "assume that the line is clear if he does not hear a detonator explosion"? (4) What bearing has praise of an old method, uttered before the appearance of a new method, as criticism on the said new method? (5) Why is it easier to read signals on the road than on the engine? (6) Where are trains to be seen running through four block sections per minute?

Now as to the 30 "indications and road numbers" per minute. I cannot admit that counting up the separate details of a signal gives a fair criterion of the work to be done in reading the signal, any more than the number of letters in a word is a gauge of the time needed to identify it. In either case the complete picture impresses itself on the eye as a whole, and when well known is identified in a flash. Independently of this consideration 30 per minute is something like double the possible. Suppose a train passing through one block section with four signalling positions per minute, and that at each position a double number is taken, there will thus be eight road numbers and eight semaphore indications, or 16 "letters," forming four "words" or pictures of great simplicity per minute.

I can assure "C. M. J." that I have not the very slightest "objection to the quotation from Sir George Findlay;" but if "the great improvements in that system" (the use of detonators) "that of late have taken place" have, as seems to be inferred by "C. M. J.," taken place subsequently to the publication of Sir G. Findlay's praise, *why* were they introduced after the system had been blessed in its former state?

It now appears that it is not an electrician but a teacher from an infant school that will have to travel on an engine fitted with my apparatus to tell the driver (literally in the case instanced) that two and two make four, and to point out that two spots are in the habit of changing colour both together from green to red and back, or, in the just possible case of a circuit failing, that they are standing fixed—one green and the other red. Experienced engine drivers have told me that they would be thankful to have my apparatus on their engines, but they have never asked for the infant school teacher.

Now as to signals on the engine taking the driver's attention off the road. I know that this is feared by some engineers, but until experience has been had, the matter is confined to conjecture. To me, it certainly appears that signals given always in the same spot on the engine and notified by a bell will monopolise far less of the driver's time than signals that he has, in all kinds of weather, to look for high up in the air and pick out from large numbers of other similar signals disposed round about.

"C. M. J." is, of course, as much entitled to his opinion as to the best plan of indicating signals as I am to mine. I am sorry I have not converted him, as I thought the back-view indicator would have met the case. The plan seems to me so straightforward and clear; every "stop" signal off is permission to go over the *whole* of the block section beyond, but no further. If you are free to go further at the time you pass the distant signal for the next section, then you are then positively told so; otherwise, you prepare to stop at the end of the section you are on.

If a wrong road number is given, whether through the default of the signalman or that of the apparatus, the driver, of course, as pointed out in my last letter, slows down and whistles for the right one. To give the number looked for in conjunction with the wrong road would need a mistake on the part of the signalman and a failure of the apparatus *at the same time*.

In regard to single line working, I must repeat that I propose to operate the danger magnets entirely in duplicate with a current indicator on each circuit. "C. M. J.'s" final question—"How can the switches that would be required for throwing these electro-magnets 'in' and 'out' be safely and efficiently controlled?"—is, coming as it does at the end of his second letter on a system based on the continual manipulation of such switches, to say the least of it, somewhat astonishing! Does "C. M. J." think that a danger magnet must be equal to the field magnet of a good-sized dynamo? As a matter of fact, the loss in each coil need not be as much as $\frac{1}{10}$th of a watt, or, the current equal to that rapidly made and broken in a small trembling bell.

In conclusion, I may say that I am glad to find that "C. M. J." can call anything of mine—even equations—simple. It would have been more in accord with the rest of his letter to have written M^2 for M_2, and called the equation quadratic!

W. S. Boult.

December 2nd, 1899.

Electric Cranes.

In the first instalment of the very interesting article on "Electric Cranes" which appeared in the issue of the REVIEW for November 17th, a three-motor crane, built by Messrs. Carrick & Ritchie, is described and illustrated.

Assuming that the hoisting and cross-traversing motors are reversed by the liquid resistances, it is difficult to see how the four cross wires are sufficient to make the necessary connections to both motors. The usual practice appears to be to fit seven or eight cross wires, according to whether the electrical brake is series or shunt wound, and if some of these wires can be dispensed with, it would be of great value to know the method of doing so.

Would the able writer of the article in question explain how the trick is done in the crane he describes?

H. W. W. D.

[We are sorry to disappoint our correspondent; but, of course, the statement referred to was a slip, and *seven* wires were used, three of them being hidden by the others.—EDS. ELEC. REV.]

Tested Lamps.

I have read with interest your correspondent's letter under the above head in your last issue. Having had a large experience with lamps, I think that I might safely give you a few of my results.

I have found that some firms can make a very good 100-volt lamp, whilst their 200-volt lamp is by no means so satisfactory.

To obtain a parallel curve between the 100 and 200-volt lamps it would take a good deal more than a ·7 increase on the watts per candle of the former. In many of the lamps that I have tested I have found that the current rises as the lamp burns, a fact that I cannot account for, unless it is that the gas which is left in the bulb, owing to it being at a very low pressure, only gradually deposits on the filament.

In testing lamps of various makes I have not selected those of the same efficiency, but taken them as they came and run them for a certain number of hours. I found that the most efficient lamps were not necessarily English.

I have been told that the Tested Lamp Company supply many different makes. This being so, your correspondent's suggestion cannot hold.

F. P. S.,
Electrical Engineer.

December 4th, 1899.

In your current issue, a correspondent signing himself "English Electric Engineer," quotes the name of the above

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company as having given you vague and unsuitable information. Permit me to say that this must be a mistake, as no information, vague or explicit, has been supplied to you by any official of this company.

Your correspondent misquotes an article which appeared in the *Electrical Engineer* of November 3rd, and makes other erroneous statements which it is no part of the duty of this company to correct.

The writer of the article in the *Electrical Engineer*, whom your correspondent accuses of making "absurd" statements, is an engineer of some distinction, and fully capable of making an adequate reply to your correspondent should he consider any commentary necessary.

Finally, it is asked whether "the Electric Tested Lamp Company is an agency for an American or Continental lamp?" As this last paragraph verges on the libellous, I must ask you to publish my statements: (1) That the company in question is in no way connected with any lamp manufacturer, English, American, or Continental. (2) That at least 95 per cent. of the company's business is in English goods of various makes.

You will greatly oblige me by publishing this letter, and should you care to go further into the matter, I shall at all times be glad to furnish you will any information at my disposal.

A. W. Gattie,
Managing Director
The Electric "Tested Lamp" Company, Limited.

London, *December 4th*, 1899.

The Influence of Cheap Fuel on the Cost of Electrical Energy.

In reference to your remarks on my paper, there is one point in which you are liable to mislead your readers. When you refer to the figures given at the end of my paper, which represent the actual cost of power at our Chelmsford works power station, you talk about them as optimistic, and then proceed to compare them with results obtained at Manchester and elsewhere. I would first remind you that the figures furnished in my paper are an actual copy of the log sheet for the 49 weeks immediately preceding the writing of my paper, and represent very accurately the actual results obtainable from a modern power station which supplies power for a modern engineering works. The sole reason why they are better than the figures for Manchester, Bradford, and Leeds, or other lighting power stations, is that naturally the load factor of an engineering shop is an extremely good one, and that there are, of course, no distribution costs or losses to be included.

As regards the question of bituminous coals, which you state receive tardy recognition, I think you will find that engineers of power stations have for many years past undoubtedly been attempting to utilise the high calorific value of bituminous fuels. It is the extreme difficulty of doing this which has prevented any great progress being made. It has been found in practice that it is an extremely difficult matter to prevent visible smoke being from time to time produced by furnaces burning bituminous fuel, and one of the objects of my paper was to call strong attention to this fact, and to the desirability of attention being paid to the perfecting of the combustion chambers, which are absolutely necessary if we are to satisfactorily attain this object.

R. E. Crompton.

An Electrical Supply Question.

In reply to the question in your issue of the 1st inst. *re* above, I think "Supply Company" will find that a company or Corporation are compelled by Act of Parliament to give a supply to all applicants within the township or boundary—whether the applicants have a private supply of current, or otherwise, providing they comply with the conditions of supply.

Zero.

[We refer to this question in our leader pages this week.—Eds. Elec. Rev.]

Three-Wire System of Distribution.

In stating the advantage gained as regards saving in copper by substituting a three-wire for a two-wire system, it is argued, where a conversion of the kind is under consideration, that the capacity of the mains would be increased fourfold; and in your leader of the 24th ult. you state, when comparing the two systems, that the weight of copper is reduced in the ratio 16:5. Surely this works out at 8:5 in transmitting *the same energy for the same distance*, for the sectional area of two mains is halved, whilst a third is added having a sectional area equal to one-eighth of their total. Of course, for the *same percentage drop in potential* the ratio 16:5 is correct, but then for the same distance double the energy is transmitted; therefore it would seem fairer to the three-wire system if, in comparing its advantages as regards mains with the two-wire arrangement, the saving in copper were always spoken of as five to eight.

I.

[This matter has been explained again and again. In comparing two systems of electrical transmission of power, the *efficiency* must be the same in both; if not, the result can be made whatever one pleases. This condition being fulfilled, the three-wire system transmits *the same energy* for *the same distance* with from $\frac{7}{16}$ths to $\frac{6}{16}$ths of the copper required by the two-wire system.—Eds. Elec. Rev.]

BUSINESS NOTICES, &c.

Electric Tramway Lists.—The publishers of the Electrical Review have had a number of copies of the "List of Electric Tramways and Railways in the United Kingdom," which accompanied our last issue, mounted on linen, and these can be obtained at 1s. per copy, or 1s. 3d. post free.

Electrical Wares Exported.

Week ending Dec. 6th, 1898.

Adelaide	Value £55
Barcelona	115
Bombay	110
,, Teleph. mat.	42
Boulogne	109
Buenos Ayres	1,427
Calcutta	1,775
Cape Town	349
Christiania	54
Cienfuegos. Teleg. cable ..	197
Durban	276
,, Teleg. mat.	73
East London	254
Ghent	33
Gibraltar	24
,, Teleg. mat.	750
Hobart	20
North Atlantic. Teleg. cable ..	1,000
Port Elizabeth	350
Shanghai	185
Singapore. Sub. Teleg. cable ..	192
Sydney	1,130
,, Teleg. mat.	66
Trinidad	96
Wellington	179
,, Teleg. mat. ..	1,287
Total ..	£19,317

Week ending Dec. 5th, 1899.

Alexandria	Value £570
,, Teleg. mat. ..	51
Amsterdam	50
Bangkok	128
Beira. Teleg. instruments ..	48
Bilbao	56
Boca. Teleg. mat.	222
Bombay	16
Boulogne	70
Brisbane	265
,, Teleg. mat.	649
Buenos Ayres	245
,, Teleg. mat. ..	118
Calcutta	705
,, Teleg. wire	47
Cape Town	209
Chinde. Teleg. mat.	941
Colombo	38
Durban	1,722
East London	50
Fremantle	13
Hamburg	330
Hong Kong. Teleg. wire ..	82
Madras	91
Malta	149
Mauritius	23
Melbourne	427
Montreal	116
Novorossisk	80
Ostend	118
Perth	93
Port Elizabeth	85
Port Said	366
Rotterdam	920
Santos	62
Shanghai	£30
Singapore	84
Stockholm. £3 T. teleg. wire ..	
,, (Value not declared)	
Sydney	1,144
Yokohama	400
Total ..	£11,257

Foreign Goods Transhipped.

Brisbane. Telephone	44
Rotterdam	35
Total	£79

Buenos Ayres. Elec. mat. ..	43
,, Teleph. mat. ..	90
Flushing. Elec. goods	30
Perth. Elec. motors	967
Total ..	£1,130

Appeal Case—Stegmann v. O'Connor.—In the Court of Appeal on Thursday, December 7th, Lords Justices A. L. Smith, Henn Collins, and Vaughan Williams on the Bench, judgment was given in the case of Stegmann *v.* O'Connor, which was argued before their Lordships on November 16th. This was the appeal of the plaintiff, Mr. Stegmann, an electrical engineer, from the judgment of a Divisional Court, composed of Justices Bruce and Ridley, on February 18th of this year, confirming a decision of the Official Referee, who had awarded the plaintiff £50 on a counterclaim as being a penalty of the liquidated damages provided for by a contract for an electric lighting installation at defendant's house, "Mount Cashel," Nightingale Lane, Clapham. Mr. Tindal Atkinson appeared for the appellant (the plaintiff in the original action), and Mr. Clavell Salter for the respondent

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(the defendant in the action). Lord Justice Collins read the judgment of himself and Lord Justice Smith. They were of opinion that the plaintiff was certainly liable for not less than £50, liquidated damages on the facts of the case, and that the appeal, therefore, should be dismissed with costs. Lord Justice Vaughan Williams dissented. After quoting several authorities, his Lordship said it seemed to his mind clear on the findings and figures of the Referee that he had given the proprietor the liquidated damages for the time after the exclusion of the engineer from doing the work. That, to his mind, was clearly wrong, and he thought the case should go back to the Official Referee to find whether the proprietor, by his conduct, had disentitled himself to claim, and so that it might be determined whether the facts were such as to make the plaintiff chargeable for the delay during the time preceding the exclusion of the engineer. It did not seem to his Lordship that the case could be satisfactorily disposed of without reference back. On the finding of the majority of the Court, the appeal was dismissed with costs.

Auer's New Incandescent Electric Lamp.—Under the heading, "A Windfall for Welsbach," the *Westminster Gazette* says:—

We are able to make an important announcement as to the great Welsbach Company. At the last meeting much was made of Dr. Auer's new incandescent electric lamp. It is claimed for this lamp, it may be remembered, that it will do for the electric light what the incandescent system has done for gas; that it cheapens the light by more than half; that the Welsbach incandescent electric lamp will give four times the light of the ordinary incandescent lamp. One new point is that the new lamp is now perfected, Dr. Auer having just gone to Berlin to give its manufacture his final supervision. New premises have been erected by Messrs. Pintsch for the manufacture of the lamp in all sizes, and it is expected that it will be ready for introduction into this country early in the new year. Another new point is as to the financing of this latest lamp. We are given to understand that according to the arrangement between the Welsbach Company and the inventor it will by no means involve any new capital expenditure; on the contrary, it will mean a windfall for the Welsbach shareholders. The Welsbach Company owns three-sevenths of the patent rights throughout the world, and this, it is estimated, represents in value about £2,000,000 sterling. According to present arrangements the Welsbach Company will not work its rights, but will immediately dispose of them, which, if half the hopes are realised, will, as we have said, mean a handsome windfall for the company and its shareholders.

Bankruptcy Proceedings.—At a sitting of the London Bankruptcy Court, held on Wednesday before Mr. Registrar Giffard, Frederick George William Adams, electrical engineer, lately carrying on business in partnership as Downie & Adams, at 24, Newman Street, Oxford Street, W., attended for his public examination. He has filed accounts showing unsecured debts £1,000, contingent liabilities £2,142 7s. 9d. (not expected to rank); and assets consisting of shares in the Premier Electricity Meter Company, Limited, value not stated. In the course of his evidence the debtor stated that he and a partner in February, 1897 (with £1,000 capital provided by himself) commenced business as electrical engineers, at Bush Lane House, Bush Lane, Cannon Street, E.C. In June, 1897, they removed to No. 24, Newman Street, Oxford Street, W. In January last, in consequence of differences between them, his partner ceased to attend to the business, and in the following July the lease of the premises was surrendered and witness abandoned the business. He had previously handed a large part of the stock to creditors who were pressing, and sold other stock, at much less than cost, to a relative for £180, which sum was paid to pressing creditors, whilst the fixtures and the remainder of the stock (of small value) were left on the premises, against rent due. He had been without occupation since July last, and is dependent on a relative. In March, 1898, he and his late partner, together with another person, promoted the Premier Electricity Meter Company, Limited, (with a nominal capital of £25,000 in £5 shares) to which the firm assigned a license which they held for the working in the United Kingdom and the Colonies of two letters patent for improvements in electric meters, and known as the Brillié patents, in consideration of £20,000, payable in shares, half of which were to be handed to their associate for his services in connection with the promotion of the company, and for raising working capital. The company also agreed to take over 50 meters made under the patents, and all fittings, instruments, &c., used in the testing and the sale of the meters, at the price of £500 payable in cash, but only £250 thereof was received by the firm. He attributed his failure and insolvency to loss on the capital contributed by him to the partnership, in consequence of bad debts and other causes. The examination was ordered to be concluded.

A receiving order has been made against H. L. Howard (Thompson, Howard & Co., Harrogate and Hull), electrical and mechanical engineer.

Liquidations, Dissolutions, &c. — The Electropathic and Turkish Baths, Limited, is winding up voluntarily. Mr W. R. Waller, 3, Bucklersbury, E.C., is liquidator. Creditors are to send particulars of debts, &c., by January 6th. Shareholders will meet on January 15th to hear an account of the winding up.

F. H. Cerrito, A. E. A. Edwards, and W. Shaw (Cerrito, Edwards and Shaw, consulting, mechanical and electrical engineers, Birmingham) have dissolved partnership. Messrs. Edwards & Shaw will continue in partnership at 105, Colmore Row, and Mr. Cerrito will carry on business at 39, Newhall Street, Birmingham.

A meeting of the London and Hampstead Battery Company, Limited, will be held at Donington House, Norfolk Street, W.C., on Friday, January 5th, to hear an account of the winding up from the liquidators, Messrs. R. J. S. Beeton and S. T. Turtle.

Books Received.—"Fire Tests with Ceilings." A ceiling constructed with slag wool, by D. Anderson & Son, Limited, London, and J. C. Broadbent & Co., Limited, London. London: The British Fire Prevention Committee. 2s. 6d net.

"Central Station Electricity Supply," by Albert Gay, and C. H. Yeaman. London: Whittaker & Co., 1899. 10s. 6d.

"The Gold Fields of Victoria." Monthly Return, August, 1899. Issued by James Travis, acting Secretary for Mines, under the authority of the Hon. Henry Foster, M.P., Minister of Mines.

"Victoria, its Mines and Minerals." Special edition (English) of the *Australian Mining Standard*. June 1st, 1899. Melbourne and Sydney: F. Critchley Parker. 1s. 6d.

The Copper Market in November.—Messrs. H. R. Merton & Co.'s last statistical return shows that during November the supplies of copper have totalled 18,650 tons, as against 18,821 tons delivered. Stocks would, therefore, have suffered only a slight diminution had not 868 tons of Standard copper been re-shipped to America. This increases the fall in stocks to 1,039 tons; and the movement in price from £72 17s. 6d. on October 31st, to £73s. 15s. on November 30th, is due chiefly to this cause.

The supplies during the second half of November made up for the shortage visible during the first half of the month; and the total of 18,650 tons is about equal to the average for the preceding 12 months. It is interesting to note that the supplies from North America have undergone considerable increase in November, and are above the average for the year. The monthly totals since July 1st are given below:—

July	7,457 tons.
August	8,150 tons.
September	8,407 tons.
October	8,135 tons.
November	10,791 tons.

Whether this increase in the shipments from New York to Europe will be maintained remains to be seen. The November increase, however, lends support to the opinion held by many, that the 8,513 tons of Standard copper which since July have been shipped to New York, will, after electrolytic refining, be returned to the European market. The supplies from Spain and Portugal, and from "other countries" during November are disappointing, the total in each case being considerably below the average; and it would be instructive to have for comparison the shipments direct from these producing countries to New York. The supplies from Chili and from Australia are about the usual figure. The latter country has not shown that increase in production during 1899, which the figures for 1898 had led one to expect.

No new copper mining companies have been floated in London during November. Mr. Alfred Beit is, however, said to be promoting a company for working the Otavi copper mines in South-West Africa. These mines are to be exploited in connection with a railway scheme in the same district. Until the present war is over, and the situation politically quiescent, it is, however, improbable that any copper mining developments in South Africa will occur.

Mr. J. Plummer, writing to the *Engineer* under date November 10th, has given some interesting details of the copper mining industry in New South Wales. The Great Colar mine is 550 miles west of Sydney, and was reopened in 1894. In 1895 it produced 1,703 tons copper; in 1896, 2,650 tons; and in 1897, 2,462 tons. The production of the smaller mines in 1897 was as follows:—Nymagee, 543 tons; Burraga, 727 tons; Mount Hope, 110 tons; South Mount Hope, 110 tons; Girilambone, 733 tons. Inadequate railway communication hinders development, but this is being remedied.

According to the *Toronto Globe*, native copper has been found upon the shores of Black Bay in shot-like particles, and samples of the conglomerate beds have assayed 2—2½ per cent. copper. If this discovery is confirmed a company will no doubt be promoted to work these deposits. The "Superior Gold and Copper Company" are the present owners of the claim.

Leading articles upon the position of copper have recently appeared in the *Investor's Guardian* and the *Financial Times*.* These deal with a pamphlet recently published, of which Messrs. Brown and Turnbull are the joint authors. The statistics of copper from 1801—1898 have been industriously compiled and presented in this pamphlet. The authors take a distinctly gloomy view of the situation, and consider that sooner or later there will be a "famine in copper." The writers of the articles named combat this opinion, and hold that supplies will increase, and that they will probably keep pace with the demand.

According to the *Financial Times*, the 10 months' consumption statistics of copper show a decline of 22¼ per cent. in England; of 10⅝ per cent. in Germany; and of 1⅛ per cent. in France. If this falling away in consumption is permanent, and indicates the substitution of other metals for copper, the capacity of the producing mines will not, therefore, be greatly strained in "keeping pace with the demand." Possibly Messrs. Brown and Turnbull are not entirely disinterested in predicting a coming famine in copper.

With reference to the future prospects of the Amalgamated Copper Company, the following extract from the *Financial Times*, of November 7th, is of interest:—

The decline of the Amalgamated Company's shares to $96 is a tolerably good indication of the average American's opinion of the chances of the concern, and the decision to cease issuing reports of the Anaconda Company will not be a cause of strength either in the United States or in Europe, nor will the official announcement by the Exploration Company that in consequence of this decision not to publish accounts they have resigned their appointment as the European agents to the company. On the other side there has of late been a prodigious decline in the values of the best copper shares, such as Calumet and Heclas, Boston and Montanas, Quincys and Tamaracks, which are excellent investments in normal circumstances; lake copper has gone back to 17c. per pound; and, as Messrs. James Lewis & Son remind us, the Americans are pressing the sale of electrolytic copper at lower quotations. "Every indication in this country," writes an American correspondent of the *Pall Mall Gazette*, "points to a steady decline" in copper shares—a decline, that is, not from the highest points reached in the spring, but from those at present ruling.

The Corporation of Cardiff v. Ferranti.—Before Mr. Justice Bigham, in the Queen's Bench Division on 1st inst., Mr. Leslie applied that the case of the Corporation of Cardiff *v.* Ferranti should

* *Investor's Guardian*, November 18th; *Financial Times*, November 7th, 14th and 20th.

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not be taken until Wednesday, while keeping its place in the list. Counsel stated that there were some 20 or 30 witnesses. His Lordship granted the application.

Catalogues and Lists.—From Messrs. Witting Bros., of Cannon Street, we have received a copy of their new illustrated traction brochure in which they describe their standard motor for electric tramway and railway work. Efficiency, torque, and speed curves are given. Their series-parallel controllers are also detailed in the list. The motors, &c., mentioned, are made at the works of the Electricité and Hydraulique, Société Anonyme, at Charleroi, Belgium, and Jeumont, France.

Messrs. R. A. Broadhurst & Co., of Tottenham Court Road, send us one of their trade list of measuring instruments, switches, fuse-boards and accessories.

From Messrs. Thomas Parker, Limited, we have received a brochure in which a description of the Bootle Corporation Electricity Supply Works is given, it being accompanied by a number of first-class photographic views of the works and plant. A reprint is also given from an engineering journal of a descriptive account of Messrs. Parker's works and specialities. The general get-up of this brochure is excellent.

The Charge of Stealing Electricity.—At the West London Court on 29th ult., A. J. Harrison, electrical engineer, surrendered to his bail, to further answer the charge of stealing electricity from the mains of the Hammersmith Vestry. Additional evidence was given showing that he had a dispute with Mrs. Thomas, who let him some rooms at 262B, King Street, Hammersmith, and made an arrangement for other lights. Wires were fixed, and according to Mrs. Thomas the prisoner caused considerable damage. After the dispute she locked him out.—In cross-examination Mrs. Thomas denied having made any arrangement with the prisoner to take the electric light from the wires, though she believed he was taking it.—Rose Brady, the servant, deposed to the prisoner stating that he was taking the electric light from the main.—Mr. Hanson, in his questions to Mr. Bell, the resident engineer, endeavoured to show that the tubing fixed was bent to pass over the fuse affixed to Mrs. Thomas's wires. He also said the electricity was taken from her fuse.—A further remand was granted for the distance to be measured.

Electrical Enterprise in Germany.—It is common knowledge, says the *Financial Times*, that electrical enterprises in Germany have been promoted on a larger scale than in the United Kingdom, but it is not so well known that a check, perhaps only of a temporary character, has been brought about in regard to speculation in these undertakings. In the course of a series of articles now appearing in the *Frankfurter Zeitung* on the subject of the "Money Market and Paper Securities," reference is made to the causes which have led to the assumption by speculators of an attitude of reserve in respect of electrical projects. The German paper states that electricity works have found it extremely more difficult to raise fresh capital, and that the manner in which large orders were previously obtained was coupled with the advantages accruing from a plentiful supply of money at easy rates. For this purpose various trust companies were formed with the object of attracting money by the issue of shares, and of taking up and completely hatching undertakings which were not ripe for the public. As soon, however, as it was found that the enterprises formed for the purpose of utilising electricity would require a longer period for development than that which was assumed with enthusiasm in the initial stages, the speculative element took up a more reserved attitude in relation to the shares, and even the placing of bonds was rendered difficult by the tightening of the money market. As a result, the electricity companies, including the largest, at the present time experience more difficulty in obtaining fresh capital, and the consequence is that they stand aloof from the promotion of new schemes, at all events, until more favourable conditions prevail. Even the construction of electric tramways and power stations is not being carried on with that zeal which was so characteristic some time ago. This is due partly to the monetary troubles already mentioned, but it is largely owing to the fact that the very sanguine expectations from the substitution of electric for horse traction have not been completely fulfilled, especially as the transformation saddles the converted lines with a large amount of dead capital, due to the laying of new rails and the change in rolling stock. It is true that certain extensions in almost every direction are being made, but speculators have practically withdrawn for the time being, from participation in new undertakings, the general opinion being that performance in the case of the numerous existing electrical enterprises should take the place of promise before speculators should again interest themselves in an industry which has received a set-back of some importance.

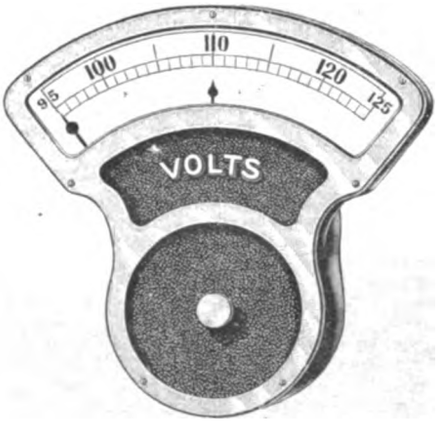
The Hornsby Improved Safety Water-Tube Boiler.—In general form this boiler partakes of the main features of the Babcock & Wilcox type, but it consists of tubes fixed into flat rectangular headers, the upper header being attached in the usual way to the steam drum and the lower header having a short connection to the mud drum by pipes parallel with the main water pipes. The mud drum is then connected by vertical pipes to the steam drum. The mud drum is thus entirely distinct from the header and is by this better fitted to perform the functions indicated by its name. To ensure the steam and water as they enter the steam drum being separated, an annulus of slotted plate is provided and forms a chamber concentric with the shell of the drum, which indeed forms one boundary of the flat annulus. The slots are for the purpose of separating the water and steam; they only occur above water level. Hence the circulating water is delivered above the water level in the drum. The standard pressure adopted by Messrs. Hornsby is 120 lbs. and the boiler is rated by its evaporative power, in terms of 1 H.P. being equivalent to 30 lbs. evaporation per hour. A boiler of 242 H.P. on this basis occupies an area of about 23 feet × 14 feet, has a grate area of 52·60 square feet and two drums 42 inches diameter. The course of the draught is directly up from the furnace amongst the water tubes and after that three more passes are made, the gases finally passing off below the tubes. The down comer pipes to the mud drum are not within the brickwork but fully open to view outside, as also is the mud drum and blow-out elbow pipe. A boiler of 242 rated H.P. is of nearly 32 tons shipping weight and 2,220 cubic feet capacity.

The Institution of Junior Engineers.—At the meeting of this Institution held at the Westminster Palace Hotel on Friday, December 1st, the chairman, Mr. Basil H. Joy, presiding, the paper read was on "Natural Methods for the Purification of Water-carried Sewage," by Mr. G. Drysdale Sweetman, member, of Ryde.

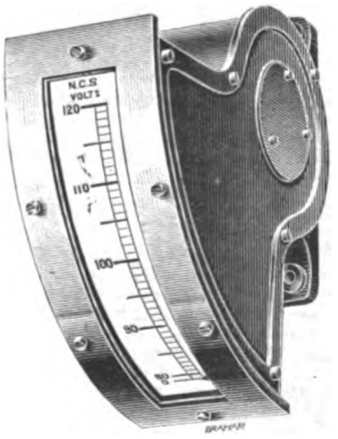
Klein Condensers.—The Klein Engineering Company Limited, have recently received an order from the Liverpool Corporation to erect at their Lister Drive Power Station, a combined condensing and water-cooling plant for engines of 3,600 H.P. The condenser and pumps are of special and improved design recently introduced by the company, and the results obtained will be watched with interest by electrical station engineers. The coolers are of the well-known Klein's patent chimney type. The complete plant will be one of the largest installations of central condensing and cooling plant supplied and erected by British engineers at electricity works in this country.

Light Railways.—The Light Railway Commissioners have asked the Board of Trade to confirm the Easington and Ashmore light railway order; and the Board has confirmed, after modification, the Wick and Lybster, and Doncaster orders.

New Central Station Instruments.—Central station instruments in edgewise and sector shape patterns are now being made by Messrs. Nalder Bros. & Thompson, Limited. The edgewise instruments are made in three sizes, 7 inches, 9 inches, and 12 inches



radius, and the two larger sizes can be made with illuminated dials if required. The sector shape instrument illustrated has a scale 12 inches long, the pointer being 9 inches in radius. This instrument is also made with either illuminated or plain dial according to require-



ments. The movements are permanent magnet moving coil dead-beat type in the case where used for continuous current, and for alternating current work the ordinary electro-magnetic movement is supplied. This can be also made with compensation so as to be capable of use on circuits of any periodicity.

New Enclosed Motor.—The illustrations given on next page show the design of a new enclosed direct current motor (the Wilson) which it is claimed embodies special and novel features of construction. The principal difficulty manufacturers of enclosed motors have to contend with, as apart from ordinary open type motors, is in con-

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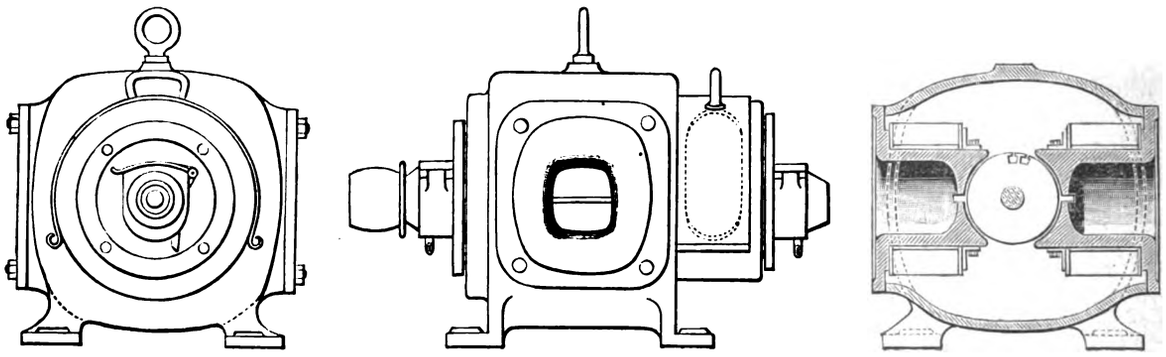
nection with getting rid of the heat generated by the resistance of the armature and field coils, and anything which tends to modify this difficulty may be considered of special utility, inasmuch that the size and cost of manufacture of the machine may be reduced in proportion. As will be seen the motor is constructed with two large hollow field cores, which are made of magnet steel, and for convenience of manufacture and dismemberment are made separate from the body or yoke casting. A large and very effective additional cooling surface is thus provided for the field coils. Another important feature in the design is the provision made for ventilating the



interior of the machine, consisting in slots cut through the pole faces and extending to the outside which allow air of outside temperature to come in immediate contact with the revolving armature, the armature also causing a perceptible current of air to pass quite through the machine. It is stated that the whole design of the motor is of very solid and strong construction, and very large openings are provided for inspecting or adjusting the brush gear, a feature of very considerable importance but often unprovided for. It will also be seen that the motor can be fixed in any position provided the bearings are turned round, and the armature and field coils can be removed without disturbing the foundation fixings of the machine. Perhaps the addition of a horizontal baffle plate in the hollow cores would improve the air circulation.

The O.K. Meter.—The British Thomson-Houston Company, Limited, has issued pamphlet No. 48 which describes type O K. ampere-hour meter for continuous current circuits only. This meter is constructed for capacities of three amperes and under, while for higher current capacities the Thomson watt-hour meter is recommended. The registering mechanism of the O K. meter is so adjusted as to read directly in KW.-hours on a usual dial, the volts on the circuit averaging the number stamped on the name-plate. The armature or movable part being made as light as possible, reduces to a minimum the wear on the bearing jewel and pivot. The meter is practically independent of temperature variation, thus insuring the accuracy of the meter regardless of variations of temperature occurring naturally. The cover is arranged in such a manner as to permit of connections being made and sealed without exposing the measuring mechanism. All parts are properly insulated, so that the danger from a ground is entirely eliminated. There is one volt drop due to the instrument resistance with full load, and so the loss of energy from this source is negligible. The motor is claimed to start with 1 per cent. of the full load current or less, thus insuring a high degree of accuracy on the smallest loads (one 5-C.P. lamp) which the instrument is expected to record.

Pedestals.—Messrs. C. Marco & Co., of 4, New Zealand Avenue, make a speciality of carved pedestals made of polished jointed wood. The construction renders them particularly worthy of the attention of electric lighting contractors, as they are ready grooved for wiring. In showrooms of electric light fittings nothing could be handier for displaying standards and bronzes. Even if never sold they would be worth their money as shop fittings.

Railway Rates.—In August last the Railway Companies gave notice in accordance with the latest regulations, that they proposed to classify ammeters and voltmeters for railway rating purposes under class 5. This, it may be mentioned, is the highest classification made for rating purposes. When the fact was advertised abroad opposition was set on foot by the various makers of such instruments, with the result that a deputation (consisting of Mr. Max Byng, of the General Electric Company, Mr. F. H. Nalder, of Nalder Bros. and Thompson, Mr. Vignoles, of Evershed & Vignoles, and Mr. Hamilton, representing Mr. James White), waited upon the Board of Trade on November 24th, and they were successful in getting the instruments mentioned put into class 4—the wording of which is to the effect that electrical instruments for electric lighting and power purposes and telephones are to come under class 4.

Skewes v. Coode and another.—In the Queen's Bench Division of the High Court of Justice on Thursday, November 30th, the Lord Chief Justice and a special jury had before them the case of Skewes *v.* Cocde and another, which was an action brought by Mr. Josiah Skewes, of 2, Upper Street, Islington, a chemist and druggist, against Mr. Arthur Cocde and Mr. J. E. P. Veale, of St. Austell's, Cornwall, for recovery of £150, being an amount which plaintiff said he had paid to Messrs. Veale & Co, electrical engineers, on application for 150 fully paid up shares in the company, which had not been allotted to him. Defendants denied that the sum sued for was paid to them, but pleaded that it was paid to their bankers as agents. Mr. Pepys appeared for the plaintiff, and Mr. Willes Chitty for the defendants. Counsel for plaintiff said that his client had applied for 150 shares in the company and forwarded £150 for them, but the shares had never been allotted to him. In October, 1897, plaintiff received a circular from Veale & Co, Limited, in which the name of Mr. Arthur Coode was mentioned. It stated that they had issued shares representing a capital of £10,000, and asked for subscriptions. On October 22nd plaintiff sent in an application for 150 shares, together with a cheque for £150, the money being forwarded as directed in the circular to the Consolidated Bank, Cornwall. After waiting about a month or so, and not having received the shares, plaintiff wrote and withdrew his offer to subscribe. Subsequently, he demanded his money back. It was stated that when plaintiff sent his cheque for £150, the company was indebted to its bankers to the extent of about £1,000; that unsuccessful negotiations took place for a further advance; and that eventually the Cornish Bank advanced £4,000 and became the company's bankers. On December 11th, the account at the bank was closed, and in September of last year the company went into voluntary liquidation. Mr. Pepys, in answer to his Lordship, said he did not allege fraud against the directors of the company; his case was that the plaintiff was entitled to have his money returned, he (plaintiff) having been invited to apply for shares which had not been allotted to him. His Lordship held, after hearing counsel for the defence, that there being no suggestion that the directors could not allot when they issued the circulars, plaintiff could not recover against the present defendants. In the result a juror was withdrawn.

Smoke Persecution.—On Tuesday the Westminster Electric Supply Corporation, Limited, was summoned for on two occasions negligently using furnaces so that smoke therefrom was not effectually consumed. The offences were not denied, and Mr. Iago, the secretary of the corporation, in palliation, urged that the Government had acquired for their transports all the available stock of Welsh smokeless coal. Mr. Horace Smith said he was afraid that was no answer to the summonses. Mr. Percy Gates, for the Vestry, suggested that a more rapid consumption of the coal by thorough draught, although not economical, might prevent the complaints. Mr. Iago.—We have done everything in our power and we cannot help it. We are bound by our Acts, under penalties, to supply the public with the light. That is our first duty. Mr. Horace Smith.—No; the first obligation is not to poison the atmosphere with foul smoke. Mr. Percy Gates said there were two previous convictions—one resulting in an abatement order, and the other in a fine of £10. Mr. Horace Smith.—The penalty goes on increasing. This time it must be a fine of £20 and a guinea costs.

Trade Announcements.—Messrs. Johnson & Phillips announce the removal of their Manchester establishment to more commodious and convenient premises, situate at Duchy Chambers, Clarence Street, Albert Square (North), Manchester, to which address all communications should now be directed. A largely increased stock of cables, arc lamps, meters and other electrical apparatus will be held at these premises.

It is stated that the several businesses of the Eclipse Brass and Copper Company, Limited, are to be removed from Halifax to York, where commodious premises are being erected for occupation during January.

Wheeler Condensers.—The Birmingham Electric Supply Company have decided to entrust the Wheeler Condenser and Engineering Company with the installation of one of their Barnard-Wheeler water cooling towers, suitable for engines of 2,000 H.P. With the above cooling tower is to be supplied one Wheeler Admiralty surface condenser having 3,200 square feet of cooling surface, mounted directly upon their combined horizontal air and circulating pumps. The gravity filter tank, hot-well pump, and pressure filter has also to be supplied, making a complete condensing outfit to deal with the above H.P. Messrs. Bewick, Moreing & Co. have also ordered one of the Wheeler combined condensing sets for the new mining engine required for the Great Fingall Consolidated Mines, Limited.

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ELECTRIC LIGHTING NOTES.

Bermondsey.—The Vestry, at a meeting on Monday, adopted a report prepared for the Electric Lighting Committee by Messrs. Kincaid, Waller & Manville, the consulting engineers, and authorised them to draw up a specification for the buildings in connection with the electricity works. It was also resolved to advertise for tenders for the erection of a refuse destructor, without specifying any particular make, leaving for future consideration the type to be adopted. It appeared from the report of the consulting engineers that the design has been arranged on a somewhat liberal scale, so as to allow for extensions of the engine house to the extent of double the capacity. The present project comprises double the plant proposed by the original scheme, the new estimates of the engineers being as follows:—

Buildings	£17,000
Destructor	4,000
Generating plant	8,000
Boiler house plant	7,000
Mains, &c.	7,000
Public lighting	600
	£43,600
Contingencies, &c., 10 per cent.	4,360
	£47,960

REVENUE.

10,500 8-c.p. lamps at 6d. per unit	£5,250
20 public arc lamps at 2d. per unit	194
40 public incandescent lamps, of 32-c.p., replacing arcs after midnight	83
	£5,527
Net saving on dust destructor	786
	£6,313
Maintenance per annum	3,300
Balance	£3,013

FINANCIAL STATEMENT.

Interest and sinking fund	£1,980
Gross profit	3,013
Surplus	£1,033

In commenting on the foregoing estimates, the consulting engineers point out that the cost of building work has increased by from 25 per cent. to 50 per cent. according to the class, and machinery upwards of 50 per cent., during the last year, owing to the great rise in the price of raw materials. The revenue and maintenance have been estimated on the most conservative bases, and with this size of plant they believe that the revenue will exceed that put down in the estimate, whilst the maintenance should be less, leaving a bigger surplus, after interest and sinking fund is paid, than shown in the estimate. They suggest that they should be instructed to prepare a specification for the destructor cells and boilers, as, until the exact type of destructor cell is ascertained (which can only be after the Vestry has accepted a tender for this part of the work), the buildings cannot be absolutely designed; if the plant is to be running by next winter, no time should be lost in getting the work well in hand.

Birkenhead.—The Electrical Committee of the Birkenhead Town Council has resolved to apply to the Local Government Board for power to borrow £3,500 for electrical purposes.

Birmingham.—The Finance Committee of the Birmingham City Council has issued a report stating that the Public Works Loan Commissioners have decided to grant the loan of £500,000 for the purpose of enabling the Corporation to acquire the electric light undertaking. The Commissioners stipulate that the security for the loan should take the form of Corporation Stock, and the Committee recommend the creation and issue of such stock, the rate of interest to be 3 per cent., the stock to be issued on January 1st, 1900, redeemable by 80 instalments in 40 years.

Bristol.—It is proposed to increase the number of arc lamps used for street lighting from 306, the present number, to 792. The electrical engineer, Mr. H. F. Proctor, has reported to the Sanitary Committee of the Town Council that if the extensions are carried out the price per lamp can be reduced from £23 to £19 per annum; the total cost will then be £15,048 per annum for street lighting.

On Tuesday Mr. E. A. Sandford Fawcett held at Bristol an inquiry in consequence of an application made by the Bristol Corporation to the Local Government Board for power to borrow £15,300 for land for the purpose of new electric lighting works. Mr. Faraday Proctor, city electrical engineer, explained that the application was the outcome of the rapid extension of the use of electricity. In the first year of its existence the Electrical Committee supplied 9,000 lamps with current, in the next year 12,000 were added, and in the next 9,803, in the next 16,901, while during the portion of the present year there had been added 16,476. The additions for the part of the present year therefore exceeded the growth of any preceding year. The Local Government Board had sanctioned the purchase of new machinery, and it was necessary to get it to work as soon as possible. Mr. Wise, on behalf of the Electrical Committee, said they proposed to purchase 9 acres of land for these new works, and they asked that the loan might be repayable in 50 years. The inspector having asked if there was any question of the Electrical Committee taking up the electric trams, Mr. Wise replied that there was not; the Tramway Company had a separate power house. There is a considerable demand for electricity for motive power apart from the trams. The inspector proceeded to visit the site in question.

Calverley.—The District Council is considering the question of electric lighting, and making inquiries in connection therewith.

Cardiff.—Repeated failures of the electric lighting service in Cardiff have aroused much dissatisfaction in the Town Council and among the residents, though it must be said that few of them have been serious. One which took place on Saturday night was due to the blowing of a fuse in connection with a sub-station transformer, which cut off a number of consumers for half an hour. The Council had under consideration the question of calling in an expert of the highest standing to report on the whole undertaking, but decided to first obtain a report from the engineer, Mr. Applebee. Perhaps if the committee had not interfered with Mr. Applebee in the choice of his staff, these troubles would not have arisen.

The Local Government Board has sanctioned a loan of £3,200 for electrical purposes.

Clontarf.—The District Council proposes to obtain powers to light the township with electricity supplied from the tramway station.

Eastbourne.—The Corporation seeks to borrow £88,636 for the purchase of these works, and Colonel A. G. Hepper, D.S.O., R.E., (Local Government Board Inspector) held a public inquiry into the matter at Eastbourne yesterday.

Eccles.—The demand for electric current has become so great that the Corporation are being urged to undertake extensions. The works at present are on rather a small scale. The capacity of the engines is equal to 8,800 8 c.p. lamps, and nearly 7,000 lamps are already connected belonging to private consumers, besides which there are 500 public lamps in the borough. The electrical engineer to the Corporation, Mr. L. H. Combe, has resigned his position, having obtained an appointment elsewhere. The Town Council on Monday last resolved to advertise for a successor to him at a salary of £200 a year.

Edinburgh.—At a meeting of the Electric Lighting Committee of the Town Council last week, it was reported that during October over 6,000 8-c.p. additional lamps had been applied for.

Epsom.—The Local Government Board has sanctioned the borrowing by the Council of the sum of £16,100 for the purpose of lighting the district by electricity. The amount of the loan is to be repaid in 25 years by mortgage on the rates.

Farnworth (Lancashire).—Mr. Clirehugh has prepared plans for new electricity works for the Urban District Council of Farnworth. The clerk to the Council has been instructed to advertise for tenders for the works in accordance with these plans, and application will be made to the Local Government Board for power to borrow £22,000.

Isle of Man.—There is talk of the Isle of Man Tramways Company utilising water-power in connection with a scheme for the electric lighting of Ramsey.

Llanelly.—The District Council on Monday approved the scheme for electric lighting and traction for the town and district, and an agreement was sealed with the British Insulated Wire Company. The work is likely to cost £80,000. The lighting installation is to be completed within 12 months, and traction is to be provided in three years.

Long Eaton.—The Urban District Council has resolved to apply to the Board of Trade for a provisional order for the supply of electricity in the district.

Lynton and Lynmouth.—Mr. J. H. Fookes Bale, A.M.I.E.E., who has been manager and director to the Electric Light Company here for the past five years, has resigned his post and will leave shortly. Mr. P. T. Kimmins, who was assistant engineer for several months, will fill the vacancy as soon as Mr. Bale has left.

Lytham.—A special meeting of the District Council was held last week for the purpose of considering the estimate of the engineers instructed to advise and report as to the cost of an electric installation. It was unanimously decided to proceed with the scheme.

Maidstone.—The Urban District Council has accepted tenders to the extent of £14,292 9s. 8d. in connection with the electric lighting of the borough.

Middlesex.—Messrs. Ellis & Ward are now carrying out the electric lighting of the works of the Fibrous Manufacturing Company, Middlesex.

Mile End.—At a special meeting of the Mile End Vestry last week, it was decided to make application to the Board of Trade for a provisional order to light the hamlet by electricity.

Newhaven.—The District Council has resolved to grant the Electric Lighting Syndicate permission to obtain a provisional order.

Plumstead.—The Vestry has decided to appoint an electrical engineer to advise on designs and take sole charge of the electric lighting department at a salary to commence at £400 a year.

Queenstown.—The tender of the Cork Electric Tramway and Lighting Company for the electric lighting of the town has been approved by the District Council.

Shildon.—The District Council has resolved to apply to the Board of Trade for a provisional order for electricity supply.

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Salford.—At Wednesday's Council meeting approval was given to the plans and estimates for the whole of the machinery, plant, and distributing mains in connection with the new electricity generating station, amounting to £335,783 (including the sum of £87,200 for dynamos and boilers already applied for), and application is to be made to the Local Government Board for borrowing powers. Mr. Haworth, the chairman of the Electricity Committee, said that in order to expedite matters the Local Government Board had promised to hold an inquiry into the matter a week hence, in the event of the resolution being adopted. The electric trams were expected to be running 17 months hence, and that being so it was important to proceed simultaneously with the erection of the buildings and the provision of the plant. A good plot of land in Pendleton, bounded on one side by the railway and on the other side by the canal, had been obtained from the Highways Committee of the Corporation. The present generating station was of 660 H.P., and the new one would be of 10,000 H.P. A sum of about £95,000 had been already spent, and the expenditure now contemplated was about £400,000. This included the cost of the provision of arc lamps for street lighting, but the Lighting Committee had not yet decided whether they would adopt this method of lighting. The provision that was being made for traction included cables such as would be suitable for the heavy traffic on race days, and in the event of the racecourse being shifted to Broughton the cables could be removed and put in suitable conduits that would be laid there. Application is also to be made for borrowing £50,000 for buildings for the new station.

Mr. Ducat, of the Local Government Board, will hold an inquiry in this borough on the 14th inst., with reference to an application by the Salford Corporation for permission to borrow £398,600 for electric lighting purposes.

Shoreditch.—The attention of the Vestry was directed by the Finance Committee, at a meeting held on Tuesday, to the great delay arising in the sanctioning of loans in consequence of the attitude of the officials of the London County Council. It appeared that those officials required minute details of expenditure under different headings and allocations from those provided in the detailed statement of the capital account of the undertaking prepared under the Board of Trade form. It was decided to make a representation to the Finance Committee of the London County Council on the subject, and to communicate the Vestry's views to the Islington authority, which was placed in a similarly awkward position. The Valuation Committee reported having discussed a letter from the London County Council requesting the Vestry to reconsider the question of the assessment of the electricity and dust destructor works, and make the necessary alterations in the assessment in the current list. The Committee recommended that the assessment of the combined undertaking, including mains and sub-stations, should be increased as follows:—Gross value from £1,800 to £3,600, and rateable value from £834 to £2,700. The recommendation was adopted without discussion. At the suggestion of the Lighting Committee the Vestry resolved to include in the specification now being prepared for new machinery, provision for a 165-KW. transformer for the Worship Street sub-station, and it was also decided to obtain a 100-KW. motor transformer from the Electric Construction Company for the same sub-station. The Vestry further resolved to obtain tenders for the construction of a new sub-station at the junction of Great Cambridge Street and Hackney Road.

Shrewsbury.—A failure occurred in the electricity supply on Saturday evening, causing great inconvenience to the townspeople. Mr. Johnson, the electrical engineer, states that the incident was due to an underground suction pipe, of which there was no duplicate, suddenly giving out, causing the supply of water to the boilers to be interrupted, so that there was no alternative but to shut down the machinery and switch off the light. Mr. Johnson succeeded in carrying out the necessary repairs to renew the supply of the light on Sunday.

Stourbridge.—The Urban District Council of Stourbridge intends to oppose the application of the Midland Electric Company for supplying electricity in the Council's district.

West Ham.—The Town Council has decided to fix the salary of the electrical engineer, Mr. Bock, to commence at £350, rising by increments of £25 to £450, and that of Mr. Steinitz, as consulting engineer for one year at £150.

West Kirby.—The District Council has accepted tenders amounting to £20,660 5s. in connection with the electricity works.

Whitechapel.—The Whitechapel District Board of Works has decided to obtain a loan of £30,000 from the London County Council on the instalment system for 42 years for the carrying out of the first portion of the electricity works.

York.—The Electric Lighting Committee of the Corporation, in the report submitted to the Council last Monday, states that with the view of inducing large consumers to take a supply of energy, the committee have adopted the following tariff for consumers who use more than 5,000 units per annum:—Over 5,000 and not more than 10,000 units, 7d. per unit for one hour's standard demand, and 2½d. per unit for all beyond the standard consumption of one hour per day. Over 10,000 and not more than 15,000 units, 7d. and 2d. Over 15,000 units, 7d. and 1½d. The committee has entered into a contract with Messrs. Venner & Co., London, for the supply of Chamberlain & Hookham meters at the price of £4 17s. 6d. each, for meters of 5 to 10 amperes capacity, and £5 each for meters above 10 and under 100 amperes capacity, during the next 12 months.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Bradford.—A number of new electric cars have been put on the Great Horton route, and a more frequent service is now provided.

Bristol.—At the County Court last week J. O'Brien, a drayman, claimed £6 13s. for damages done by an electric car of the Bristol Tramways and Carriage Company. The car collided with the dray, knocked O'Brien off his dray and injured his back. Judgment for the plaintiff for the amount claimed.

Darlington.—To the Council, sitting as General Purposes Committee last week, the Tramways Committee submitted a letter from Mr. Burnley, the local solicitor to the Imperial Tramways Company, in which he said that the promoters of the light railway, before entering into an agreement with the Corporation for the supply of electrical power, desired to have a modification of the terms of the agreement already entered into as to the various routes. The company desired to postpone the carrying out of the railway from High Row to Bank Top Station, and the railway through Blackwellgate, the Haughton Road route, and the Conniscliffe Road and Salisbury Terrace line. The Committee resolved that they would not deviate in any way from the original agreement that a complete system should be laid down within two years of the granting by the Board of Trade of the necessary order.

Dudley.—Our local correspondent writes:—It is a pleasure to be able to state that greater satisfaction is now being found with the Dudley electric trams. They are running regularly at proper intervals, their frequency is equal to the public requirements, and those persons who were so ready with their hostile criticisms a month or two ago are significantly silent. The line from Dudley to Wolverhampton is in course of construction for electric traction, and it is anticipated that the new cars will be running thereon in six months. Progress is also being made with the Kingswinford and Netherton lines from Dudley, both of which will be of enormous advantage to the district.

The Tramways and Electric Lighting Committee recommend the Council that they be an executive committee for the purpose of carrying out the necessary work of constructing and equipping the electrical station, and all matters in connection with the question of the supply of energy in reference to the tramways in the borough. They have decided the position of the turnouts, and the part of the route upon which bracket poles and span-wire system respectively should be adopted in connection with the reconstruction of the Dudley and Wolverhampton tramway within the borough.

Electrical Motor Carriage Run.—We are informed that one day last week an electric game cart of the Electrical Undertakings, Limited, did the journey from Piccadilly Circus, London, to Hôtel Metropole, Brighton, with only one charge of batteries. The rate of travelling averaged 11 miles an hour.

Greenock.—The Police Board recently invited offers for the leasing of the tramways system. It is stated that the conditions set forth were very stringent, and only one offer has been received; that is from the Greenock and Port Glasgow Tramways Company.

Hemel Hempstead.—The Highways Committee of the Town Council has been considering the schemes of the British Electric Traction Company and of the Herts County Council to promote a tramway service. Under certain conditions, the Committee recommends the Town Council to support the company's scheme.

Kidderminster.—An electric tramcar coming down Comberton Hill collided with a dray. The car, car driver, and dray driver were all the worse for the occurrence.

Leeds.—A local paper says that 50 additional electric cars are to be ordered by the Corporation from Messrs. Dick, Kerr & Co. for £28,896. They are to be delivered at the rate of 10 a month.

Light Railways in Belgium.—If progress is any sign of satisfaction, the Belgians must surely have solved the question of light railways with some considerable amount of satisfaction. Since 1884 the Government have subscribed nearly 4½ million sterling towards the cost of the Vicinal railways. The lines are constructed by the Societe Nationale des Chemins de Fer Vicinaux, founded in 1884. Over 1,021 miles are now in operation in 76 lines; 18 other lines when complete, will bring up the mileage to 1,371 miles if we include three new concessions. Eighty-five new projects are under consideration, which will, probably, be subjected to weeding out, give another 43 miles. These lines are not all. There are other lines owned by various companies, aggregating 43 miles, bringing the total to 1,414 miles, as compared with the main line railways, which aggregate 2,858 miles. The ratio is thus about 50 per cent., and calculating thus, there ought to be about 10,000 miles of light line in England. The Vicinal lines are laid to the metre gauge, except where there appears a prospect of them being worked in connection with the main lines, or they are actually so worked when the broader gauge of 4 feet 8½ inches is adopted. If likely to be connected with the lines in Holland, the gauge is (3 feet 5·66 inches) 1·067 metre. The mean cost of rolling stock has been nearly £637 per mile. Locomotives weigh in most cases 18½ tons. Their total number is 321, or about one to each three miles of principal way. One line is worked by horses and one by electricity, while others are now being prepared for electric working. The working expenses are 67·2 per cent. of the gross

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receipts, and last year the train mileage was nearly five millions. Out of 69 lines that have been worked for more than one financial year, not one has shown a loss; 31 pay over the guaranteed dividend, 9 pay more than 3 per cent., 10 pay over 2½ per cent., and 8 pay above 2 per cent. The results are at least encouraging for so small a country as Belgium, and would be paralleled, there can be very little doubt, in England, were it not that the intention of Parliament is frustrated at every turn and corner by the action of authorities and of railway companies. It was a great mistake to ever leave agreements between projected lines and established railways to be mutually arranged. There ought in all cases to be provision for compulsory and prompt settlement of disputed points. As matters stand, the will of Parliament is practically blocked by any peevish or irrational man with whom agreement is necessary. Parliament, while appearing to favour light railway extension with one hand, stays progress with the other by its overweening regard for municipalisation.

Liverpool.—It is proposed to include in next year's estimates a sum for reconstructing, for electrical working, the whole of the lines which are now worked by horse haulage—a distance of 40 miles—and to arrange for the construction of new lines. About £350,000 will be needed to complete the work. A Manchester paper remarks that the Corporation look upon the expenditure, large as it is, with a light heart, knowing, from the experience already gained of the workings of the electric cars, that a capital return for their investment is assured.

Llanelly.—The Borough Council has decided to seek powers to light certain portions of the town and to run electric cars from Llanelly to the outlying villages of Pwll, Felinfoel, and Llwynhendy.

Newport.—At the last Council meeting it was stated that the South Wales electrical power scheme was being watched by the Electricity Committee, along with other Bills affecting the town and district.

There is grumbling regarding delays on the tramways, and it is stated that these cannot be remedied until the electrical traction scheme, now submitted for Parliamentary sanction, gets to work, in about two years' time.

Rochdale.—The tramways to be constructed under the Rochdale Corporation Bill to be introduced next session will embrace a total length of about 18 miles, and will cost (exclusive of the amount required for the purchase of the present tramway company's property) about £250,000. The scheme proposes to alter the gauge of the tramways from 3 feet 6 inches to the standard gauge of 4 feet 8½ inches, with a view to joining up with the systems of the neighbouring authorities of Oldham and Bury. The Bill also seeks power to construct several new streets and to widen others, with a view to better communication, both for ordinary and tramway traffic, with the outlying parts of the borough. This will involve a further expenditure of about £60,000.

St. Helens.—At a special meeting of the Electric Supply and Tramways Committee the electrical engineer submitted a statement showing the amount already expended on the electrical equipment of the tramways on the Prescot and Denton's Green section to be £25,866. This was £866 in excess of the amount already authorised to be borrowed. The engineer also submitted his estimate of the cost of the electrical equipment of the Haydock and Peasley Cross sections and of the extensions now being carried out. It was resolved to apply to the Board of Trade for their sanction to the borrowing of the sum of £25,000, the total amount required for the purposes mentioned. It was also resolved to apply to the Local Government Board for permission to borrow £20,000, to cover the cost for plant laid down and proposed to be increased at the Cropper's Hill power station.

Last week the Council formally approved of an application being made to the Board of Trade for a provisional order sanctioning the construction of the new tramways.

San Paulo, Brazil.—A Brazilian water-power plant is about to be laid down to obtain 16,000 H.P. from the Tieté river, and transmit it electrically to the city of San Paulo, 24 miles distant. A masonry dam, 1,000 feet long, and 35 feet high, will be built, and the water will be conducted by a steel conduit 12 feet in diameter, and ½ mile long, to turbines. These have been contracted for with the Stillwell-Bierce and Smith-Vaile Company, together with other machinery for the power plant, at a cost of £100,000. The electric energy to be developed is to be used by the San Paulo Tramway, Light, and Power Company, which controls 104 miles of street railway track in that city. The contract for the electrical equipment is yet to be placed. Capital to the extent of £1,000,000 is to be furnished for the undertaking by American and Canadian capitalists, and the time required for the completion of the entire plant is two years. Mr. F. S. Pearson is the consulting engineer to the company. Mr. R. C. Brown is the general manager; he is in charge at San Paulo, and Mr. H. L. Cooper is the chief engineer of the hydraulic installation.

South Coast.—A scheme for an electric tramway connecting the coast towns between Margate and Hastings, at a cost of £330,000, was before the Dover Town Council on Tuesday, the promoters wishing for running powers over the municipal tramways.

South Lancashire.—The large scheme promoted by the South Lancashire Tramways Company is being rapidly pushed forward. The capital required is understood to be about £1,000,000. The scheme provides for the construction of electric tramways from the terminus of the St. Helens system at Parr, to proceed through Newton, Earlstown, Leigh, and Atherton to Bolton; from Atherton through Tyldesley and Worsley to Patricroft, connecting with the Ship Canal; and from Atherton to Little Hulton, through Walkden, and connecting with the Manchester Tramway system at Swindon. The total length of lines, with branches and junctions, will be 82 miles, and they will tap large and important industrial centres. Amongst the companies interested are the St. Helens Tramways Company, the British Insulated Wire Company, and a number of leading electricians in various parts of the country. The engineers to the scheme are Sir W. H. Preece and Major Cardew, of London, and Messrs. Kincaid, Waller & Manville. The various authorities through whose areas the lines will pass are favourably disposed toward the project, which is one of the most important ever put forward outside Manchester and Liverpool.

Southport.—The negotiations between the Southport Corporation and Birkdale and Southport Tramway Company have at length come to a satisfactory issue. The Corporation desired to purchase the portion of the company's lines in the borough of Southport, and to work them in conjunction with the new lines which they are laying down for the purpose of introducing electric tramways in Southport. The company has been in existence for some 19 years, and for some time past has declared satisfactory dividends upon its stock. On more than one occasion the proposals have been within an ace of breaking down, but the final offer of the Corporation has been accepted this week by the directors. The price has not transpired, and the bargain will require confirmation by the Council and ratification by the shareholders of the company before it is complete. The Corporation are also seeking Parliamentary powers for the purchase of the portion of the company's line in Birkdale, failing its acquisition by the local authority of that township, with the object of carrying out a comprehensive system of electric tramways. The permission to borrow £66,000 for the work in Southport has just been received from the Local Government Board, and this portion, it is hoped, will be completed by next summer.

Walsall.—The Corporation of the Borough have concluded an agreement with the South Staffordshire Tramways Company, the British Electric Traction Company, Limited, and the South Staffordshire Tramways (Lessee) Company, Limited, under which the Corporation are to purchase the whole of the tramway undertaking in the borough (except the James Bridge generating station) as from December 31st, 1900, at the price of £18,500, and the Corporation are to grant a lease to the Lessee Company of so much of the lines as extend from the Brown Lion Inn, Wednesbury Road, Pleck, to the Wednesbury boundary on the Bescot Road, and also to the Darlaston boundary at James Bridge, for a term of 21 years from January 1st, 1901, and of the remaining portion of the tramways in the borough for a term of three years from the same date, at such a rent as will indemnify the Corporation from all loss in regard to the undertaking, and relieve the rates of any additional burden in respect of the purchase.

Warrington.—The Town Council held a special meeting last week to consider a proposal to apply to the Board of Trade for a provisional order sanctioning the construction of tramways in the borough. It is proposed to construct four main lines, extending from near the centre of the town to the principal suburbs, but avoiding, as far as possible, the streets which are narrow and congested. Electric traction is contemplated, but power will be sought to use either mechanical or horse-power. The town clerk, in a report which he presented, said that the Tramways Committee called Major Cardew in to advise them as to the best routes and system to be adopted. The town clerk emphasised the necessity of keeping private companies at a distance, though he said this was not the main object in seeking a provisional order, for, so long ago as 1882, they approved the principle of tramway construction for the borough. Certain streets which had been originally scheduled had been struck out. They had been advised all through by Major Cardew that in the first place they should not overburden the application, which covered all the main arteries of the borough, and no scheme would be accepted or permitted which did not in the first instance include these main arteries. The estimated cost of the scheme is £170,000. The adoption of the report was unanimously agreed to.

Wellingborough.—The Finedon Urban Council last week listened to Mr. Stephen Sellon's explanation of the details of the British Electric Traction Company's scheme for electric tramways for Wellingborough and district.

West Bromwich.—The Council is considering the promotion of a Bill to confer powers respecting tramways, electric lighting, and other undertakings.

West Cumberland.—It is reported that a proposal has been made to the Corporation of Whitehaven by a substantial company seeking to acquire powers to run a tramway through the borough on the overhead wire system. A plan submitted shows a line from Cleator Moor through Whitehaven to Distington. The route from Maryport to Allonby has been surveyed by Mr. Ward Thomas, of the firm of Messrs. Bennett & Ward Thomas, electrical engineers, Manchester, on behalf of the English Industrials Company, Limited, who contemplate the construction of an electric tramway under the Light Railways Act between Maryport and Allonby. The distance from Maryport to Allonby is about five miles, and with the exception of a brow near Netherhall and the one just outside Allonby the road is almost level. The clerk to the Maryport District Council has been informed that if the Council succeeds in securing a provisional order for supplying electricity, application will be made to them for electric power to work the proposed tramway.

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TELEGRAPH AND TELEPHONE NOTES.

Grimsby Telephones.—The Corporation Highways Committee have had under their consideration the advisability of establishing a municipal telephone in the borough, and the matter has been referred to the Sub-Lighting Committee.

Manchester Telephones.—A number of gentlemen interested in the New Mutual Telephone Company met on Monday in Manchester, under the presidency of Mr. Wm. Thomson, to petition the City Council to reaffirm its resolution of April 14th, 1897, in favour of a license being granted to the company by the Postmaster-General. The Council followed up its former resolution by appointing a deputation to wait upon the Postmaster-General so late as May last. Subsequently, however, a feeling was developed in favour of a municipal telephone service. It is submitted on behalf of the company that, under the resolution which the company ask, it would be impossible for them to establish competition in Manchester, after the license is obtained, without the formal consent of the Council. Further, as the company has undertaken to transfer its interest in a competitive system in Manchester (if it be allowed to create one) to the Corporation, it is obvious that if the City Council should elect to establish a municipal service forthwith it can do so. If the Corporation decide to commence a telephonic exchange in Manchester, the company would still be essential to extend efficient telephonic communication in the surrounding manufacturing towns having intimate business relations with Manchester. It is imperative, however, to comply with the requirement of the Postmaster-General by re-confirming the previous resolution, so that no injustice may be done to the merchants and inhabitants of Manchester, and to those who have expended so much time and money in the effort to establish competition in the telephone service of the district. The chairman explained the position of the Mutual Company. If they failed to obtain a license by December 31st next, they would cease to exist as a company. Further delay by the Corporation meant death to the company. But for the creation of the Mutual Company, the existing service in Manchester would not have been what it was, opposition having stimulated the National Telephone Company.—On Tuesday afternoon the Lord Mayor was waited upon by a deputation representing the New Company, who presented the petition, and urged reasons why the Corporation should accede to it without delay. A competitive system was declared to be an absolute necessity. With reference to the National Company's proposal to charge, in some cases, 1d. per message, in addition to an annual subscription of £3 10s., a member of the deputation insisted that this was anything but a concession. If he were to adopt that system of payment, it would mean, in his case, an annual charge of £50 in place of the present subscription of £10.

It was announced that at Wednesday's meeting of the City Council Mr. Plummer was to bring forward a motion to the effect that the Special Committee *re* Telephones be instructed to consider the question of a municipal license, and prepare a report and recommendation for the Council. He was also to move that the application of the Mutual Telephone Company, Limited, to the Postmaster-General for a license to provide a system of public telephone communication in the Manchester exchange area for a term which shall not extend beyond that of the existing license of the National Telephone Company be approved by the Council, "subject to the terms and conditions on which the Mutual Telephone Company shall hold and exercise such license being hereafter arranged to the satisfaction of the Corporation, and reserving to the Corporation a status to communicate with and be heard before the Postmaster-General or other Government authority in reference to the subject."

Paris Telephones.—It is stated that the Paris telephone tariff is to be reduced on January 1st, 1902, from 400 francs to 300 francs a year, and the cost of a three-minutes' conversation is to be at once reduced from 25 cents to 15 cents.

Pembroke Telephones.—The District Council will not allow the National Telephone Company to erect poles for telephone service unless a charge of 10s. per pole per annum is agreed to. The present agreement with the company is to be rescinded from January 1st next.

Proposed American Cable to Manila.—Reuter's Washington agent says that the report of Mr. Elihu Root, Secretary for War, strongly recommends the laying of a cable between San Francisco and Manila, to touch at Hawaii, Wake Island, and Guam, as of great military and political importance. He estimates that the cost will not exceed $8,500,000.

In his presidential address President McKinley refers to the necessity for a cable to Manila, and it is suggested that should not Congress authorise the construction of the cable by the direct action of the Government, the Postmaster-General should be authorised to invite bids for the laying of such a cable.

Subways of London.—The Corporation of the City of London are seeking powers in the coming Parliamentary session to construct subways under the streets for the accommodation of electric lighting, telegraphic, telephonic, and other electric cables and wires, and they seek also compulsory authority to enforce the placing of these things in the subways.

Proposed French Submarine Cables.—The Paris correspondent of the *Times* made the following interesting remarks on the subject of a French submarine cable service in a despatch dated November 30th:—

The Government has resolved on proposing a scheme for the construction of a system of French cables, and the *Figaro* urges that France cannot safely remain dependent on English companies, but must have a complete system of communication with all her possessions. As soon as the Transvaal war broke out the papers began to publish articles protesting against the monopoly of telegraphic cables by the foreigner, and the Government was attacked for not taking the initiative of a new system so that France might be independent of the foreigner. As always, it was the note of patriotism for the benefit of the public and the Fatherland, but also for the benefit of those who were putting forward claims for work in connection with the laying down of the future colossal network. A nation, no doubt, should have such a network of its own, and the present agitation is not incomprehensible. But in France, as in England, private initiative should undertake to respond to this want. As it is, we are to see what is always beheld here. The State will be asked to guarantee a certain rate of interest, and so even the taxpayer who has nothing whatever to do with the cables will have to pay. The system is deplorable, for it paralyses individual action and keeps an industry going at the expense of everyone's purse. It is Socialistic indolence. The work goes on without conviction because no one feels any special risk, and the money spent by the State inevitably goes into the pockets of individuals. But when once the cry of "patriotism" is raised, a cry which serves for all purposes, no one any longer dares to make an appeal to reason and to sound principles of political economy.

The same correspondent, telegraphing the following day, said:—

The Colonial Committee of the Chamber has submitted a resolution calling on the Government to provide telegraphic communication with the Colonies. A preface to this resolution complains that the English censorship has been rigidly applied since the outbreak of the war in South Africa to countries outside the zone of hostilities, such as Madagascar, cipher telegrams to which have been stopped, even though these were Government despatches to their agents. In the event of war, accordingly, France might thus be prevented from telegraphing the outbreak of hostilities beyond Marseilles for the East and Algeria for Africa. Colonial Governors might thus be without instructions and without the means of defence. It would be culpable imprudence not to avert this danger. Colonial commerce, moreover, as England's example proves, runs parallel with the extension of submarine cables. The Committee accordingly recommend cables in the Atlantic, the Indian Ocean, the Far East, and the West Coast of Africa, at an estimated outlay in five years of 100,000,000 francs.

Reuter's Paris agent says that on 2nd inst. M. Millerand, Minister of Commerce, presided at a meeting of the Cables Committee, which he had summoned for the express purpose of submitting to it the outline of a Bill elaborated by the Government with the object of uniting the colonies to the mother-country by French cables. After a conference lasting two hours, the Committee accepted the proposals of the Minister and appointed a sub-committee to draw up as soon as possible the details of a Bill to be laid before the Chamber.

The Reduction of Rates to India.—**The following letter, written by Mr. Henniker-Heaton, M.P., appears in the Indian press:—**

The merchants of India, the Press of India (without regard to politics) and in fact, the whole of the people of India have given expression to thanks and goodwill to those associated with me, engaged in the task of reducing the high postal rates of the past and high telegraph rates of the present time between the mother country and her Dependencies. A critical moment has arrived, and I ask for the strongest possible support in my appeal to the Viceroy and his Council.

We are on the eve of success. Telegraphic communication between Great Britain and India can be reduced to 1s. a word at this moment if the Viceroy and his Council wills it. I will explain what I mean. The telegraph rate from London to Fao (at the head of the Persian Gulf) is now 6½d. per word. From Fao to Kurrachee the Indian Government own the cable and telegraph line, and it will pay them well to convey the telegrams for 5d. per word. It is about 3,400 miles from London to Fao, and only about 1,400 miles from Fao to Kurrachee.

"Who stops the way?" is asked. I have information of a very grave character in reply to this question, which I decline to believe at this stage of the proceedings.

It is alleged that the telegraph line is working badly between Fao and London, but well between Bushire and London. Now I pledge my political reputation to remedy this with the aid of two eminent telegraph officials in India, and I have a note from a high official in Turkey guaranteeing the help of the Sultan.

It is also alleged that the Telegraph Convention stops the way. This is nonsense. I have been a member and representative on these Conventions. The Convention is ruled by the Eastern Telegraph Company and its satellites.

We can break away from the Convention by giving six months' notice, so it is unnecessary to consider this point.

The Indian and Home Governments have had pressure placed upon them to grant a subsidy or give a guarantee to the Eastern Telegraph Company, on the ground that in war time it is necessary to have an all-British cable.

This is a very clever argument. But the answer is, that the Eastern Company's cables are landed in Portugal and go up the Mediterranean and the Red Sea; further that, in war time, it is impossible to patrol 2,500 miles of cable, and that the first thing the enemy will do is to despatch a vessel specially fitted up to cut cables. "Fast cruisers," said the ablest director of the Eastern Telegraph Company, when this question was raised some years ago, "is the only guarantee." Now the Eastern Telegraph Company, which has a joint-purse arrangement with the Indo-European Telegraph Company, is silent on this point, or professes to have an all-sea line which they dare not defend.

I and those associated have no interest to serve but one, and that is, to obtain cheap telegraph communication with every part of the British Empire. Only one telegram in a hundred is of a family matter, and social telegrams are almost impossible.

If the merchants and people of India do not successfully appeal to the Council of the Government of India against a subsidy to the Eastern Telegraph Company, we shall be handicapped, and our work will be in vain.

Sir Michael Hicks-Beach has promised us an inquiry, but meanwhile we are in the greatest danger of receiving a recommendation from the Council of the Government of India to give a guarantee to the cable companies against loss on reduction of rates.

I am writing very hurriedly to catch the post. I hope every paper in India will publish this letter.

Telegraphic Communication between Buda-Pesth and London.—**The *Times* correspondent at Vienna says that on the afternoon of the 4th inst. direct telegraphic communication between Buda-Pesth and London was opened by an exchange of complimentary messages between M. Hegedus, the Hungarian Minister of Commerce, and the English Postmaster-General, the Duke of Norfolk. The line is 2,200 kilometres long. It passes through Austria, Switzerland, France, and the Channel. Copper wire has been principally used.**

(*Continued on page* 931.)

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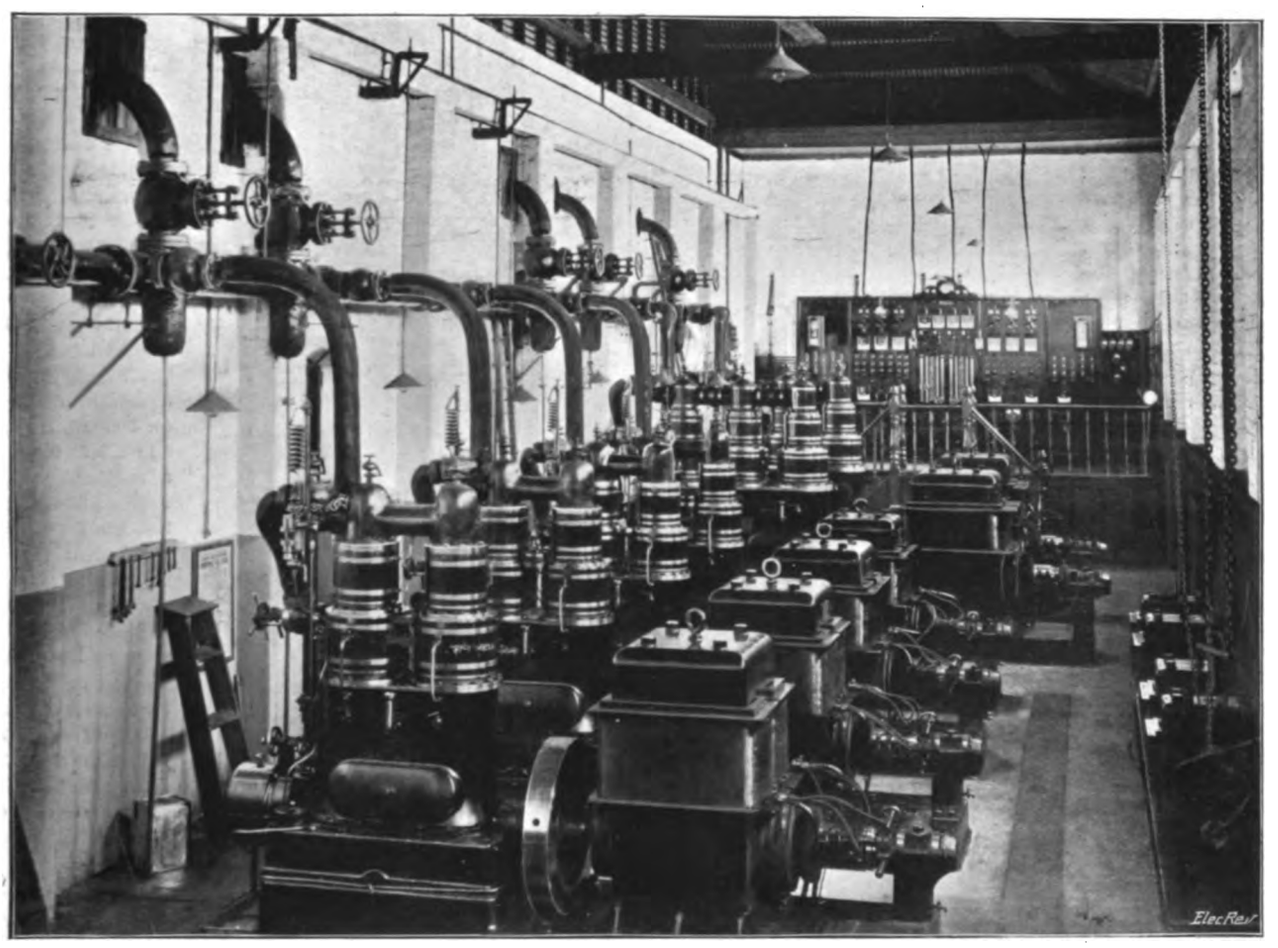
THE PERTH (W.A.) ELECTRICITY WORKS.

The first attempts at electric lighting in the city of Perth, Western Australia, were not attended with good results; several companies were formed, but did little or nothing. A concession which was about to be given to another company, was opposed by the Gas company; this led to a public ballot, in which the electric light side won, but it was not able to carry out its ideas for lack of funds. After some time, when electric lighting was again talked of, the Gas company thought it would be advisable to take up the matter on their own account. Accordingly, after getting an Act empowering them to supply electricity, they put down a plant consisting of a boiler of the locomotive type and a horizontal engine of 100 I.H.P., driving two dynamos each giving 240 amperes at 110 volts. The three-wire system of distribution was adopted; cables were fixed on poles in the busier portions of the city, a few consumers connected, and current supplied from sunset till midnight. The charge was fixed at 1s. per Board of Trade unit, but owing to the limited scale on which the operations were carried on, the company worked at a loss for three years.

About three years ago the city began to increase very rapidly, and the company, seeing that their machinery would soon be too small, ordered a complete up-to-date outfit of generating plant from Messrs. J. H. Holmes and Co., Newcastle-on-Tyne. The firm had also to erect the machinery, and to guarantee its working; they therefore sent out with it Mr. Herbert Broadbent, who had had much previous experience abroad with their machinery. It was originally intended to run the new machinery in conjunction with the old, but eventually a new site was chosen, and a handsome generating station erected thereon. Everything was complete and in running order in April, 1897; the load began to increase rapidly, and during the Jubilee celebrations the plant was taxed to its utmost capacity. The plant then consisted of three Babcock & Wilcox boilers, with all the necessary steam pipes, pumps in duplicate, feed water heater, &c., and four 80-H.P. Willans engines, coupled direct to four "Castle" dynamos, two of which were rated at 110 volts, 400 amperes each, and two at 220 volts, 200 amperes each. A handsome three panel slate switchboard, with all the necessary instruments, including battery regulating switches, &c., and two sets of accumulators each of 63 cells, completed the equipment.



PERTH (W.A.).—ENGINE ROOM.

It was soon seen that the plant would be too small, so more machinery was ordered, and at the same time it was decided to double the voltage, to save the necessity of having shortly to increase the size of the feeders. This order included two Babcock & Wilcox boilers, pumps, heater, &c., and two three-crank compound Willans engines, coupled to two "Castle" dynamos of 440 volts, 250 amperes each, as well as new armatures and bobbins to alter the 110-volt machines to 440 volts, and two motor-generators for charging and discharging the battery, which was decided on in preference to doubling the number of cells. Long before these arrived the other machines were over-taxed, and the company had to refuse to connect intending consumers; at last, however, the machinery was fixed, and on May 16th last everything was in readiness for changing-over the system.

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Before this date all the large consumers' premises had been altered to 220 volts, and in one or two cases whole streets had been changed, which helped to expedite the work considerably, as it was only necessary to remove the outer wire from its socket at the corner of the street, and put it in the middle wire socket, of course, to be replaced at a convenient opportunity and the proper balancing effected. Altogether there were about 80 places where the wires required changing from the outer to the middle, and about 350 premises to be entered to change the lamps.

About seven in the morning on the above date the whole staff (who had previously had their instructions) turned up; everybody had been pressed into the service for lamp changing, switchboard attendants, carpenters, &c., all entered into the spirit of the thing, each anxious to be first to telephone to the works when he had got to the end of his list; in fact, great rivalry was shown, as each man was handicapped according to his knowledge of the work; each had a list showing the probable number of lamps required for each of the premises to be visited, and was provided with a carrier's cart, boxes of lamps, and a step-ladder.

The procession set off about 7.30, but the men were not able to do much till the business premises were opened; several of the men, however, had arranged with clients on their round to let them have access earlier, others had planted ladders at different places on their route, to save time, and others availed themselves of the services of willing volunteers. The first to report at about 11.30 was then told off to assist another not so fortunate. Between 12 and 1 the telephone was busy with reports, but the last did not reach the works till about 2.30, very far behind the others, as the difficulties on his route had not been so accurately gauged. During this time work was not at a standstill in the station; a 440-volt machine choked down to 220 was kept on all day with the battery as a balancer, the alterations to the connections on the switchboard were commenced, the 220-volt connections taking the place of the 110, and new voltmeters, ammeters, and watt-hour meters were fixed. Everything was in readiness at 2.45, before which hour the men on the cables had reported everything changed except the post office, as had been previously arranged; directly everything was ready in the station word was sent to change this wire quickly and telephone immediately. In the meantime pressure was got up on the 220-volt machines, and directly word was received off went the battery, and on went the dynamos, and the change over was an accomplished fact at 3 p.m.; everything went smoothly, and hardly a complaint was received.

Much remained to be done afterwards, such as converting the 110-volt machines to 440 volts, changing arc lamps, and making good the connections to the cables in the streets. The meters were the most serious part of the whole business; Ferranti meters are in use, so the meter readings are doubled, and it is a very difficult matter to explain to a good many of the consumers that they are not paying twice as much for the new as for the old pressure.

Fig. 1.—Dam of Albion Power Company at Waterport.

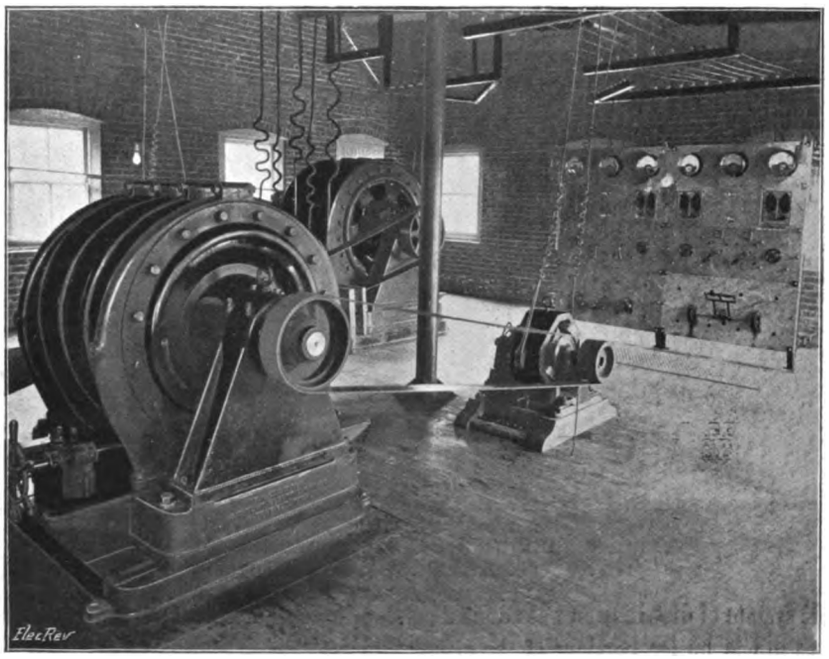

Fig. 2.—Generating Station at Waterport.
Water-Power Transmission Plant.

Our illustration, for which we have to thank Mr. Broadbent, shows a view of the engine room, which is 100 feet long by 22 feet wide. The motor-generator panel is on the extreme right of the switchboard, and the battery switches and shunt resistance on the centre panel; the new machines are nearest the switchboard, and the converted ones next, while on the right the boosters are visible.

The whole of the scheme for the additions and alterations was planned and carried out by Mr. H. Broadbent, who, on the completion of his contract with Messrs. J. H. Holmes and Co., took sole control of the department, which is maintained in a thoroughly efficient condition; there has not been a single failure of the light since its installation, and so rapidly is the consumption increasing that further extensions will have to be considered very shortly.

We may add that a very substantial balance on the right side resulted from the first year's working of the new station.

A WATER-POWER TRANSMISSION PLANT.

By ORRIN E. DUNLAP.

There is no doubt but that numerous places in the United States and Europe can profit largely by what has been accom-

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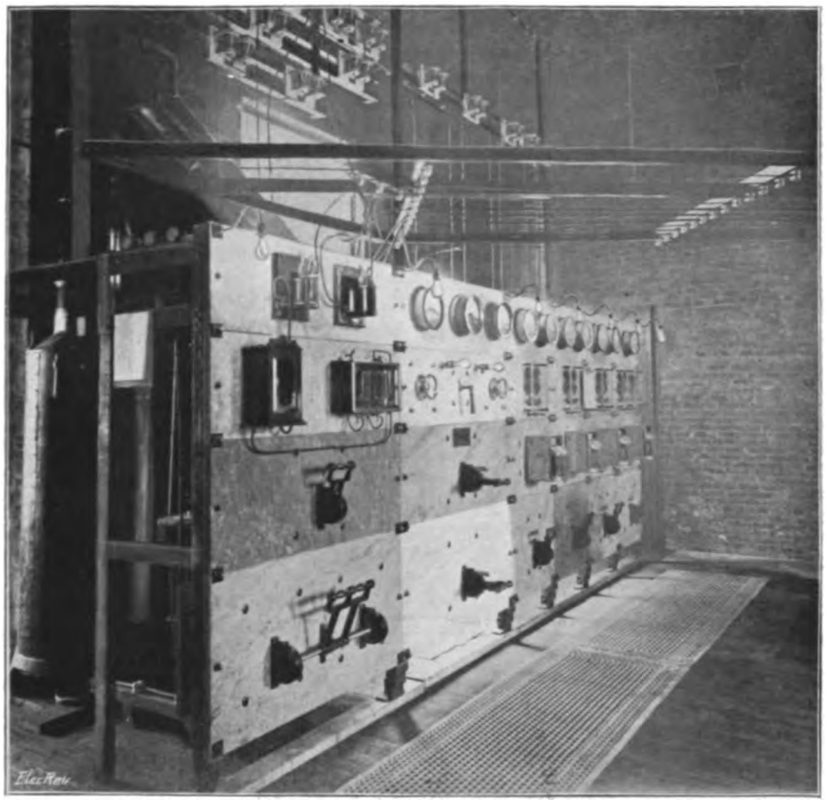
plished by the Albion Power Company in their generating plant at Waterport, and their sub-station in the village of Albion, both places being in the county of Orleans, east of Niagara Falls. This company has a capital of $50,000, and it secured water and power rights on Oak Orchard and Otter Creeks at Waterport. At that point the Oak Orchard Creek runs through a deep gorge, the banks being quite high. Here the Albion Power Company has constructed a dam 200 feet long and an earth embankment 100 feet long. This dam has a height of 12 feet, and it sets the water of the Oak Orchard Creek back for fully three-quarters of a mile, the company owning all the land likely to be flooded by the water. Thus a big reservoir is formed from which a full supply of water may be drawn at times of heavy load, the reservoir refilling at times of light load. The head of water available is 18 feet, the difference between this and the height of the dam being obtained by means of a tail race extending for 1,000 feet down the Oak Orchard Creek.

To the east of the dam, just behind the earth embankment, the company has built its generating station and power house. In the construction of the flume novel methods were adopted. It is set right into the earth embankment, and it is built of steel framework filled in with concrete, so that practically it is a concrete wall 2 feet thick. The steel frame is designed to sustain the pressure, while the concrete is used for filling in the spaces, making it tight at every point. The construction has been found to be most successful, and is likely to last for ever.

The company has installed two McCormack wheels made by J. & W. Jolly, of Holyoke, Mass. One of these wheels has a capacity of about 250 H.P., while the other is of about 175 H.P. capacity. These wheels are set right into the open flume on a horizontal shaft, discharging through a quarter turn and a draught tube outside the flume into the tail race. In the generating station the company has placed two alternators of Stanley make. One of these has a capacity of 150 KW. when operated at a speed of 600 revolutions per minute, and the other has a capacity of 100 KW. when operated at a speed of 900 revolutions per minute. Both machines are of the inductor type, three-phase, are wound for a maximum E.M.F. of 6,600 volts at full load, and are intended to generate current at 7,200 alternations. Each generator is designed to operate in parallel. The station is also equipped with two 6-KW. multipolar exciters, each capable of exciting the fields of the two generators when operating on a non-inductive load. These exciters are arranged for belt driving from the shaft of the generator. In one of the accompanying illustrations the generating room is shown, well portraying the location of the generators, one of the exciters, and the switchboard, which is of blue marble, and equipped with all the necessary instruments. Both of the generators feed directly into the transmission line at a voltage of 6,600. The larger generator is connected to the larger wheel, and the smaller generator is connected to the smaller wheel.

The transmission line also has its novel features. Waterport is situated 6½ miles distant from Albion, and this is the length of pole line. The poles are 30 feet high, and are set 100 feet apart. The cross arm supports three pure aluminium stranded cables, each cable being composed of seven wires. Triple petticoated glass insulators, on a porcelain base pin, having an iron bolt through the cross arm, and made by F. M. Locke, of Victor, N.Y., are used. When the line was first built, pure aluminium wire, about ¼ inch in diameter, was used, but as this was found to have been too tightly drawn, the stranded aluminium cable was strung to replace it, the first construction having resulted in numerous annoying breaks.

The current passes over this aluminium transmission line to the sub-station in Albion. This was the generating station of the old electric light company of the village, and was purchased by the Albion Power Company. In this sub-station the company has installed three Stanley static transformers, having a total capacity of 200 KW. These machines are of the indoor type, self-ventilating, for service without oil, and designed for continuous operation, transforming from 6,000 volts to 1,100 volts three-phase. The company has also placed in this station one 75-H P. inductor type alternator for service as a synchronous motor, the same to operate on 1,100 volts three-phase, this motor in every way being a counterpart of the machines used in the generating station. A 1-KW. exciter to excite the fields of the motor, and one 5-H P. three-phase motor for service in bringing the synchronous motor up to speed, have also been placed in the sub-station. The 75-H P. motor drives an 80-light direct current Brush arc machine for public lighting. This sub-station is equipped with a complete steam plant, which gives the company a full reserve up to the capacity of the generating station.



WATER-POWER TRANSMISSION PLANT: FIG. 3.—VIEW OF SWITCHBOARD.

The business part of the village of Albion has been divided into three districts by the company, and in each of these districts, in the street, there have been placed three 300-light transformers connected in parallel, stepping down to 110 volts. Each district is connected to one leg of the three-phase system. Running around the outskirts of the village there is also a three-phase line from which all outside lighting and all power are taken.

The total power available through the present development at Waterport is 400 H.P., and the development, transmission, and use of this force, have added much to the light and power conditions in Albion, which is the county seat of Orleans county. Electric power is supplied to a cold storage warehouse plant in Albion, and the Waterport Manufacturing Company has been organised to use power at Waterport.

The chief engineer and general manager of the Albion Power Company is Wallace C. Johnson, M.Am.Soc.C.E., of Niagara Falls. Mr. Johnson is well known both in Europe and America as the chief engineer of the Niagara Falls Hydraulic Power and Manufacturing Company, of Niagara Falls. Mr. Johnson had charge of all the plans of the development.

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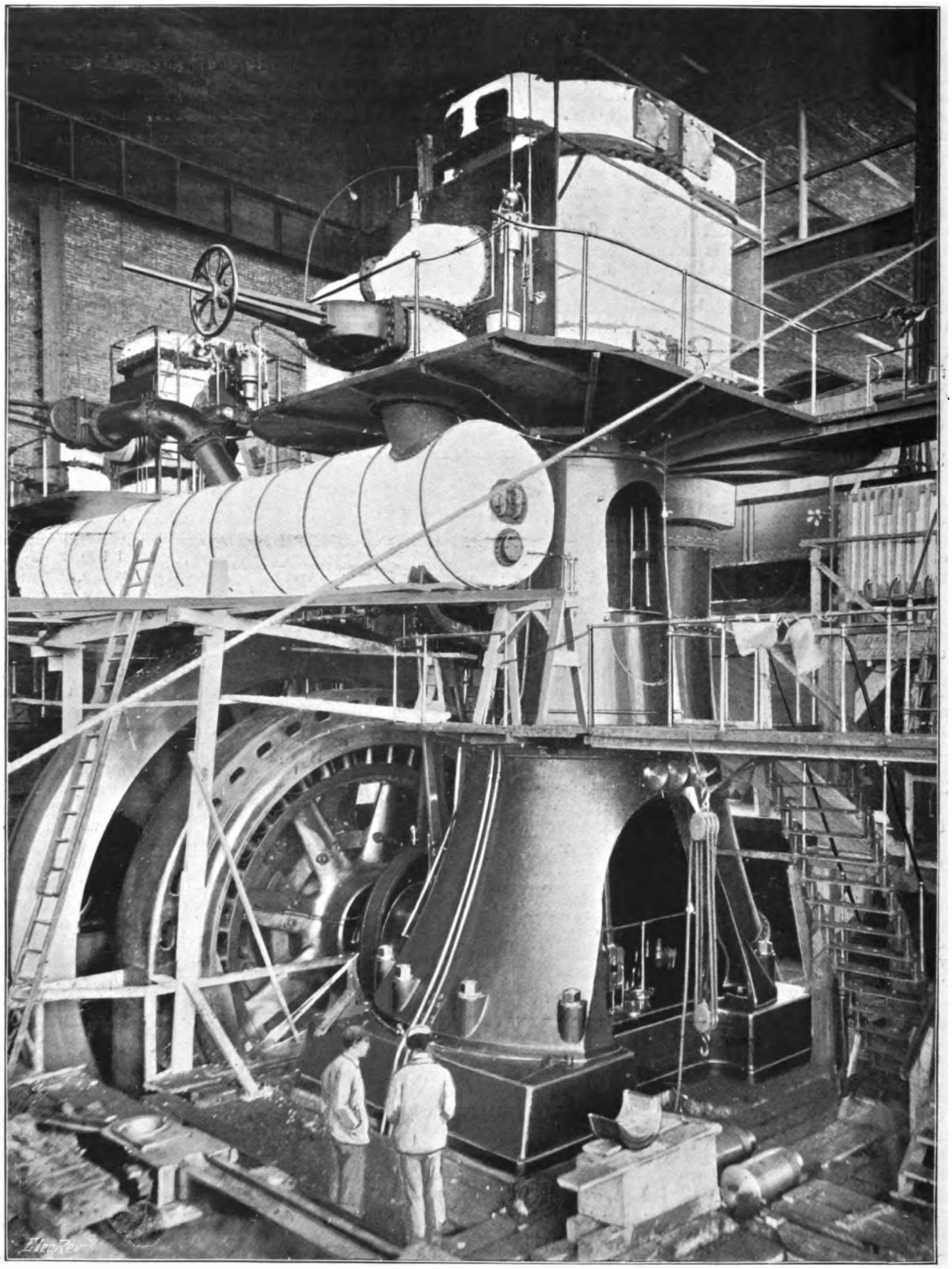

3,500-kw. Electric Railway Generator.

The electric contracts were placed by the Albion Power Company with the Niagara Electric Equipment Company, of Niagara Falls.

LARGE ELECTRIC GENERATORS.

At the present moment few questions are of so much interest to central station engineers as the increasing use of large generating units. From orders recently placed, it has been clear that 1,500 kw. direct coupled sets, and even larger sizes, will be pretty general in the extensions which are now being carried out.

The new works of the Midland Corporation for Electrical Power Distribution will be equipped with half-a-dozen sets of a total capacity of 10,000 e.h.p.; at Glasgow tramway power station there will be several 2,500 kw. three-phase generators; and at the Metropolitan Electric Supply Company's new works at Willesden, which have now arrived at a stage when they are nearly ready to be brought into service for practical supply business, there will be three Westinghouse sets of

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2,500 to 3,500 H.P. each.* But large as these and the Manchester, City of London, and various new plants may be to English practice, they are small when compared with units which are now being manufactured or put into position in connection with certain American installations.

We are enabled, by the courtesy of the British Thomson-Houston Company, Limited, to give a photographic view of one of the 3,500-KW. (6,600 volts) three-phase alternating current generators which have been supplied by the General Electric Company, of America, for the station of the Metropolitan Street Railway Company of New York City.

This generator has 40 poles, and is of the revolving field type. The speed is 75 revolutions per minute, and the frequency 25 cycles per second. The field of the generator is mounted directly on the engine shaft. The general method of construction follows the Thomson-Houston well-known standards, the armature core being built up of sheet iron punchings of high permeability and low hysteresis, well japanned before assembling, and further insulated from one another by sheets of paper inserted at intervals to reduce the eddy current losses. The windings are in slots on the inner side, the teeth of the core being recessed for the insertion of wooden wedges to hold the windings firmly in place. The punchings are assembled with ventilating spaces between, thus allowing free circulation of air in direct contact with the cores and windings. The coils forming the winding are completely insulated before being placed in the machine, the coils being so arranged that any one can be taken out by removing a few adjacent ones, and, in case of a burn-out, the defective coil can be readily taken out and another put in its place.

The outside frame of the armature is of cast-iron supported on slide rails so that it may be moved to one side clear of the revolving field to facilitate inspection or repair.

The magnet frame consists of a cast-steel ring with outwardly projecting poles of sheet iron, bolted to the steel ring, the ring being mounted on a substantial cast-iron spider.

The field coils consist of copper strip wound on edge, and are insulated to stand a high potential test of 4,000 volts alternating between the winding and core. The excitation E.M.F. is 125 volts. The armature windings were tested to 15,000 volts alternating.

The exciting collectors consist of two insulated rings supported on the shaft, carbon brushes being used. The overall width at right angles to the shaft is 22 feet 6 inches. The overall width of frame parallel with the shaft is 51 inches; diameter of engine shaft, 37 inches; and the diameter of field, 16 feet 9 inches.

As we write this there comes to hand an official statement made by the Manhattan Elevated Railway Company, of New York, to the effect that a contract has just been awarded to the Westinghouse Electric and Manufacturing Company, of Pittsburg, for the heavy generating machinery for the new power house, also the apparatus for sub-stations, which, with the contract already given for engines, boilers, &c., practically completes the material required for the stationary installation. The Manhattan Railway Company state that they have been actively studying the problem which to-day culminates in awarding this contract, for over two years, and have taken every possible precaution to arrive at a correct decision in this important matter. The apparatus covered by the contract consists of eight three-phase alternating current generators, each of 6,650 H P. capacity, together with such step-down and converting devices for the sub-stations as will be necessary to transform the alternating current in the power house into direct current of 500 volts, which direct current will be fed to the third rail of the elevated system. The 6,650-H P. generators will be the largest ever designed or constructed, their external dimensions being something over 40 feet in height, while the rotary element which includes in itself the rotary field of the generator and the necessary fly-wheel for the engine, and which will be mounted directly upon the shaft of the engine, has a diameter of 32 feet. Some idea of the enormous size of these generators may be gained from their dimensions, and from the fact that the weight of each machine and engine complete will be nearly 1,000 tons. The current generated by these large machines will be conveyed to various sub-stations conveniently placed about the city. In these sub-stations will be installed 20 rotary converters in units of 2,000 H P. each. These rotary converters are designed to produce direct current at 500 volts for use upon the elevated structure. The first of the large dynamos is due for delivery in 10 months from date, and it is therefore thought reasonable to expect that electric trains will be running on a portion of the Manhattan system during 1900.

The selection of the engineering plans of the Westinghouse Electric and Manufacturing Company was made after much careful study by the above-named technical board, which we understand is composed of men prominent in engineering matters, who are authorities and experts in their respective lines. The action now taken by the company is considered to insure an equipment of the highest efficiency, of the most modern construction, and in magnitude second to none in the world.

* Electrical Review, September 23rd, 1898, p. 453.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 926.)

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies:—		
Jamaica-Colon	June 30, 1899 ...	...
Trinidad-Demerara (1871 original)	Oct. 20, 1899 }	Nov. 9, 1899.
Do. do. (1891 duplicate)	Oct. 6, 1899 }	one cable restored.
South African:—		
Zanzibar-Mombasa	Oct. 27, 1899 ...	...
Aden-Zanzibar	Nov. 27, 1899 ...	Dec. 4, 1899.
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Latakia-Cyprus	June 20, 1899 ...	...
Landlines.		
West Indies:—		
Cuban Government lines... ...	Oct. 30, 1899 ...	...
Communication with Les Cayes (Haiti)	Nov. 22, 1899 ...	...
South African:—		
Communication with Mafeking...	Oct. 13, 1899 ...	...
Communication with all offices beyond Orange River	Oct. 18, 1899 ...	...
Communication beyond Burghersdorp, Cape of Good Hope, and Estcourt, Natal...	Nov. 7, 1899 ...	...
Communication with north of Mooi River (Natal)	Oct. 22, 1899 ...	...
Colombian Government lines to Bogota	Oct. 21, 1899 ...	...
Communication with interior of Colombia, excepting Amalfi, Ambalema, Baga, Cartago, Ibagua, Manizales, Medellin, Palmire, Pasto, Popoyans, Reimedos, Sonson, and Santo Domingo... ...	Nov. 6, 1899 ...	...
Communication with Valentia (Venezuela)	Nov. 18, 1899 ...	...
Majunga-Tananaira	Nov. 25, 1899 ...	Dec. 1, 1899.
Indo-European lines between Southcum-Kalestaté-éran ...	Nov. 30, 1899 ...	Dec. 3, 1899.

Trans-African Telegraphs.—Mr. F. E. Baines, sometime Surveyor-General (Telegraphs) writes from Bournemouth to the *Times* offering a suggestion on this subject. He says:—

The Wingate victory and the death of the Khalifa promising peace and security to the Soudan south of Khartoum, and especially to the navigation of the Nile, now, in my opinion, is the time to extend the telegraph beyond its present terminus to connect the frontier posts with the centre of Government, and especially to meet the advancing wire from Rhodesia. But not by any land route. Even now casual interruptions in the desert would be easy and repairs tedious and difficult to effect. The bed of the Nile itself would be a safe resting place for an ocean pattern cable. To Fashoda the distance from Khartoum is perhaps 600 or 700 miles—a convenient length for a good cable to work without a relay station, and such a cable could be made and shipped to Alexandria by the time (or soon after) the railway opens to Khartoum. What next need not be considered now. The Nile is known to be navigable a long way beyond Fashoda, and where a gunboat can swim there can a cable be securely laid.

Wireless Telegraphy.—The *Times* Hamburg correspondent says that on November 29th, by the courtesy of the authorities at Cuxhaven and of the experts engaged in testing the system of wireless telegraphy invented by Prof. Braun, of Strassburg, a series of experiments was conducted between the shore station at Cuxhaven and the operators on board the steamship *Silvana* while *en route* to Heligoland in the presence and for the information of Colonel Hozier, C.B., of Lloyd's. The interest shown is due to the wish to adopt the most perfect communication between sea and

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shore, and "it is understood that in Colonel Hozier's opinion the Braun system so far shows a considerable advance on similar experiments with other systems in England."

An evening paper says that Captain H. B. Jackson has been temporarily appointed to the torpedo ship *Vernon*, at Portsmouth, to prosecute his studies in wireless telegraphy before he is sent to the special torpedo vessel *Vulcan* to introduce the system in the Mediterranean Squadron.

CONTRACTS OPEN AND CLOSED.

OPEN.

Belfast.—December 14th. The Electric Committee wants tenders for the purchase of old incandescent and arc lamps, scrap copper, iron, &c. See "Official Notices" to-day.

Birkenhead.—December 12th. The Corporation wants tenders for the supply of condensing plant, overhead crane, and feeder mains for the electric tramway works and scheme. See "Official Notices" November 24th.

Blackburn.—December 23rd. The Corporation wants tenders for overhead trolley line equipment. See "Official Notices" November 24th.

Blackpool.—December 15th. The Corporation wants for the electricity works four boilers and accessorial steam plant; two 600-KW. steam alternators (or one 1,200-KW.), switchboard, mains, transformers, and battery. See "Official Notices" November 24th.

Denmark.—December 28th. The Corporation of Aarhus is inviting tenders for water-tube boiler plant, steam dynamos, switchboard, and accumulators for electricity works. From our "Official Notices," November 3rd, further particulars may be obtained.

Gloucester.—December 28th. The Electricity Committee wants tenders for extension plant including Lancashire boiler, &c., one 300-KW. steam dynamo, switchboard work, condensing plant. See "Official Notices" November 24th.

Hackney.—December 12th. The Vestry Electric Lighting Committee is inviting tenders for refuse destructors to deal with the whole of the refuse of the parish. Specification, &c., may be obtained at the offices of Mr. Robert Hammond, M.Inst.C.E.

Hackney.—January 2nd, 1900. The Vestry wants tenders for the supply of accumulators. See "Official Notices" December 1st.

Hull.—December 28th. The Electric Lighting Committee wants tenders for two 750-H.P. high speed three-crank vertical engines; and two 460-KW. continuous current dynamos (2,250 volts) for the Sculcoates Lane electric lighting station. See "Official Notices" to-day.

Manchester.—December 16th. The Corporation Tramways Committee wants tenders for steel tie-bars, bolts and nuts for permanent way work. See "Official Notices" December 1st.

The Midland Corporation.—December 18th. From an "Official Notice" Nov. 24th, particulars may be obtained of certain plant and machinery and conductors, for 10,000 B.H.P. output, required for the new power house to be erected by the Midland Electric Corporation for Power Distribution, Limited. There will be 16 water-tube boilers, six sets of Corliss engines and three-phase generators, transformers, switchboards, mains, batteries, &c.

Mistretta (Sicily).—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Palermo, stating that tenders are invited by the Municipality of Mistretta, not later than December 31st next, for the establishment of a service of electric lighting in that town. Such particulars as have been received may be examined on personal application at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 5 p.m.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

Plymouth.—December 8th. The Corporation wants tenders for tramcars, trucks, motors, trolley arms, &c. See "Official Notices" November 17th.

Rathmines and Rathgar.—December 13th. The Council is inviting tenders for additional feeding and distributing mains, including trenching, cables, joint boxes and house services. See "Official Notices" November 24th.

Roumania.—December 8th. The Roumanian State Railway authorities in Bucharest are inviting tenders until December 8th for the supply of 11,320 porcelain insulators and 10 tons of ingot lead.

St. Annes-on-the-Sea.—December 21st. The Urban District Council wants tenders for mains, street arc lighting (enclosed globes), and street incandescent lighting. See "Official Notices" to-day.

St. Pancras.—December 12th. The Vestry wants tenders for (*a*) two dry back marine boilers; (*b*) condensing plant, feed water heaters, steam and feed pipes. See "Official Notices" December 1st.

Trimdon Grange (Durham).—The owners of East Hetton Trimdon and Trimdon Grange Collieries want tenders for 12 months supply of iron and steel castings, gas and steam piping, and a variety of other sundries including electric light fittings. Specifications from the Storekeeper, Trimdon Grange Colliery Company.

Wallasey.—December 20th. The District Council wants tenders for a Lancashire boiler for the electricity works. See "Official Notices" to-day.

West Bromwich.—December 22nd. The Corporation wants tenders for boilers, steam dynamos and condensers, switchboard, mains, and storage battery, for electricity supply. See "Official Notices" to-day.

CLOSED.

Croydon.—The Board of Guardians has accepted the offer of Messrs. W. J. Bishop & Co., of 88, George Street, Croydon, to carry out the work tendered for at the Union Offices, Infirmary, and Workhouse for the sum of £1,995, subject to the usual conditions.

Hull.—The Electric Lighting Committee has ordered 1,000 tons of Kilnhurst best hard steam coal at 14s. 11d. per ton, for the electricity works, from Messrs. Strachan & Son.

Leicester.—The Corporation have placed an order for two 1,000-KW. steam alternators with the Brush Electrical Engineering Company, Limited. The dynamos will be of the "Inductor" type, of which a large number, both for monophase and polyphase working, are in course of construction at the Brush Company's Works at Loughborough.

FORTHCOMING EVENTS.

Friday, December 8th.—At 2.30 p.m. Institution of Civil Engineers. Students' visit to the works of the Baker Street–Waterloo Railway.

At 2.30 p.m.—Institution of Civil Engineers. Students' visit to the works of the Baker Street—Waterloo Railway, in course of construction.

At 5 p.m.—Physical Society meeting in the physical laboratory of the City and Guilds' Technical College, Leonard Street, Finsbury. "Cylindrical Lenses," by Prof. Silvanus Thompson, F.R.S.; "Exact Formulæ for Lenses," by Mr. T. H. Blakesley; "On an Organic Compound of great Double-Refraction," by Prof. Silvanus Thompson, F.R.S.

At 8 p.m.—Institution of Mechanical Engineers, Storey's Gate, St. James's Park, S.W. "A Continuous Mean-pressure Indicator for Steam Engines," by Prof. W. Ripper.

7 to 11 p.m.—Northampton Institute (City Polytechnic) St. John Street Road, E.C. Members' and students annual conversazione.

Tuesday, December 12th.—At 8 p.m. The Institution of Civil Engineers. Paper for discussion:—"Combined Refuse Destructors and Power Plants," by C. Newton Russell, Assoc.M.Inst.C.E.

Thursday, December 14th.—At 8 p.m. The Institution of Electrical Engineers. Discussion on Mr. Crompton's and Mr. John Holliday's papers if adjourned on the 7th inst, and "Electrical Time Service," by Mr. F. Hope-Jones.

DINNER OF THE INSTITUTION OF ELECTRICAL ENGINEERS.

THE eleventh annual dinner of the Institution was held on Wednesday evening at the Hotel Cecil, the president, Prof. Silvanus P. Thompson, F.R.S., in the chair. About 250 were present, the guests including Lord Kelvin, the Hon. Justice H. H. Cozens-Hardy, Sir Courtenay Boyle, K.C.B., Sir W. C. Roberts-Austen, K.C.B., F.R.S., Sir Douglas Fox, Sir Philip Magnus, Gen. Sir R. Harrison, K.C.B., Sir W. H.

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White, K.C.B., F.R.S., Sir G. Murray, K.C.B., Sir H. Roscoe, F.R.S., Sir J. Crichton-Browne, F.R.S., and many other distinguished gentlemen.

The loyal toasts were proposed by the President, and were duly honoured. Mr. R. E. Crompton gave the "Navy, Army, and Auxiliary Forces," reminding the company that he himself was an old soldier, and wished he were out in South Africa—he suggested that his hearers would wish the same! Mr. Crompton's experience of the work done by the Electrical Engineers' Volunteer Corps, of which he is Major, showed what excellent results were derived from the union of military training with cultivated intelligence.

General Sir Richard Harrison, responding, in the absence of Captain Creak, R.N., F.R.S., for the Navy, as well as the Army, remarked on the admirable co-operation of the two departments in transporting troops to South Africa, and in carrying on the war inland. The so-called Auxiliary Forces he looked upon as an integral part of our military system, forming our third line of defence. A reference to the splendid conduct of the Volunteers, gathered from all parts of the Empire, in South Africa, evoked a round of cheers.

The President, exercising his prerogative, next rose to congratulate the Institution upon the presence of Lord Kelvin, who is at the very head of science in this country. He was also the head of the Clan Thomson (but without the "p.")

Lord Kelvin, who was enthusiastically received, proposed the toast of "Science." He had only to mention the word, he said, to call forth the enthusiasm and applause of engineers, to whom, on the other hand, pure science was deeply indebted. When the electric telegraph came into existence, followed, ten years later, by the first submarine cable, and ten years later still by the first Atlantic cable, electrical science was in a very backward state; an immense stimulus was given to its study by its application to telegraphy, and to the great system of electrical measurements, which originated among University professors. Gauss and Weber laid the foundation of the system, the development of which was carried out by practical engineers. He expressed profound admiration for the practical use made of mathematics by engineers; a great debt was due to the electrical journals, which published mathematical investigations freely. Excellent work is now being done by the technical training colleges, among which the University of Glasgow was the earliest to establish a Chair of Engineering.

Sir W. C. Roberts-Austen, replying to the toast, referred to the influence of the telegraph upon the maintenance of peace. Sir Henry Roscoe, who also replied, remarked that where formerly young men would have had to enter the army or navy, or to join the Church, many of them were nowadays claimed by Science. Some of the audience wondered whether Sir Henry was thinking of "Parsons'" turbines or "Vicars'" stokers!

Sir Douglas Fox proposed "Engineering," and pointed out its close connection with science. Sir W. H. White also referred to this point, as exemplified in the persons of Lord Kelvin and the late Dr. John Hopkinson. Mr. Justice Cozens-Hardy gave "The Institution of Electrical Engineers," and expatiated on the vast possibilities of electricity, which, for instance, annihilates distance, and brings news from the ends of the world, both false and true, but mostly false. The toast was coupled with the name of the President, and was pledged with musical honours. The President expressed regret at the absence of General Webber, Sir W. H. Preece, Prof. Ayrton, Colonel Huber, Mr. C. E. L. Brown, and others, and called attention to the reminder of the Swiss tour in the shape of the Exhibition of Photographs in the library of the Institution. The President also described the arrangements which are being made to organise local centres of the Institution in Newcastle, Dublin, Cape Town, and elsewhere, and invited well-to-do members to follow the munificent example of Mr. H. Wilde by contributing to the Building Fund.

Prof. Perry toasted "Our Guests" in a humorous speech, in which he invited State officials and others to consult the Institution more freely when they meet with difficult questions, while acknowledging that Sir Courtenay Boyle already did so. Sir Courtenay, in replying, offered to argue with anyone the question whether the century dies with this month, and gave useful advice to the younger members.

The proceedings terminated soon after 11 p.m.

NOTES.

Electric Car Driving.—A delightful little "Novices' Guide" to the above-named art, written by Mr. E. W. Elsley, inspector of Leeds City Tramways, and formerly a motorman himself, has reached our hands. In the preface the writer proposes "to take the novice to the car shed, show him how to bring out the car, work it during the day, together with many of the scores of things that are likely to befall him before he gets it safe into the depôt at night again." Referring to the selfish practice of some drivers, who seem to believe they know all there is to know about electric traction—and keep it to themselves—he says:—

"This is not as it should be; one man can only drive one car; no man was born with one, and no man can take one away with him when he goes" . . .

"*Power, Current, and Electricity* mean one and the same thing as far as this book is concerned."

The Guide begins with a solemn warning—

DRUNKENNESS.

"Anyone drunk when in charge of *any* vehicle is liable to three months' hard, without the option of a fine, and the driver of a tramcar deserves it." . . .

Then follows excellent advice about starting the car, varied by philosophical reflections, *e.g.*, speaking of improper operation of the controller handle—

"A so-called experienced hand will often bring it round carelessly, not making a pause on any notch, but slugger it over all of them, like one who has been turning a mangle a long time, and got tired of it."

There appears to be no detail of car driving which is unnoticed. The detection of failures is dealt with at length, the only rule for this purpose being "Look until you *do* find it."

"Are all cut-out switches in their proper place? Right home? Nothing lodging across from one to the other of them?"

"Well, now, cut out one motor, and try and work the car with the other. Won't go, eh? Well, replace that switch and try the other. . . . ."

The tricks of horse drivers and others obstructing the car or wilfully causing collisions, and the readiness of bystanders to blame the motorman, have sometimes led the author to wonder why cars were allowed to run at all. But amiable and well-disposed carters are not unknown, and are to be treated kindly.

"In fog do not travel any faster but that you can stop in the same distance as you can see. . . . You may run out of one cloud into clear weather, *then* get your speed again, but before you enter that cloud 50 yards ahead of you there, have your car well in hand again, for in that very bank there may be a man with an old broken-down pony and cart, a horse dealer with one he can't sell, fair on your track. He's waiting for a new lot, and intends getting it out of your pocket if he can, so be careful."

On frosty mornings extra sand should be carried, to help up horses which may have fallen on the track. Is not this returning good for evil? The author does not fail to give numerous instances of difficulties he has met with, and the remedies he applied. He concludes with an exhortation to all to be thorough in their work, and deprecates criticism of his style:—

"The scholar may find faults in my booklet. There are probably some errors of diction and grammar; I am no collegian, and writing is not my strong point."

The author wrote the booklet at a time when he was laid up by some mischance, and had nothing to do but read and write, and

"*this* is the result. If you think it worth the coppers, buy it; if not, don't."

We do, indeed.

Personal.—Mr. Alex. Marr notifies us that he has severed his connection with Messrs. W. T. Glover & Co., Limited, and joined the St. Helens Cable Company, Limited, as their superintendent.

The Electricity Committee of the Manchester Corporation have appointed Mr. F. E. Procter as mains engineer, at a salary of £350. The appointment is provisionally for one year only, but the prospect is held out of its being permanent. Mr. Procter will have as assistant Mr. L. R. Lee, at a salary of £185.

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What Does This Mean?—We observe from a note in our New York namesake that: "At Dover, Del, on November 11th, these companies were incorporated: British Electric Street Tramway Company, to construct and operate electric street tramways in Great Britain and its colonies; capital, $5,000,000. London Electric Tramways Construction and Maintenance Company, for the purpose of constructing and operating electric street tramways; capital, $2,500,000." Our contemporary does not appear to be in the know as to the objects, &c., of these newly-formed enterprises, and in the absence of further information, comment on our part would be premature.

Up-to-Date Equipment for Printing Offices.—The new American Government Printing Offices will be provided with 12 electric elevators for access to the different floors, the buildings will be lighted by 7,000 incandescent lamps, and refuse will be destroyed for water heating. A contemporary, from which we derive this information, does not mention the electric driving of printing presses, &c., but we presume this will be part of the programme.

Obituary.—The death is announced from Abbazia of Frau Anna von Helmholtz, the widow of the distinguished Berlin professor of physics, the late Hermann von Helmholtz. Her only daughter is the wife of Herr Arnold von Siemens, the head of the great firm of electricians.

We hear with deep regret that Mr. D. Bruce Peebles, the senior partner and founder of the firm of Messrs. D. Bruce Peebles & Co., died on Tuesday morning. Mr. Peebles was perhaps one of the best known men in the gas world for the last 30 years, and it redounds to his broad-minded spirit that, in face of this fact, he, two years ago, started the electrical manufacturing department, which, despite the short time it has been established, is already one of the largest in the country. His advancing years notwithstanding, Mr. Peebles took the greatest interest in each succeeding development of the new department, and although originally brought up in the old school, was ever a staunch supporter of the latest improvements. It is a consolation to think that he lived to see the success of his labours firmly established.

Correction.—In an article on "Electric Railways in America" in our issue of November 10th, we referred to a special issue of the *Street Railway Review*, upon an article in which our comments were based. We regret, however, that the name of the journal was given incorrectly. The issue referred to was the "World's Practice Number" of the *Street Railway Journal*.

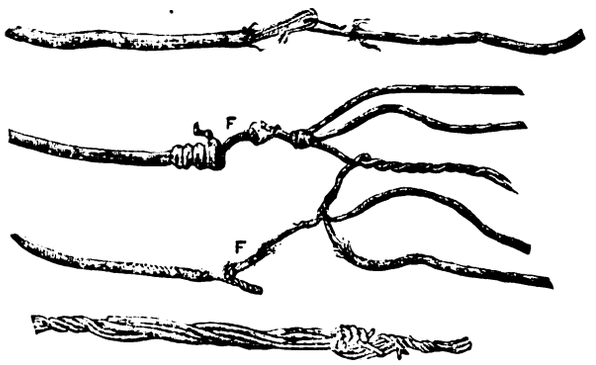
Appointments Vacant.—For the Whitechapel electricity undertaking a mains foreman, shift engineer, and other members of staff are required. See "Official Notices" this week.

The Bury St. Edmunds Corporation wants a resident electrical engineer at £150 per annum. See "Official Notices."

The Manhattan Railway Generators.—The halfpenny daily press, in its efforts to manufacture sensational headings, sometimes overshoots the mark, and makes itself very ridiculous. A case in point is just found in the *Daily Mail* columns. In recording the placing of the Manhattan large generator contract with the Westinghouse Electric Company, "which is about to erect extensive works at Manchester," the paper in question heads the note, "Trade comes to England!" From this, the ordinary reader would gather that these enormous generators are to be made in this country, but such is certainly not the case. The Manchester works are hardly likely to be opened for some little time yet, and the first of these 6,650 H.P. sets is promised for delivery in 10 months.

Lecture.—At a meeting of the Liverpool Engineering Society last week, Mr. A. Lester Taylor read a paper on the "Fire Risks of Electrical Installations." The chair was taken by the president, Mr. A. Bromley Holmes, and there was a large attendance of members.

Jerry Wiring.—The first of the annexed figures shows what is probably the worst attempt at a "joint"—save the mark—that we have ever met with. This extraordinary connection was covered with a strip of chair-webbing, laid lengthways, a rag of flannel, and a strip of similar material rolled many times round the bundle, and dabbed with red paint. The next figure shows the wiring of a three-light ball fitting, the letters, F F, distinguishing two bits of flexible of small size, which unite the branches with the main leads; pieces of India-rubber tape are lavished



on the dry joints, and are fastened in place by half-hitches, but plenty of the bare wire is exposed. The remaining figure shows a part of one of the main leads in the hotel, from which the preceding example was obtained. The 7 × 18 cable is roughly dry-jointed to a 7 × 23 cable, which latter had to carry the whole current for lighting the hotel. When this "joint" was uncovered it was actually *red-hot*, and all the tin had been burnt off the copper wires! When will something be done to bring such criminal work within control of the law? The perpetrator of such misdeeds ought to be liable to penal servitude, and the contractor who allows such work should take his place beside him.

Royal Society.—On November 30th the anniversary of the Royal Society was held at Burlington House. Lord Lister delivered his anniversary address. In the evening the annual dinner was held at the Hôtel Metropole, Lord Lister again presiding.

Swiss Photographs.—The secretary of the Institution of Electrical Engineers informs us that the collection of photographs taken by members during the recent visit of the Institution to Switzerland were placed on exhibition in the library on Tuesday, 5th inst., and they will remain so until Tuesday next, 12th inst.

Northampton Institute.—Mr. E. Kilburn Scott has been recently appointed to the post of instructorship in electrical engineering and design.

Royal Institution.—The Goldsmiths' Company has made a further grant of £1,000 for the continuation and development of original research, and especially for the prosecution of further investigations of the properties of matter at temperatures approaching that of the absolute zero of temperature.

Presentation.—On Wednesday last week, at a meeting in the Lecture Theatre of the Victoria and Albert Museum, very numerously attended by members of the present and past staff of the department and by men of Science and Artists who have been connected with it, Sir John Gorst presented on the behalf of some 500 subscribers, a testimonial to Major-General Sir J. F. D. Donnelly, K.C.B. This consisted of a silver salver, a set of library furniture, a collection of books of reference, a Zeiss binocular, and a diamond brooch for Lady Donnelly. The inscription on the salver stated that it was a recognition of high regard and in remembrance of cordial relations of more than 40 years.

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The Possibilities of Electricity.—At a meeting of the Railway Institute at Darlington last Friday evening, Sir James Kitson, M.P., a director of the North-Eastern Railway Company, in the course of his address, went on to comment on the development of electricity in the United States. They were many years ahead of us, he said, because of the scientific attainments of the American people. The way in which electricity was being developed and applied was one of the great things of the future, to which the young men of the present day should particularly turn their attention. Just now the great firm of Westinghouse, of Pittsburg, had arranged to erect works at Manchester for the production of electrical machinery. There was no difficulty with us in finding workmen who would follow the instructions of the foreman, but we had a difficulty in finding the young scientists who would instruct the men, and show how the machinery should be produced. Men were being brought over from the United States to establish these works. We in England ought to be able to do these things for ourselves. It was simply a question of education. In Sweden, where he had lately been, they were becoming independent of coal, and he had seen great ironworks driven entirely by adjoining water-power converted into electricity. From one of the Scottish lochs there was available 40,000 H.P. daily which was now passing away to the sea. Brilliant opportunities were now opening to the new generation.

A Woman of No Importance.—"Meteor" says that the word "Aerogram," if used as a name for wireless telegraph messages, is certain to be mispronounced. "Who does not know ladies who invariably speak of an *aerated* bread shop," remarks the earthly embodiment of the Leonidæ. This shows the kind of female society *he* affects!

Fatality.—Last Saturday an inquest was opened at Willesden into the death of A. J. Barnes, 22, who met his death on 29th ult., at the new works of the Metropolitan Electric Supply Company, where he was employed as engineer. Somehow or other deceased fell among the moving parts of one of the large machines, and was torn to pieces. The hearing was adjourned for the attendance of the Home Office inspector in regard to the protection of the machinery.

NEW COMPANIES REGISTERED.

Newhaven and Seaford Electric Lighting Company, Limited (64,307).—This company was registered on November 25th, with a capital of £20,000 in £1 shares, to carry on the business of an electric light company, electrical engineers, electricians, suppliers of electricity for all purposes, telephone, telegraph and general contractors, engineers, wire and cable manufacturers, &c. The subscribers are:—A. J. Jack, The Crouch, Seaford, civil engineer, 50 shares; J. F. Plaister, Highlands, Seaford, manufacturer, 50 shares; J. A. M. Bannister, Lorraine, Newhaven, draper, 50 shares; A. G. Mossop, Wiegland, Newhaven, M.D., 20 shares; E. J. Gorringe, Chynton, Seaford, farmer, 50 shares; W. P. Morgan, Hurdis House, Seaford, M.B., 50 shares; Rev. H. H. Goodwin, Bonnewell, The Vicarage, Seaford, 50 shares; and E. Towner, Steam Mills, Newhaven, miller, 50 shares. The number of directors is not to be less than three nor more than seven; the subscribers are to appoint the first; qualification, £100; remuneration, £25 each per annum and a share in the profits.

Atlas Engineering Company, Limited (64,320).—This company was registered on November 27th, with a capital of £2,000 in £1 shares, to acquire the business carried on by Benjamin Wild and John H. Clarke, under the style or firm of "Wild, Rothwell and Co.," at Atlas Works, Virginia Street, Southport, and to carry on the business of electrical and mechanical engineers, iron founders, cycle, motor, motor car, and motor cycle manufacturers, carriage builders, &c. The first subscribers (each with one share) are:—Nicholas T. Pollitt, Lansdowne Villa, Sheffield Road, Godley, engineer; James Malam, 21, Sefton Street, Southport gentleman; Thomas Pendlebury, 16, Ivy Street, Southport, engine driver; John R Haworth, 4, Norwood Avenue, Southport, accountant; James B Davenport, 73, Ridley Lane, Hyde, printworks manager; James Hall, 8, Lathbridge Road, Southport, mineral water manufacturer; and Mrs. Alice Pendlebury, 16, Ivy Street, Southport. The number of directors is not to be less than three nor more than five; the first are James Malam, Nicholas T. Pollitt, and Thomas Pendlebury; qualification, 50 shares; remuneration as fixed by the company. Registered office, Atlas Works, Virginia Street, Swansea.

Rotary Piston Engine Company, Limited (64,327).—This company was registered on November 28th, with a capital of £2,000 in £1 shares, to acquire the British, Foreign and Colonial rights in patents Nos. 5,086 and 20,332, both of 1899, and to carry on the business of engineers, electricians, &c. The first subscribers (each with one share) are:—A. Binnie, 9, Warwick Court, Gray's Inn, W.C., engineer; A. E. Vidal, 20, Central Hill, Norwood, S.E., law student; W. Everett, 9, Warwick Court, Gray's Inn, W.C., draughtsman; J. M. Langdon, 80, Beaufort Street, Chelsea, S.W., gentleman; C. S. Mole, 17, Kenton Road, South Hackney, clerk; J. Starey, 37, Cursitor Street, E.C., agent; and E. J. V. Davis, 11, Harringay Villas, Green Lanes, N., ironfounder. Registered without articles of association.

County of Sussex Electrical Power Distribution Company, Limited (64,333).—This company was registered on November 28th, with a capital of £50,000 in £10 shares, to carry on the business of electrical engineers, electricians, engineers and contractors, suppliers of electricity, manufacturers of electrical apparatus, mechanical and chemical engineers, tramway and light railway proprietors, wharfingers, warehousemen, &c. The first subscribers (each with one share) are:—J. Renwick, 29, Hillside Road, Stamford Hill, N., clerk; M. E. Sheerboom, 6, Ferncliffe Road, N.E., clerk; C. Walmsley, Donington House, Norfolk Street, W.C., accountant; E. Hopwood, 35A, Hertford Street, Mayfair, W., clerk; W. L. Madgen, 47, Lower Belgrave Street, S.W., electrical engineer; R. P. Sellon, Queen Anne's Mansions, Westminster, electrical engineer; and J. S. Raworth, 2, Queen Anne's Gate, S.W., civil engineer. The number of directors is not to be less than three nor more than five; the subscribers are to appoint the first; qualification, £100; remuneration as fixed by the company. Registered office, Surrey House, Victoria Embankment, W.C.

Llanelly and District Electric Lighting and Traction Company, Limited (64,341.)—This company was registered on November 29th, with a capital of £50,000 in £1 shares, to carry on the business of an electric light company in all its branches, and in particular to construct, lay down, establish, fix, and carry out all necessary cables, wires, lines, accumulators, lamps, and works, to generate and supply electricity for all purposes, to light towns, streets, markets, theatres, shops, houses, buildings, and places, to erect destructors for dealing with refuse, and to manufacture and deal in chemical and other substances obtained therefrom. The first subscribers (each with one share) are:—Wm. M. M. Forwood, 15, Union Court, Liverpool, solicitor; Chas. O. Grindrod, 11, Knowsley Road, Rock Ferry, Cheshire, solicitor; Albert E. Haptie, 5, Durham Road, Seaforth, near Liverpool, manager; Fredk. W. Lintern, 22, Beaumont Street, Liverpool, book-keeper; Allen Buckley, 8, York Road, Seacombe, Cheshire, book-keeper; Herbert J. Russell, 25, Demesne Street, Seacombe, Cheshire, book keeper; and John Hayes, 113, St. James Street, Liverpool, book-keeper. The number of directors is not to be less than two nor more than five; the first are to be appointed by the subscribers; qualification, £100; remuneration as fixed by the company.

Electrolytic Alkali Company, Limited (64,360).—This company was registered on November 30th, with a capital of £500,000 in £1 shares (2,000 preference), to enter into agreements with the General Electrolytic (Parent) Company, Limited, Charles O. Connor and Douglas Hermann, to manufacture alkali, chlorine, bleaching powder, and other chemical substances by electrolysis or otherwise, and to carry on the business of soap and chemical manufacturers, electro-metallurgists, &c. The first subscribers (each with one ordinary share) are:—Charles O. Connor, 4, Queen's Elms, Belfast, merchant; William Thomson, Royal Institution Laboratory, Manchester, consulting chemist; James A. Morrice, 124, St. Vincent Street, Glasgow, manufacturing chemist; W. T. Thomson, Ghyllbank, St. Helens, Lancs., copper smelter; A. Weilson, 6, Chapel Street, Liverpool, general produce broker; W. Varley, St. Annes, St. Helens, Lancs., bank manager; and John Wilson, Oxford Road, Runcorn, chemical engineer. The number of directors is not to be less than three nor more than nine; the first are John Barr, Alfred E. Fletcher, Zachariah J. Heys, John A. Morrice, William Thomson, and two others to be nominated by the General Electrolytic (Parent) Company, Limited; qualification, £500; remuneration as fixed by the company.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Monte Video Telephone Company, Limited (27,208).—This company's annual return was filed on November 13th, when 86,492 preference, and 72,680 ordinary shares had been taken up out of a nominal capital of £160,000 in 87,000 preference, and 73,000 ordinary shares of £1 each. £159,172 is considered as paid.

Brush Electrical Engineering Company, Limited (29,533).—This company's annual return was filed on October 24th, when 90,000 ordinary and 90,000 preference shares had been taken up out of a nominal capital of £660,000 in 180,000 ordinary and 150,000 preference shares of £2 each. £360,000 has been received.

East Grinstead Electrical Lighting Company, Limited (48,522).—This company's annual return was filed on November 6th, when seven ordinary shares were taken up out of a nominal capital of £15,000 in 5,000 preference and 10,000 ordinary shares of £1 each. No calls have been made.

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SUPPLY STATION ACCOUNTS.

Leyton Urban District Council Electricity Accounts.

The accounts of the Leyton Electricity Supply Undertaking are interesting as showing what can be done with gas power. The price charged is low, being 5d. and 3d. per unit for lighting, and 3d. for "power and heat." The late engineer, Mr. H. Collings Bishop, is now engaged in designing works for the Wigan Corporation. The first of the accounts analysed below is signed by him, and the second by his successor, Mr. F. Harman Lewis, who gained valuable experience at Wolverhampton in the early days of the supply there, for which he was principally responsible.

General Statement.

	1897.	1898.	Increase.
Total capital expenditure ...	£28,247	£47,047	£18 800
Number of units sold	123,797	248,905	125,108
Number of lamps connected ...	6,788	13,644	6,856
Gross revenue	£1,802	£3,417	£1,615
Gross profit	£466	£926	£460
Average price per unit sold ...	3·14d.	3·26d.	·12d.

The units sold have more than doubled, and the gross profit has almost exactly doubled, but it will be noticed below that the sum required to meet interest and sinking fund has risen still more rapidly, being about £1,200 in 1897 and £1,850 in 1898, or an increase of £650 against an available additional sum of £460 in the gross profits. The result is that the net deficiency has risen from £730 to nearly £930, or almost £200 increased loss. Notwithstanding low "costs" there is every indication that this deficiency can only be met by charging a price higher than that so far asked. One may say that like other undertakings of similar size the Leyton supply has attempted to create a quick and large demand by charging an inadequate price.

Revenue Statement.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current ..	£1,622	3·14d.	£3,375	3·26d.	+·12d.
Meter rents	21	·04d.	83	·08d.	+·04d.
Supply of fittings, &c.	109	·21d.	76	·07d.	−·28d.
Sundry	50	·10d.	35	·03d.	−·07d.
Gross revenue	£1,802	3·49d.	£3,417	3·30d.	−·19d.

It appears, on analysis of the printed accounts, that, notwithstanding the revenue from sale of current being nearly an eighth of a penny greater than in 1897, the gross revenue per unit has dropped by nearly one-fifth of a penny. This is accounted for by the unusual item of a loss on supply of fittings, which exceeds ¼d. per unit.

Cost of Production.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal and other fuel	£266	·52d.	£703	·68d.	+·16d.
Oil, waste, water, and engine room stores.	48	·09d.	119	·11d.	+·02d.
Salaries and wages incurred in generation and distribution.	722	1·40d.	905	·87d.	−·53d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	19	·04d.	193	·19d.	+·15d.
Works' cost	£1,055	2·05d.	£1,920	1·85d.	−·20d.
Rent, rates and taxes ..	...	...	1	...	...
Management and expenses, salaries of managing engineer, secretary, clerks, &c.	281	·54d.	350	·34d.	−·20d.
General establishment charges, stationery and printing, law charges and insurance	...	...	220	·21d.	+·21d.
Other expenses	...	...	...	...	...
Total costs ...	£1,336	2·59d.	£2,491	2·40d.	−·19d.

The costs are exceptionally favourable. Low as they were in 1897, a further reduction of one-fifth of a penny has been made in both "Works'" and "Total" costs, and this in spite of the much increased coal bill per unit, and the new item of establishment charges. Leyton is fortunate in being able to meet "Rent, &c.," with the sum of £1 sterling annually. Many engineers will wish similar leniency was meted out to their undertakings.

Profit Statement.

	1897.	1898.
Interest on loans	£578	£861
Sinking fund for repayments	625	993
Net profit carried to rates	−737	−928
Gross profit	£466	£926

CITY NOTES.

The Allgemeine Elektricitäts-Gesellschaft.

The seventeenth annual general meeting of this company was held in Berlin on November 30th last. The board was able to recommend a dividend of 15 per cent. for the business year 1898-1899, on a capital which was 17 million marks greater than last year. The increase of capital decided on in May last has enabled the company to purchase several electro-chemical businesses.

The manufacture of small motors has been separated from the general machine factory, which had to work overtime to carry out the great increase of business. 11,438 machines, of 197,689 H.P., were manufactured, as against 8,328, of 152,900 H.P.; amongst these were dynamos of 4,000 H.P. and motors of 1,000 H.P. The simplicity of construction of Drehstrom machines, and their high efficiency, has brought them into great favour, especially in all industries on a large scale, such as mining and smelting works, while the direct current appears to be limiting itself to lighting and traction in densely built cities.

The cable factory has been affected by the anomalous condition of the copper market. The other materials, such as rubber, gutta-percha, lead and silk, have also shown an upward tendency. Yet the turnover in this department has been double that of last year, and the number of workmen has increased by 25 per cent. The rise in the price of copper has led to trials with aluminium wire, which promise favourable results.

The glow lamp factory has increased its production by a million lamps. As soon as the required workshops are erected, a trial is to be made of the technical and economical value of the Nernst lamp by supplying the numerous orders already in hand. The principal patent has been granted by the German Patent Office, and all the European patents, except those for Austria-Hungary, Italy, and the Balkan States have been secured by this company.

At the end of the last business year there were 65 electric tramlines of this company's system at work or in course of construction. For the new account, contracts have been signed or prepared for 35 new lines.

Apart from the great works carried out for the Berlin electricity works, 19 electricity works of about 40,000 H.P. have been completed and are now at work, while 34 more of 80,000 H.P. are in course of construction. The great power transmission works at Rheinfelden have been completed in the past year. Details are given of the working of numerous companies associated with the Allgemeine Elektricitäts-Gesellschaft. The sole representatives of this prosperous company in this country are the Electrical Company, Limited, 122 and 124, Charing Cross Road.

Kalgoorlie Electric Light and Power Company.

On Monday last, Mr. R. W. Wallace, Q.C., presided at the statutory meeting of this company at Winchester House.

The Chairman said that there was little to report, as in the four months it was not possible for the directors to have achieved very much. The objects of the company were thoroughly set out in the prospectus. The company was incorporated on August 8th, 1899, and went to allotment on September 15th, 1899. The whole of the issue of £150,000 6 per cent. cumulative preference shares were allotted, and 5s. per share had been called up and practically all paid. There were 547 shareholders, most of whom were interested in the mines in their district. Nearly the whole of the mining properties in Kalgoorlie were situated within a radius of 1½ miles from the central station. That was exceedingly favourable from the point of view of distribution. Some of the London electric lighting companies had to go to a far greater distance than that. Their business was different to that of lighting companies, because such concerns only gave a supply for a few hours a day, except at times of fog, and they had to have their whole plant available for the supply of those few hours. The plant remained idle for a very large part of the 24 hours. But in the supply of current to mining industries such as this, the power was wanted for practically the whole 24 hours, so that the plant might be working continuously. The supply of electricity for power purposes had been very much on the increase during the past few years. Most factories, even where coal was very cheap, found it better; instead of taking their power by belts and pulleys they preferred to convert to electrical systems, so that they might get a supply of power readily, continuously, close to the machine, and do away with intermediate transmission. The mining experts had seen that that was almost a necessity for them, and that was why such a company as this had been so favourably received by the mine managers. The chairman gave names of well-known mines within their radius. If a mining engineer found for any reason that his pumps ceased working or if the power was not supplied continuously for his various operations in gold getting, his output fell very considerably short, and in order to prevent this he must have duplicate supplies. That was almost impossible in those large mining companies. It would be too costly for them to keep plant idle, and it was a combination of this kind which was manifestly a great advantage to them, inasmuch as keeping one spare unit enabled the whole district to take power supply which would not fail. When the directors took charge of the company they had to face the reports of various electrical engineers, and there was a great deal of difference in their estimates, and also a great divergence of opinion as to the best means of carrying out the work. They, therefore, decided not to fix upon any system in detail until they had seen Mr. Callender, of Lake View mines, and Mr. Cook, who had superintended the erection of the Perth tramways. They had seen these two gentlemen in London recently, and

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had received very valuable information and suggestions from them. The plans were nearly all prepared. He (the speaker) on reading the reports, came to the conclusion that ultimately the power would be produced by means of gas engines, but they must not experiment. They had not had sufficient experience of the working of large gas engines at present. They had been at work at Brunner Mond's, and in the Westinghouse Company's works, but they had not been sufficiently experimented upon to warrant the company using them as a source of supply at first. The board was having experiments made, and when they came to future extensions gas engines would no doubt be adopted. The reason that gas would be cheaper than steam power was the nature of the water supply at Kalgoorlie. The water was very largely impregnated with salt, and if used for condensing engines there was a very large expenditure in getting water for that purpose. In cooling gas engines, they could use the salt water without any condensation, and get a very much more economical rate of working. He (the chairman) believed that with the use of gas engines they could save on annual expenditure something like £30,000 a year. The experiments being made were not at the company's expense, but it was necessary that the system should be thoroughly investigated for the future. At present they were contemplating putting down 4,000 H.P. plant, and they hoped that would be got to work in the course of a year, but the details of the plans had had to be considerably modified from those originally placed before the directors in the schemes of the engineers. They were convinced that it was absolutely necessary that they should supply compressed air as well as electricity. They had found from inquiries that electrical drills were not at present in a position to be used; drills had to be driven by compressed air. There was not the slightest doubt that the amount of power which they originally expected to supply would be exceeded, as the mine managers were only too anxious to get it. The company had experienced mining men on the board, an excellent local board, and they had under their consideration the appointment of managers. Inquiries to that end had been made in America and Germany, and appointments would shortly be made.

In reply to questions, the CHAIRMAN said that they were not bound by the syndicate in the matter of tenders; they had a free hand. In order to get proper tenders the plans, &c., must be completely finished. The very slight delay in sending out for tenders would save the company a good deal of money in the end. A great many provisional contracts had been entered into, but they did not care to enter into binding contracts until they had the power to deliver. The coal obtainable had not been looked upon favourably for the purpose of making gas. They were making investigations as to gas production. It would be impossible to put down large gas works, so that one of the cheaper forms of gas would have to be used.

The India-Rubber, Gutta-Percha, and Telegraph Works Company, Limited.

THE directors' report for the nine months ending September 30th, 1899, to be presented at the meeting at Cannon Street Hotel, London, on Thursday, December 14th, reads:—"The annexed accounts show, after provision for doubtful debts, a net profit for the past nine months of £43,616 5s. 7d. Adding £25,395 3s. 3d. brought forward, and deducting £12,500 interim dividend paid in July, there remains a disposable balance of £56,511 8s. 10d. The directors recommend the distribution of a dividend of 10s. a share, free of income-tax, amounting to £25,000, making, with the interim dividend paid in July, a total payment at the rate of 10 per cent. per annum, and leaving £31,511 8s. 10d. to be carried forward. The general business has been fairly profitable, the selling prices of goods having been increased to meet the advance in the cost of the raw materials. The cable vessels have been moderately employed. The *Dacia* completed the laying of a short cable which the company had manufactured for the International Ocean Telegraph Company of New York. As the period under review was closing, the company concluded a contract with the Commercial Cable Company for the making and laying of a cable which will connect Canso, Nova Scotia, with New York. This cable will be laid by the *Silvertown* next year. The works at Silvertown and Persan have been maintained in their usual state of high efficiency. The board record, with deep regret, the loss they have sustained through the death of Mr. F. L. Hutchins, who had been their legal adviser for 32 years. Mr. Robert Kaye Gray has been elected a director of the company. Mr. Marsham and Mr. Jarvis, the directors retiring by rotation, offer themselves for election."

The Cape Electric Tramways, Limited.

THE ordinary general meeting of the shareholders of this company was held on Thursday of last week at Winchester House, Old Broad Street, Col. Sir Charles Euan-Smith, K.C.B., &c., presiding.

The CHAIRMAN, in proposing the motion for the adoption of the report, said he felt that he might again, on behalf of the board, congratulate the shareholders upon the results of the past year's working. In the year under review, after making full provision for debenture interest, they had been able to pay the shareholders 6½ per cent. upon their capital, as against 5½ per cent. last year. They had placed £8,000 to the credit of the reserve fund, as against £2,000 in 1898, and they were still able to carry forward between £15,000 and £16,000 to the next year's account. Had the board considered it wise and prudent, a still further dividend of 2½ or 3 per cent. could have been paid, but the directors considered that they were best serving the interests of the shareholders by not dividing all that could possibly be divided. The circumstances of the time were such that they demanded conservative and cautious treatment of the resources of the company. The object of the board was to do everything they could to place the future of the company upon a sure and sound basis, so that they might be prepared, as far as possible, for any unforeseen circumstances that might occur. He hoped that that policy would have the approval of the shareholders. The company was, he was glad to say, progressing They carried 1,602,720 more passengers last year than they did in the preceding year, and he might mention that in the month of October this year the tramways, both at Cape Town and Port Elizabeth, had established a record, as for that month they received no less than £14,635, whereas the highest takings hitherto recorded for any single month since the company had been established was £13,180. Of course, the situation existing at the present time, both in Cape Town and Port Elizabeth, was very favourable for passenger traffic on their lines, but he did not think there was any reason to anticipate for South Africa generally anything but marked prosperity and advancement. As regarded the action now pending between the Eastern Telegraph Company and themselves, it was impossible for him to say much regarding a case that was still *sub judice*. He might, however, state that the directors believed they had a complete answer to the extravagant claim for damages which the Eastern Telegraph Company had brought against them. They were conscious of having done everything they possibly could in order to avoid litigation, and they were informed that in America, where very similar cases had been tried, in no single instance had a verdict been given against the tramway companies. They had taken every step necessary to ensure their case being properly represented, and they awaited with confidence the decision that would be given.

Vice-Admiral MARKHAM seconded the motion.

The CHAIRMAN, in answer to a SHAREHOLDER, said that the Eastern Telegraph Company's claim was for damages, based on the allegation that the action of their electrical tramways disturbed the action of their cables.

The report was then adopted.

The directors and auditors having been re-elected the proceedings terminated with a vote of thanks to the chairman for presiding.

Electric Street Car Syndicate.

THE annual meeting of this syndicate was held last week at the works of the syndicate in Withersfield Road, Wolverhampton. The chair was occupied by Mr. Thomas Parker, J.P. The proceedings were of a purely routine and private character, and passed off satisfactorily. The syndicate, it is stated, is initiating a new method of working tramways, a system which it is claimed has great promise for the future. The company is also in an excellent position to supply electric motor cars.

Prospectus.

THE list of applications closed yesterday in the English Electric Manufacturing Company, Limited, which has been offering for public subscription £125,000 4½ per cent. first mortgage debenture, and 37,000 £5 6 per cent. cumulative preference shares. The total share capital of the concern is £385,000 (40,000 ordinary, and 37,000 preference, all £5 shares). The whole of the ordinary shares are issued to the vendors in part payment of the purchase money. The undertaking and works of the company are referred to on another page of this issue, from which it will be seen that there is great scope for the company's operations in traction work. The whole of the debentures mentioned above are to be reserved for working capital. The prospectus gives particulars of the agreements entered into with S. H. Short, the Equipment Syndicate, Limited, Dick, Kerr & Co., and others, quotes facts and figures showing the amount of work in hand and in prospect, details the capacity of the works, and prints a report by Mr. Stephen Sellon, of Westminster, and Mr. William Wilson, surveyor and valuer, Manchester, stating the value of the property to be acquired from the Equipment Syndicate (who are the promoters and vendors) is £306,805. The directors, are:—Richard Henry Prestwich (director Blackpool and Fleetwood Tramroad Company), Manchester, chairman; George Flett, 110, Cannon Street, London, E.C.; John Kerr, 94, George Street, Edinburgh; Thomas Dawhurst Lingard, Booth Street, Piccadilly, Manchester; George Richardson (chairman North Metropolitan Tramways), London; Sidney H. Short, 110, Cannon Street, London, E.C. (technical director). The secretary (*pro tem*) is Mr. Fredk. Crimes, 13, Spring Gardens, Manchester.

Venezuela Telephone and Electrical Appliances Company, Limited.

ON Thursday last week a meeting of this company was held at 28, Victoria Street, S.W., Sir Douglas Fox presiding.

The CHAIRMAN said that fair progress had been made with the company's business during the year. Good relations had been maintained with the Central Government and the municipalities of the various towns with which they were connected. There had been very few complaints in regard to the working of the telephonic system. The company had been passing through rather troublous times, the trade of Venezuela having been bad owing to the low prices of coffee, and other circumstances. For the year ended June 30th last, the accounts showed a profit of £9,079, excluding £693 brought forward. After providing for the interest on the first and second debentures, &c., and the dividend on the preference shares, there remained £4,532. Out of this sum the directors recommended a dividend on

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the ordinary shares at the rate of 2 per cent. per annum, which would absorb £1,400; the writing off of the expenses in relation to the new contract, £1,103, and the transfer of £1,500 to reserve, leaving £531 to be carried forward. The number of subscribers increased from 2,640 to 6,691, while the capital outlay was £1,302, against £1,754 during the previous financial year. The whole of the plant, machinery, &c., had been maintained in good working order and repair out of revenue, and the company's position was gradually becoming consolidated, so that better results might be hoped for in the future.

The report was adopted.

Southern Electrical Installation and Wiring Company.

The statutory meeting of this company was held on Friday at Hastings, Captain Colvile presiding. The Chairman, in his speech, said that the directors had completed the purchase of the businesses, and had had the accounts for the first three months of the company's working gone through by the company's professional auditor. He was glad to be able to tell them, as they would be glad to hear, that the books showed a considerable margin of profit. They had between 30 to 40 shareholders, who had taken up 1,855 preference and 3,493 ordinary shares. Application for free wiring concessions had been made in a neighbouring town, but the matter was not yet settled.

The Electric and General Investment Company, Limited.—The directors have declared an interim dividend of 10 per cent. on the capital paid up on the ordinary shares of the company, being 2s. per cent., less income-tax. The dividend is for the six months ended the 30th ult., and will be payable on the 20th inst. to those shareholders registered on the books of the company on November 30th, 1899.

Brazilian Submarine Telegraph Company, Limited.—The directors have declared an interim dividend of 3s. per share, or at the rate of 6 per cent. per annum, free of income-tax, for the quarter ended September 30th last, and payable on December 21st. The transfer books of this company will be closed from December 14th to 20th, both days inclusive.

Stock Exchange Notices.—The Stock Exchange Committee have appointed special settling days as under:—Wednesday, December 13th—New General Traction Company, Limited—Further issue of 20,000 6 per cent. cumulative preference shares of £5 each, fully paid, Nos. 54,001 to 74,000.

British Columbia Electric Railway Company, Limited.—An interim dividend at 4 per cent. per annum (tax free) has been declared on the ordinary shares for the six months to September 30th.

British Electric Traction Company.—The letters of allotment in respect of the issue of 20,000 preference shares have been issued.

The Electric Lighting and Traction Company of Australia, Limited.—The first ordinary general meeting of this company will be held at Winchester House on Monday, 11th inst., at 12.0 noon.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending December 2nd, 1899, were £161 16s. 0d.; December 2nd, 1898, £143 8s. 8d.; aggregate for half-year to date, £19,787 13s. 0d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending December 1st, 1899, were £2,696 11s. 10d.; corresponding period, 1898, £2,478 5s. 0d.; increase, £218 6s. 10d.

The City and South London Railway Company.—The receipts for the week ending December 3rd, 1899, were £1,053; December 4th, 1898, £1,119; decrease £66. Total receipts for half-year, 1899, £22,540; total receipts corresponding period, 1898, £22,636; decrease, £96. Miles open, 8¼.

The Dover Corporation Tramways.—The receipts for the week ending December 2nd, 1899, were £154 10s. 8d.; December 3rd, 1898, £140 14s. 4d.; increase, £13 15s. 11d. Total receipts to date, 1899, £9,462 14s. 2d.; corresponding period, 1898, £7,927 2s. 2d.; increase, £1,535 12s. 0d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,783; 1898, 4,222. Number of cars, 1899, 11; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, December 1st, 1899, were as follows:—D. U. T. Co., horse cars, £172 14s. 1d.; ditto, electric cars, £2,753 14s. 2d.; D. S. D. Co., electric cars, £665 6s. 6d.; total, £3 591 14s. 9d.; corresponding week last year—D. U. T. Co., horse cars, £1,891 9s. 0d.; ditto, electric cars, £498 5s. 9d.; D. S. D. Co., electric cars, £497 7s 8d.; total, £2,887 2s. 5d.; increase, £704 12s. 4d. Aggregate to date, £92,833 8s. 7d.; aggregate to date last year, £88,136 4s. 1d.; increase to date, £4,697 4s. 6d. Worked:—The mileage open is 39 miles electrically, 5 miles by horses, as against 16 miles electrically, and 26 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending December 3rd, 1899, were £576; December 7th, 1898, £236; Increase, £340. Number of cars, 1899, 28; 1898, 10. Total receipts to date, from April 1st, 1899, £21,196; 1898, from June 29th, 1898, £6,067. Miles of track open, 12; 1898, 3¼. Car miles run, 12,024; 1898, 4,084.

The Liverpool Overhead Railway Company.—The receipts for the week ending December 3rd, 1899, amounted to £1,747; corresponding week last year, £1,317; increase, £430.

The South Staffordshire Tramways Company.—The receipts for week ending December 1st, 1899, were £701 8s. 7d.; December 2nd, 1898, £610 14s. 3d.; aggregate receipts for 48 weeks £31,980 10s. 11d. 1898, £30,349 16s. 4d.

STOCKS AND SHARES.

Wednesday Evening.

Again our report has to tell of the downward path pursued by electrical stocks and shares. The changes are, however, few and unimportant, except as regards two or three stocks, and, on the whole, the market has up to the present escaped lightly under the wave of depression that is threatening other departments of the Stock Exchange. Dear money is at the root of the trouble, and apprehensions with regard to the Bank rate are causing anxiety in every direction. Investment and speculation both lie dormant under the dark horizon, nor is it likely that business will return to any appreciable extent until after the new year, when there may be less difficulty in the money market.

In the supply section there is a widening in the quotation for City of Londons, which gives them an air of being ¼ up, but the improvement is more nominal than real. It is interesting to note, in these days of new developments, that the City Company has the power of issuing another £200,000 worth of ordinary share capital, while its great rival, the Charing Cross and Strand, would have to appeal to Parliament before raising fresh money, as its authorised powers have all been exercised. The Metropolitan Company has a further 15,000 shares of £10 each in reserve, besides Debenture Stock to the amount of £30,000. "Mets." are a weak market, and it is feared that the enterprising Marylebone Vestry may introduce a fresh element of discord into the protracted negotiations now going on between itself and the company by allowing a competitor to enter the parish. The proposal is down on the minutes of the Vestry, together with another which suggests the purchase of the company's interests in Marylebone, which, by the way, the company values at the sum of £933,211!

South Londons are now fully paid, and the fact that there is no liability upon them may help to keep the price steadier than it has hitherto been. Westminsters are a dull spot and have lost another 10s., making £1 within the last fortnight. Blackheath and Greenwich are ¾ to 1, and Aron Meter are ⅞ ex the dividend of 7½d.

Welsbach Incandescent stocks are receiving some attention upon the reported perfecting of the company's invention for applying the system to electric lights as well as gas. The advantages claimed comprise much greater economy in burning, much greater power in illuminating, and the others connected with the familiar gas lighting arrangement. If the new invention proves practicable, it will result in a nice little bonus falling to Welsbach stockholders, whose spirits have lately moved downwards as the stocks fell day after day. The Ordinary stock now stands at 64 and the 5 per cent. Preference at 73, the latter appearing to be the more desirable investment.

The telegraph market shows most fall on the week of any of the electrical sections. Eastern Ordinary has shed a brace of points, the Preference and Debentures stocks one each. "Chinas" are also weaker, both as regards the shares and Debenture stock, the continual delay on the wires and the strict Press censorship are causing a good deal of disappointment to a market which has only lately recovered from a severe blow. Moreover, Eastern stock is being sold by "bulls," who bought in anticipation of the company doing a roaring business over the war, and who are getting weary of the constant "pin-pricks" to which their company is subjected. Dear money also operates powerfully in the stock's disfavour. The Anglo group is also dull and flat, due to the money scare that is agitating Wall Street. Submarine Cables Trust is down a point, holders of the old selling their stock in order to take up the new issue. West India and Panama are quoted ex-dividend, but so far from recovering the amounts, the Ordinary and Preference have suffered to the extent of 2s. and 4s. respectively.

Traction descriptions are mainly remarkable for a sharp drop in City and South London stock, for which a small selling order was responsible, in a dull market. British Electric Traction keep steady with no particular feature. The new issue of Preference shares was subscribed several times over, but the market wants to know how the allotments were worked out, some people having apparently got 5 per cent. more than others. The premium on the new issue is about 15s. per share. The tramway traffics were irregular, but the increase of £749, reported by the Buenos Ayres and Belgrano, had a stimulating effect upon business in the shares, the price advancing to 5½. Barcelonas have been done at 12¾, and there is no move to report in Anglo-Argentine, which remain at 4. Blackpool and Fleetwood shares are 18, and there is a talk of a new system of electrical trams all over South Lancashire. Oldham, Ashton & Hyde's are quoted in the Manchester list:—Ordinary, 19—19½, and Preference, 10⅞—10¾; and Kidderminster and District Preference are in the Birmingham list at 6—6½.

There are several new companies now before the public, and we must congratulate the promoters upon their bravery in attempting to launch fresh ventures at a time like the present. The market has taken very little interest in them. The American Government's proposal to lay a new cable to the Far East is not taken very seriously, and its effect upon the existing companies has scarcely been discussed.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. †	Dividends for the last three years. 1898.	1897.	1896.	Closing Quotation, Nov. 29th.	Closing Quotation, Dec. 6th.	Business done during week ended Dec. 6th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red	100	...	...	...	85 — 90	85 — 90	..	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	66 — 69	65 — 68	66⅞	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	117 —118	115½—116½	117⅜	115½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	17½— 18	17 — 17⅝	17⅞	17½
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	15 — 15⅝	15½	15
75,000£	Do. do. 5 % Debs. 2nd series, 1906 ...	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	198 —203	198 —202	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	103 —105	103 —105	104⅛	104½
234,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	½— ¼	½— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	9 — 10	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	...	...
12,981	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3¼%	3½%	11¾— 12¼	11¾ — 12¼	12⅛	12
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101 —104	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	156 —161	154 —159	157½	154
1,795,000	Do. 3½% Pref. Stock	100	...	...	...	99 —102	98 —101	99¾	99¼
89,200	Do. 5 % Debs., repayable August, 1899 ...	100	5 %	5 %	...	... ...	... ...	...	...
1,462,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	117 —122	116 —121	118½	117½
250,000	Eastern Extension, Australasia, and China Telegraph ...	10	7 %	7 %	7 %	15½— 16	15½— 15¾	15 13/16	15½
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
220,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	118 —123	117 —122	...	...
35,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,800£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
200,000£	Do. 4 % Mort. Debs., Nos. 1 to 8,000, red. 1909	100	4 %	...	...	101 —104	101 —104	102⅜	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—6,000	25	4 %	...	...	101 —104%	101—104%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½%	5½%	11¼— 11⅜	11¼— 11⅜	11⅜	11 1/16
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15⅝— 16	15⅝— 16	15⅞	15⅝
180,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	31 — 33	31 — 33	...	...
89,800	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	48	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000 ...	1	...	...	...	¾— ⅞	¾— ⅞	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½%	6 %	6 %	5 — 5¼	5 — 5¼	5 1/16	5 1/16
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	14½	14
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5⅜	5¼— 5⅜	5 1/16	...
1,239,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —103	100 —103	101⅜	100
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	⅜— 1	⅜— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000 ...	100	4 %	4 %	...	103 —106	103 —105	103	102
11,339	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	7⅞	...
3,361	Submarine Cables Trust	Cert.	...	...	...	128 —133	127 —132	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4⅜— 5⅛	4⅜— 5⅛	...	...
151,728£	Do. do. 5 % Debs.	Stock	...	..	...	105 —108	105 —108	115⅜	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	%	...	99 —102	99 —102	101⅛	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	102 —105	102 —105	...	...
359,531	Western and Brazilian Telegraph 4 % Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
98,321	West India and Panama Telegraph	10	1 %	3%	...	1 — 1¼	⅞— 1¼xd	1 1/16	1
34,569	Do. do. do. 6 % Cum. 1st Pref. ...	10	6 %	6 %	...	10 — 10½	9½— 10 xd	9 15/16	...
4,669	Do. do. do. 6 % Cum. 2nd Pref. ...	10	6 %	6 %	...	8 — 9	7½— 8½xd	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	106 —109	106 —109	...	...
155,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds ...	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7½— 8½	7½— 8½	...	...
12,000	Do. do. 7 % Cum. Pref. ...	5	7 %	7 %	...	9 — 10	9 — 10	...	...
30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	10 — 11	10	...
20,000	Do. do. do. do. Nos. 30,001—50,000	5	...	...	...	9½— 10½	9½— 10½	...	..
30,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅜— 6⅛	5⅜— 6⅛	...	...
84,000	*Chelsea Electricity Supply, Ord., ...	5	5 %	6 %	6 %	8 — 9	8 — 9	...	...
100,000	Do. do. % Deb. Stock Red....	Stock	4½ %	4½ %	...	111 —113	111 —113	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000 ...	10	7 %	10 %	6 %	11½— 12	11½— 12⅛	11⅜	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (ins. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	127½	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10½— 11½	10½— 11½	11	10⅜
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
300,000	Do. 4½% Deb. Stock, Prov. Certs (all paid) Rd. ...	...	...	...	...	111 — 114	111 —114	112½	111½
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5½	5 — 5½	...	...
110,000	London Electric Supply Corporation, Limited, Ord. ...	3	...	...	...	2⅞— 3⅛	2⅞— 3⅛	3	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6 — 6½	6 — 6½	6⅜	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	14½— 15½	14 — 15	14⅜	14
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	14½— 15½	13½— 14½	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½— 16½	15½— 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	15½— 16½	15½— 16½	16⅛	...
30,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	3½— 3⅝	4½— 4⅝	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000 ...	5	9 %	12 %	12 %	14 — 15	14 — 15	14½	13⅞

* Subject to Founder's Shares. † Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid. ‡ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Nov. 29th.	Closing Quotation Dec. 6th.	Business done during week ended Dec. 6th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2⅜— 3¼	2⅜— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	16½— 17	16½— 17	17	16 1/16
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13 — 13⅛	12¼— 13¼	13⅜	13
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11½— 12½	11½— 12½	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6⅝	6½— 6⅝	...	...
90,000	Brush Elecl. Engng., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅞— 2⅛	1⅞— 2⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛— 2⅛	2⅛— 2⅛	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —115	110 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13 — 14	13 — 14	...	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	...	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	113 —116	113 —116	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10⅜	10¼— 10⅜	10⅜	...
178,303	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,083	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5¼	4⅜— 5¼	5	4⅞
71,447	Do. do. Def. do.	5	...	...	...	5¼— 5⅜	5¼— 5⅜	5¼	...
630,000£	City and South London Railway	Stock	1 9/16 %	1 9/16 %	2⅛ %	63 — 66	61 — 64	63	62⅛
37,000	Do. do. Ord. shares, Nos. 22,501 to 60,000	4½	...	...	...	3½— 4½	3½— 4½	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛ %	6 %	6 %	2 — 2⅛	2 — 2⅛	...	...
17,189	Do. do. do. "A" Shares, 01—017,189	5	5⅛ %	6 %	6 %	3½— 4½	3½— 4½	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2 — 2¼	2 — 2¼	2 3/16	2 1/16
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	2⅜— 3¼	2⅜— 3¼	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	104 —107	104 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	¼ — ⅜	⅜— ⅝	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	11 — 13	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	10 %	12 %	14 %	13 — 14	12½— 13½	...	...
15,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	7 %	5¼— 5⅜	5¼— 5⅜	5 9/16	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21⅜	21⅛
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3½ %	3½ %	8⅜— 9	8⅜— 9	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13½— 13⅝	13½— 13⅝	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	37 — 41	36 — 40	36	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9 — 10	9 — 10 xd	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6	5½— 6	5⅝	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	8 %	101 —104	101 —104	102½	...

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked § are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½% Debentures of £100, 105—108.
National Electric Free Wiring, 10s. paid, 5s.—7s.
Oldham, Ashton, and Hyde Electric, Ord., 19—19½.
Do. do. Pref., 10⅝—10⅞.
Smithfield Market Electric, 1—3.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6%, £5 (fully paid), 7¼—7⅝. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
Kidderminster and District Electric, Pref., 6—6½ xd.
*T. Parker, £10 (fully paid), 18⅜.

* From Birmingham Share List.

Bank rate of discount 6 per cent. (November 30th. 1899).

MARKET QUOTATIONS, Wednesday, December 6th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a " Nitric .. .. .. per cwt.	22/-	22/-	..
a " Oxalic .. .. .. per cwt.	32/-	32/-	..
a " Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) .. per ton	£29	£29	..
a " " .. .. per ton	£27	£27	..
a Bleaching powder .. .. per ton	£6 1	£6 10	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a " (50/90 %) .. .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25 10	£25 10	..
a Lead, Nitrate .. .. .. per ton	£25	£25	..
a " White Sugar .. .. per ton	£31	£31	..
a " Peroxide .. .. .. per ton	£27 10	£27 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks.. per lb.	8½d.	8½d.	..
a " Caustic (75/80 %) .. per ton	£24	£24	..
a " Bisulphate .. .. per ton	£35	£35	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a " Recovered .. .. per ton	£5 10	£5 10	..
a " Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
Crystals .. .. .. per ton	£3	£3	..
a " Bichromate, casks .. per lb.	2¾d.	2¾d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£224	£224	..
b " Sheet, in ton lots.. per ton	£191	£191	..
p Babbitt's metal ingots .. .. per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 2" to 12") basis per lb.	8½d.	8½d.	..
c " Tube (brazed) .. .. per lb.	10d.	10d.	..
" Wire, basis .. .. per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	8/-	8/-	..
f " Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£85	£85	..
g " Wire (basis price) .. per lb.	10½d.	10½d.	..
g " Sheet .. .. .. per ton	£85	£85	..
g " Rod .. .. .. per ton	£85	£85	..
n German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	7/-	7/-	..
h India-rubber, Para fine .. per lb.	4/6½ to 4/7½	4/6½ to 4/7½	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i " Pig (Cleveland warrants) per ton	68/4	69/1½	9½d. dec.
i " Forgings, according to size per ton	From £11	From £11	..
i " Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i " Wire galvanised No. 8 .. per ton	£14 5	£14 5	..
g Lead, English Ingot .. .. per ton	£17 10	£17 12 6	2s. 6d. dec.
g " Sheet .. .. per ton	£19	£18 16	4s. inc.
m Manganin Wire No. 28.. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£9 10	£9 10	..
d Mica (in original cases), small per lb.	2d. to 8d.	2d. to 8d.	..
d " " " medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d " " " large per lb.	3/6 to 7/6	3/6 to 7/6	..
p Phosphor Bronze, plain castings per lb.	1/1 to1 1/4	1/1 to 1/4	..
p rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p " r'l'd str'p & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 11	£3 11	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/	10½d. to 1/1	..
i Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
i Steel, Magnet, in bars	£7 8	£58	..
g Tin, block .. .. per ton	£124 5]	119 10	£5 5s. dec.
g " foil .. .. per lb.	1/7	1/6	1d. inc.
n " wire Nos. 1 to 16 .. .. per lb.	1/11	1/11	..
p White Anti-friction Metals— "White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7¾d.	7¾d.	..
j " Best Flax, 6 lea. .. per lb.	5d.	5d.	..
j " Hemp, 3 ply 10 lbs. .. per lb.	3¾d.	3¾d.	..
j " " Russian, 10 lbs. per lb.	4½d.	4½d.	..
j " Jute, 180 lbs. rove .. per ton	£14	£14	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£25	£26	£1 dec.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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APPLICATIONS TO PARLIAMENT FOR ELECTRICAL POWERS.

(*Concluded from page* 878.)

The following particulars are intended to supplement those which appeared in our last issue:—

(*a*) Electric Lighting.

Name of place or town.	Description of powers.	Authority promoting.
Barmouth	... ...	Urban District Council
Basingstoke	... ...	Council
Brecon	... ...	Corporation
Brierfield	... ...	Urban District Council
Clacton	... ...	Urban District Council
Cobham	Cobham, Stoke-d'Abernon, and Byfleet	Cobham Gas Company
Crowborough	Electric lighting of Rotherfield, Buxted and Mayfield parishes (Sussex)	Uckfield Rural District Council
Freshwater and Totland (I.W.)	Brightstone, Brook, Calbourne, Freshwater, Mottistone, Newtown, St. Nicholas-in-the-Castle, Shalfleet, Thorley, Totland, Yarmouth (I.W.)	Freshwater and Totland Electricity Supply Company
Llandilo	... ...	Urban District Council
Llanrwst	Electric lighting of Llanrwst and Trefriw	Llanrwst Electricity Supply Company
Long Eaton	... ...	Urban District Council
Ogmore Valley ...	... ...	Ogmore Valley Electric Light and Power Supply Company
Do.	Extension of 1892 license	Ogmore Valley Electric Light and Power Supply Company
Ormesby	... ...	Urban District Council
Ormskirk	... ...	Urban District Council
Oswestry	Purchase of undertaking of Oswestry Electric Lighting and Power Company, Limited; revocation of 1894 order, &c.	Council
Pwllheli	... ...	Corporation
Ramsgate	... ...	Isle of Thanet Electric Tramway and Lighting Company
Redcar	... ...	Urban District Council
Shildon and East Thickley	... ...	Urban District Council

(*b*) Electric Traction (Tramways, Railways, and Light Railways).

Ashton-under-Lyme ...	Construct and work tramways, electricity, 4-ft. 8½-in. gauge, junctions with the Oldham, Ashton, Hyde and District electric lines, and with Manchester Company's system	Corporation
Bootle	New tramways, electrical working, &c.	Corporation
Camborne and Redruth ...	Tramways, 3-ft. 6-in, electrical working, generating stations, and purchase of power from other companies	Urban Electric Supply Company
Cheltenham and District ...	Light railway extension	T. Nevins, of New Jersey, U.S.A., and 22, James Street, London
Cinque Ports	Light railways for connecting a number of towns and districts, electrical working. (See Electrical Review, page 887, December 1st, 1899.)	David Cook, promoter; J. T. Rossiter, engineer; and Mark Parker, resident engineer
County of Hertford ...	Light railways	County Council and Metropolitan Tramways and Omnibus Company
Dewsbury	New tramways, electrical working, &c.	Corporation
Garston	New tramways, electrical working, &c.	Garston District Tramways Company
Gloucester and District ...	Light railways, within the City and County of Gloucester, electrical powers	City of Gloucester Tramways Company
Gorton	New tramways, electrical working, &c.	Urban District Council
Hereford (County of) ...	Light railways	County Council and the Metropolitan Tramways and Omnibus Company
Hull	Construction and working of additional electric tramways and purchase of Drypool and Marfleet Steam Tramways	Corporation
Kearsley	Various tramway powers, new lines, electrical working agreement, &c.	Urban District Council
Llanelly and District ...	Light railways in the County of Carmarthen	Llanelly and District Electric Lighting and Traction Company
Mansfield and District ...	Light railways	J. Fell, J. Lewis, W. J. Kershaw, and others
Plymouth	Construction and working of additional electric tramways ...	Corporation
Radcliffe	Construction and working of electric tramways, 4-ft. 8½-in. ...	Urban District Council
St. Helens	New tramways, electrical working, &c.	Corporation
Southampton	Construction of new and reconstruction of old lines for electrical working	Corporation
Surbiton	New tramways, electrical working, &c.	Urban District Council
Taunton	Construct and work electric tramways and supply of current for power for public and private purposes	Corporation
Wakefield and District ...	Light railways	Company promoted by J. Fell, J. J. Gittings, E. Horton, W. J. Kershaw, and others
Warrington	Construction and working of electric tramways, 4-ft. 8½ in. ...	Corporation
West Hartlepool ...	Light railways extensions	Hartlepool Electric Tramways Company
Whitefield	New tramways, electrical working, &c.	Urban District Council
Wigan	Construction of 3-ft. 6-in. gauge tramways, and electrical working	Corporation
Wotton-under-Edge ...	Light railways in the County of Gloucester	Railway Developments, Limited

The Cork Electric (Blackrock extension) Trams, and the Shannon water and electric power scheme are also down in the list.

Other light railway orders are being applied for (but the motive power is not indicated) respecting East Sussex; Bridgwater, Stowey and Stogursey; New Romney and Hythe; Brackenhill; East and West Yorkshire Union Railways; Warrington and Northwich.

We read in the *Times* that November 30th was the final day for the deposit of plans and other documents at the Private Bill office in connection with local Bills in promotion for the ensuing session of Parliament. The number of plans deposited by November 30th last year for the session of 1899 was:—Railways, 60; tramways, 16; and miscellaneous (including water, gas, navigation, and County Council Bills), 98; general provisional orders, 77; and electric lighting provisional orders, 114; or a total of 365. The deposits this year for the session of 1900 were:—Railways, 50; tramways, 32; and miscellaneous, 97; general provisional orders, 133; and electric lighting provisional orders, 109; or a total of 421.

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TESTS OF RAIL BONDS.

At the American Street Railway Association Exhibition in Chicago in October last some electrical tests of the Edison-Brown rail bonds were made in the presence of prominent railway men. Some particulars of the tests are furnished to us by Mr. Harold P. Brown, of New York, as follows:—

"Joint of 80-lb. tee rail unbonded, connected in series with a joint of 70-lb. tee rail having one Edison-Brown solid copper bond under each angle plate.

"With a current of 2,000 amperes through the 80-lb. joint the drop was ·423 volt. As a bond could not be put in the proper place and removed quickly enough for purposes of demonstration, contact spots were amalgamated on the top of each rail at inner ends. A No. 0000 solid copper bond was then laid upon these amalgamated spots so as to bridge the joint. The drop with 2,000 amperes was ·018 volt; the drop of 1 inch of this rail with the same current was ·00223 volt. The bond merely laid on top of the rail held in contact by nothing but its own weight, was equal in resistance to but 8¼ inches of rail.

"The drop on 70-lb. tee rail joint with 2,000 amperes through the joint and bonds was ·01946 volt.

"With an extra bond laid on top of this rail, the drop with same current was reduced to ·00762 volt. And with 2,000 amperes the drop in 1 inch of this rail was ·00286 volt; the resistance of the bond was therefore equal to that of 7 inches of rail. As there were no track tools at hand this joint was made up with a 14-inch monkey wrench, and was therefore not as tight as it should have been for service. However, the showing is simply beyond the reach of any other copper bond.

"Two of the leading types of copper bonds were sent in for test by one of the Chicago railways under the same conditions; both being the No. 0000 size and applied in the proper manner to the rails. The loss on one with 1,000 amperes was ·425 volt; and with 2,000 amperes ·75 volt. With the other bond the drop was ·22 and ·37 volt. In each case the bond became red hot in the short time required to make the test."

We are informed that Mr. C. E. Sergeant, general manager of the Boston Elevated Railroad, states that tests recently made on Edison-Brown bonds show exactly the same low drop as when put in during May and June, 1898.

"The same make of bond was put in on October 28th, 1896, between expansion joints of the Metropolitan West Side Elevated Railway in Chicago, and these showed a drop of ·0010 to ·0015 volt. When measured under the same conditions on October 24th, 1899, it is stated that the drop was ·0010 to ·00122 volt.

"These tests were made in presence of Mr. M. M. Scott, electrical engineer of the road."

Other tests have been made and are reported to us as follows:—

Test made in presence of officials of the Chicago-Edison Company, in manhole on Adams Street, near Adams Street station of Chicago-Edison Company, on Edison tube across joint contacts draw-filed and bolted, through extension strips. Temperature 18° C. October 22nd, 1899. Drop taken with Weston millivoltmeter reading ·00002 per degree. Average of 10 readings, ·095464 volt. Average current 1,800 amperes. Time 10.55 to 10.57 a.m.

Drop across same joint with contacts amalgamated and treated with Edison-Brown plastic alloy. Average of nine readings, ·00863 volt. Average current 1,740 amperes. Time 11.26 to 11.29 a.m.

Similar tests on tube No. 13 in Chicago-Edison Company's subway near Chicago River. Ordinary bolted contact. Average of seven readings, ·00462 volt. Average current 1,800 amperes. Time 3.06 to 3.08 p.m.

Same joint on tube No. 13 with contacts amalgamated and treated with Edison-Brown plastic alloy. Average of seven readings, ·00321 volt. Average current 1,730 amperes. Time 5.47 to 5.49 p.m.

Tests on next joint east of above joint in tube No. 13 in subway; ordinary bolted contact. Average of seven readings, ·00448 volt. Average current 1,800 amperes. Time 3.23 to 3.25 p.m.

Drop across same joints with contacts amalgamated and treated with Edison-Brown plastic alloy. Average of seven readings, ·00303 volt. Current 1,730 amperes. Time 5.47 to 5.50 p.m.

Drop on one extension strip of flexible laminated sheet copper connecting above conductors. Average of 16 readings, ·00268 volt. Average current 2,000 amperes. Time 3.15 p.m.

Drop across hot switch in Edison Company's power house with current of 540 amperes, ·0176 volt.

Drop with same current after one-quarter of the contact surface was amalgamated and coated with Edison-Brown plastic alloy, ·00168 volt.

NEW ELECTRICAL WORKS AT PRESTON.

There are strong evidences that great effort is being made to enable the supply of home-manufactured electric traction plant and material to keep pace with the demand. It is in connection with this very laudable object that we hail with satisfaction the completion of a very important electrical works in the Preston district. These works derive much importance from the fact that they are claimed to be by far the largest in Great Britain devoted to the manufacture of electrical apparatus. We refer to the factories of the English Electrical Manufacturing Company, whose prospectus has this week been before the public. The works are equipped with machinery and tools necessary for the manufacture of electrical machinery—more particularly tramway and railway equipment apparatus—on a large scale.

One point of special interest in connection with the undertaking is the question of labour. It is interesting to learn that, although when the works are in full running the employés will number 3,500 men, there is no great difficulty anticipated in finding the labour required.

The experience of the kindred undertaking under the same auspices—the Electric Railway and Tramway Carriage Works, Limited—which, within six months, has reached its full output of 13 tramcars per week, and which for this employs some 500 men, goes to show that with airy, well lighted and comfortable shops, joined with fair treatment and liberal scales of payment, the British workman is capable, if he so incline, of meeting his American competitor both as to the quality of his work and ability to turn it out.

As part of the new Preston undertaking, there is now in hand the erection of some 250 workmen's cottages on an excellent site in the immediate neighbourhood of the works, and this number will rapidly be added to during the course of next year.

The works of the English Electrical Manufacturing Company will be in full operation by the end of next month (January, 1900). They will commence with the production of electrical traction equipment at the rate of 3,000 tramway motors, and 50,000 kw. capacity in generators per annum. The erection of the works has been carried on with noteworthy rapidity, for the first excavation for the foundations was made in June last; by December 31st of this year the buildings will all be completed, and the machinery throughout in place. It is hoped that delivery of finished motors and controllers will commence by March 1st next. If these hopes are fulfilled the whole undertaking, from laying the foundation stone to actual turning out of work, will have occupied only nine months.

The factories are situated in Strand Road, Preston, where 10½ acres of land has been secured from the Preston Corporation. In addition to electric traction equipments, the works will devote special attention to the manufacture of the larger units—both for alternating and direct currents—for electric lighting and transmission of power. The facilities provided in the shops will enable the company to build motors of any required size, electric locomotives up to 100 tons in weight, and generators with a capacity of 10,000 H.P. each.

The equipments of the machine shops, foundry and power house, are, of course, of the most efficient and up-to-date character. All the machine tools and appliances are arranged to be driven, either individually or in groups, by electric motors ranging in capacity from 5 to 100 H.P. The main line shafts will be driven by 10 slow-speed 50-H.P. motors.

As to the present position of the order books, we are informed that already orders have been received through Messrs. Dick, Kerr & Co., Limited, for over 2,000 tramway motors to be manufactured during next year, as well as for a considerable number of generators. This fact, in itself, shows the room which exists for an undertaking of this character. Amongst these orders are numbered 400 motors for the Corporation of Liverpool, 200 motors for the British Electric Traction Company, and also orders for the motors required for the tramways of the Corporation of Sunderland, the Corporation of Dundee, the Corporation of Southport, the Corporation of East Ham, the Corporation of Leeds, the Grimsby and Cleethorpes tramways, &c.

An order of particular significance which the works have received through Messrs. Dick, Kerr & Co., Limited, is one from France for 800 motors for general distribution throughout the Continent of Europe. This is the first occasion on which so important an order for electric traction apparatus has been placed with any British manufacturer, and we have no doubt that the Preston works will play an important part amongst the great electrical manufacturing concerns of the world.

The works have the advantage of the knowledge and long experience of Prof. Sidney H. Short, whose reputation in the States is well known to readers of the Electrical Review.

That the undertaking will be run on a combination of the most modern American and English methods and practice goes without saying, and we wish the English Electrical Manufacturing Company a successful career.

LONDON COUNTY COUNCIL AND ELECTRIC LIGHTING LOANS.

At last week's meeting the Council decided to sanction the borrowing by the Islington Vestry of £7,689 to defray the cost of providing street arc lamps and lamp columns.

Dispute as to Lighting Loans.

The Finance Committee reported that the Islington Vestry had applied for sanction to borrow £13,200 for the provision of additional plant at the Eden Grove station. The information supplied with the application, and on a subsequent occasion, was not sufficiently detailed to enable the Committee to judge whether the cost was fair and reasonable, and they had therefore directed the Comptroller to apply for further details. To this request the Vestry replied through their clerk that they had given every particular which could reasonably be asked for and added:—

That the estimates have been prepared by the Vestry's electrical engineer, and approved by its Electric Lighting Committee, and that my Vestry having perfect confidence in the judgment of both deems it inconsistent with its position as electric lighting undertakers for the parish, to recognise the claim of the Council's officials to be supplied with the details in question.

It was further stated by the Finance Committee that the Islington Vestry had for some time past been questioning the right of the Council to satisfy itself, before sanctioning the borrowing of money by local authorities, as to the legality and reasonableness of the proposed expenditure. The Council, following the practice of the late Metropolitan Board of Works, had always held the opinion that it was its duty, as the sanctioning authority, to consider those points, and that practice, which had never been questioned by the other local authorities in London, was in conformity with that of the Local Government Board when dealing with applications from other local authorities throughout the kingdom for sanction to the raising of loans. In view of the opinion expressed in the letter from the vestry referred to above, and of the practical refusal to supply the

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details asked for, the Committee recommended the Council to inform the Islington Vestry that until the particulars required were supplied, the Council would be unable to arrive at a decision upon the application to borrow £13,200. Mr. A. M. Torrance asked the chairman of the Committee to take back the recommendation for further consideration. Dr. Napier said that the question at issue was a matter of principle which the Council should not pass over without serious consideration. It was the duty of the Council to sanction a number of loans, probably nine-tenths of the loans required by the local authorities in London, and they must be satisfied that the manner in which the money was to be expended was economical and for the districts concerned. The Council's engineer had advised the Committee that the method proposed by the Islington Vestry was not fully explained, and the Committee had only adopted the usual course. It was, however, contended by the Vestry that if the Council was satisfied that the former had power to borrow the money it ought to give its sanction, that it ought not to fix the rate of interest or the period of repayment, and that it ought not to institute an inquiry as to whether the Vestry was spending its money economically. Next year there would be a right of appeal of the local authorities to the Local Government Board in cases where the Council refused to sanction loans, and the Board might then make rules dealing with the question. The speaker proposed, therefore, that the recommendation should be referred back to the Committee so that the subject might receive further consideration. Mr. T. B. Williams, in seconding the amendment, submitted that the Council should be fully informed of the points of difference between the Finance Committee and the Vestry. There was no information in the report to serve as a guide to the members, and he thought some details should be presented to the Council before an expression of opinion on the matter was given. Mr. Howell J. Williams suggested that as the chairman of the Finance Committee had expressed his readiness to take back the report, the mover of the amendment should withdraw his proposal. The Islington Vestry desired to have a friendly conference with the Committee in regard to the matter.

Mr. W. W. Bruce, chairman of the Finance Committee stated that he was prepared to withdraw the report for the purpose of having a conference with the Islington Authority on the subject, and the Council decided to allow this course to be adopted.

Electric Lighting of Asylums.

The adjourned report of the Asylums Committee, to which reference has been made in our columns, recommended the Council to approve the principle of the provision of a central station for the supply of the electric light and water to the asylums to be built on the Horton Estate, and that the Committee should be authorised to bring up a scheme for the approval of the Council. Colonel Ford, as an amendment, proposed that the recommendation should be referred back to the Committee pending the issue of the report in regard to additional asylum accommodation. He said that the Council was being asked to vote in the dark, there being no estimates submitted by the Committee. Mr. M. Beachcroft, in seconding the amendment, contended that the proposal of the Committee was premature since they did not know where the principle would lead them. Mr. N. W. Hubbard, chairman of the Asylums Committee, read a letter from Mr. Clifford Smith stating that the cost of buildings and plant for a central station for the supply of electricity would amount to £42,000, and that that sum would include certain provisions for future extensions. As a matter of economy it would be wise for the Council to give the Committee authority at any rate to prepare a scheme for submission to the Council.

The amendment having been rejected by a large majority, Mr. W. Bruce, as a further amendment proposed that the Asylums Committee should be authorised to bring up a scheme for the erection of a central station, together with an estimate of the cost. That would not, he contended, pledge the Council to the approval of the principle of the scheme. Mr. D. S. Waterlow formally seconded the amendment which was agreed to.

HEAT ABSORPTIVE POWER OF WATER.

Hardly sufficient notice has, we think, been accorded to a recent paper by Mr. C. Holliday before the Institute of Marine Engineers. Mr. Holliday dealt with the absorption of heat by water in tubes especially with reference to differences of temperature and differences of velocity. We may take it to be generally true that more heat will be absorbed when the difference of temperature is greater, and it does not require much reasoning to arrive at a prompt solution of the problem as regards velocity. When water flows through a pipe, the molecules next the pipe are retarded by the roughness of the surfaces over which they pass, and we may take it for granted that the water column has its exterior put into a state of movement. The skin of the water column is held back, and the interior of the column in turn presented to the pipe. A solid India-rubber ring, rolled along a stick—an umbrella ring, for example, may be taken as illustrative of the action that occurs all along the length of a column of water moving in a pipe. Now, if the velocity of such column be made great, the ring will revolve more frequently, and will serve to maintain the inner surface of the pipe at a lower temperature by more rapidly transferring the heat from the pipe to the interior of the water column. The rolling rings are, in fact, alternately receiving heat at their outer circumference and parting with it at their inner circumference. This inner circumference in its turn is acting by friction upon the next layer of water, and in this way we may assume that a moving column of water consists of a numberless series of ring columns one inside another all in a condition of vortical rotation and transferring heat from without to the centre of the column. Obviously if a column move slowly its outer rings will be more heated, and there will be less difference of temperature to transfer and the heating efficiency will be reduced. Mr. Holliday's experiments bear out this reasoning. By quadrupling the flow though a pipe from 5 to 20·7 cubic centimetres per minute, the difference of temperature of the ingoing and outgoing water remained nearly the same. This means, of course, that the thermal units absorbed from a source of heat of the same capacity in each case were nearly fourfold in the latter case. In a second series of experiments ranging from 9·2 to 84·5 cubic cm. per minute the heat supplied was varied, and the results are not very comparable, but in a third set with constant capacity of gas heater and a flow varying from 7·2 to 150 cubic cm., the heat absorption varied from 1,095 to 2,460 thermal units per minute, the difference of temperature of the in and outgoing water varying from 152·1 to 16·4.

Other tests proved a point of maximum absorption of heat. With a flow varying from 24 to 210 cb. cm., the heat absorption varied from 3,648 to 4,998, and the difference of temperature from 152 to 23·8, but there were intermediate rates of flow, namely, 118 and 160 cb. cm. per minute, which gave heat absorption of 5,123·5 and 5,120 thermal units. At both lower and higher speeds the heat absorption is less. All these tests were with comparatively cool water. It was next attempted to show effects when the flowing stream was near ebullition point, so as to prove if the absorption of heat by such water is the result of more rapid movement of the water over the surface, or of some change in the quality or nature of the water, causing it to take up heat more readily. For this purpose straight tubes were used in place of spirals, as heretofore, and longer jackets were employed, so as to give the necessary area of exposure to heat.

With an outflow of 17·5 cb. cm. per minute at 211° and 212°, the inflow was 55°, and the difference 155·4°, showing an absorption of 1,787 units per minute. Increasing the flow to 30 cb. cm., with 195° to 200° outflow and 50° inflow temperature, or 143·5 average difference, the heat absorption was 4,314, as against the 1,787 when the water was near the boiling point. This appears to disprove any idea of a different physical characteristic of the water, and leaves the difference to the credit of the more rapid movement. Further tests under the same conditions of large capacity of source of heat gave results, with flows varied from 36·5 to 205 cb. cm., which varied from 4,684 units, through a maximum of 5,458·6 down again to a final 2,747, the maximum occurring at a flow rate of 106·2, and the final maximum of 2,747 occurring at 205 cb. cm. of flow. This last, occurring as it does after the 4,585 units shown for a flow of 175 cb. cm., is very remarkable. Equality of heat absorption is the notable fact from 77·5 to 135 cb. cm. rates of flow.

Evidently, so far as these tests show, there is a maximum heat absorption at or near a flow of 100 c.c. per minute.

It is not wise to found too much on this figure, for it must have a certain relation to the tube diameter and to the linear velocity, but it is interesting as fixing a point for the same conditions as to tube diameter and velocity of flow. Mr. Holliday finds that when steam is formed the results are reduced, more heat being absorbed by a flow of 26·43 c.c. per minute ejected at 202° from an inflow at 53° than was secured with a flow of 19·4 c.c. ejected at 212° with inlet at 51°. The heat units were 3,113·7 when steam was formed, and 3,933·6 when the boiling point was not reached—a difference of 819·9 units, which can only be accounted for by the reduced absorption due to the steam and by the increase of velocity. A still further increase of the flow in this last case gave *ceteris paribus*, a maximum heat absorption of 6,344 units, with 158·6 c.c. of flow, with a rapid drop to 3,286·1 units, when the flow was increased still more to 193·3. Maximum heat absorption, in the conditions of the test, seems to centre about a temperature difference of the in and outgoing water of 40 to 50° F.

It should be noted, however, that the falling off in the heat absorption after the critical point of maximum is ascribed by Mr. Holliday to the insufficient supply of heat to meet the demands of the rapidly moving water. Possibly, therefore, with a larger source of heat the thermal absorption would continue to increase with velocity. In diagrammatic form the sudden drop of the heat unit curve of absorption is so sudden as to lend support to Mr. Holliday's explanation, though the rising curve rather points to another conclusion, for the curve of rise of effect is hardly less steep than the curve of final drop. Taking the whole into general review, it would appear probable that there are velocities suitable to each size of tube, and it is to be hoped that experiments may be made on practical tubes of different sizes and materials.

Mr. Holliday's conclusions are that the absorption of heat is a function of the velocity of flow and the quantity of heat present in the heat source, that absorption increases with the velocity of the water up to a certain point which depends on the source of heat, a Bunsen flame or steam jacket; that heat absorption falls off after a certain velocity, which also depends on the source of heat and may depend on the kind of motion the water has within the tube. He asks very pertinently, "Does the water move rigidly at these velocities, and therefore fall in absorptive power because there is not time for the heat to be conducted to the inner layers of the moving column?" This brings us back to the idea of the vortex rings with which we prefaced this article. It is probable that if this suggested rigidity of flow really occurs, its formation would be delayed by the use of spiral retarders of flat strip, with a long pitch of revolution. Such retarders, so called, would serve to disrupt the inner mass of the moving columns of water and give a spiral rotation, which might counteract the rigidity or its effects. The subject is one which is of great interest, and is specially so to those interested in water-tube boilers of the small tube variety.

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ELECTRICITY ON WARSHIPS.

Writing in the *Engineering Magazine* Lieut. J. K. Robison deplores the wastefulness of electrical engines on board ship as compared with engines ashore.

It was naturally supposed that the economies of central station practice ashore could have been repeated afloat, but this has not proved to be the case, and the steam consumption per unit is anything from 55 to 100 lbs. per I.H.P.-hour. Later engines of better type are, it is hoped, going to run for 30 lbs., but even this is too much, and better engines ought certainly to be produced, an end to be attained, in the author's mind, in part when flat valves are used on low pressure cylinders, and leakage is thereby much reduced. In the United States Navy 50-kw. sets are a maximum, and our author thinks if connected with the main condenser that they will run for as little as 20 lbs. per I.H.P.-hour, or 26 lbs. if the exhaust be carried to a feed heater. When run non-condensing he estimates that 30 per cent. will be added to the steam consumption. Something like 9 per cent. of the total coal may be saved by exhaust feed heating. Hence, if 30 per cent. of the auxiliary plant steam exceeds 9 per cent. of the total steam consumption it will pay to run condensing on the auxiliaries, as to which, however, we would add that this supposes cold feed, and that feed heating by waste gases on shipboard appears to attract very little attention from marine engineers, probably because of the complication it is supposed, we think erroneously, to bring about.

Much depends on the total efficiency of conversion between the generating engine and the motor shaft. Prof. Thompson gives figures showing 52 per cent. average under fairly good conditions. Naval experience has pointed to 50 per cent., and the experience of large commercial users of electricity shows from 40 to 50 per cent. Mr. S. Dana Greene has stated recently that it may be 60 to 65 per cent. The author considers it fair to assume 59 per cent., namely: engine, 86; generator, 93; line, 95; motor, 78. This assumes commutators in good condition all round. These efficiencies do not appear to be startling. They ought to be secured. In the United States Navy commutators are not in order, but would be kept so if electricity were largely installed. Beyond the motor the efficiency is assumed the same for both electrical and steam driving, an assumption obviously unfair to electricity in some cases, as for example, fans which can be driven by an electrical motor direct in a much more efficient manner than by a steam engine. But in other cases, as in a steam pump or an ice machine, the steam engine has the advantage over a geared motor. Taken all round, therefore, 59 per cent. is claimed to be a fair figure. Roughly, it will require 5 H.P. in the generator engine for 3 H.P. in the motor shaft. Steam at 26 lbs. per H.P.-hour implies, therefore, about 44 lbs. of steam in auxiliary engines.

This, then, is the figure with which for reasons of economy it is necessary to compete, and this is 35 per cent. less than the amount of steam used by most modern steam auxiliaries. If auxiliaries now use 18 per cent. of total steam, they will in electrical work only use 12 per cent. All the gain of the electrical system is estimated to be clear saving down to 15 per cent. which means that each pound of coal on a warship is potentially increased 3 per cent., and the steam consumption of electrical auxiliaries is now reduced to such a figure that practically all the exhaust can be swallowed up in the feed heater. At any rate, 40 per cent. of the difference between 12 and 15 per cent. will be a saving owing to the fact that more steam is used in the evaporating plant if the pressure is reduced to that of the auxiliary exhaust.

The net saving due to electricity is thus 4·2 to 6 per cent. when generating engines do not exceed 26 lbs. per I.H.P.-hour. But other considerations demand attention. These are connected with the weight of auxiliary machinery. In a full-sized battleship the auxiliaries have about 1,500 H.P. and weigh 150,000 lbs. or 100 lbs. per H.P. With electric motors torque must be obtained by having motors at least 50 per cent. above the steam rating. This involves about 2,250 H.P. of motors, for ship motors are usually small. The increase of weight will be 35 tons. Of the total of 1,500 H.P. only a part will be run in action, say, 700 H.P., many articles such as deck winches being out of use. With electricity probably 1,000 H.P. would be in use in action, or 1,600 at the generating engines. This implies five 250-kw. generators, counting one as spare. This 1,250 kw. of plant will weigh 180 tons, so that the total electrical plant will weigh 295 tons as against 85 tons with steam operation, or 3½ times as much. Mr. Dana Greene gives the more optimistic figure of 2½ to 3 times as much weight. Our author thinks 4 times will be much nearer than 2½. Even at the optimist's figures an additional weight of 150 tons must be carried, an increase considerably greater than 6 per cent. of the 2,000 tons bunker capacity of the largest ships. Hence, to add 6 per cent. to the potential of the coal, we must reduce its weight by 10 per cent. and shorten the radius of action of the ship. Now, this is a very serious factor, and it is more serious in the British Navy than in any other in some respects, for though we may possess many coaling stations it is wise not to depend too seriously on every one of these, and a battleship out of coal is in a very serious plight indeed.

Our author proceeds to show the value of coal endurance by citing U.S. *Newark*, disabled 300 miles north of the Straits of Magellan for lack of coal to complete 2,500 miles of a voyage between Monte Video and Valparaiso. Nor should the *Rio de Janeiro* be forgotten, which had to turn back on the voyage between Honolulu and Yokohama, a matter of only 3,500 miles, and only succeeded in reaching her port of departure by using her cabin fittings as fuel.

The Russian ships built by Cramps are the most modern examples of electrical fitting for auxiliary plant, and it will be of interest to watch their performance. The principal advance foreshadowed by Lieut. Robison is an efficient turbine engine able to maintain high efficiency over a wide range of power. This will save steam and reduce the weight of a generating set by some 40 or 50 per cent. A better efficiency of conversion overall may also be anticipated in the future, especially in the case of motors. With these improved conditions, possibly 100 tons increased weight would serve, and the effect on coal endurance being lessened, there would be so much convenience attaching to electrical operation as to render its adoption probable. At present, we believe, in our own Navy, hydraulic power holds the field; steam is so easily cooled and condensed that auxiliaries distant from the boiler must always be most wasteful. Even the wastefulness of compressed air is not so great but that compressed air appears to be a very formidable rival to steam.

The author, in conclusion, points out that steam engines may be much improved, more especially in the line of feed heating from intermediate receivers. To-day, electricity asks in its usage more than it can return. Hence it is premature to force its use on board ship, and more especially on ships of war. Obviously the floating station has wide differences of conditions from a station ashore, and what may be an easy economy in one case is in another converted into a loss. Lieut. Robison's article takes a very broad and impartial view of the whole question; while not too optimistic, it is hopeful.

NORTHERN SOCIETY OF ELECTRICAL ENGINEERS.

METHODS OF SUPPRESSING ARCS IN SWITCHES, FUSES, &c.

By Ernest Kilburn Scott, A.M.I.C.E.

(*Read at Manchester, Tuesday, December 5th*)

Part I.—Switches.

When two terminals through which current is flowing are drawn apart, the area of contact becomes gradually less and less until just before connection is actually broken, the area is so small that the metal vaporises. This vapour is equivalent to inserting a resistance between the terminals, and if there is a well-sustained voltage, then current is forced across, and the C^2R loss appearing as heat in a very confined space, we get an arc which, unless suppressed in some way, will continue to feed itself by vaporising still more metal.

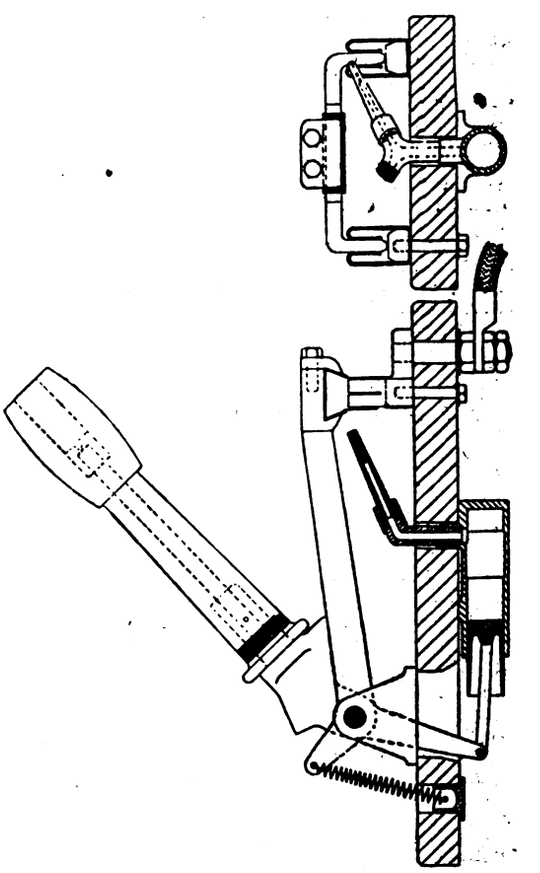

Fig. 1.—Pneumatic Blow-Out Switch.

Except under very special circumstances, to be mentioned later, we cannot *prevent* an arc forming. We can, however, *suppress* it after it has formed, and the writer proposes to discuss some of the devices which have been devised from time to time with this object.

Quick Break.—At a very early stage in electrical work it was found that, by separating two contacts at a very *rapid* rate, the path of vaporised metal increased so quickly that the current was unable to maintain its value and the arc broke down.

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Material of Contact.—Another point soon noticed was that the higher the melting point of the metal the less the arcing, due to the fact that less conducting vapour was set free in a given time. An absolutely infusible metal, if such were possible, would not arc, neither would a metal having zero resistance; it follows, therefore, that switch contacts should have as low a resistance and as high a melting point as possible; the low resistance of copper and the high fusing point of platinum, for example, as is arranged in Berend's switches, which have copper contacts fitted with platinum tips to take the arc. Carbon is one of the most refractory of conducting substances which electrical engineers use, but, unfortunately, owing to its granular formation, a good contact cannot be depended on, and

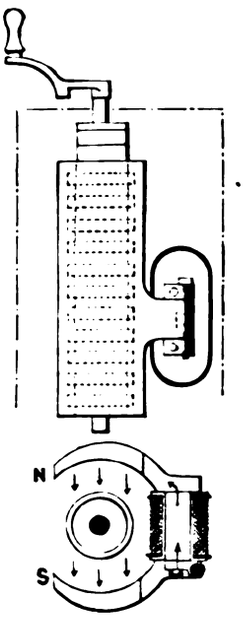

Fig. 2.—Magnet Blow-Out Controller.

even if it could, the resistance would in most cases be too great for practical work. The best that can be done, therefore, is to employ it as a subsidiary contact block by arranging the carbon in multiple with the main switch in such a way that the main contacts are opened first, current being thus shunted through the carbons, which act as a resistance, and at the final break receive the full effect of the arc.

Multiplication of Breaking Points.—Other things being equal, the arcing which takes place between two sharp points is much less than that between flat surfaces. It is also found that breaking a given current at a number of points does not volatilise nearly so much metal as if all the arcing occurred at one point. This being probably due to the cooling effect of the larger volume of metal necessitated where there are a number of breaking points. Once an arc is fairly established there would be, of course, no cooling effect worth mentioning however large the surface.

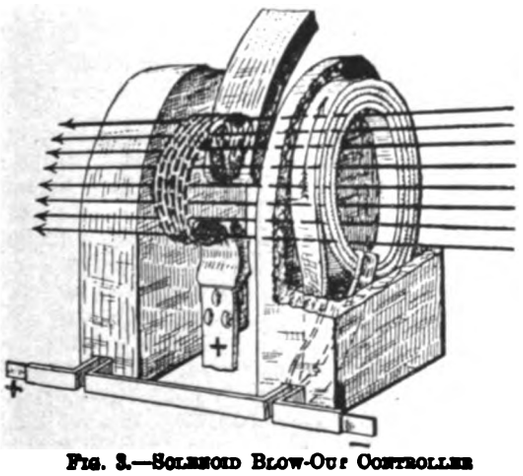

Fig. 3.—Solenoid Blow-Out Controller

There is a limit at which a quick break, multiplication of contacts, the employment of carbon, &c., gives satisfaction, and with the increasing employment of high voltage and large powers much ingenuity has been called into play.

Pneumatic Blow-out.—As the arc is primarily the result of a stratum of metallic vapour reaching from one place of metal to another, it follows that a simple way to stop arcing would be to dissipate the conducting vapour in some way, and an effective method of doing this is to blow out the arc. This idea was first introduced on the Thomson-Houston arc lighting machines, each machine being fitted with a small blower capable of giving two jets of air at about 10 lbs. pressure. (In some of the larger American stations an air pump and reservoir is laid down, capable of supplying several machines.)

The bare idea of applying a pneumatic blow-out to a switch has been suggested many times, but although such an excellent arrangement, it is only within the last year or so that it has had practical application, it being now used for switches for long distance transmission of power work in America. The writer got out designs for a high tension switch, fitted with air blow-out, as early as 1895, and fig. 1 shows such a switch for 2,200 volts, 75 amperes, fitted with loose handle and spring quick break. In being pulled into the off position air is forced from the cylinder at back of marble slab, and is directed against the contacts by means of two fibre nozzles.*

To Stop Arcing by Partial Vacuum.—At the central station of the Burgdorf-Thun, three-phase electric railway at Spiez, the switch contacts are so arranged that, when drawn apart, a partial vacuum is set up, which has the effect of shutting down the arc. The arrangement is very simple, the switch contact being driven into an ebonite tube, into which it fits fairly closely, and at the bottom of which there is the other contact.

Magnetic Blow-out.—It was thought at one time that the *magnetic blow-out device* of Prof. Elihu Thomson had solved the trouble of arcing at switch contacts, but experience has shown that it has its limitations.† As is well known, it was originally designed for lightning arresters; it was then brought into use for circuit breakers on tramway switchboards, but its principal application has been on series parallel controllers for tramcars.

The arrangement of a controller blow-out is shown diagrammatically in fig. 2. It will be seen that the North and South poles of the magnet are so arranged, that lines of force stream right across the cylinder contacts, and as this distance is about 9 inches, a good deal of energy is required to produce a strong magnetic field between

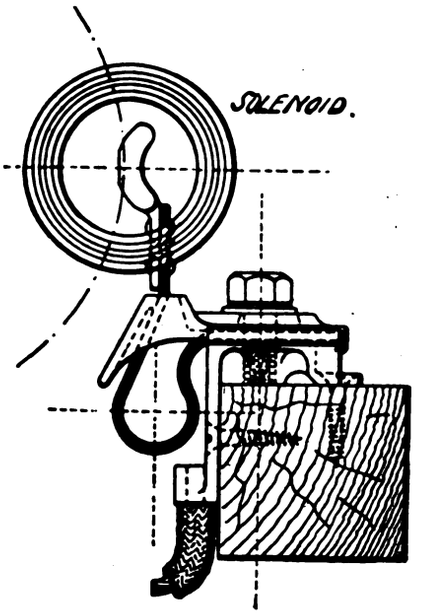

Fig. 4.—Contact of Solenoid Blow-Out Controller.

them. Whilst the car is in use, the magnet coil must always be kept in the main circuit of the trolley wire, because if it were only cut in just before the motorman moved his controller handle, the pole pieces would not be magnetised in time to blow out the arc formed between the segment and contact finger. There would also probably be further trouble, due to self-induction. It will thus be seen that keeping the magnet continuously excited is a serious drawback, on account of energy being used up all the time. A further obvious objection is that owing to the confined space, the area of the magnet iron is limited, and thus, although the blow-out works satisfactorily up to the point when the magnet becomes magnetically saturated, for any extra large currents which have to be taken, the magnetic field is not strengthened in proportion, and the blow-out thus falls short just at the very time that effective operation is most sorely needed.

Solenoid Blow-out.—These drawbacks led Mr. S. H. Short to intro-

* Simply striking at arc with a mop of cocoa-nut fibre, or other material that will not easily catch fire, is very effective. At Deptford arcs of 3,000 H.P. and 10,000 volts have been repeatedly broken in this way.

It may be noted that the main switches used on the Brooklyn electric lighting system are fitted with an electrically controlled pneumatic attachment, but the actual break is made under oil. It is therefore not a blow-out switch, but one in which compressed air is used for actually operating the switch. A similar arrangement is used at Niagara, and on the Pennsylvania Railroad.

† It is interesting to note that Mr. J. D. F. Andrews, as early as the year 1887, carried out experiments in which this magnetic blow-out idea was used. He was endeavouring to produce a satisfactory alternating current rectifier, and to overcome the sparking, used laminated iron brushes, magnetised by means of coils wound upon them.

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duce what is known as the "*solenoid blow-out controller*," in which the electric magnet is replaced by a number of small solenoids (one to each contact). Each solenoid consists of a spiral of copper ribbon insulated with asbestos, forming a disc about 3 inches in diameter, and $\frac{3}{8}$ths of an inch in thickness, with a hole in the centre $1\frac{1}{2}$ inches in diameter. This spiral is embedded in a vulcabeston partition placed between the contact fingers of the controller. The two ends of the copper ribbon are brought through the edge of the vulcabeston partition, as shown in fig. 3, and are connected with the adjacent solenoids throughout the entire length of the finger board. The opening in the centre of the spiral comes just opposite the contact of the finger with the cylinder, and it is through this that the blowing-out effect is produced. The main trolley current passes through these solenoids for an instant only when an arc is to be broken, this being accomplished by a contact finger and its corresponding controller segment shunting the current through the solenoids at every running notch of the controller. Fig. 4 shows a detail of the finger contact in relation to the solenoid.

The advantages of the arrangement are:—

1. There are no metallic pole pieces in close proximity to the points where the arc is formed, and consequently less danger of the

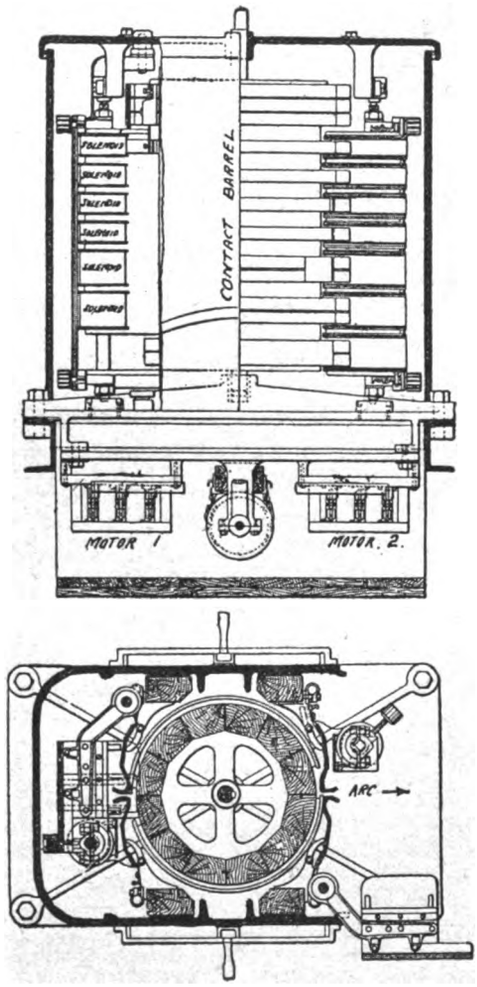

FIG. 5.—SOLENOID BLOW-OUT CONTROLLER AS USED ON CENTRAL LONDON RAILWAY.

current being grounded. The contact fingers and segments of the cylinders are also quite free and open for inspection and repair.

2. As the solenoid does not get saturated, the blow-out effect increases in direct proportion to the current whose arc is to be destroyed.

3. The magnet blow-out drives the arc in a direction parallel to the axis of the controller cylinder, and thus causes the flame to impinge against the vulcabeston partitions, burning holes, and sometimes forcing the arc round to the next contact finger. With the solenoid blow-out the arc is driven directly away from the cylinder in a direction at right angles to its axis, and the insulating partitions are therefore never swept by the arc, nor is it possible for the arc to jump to the next segment, as the solenoid effect is produced between each of them individually.

4. There is no magnet to excite, and the action is therefore instantaneous, whilst there is very little waste of energy as the solenoid is only in circuit at the instant of the formation of the arc.

5. The magnet blow-out depends solely for its action on the magnetic field, and this has the effect of cutting the arc instantly in two (made manifest by the sharp report produced). Excessive self-induction in the windings of the motors is the result, and the insulation of the armatures and field magnets is thus very liable to be punctured. The solenoid, on the other hand, appears to have the property of easing down the current quietly, something like the effect of a fuse.

Fig. 5 shows the controller fitted with solenoid blow-outs, as used on the Central London Railway.

Hopkinson & Wood, Magnetic Blow-out.—Fig. 6 shows the magnetic blow-out as applied to a point contact switch by Messrs. Mather and

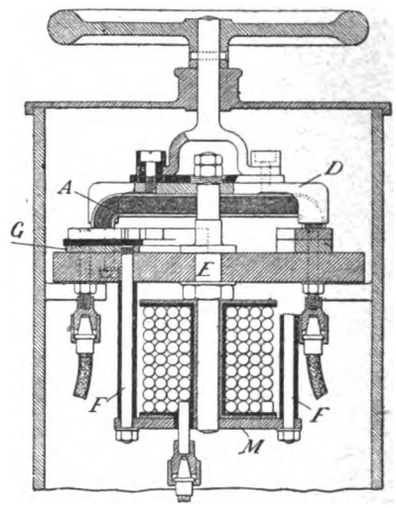

FIG. 6.—HOPKINSON & WOOD'S MAGNET BLOW-OUT.

Platt. A is the laminated contact brush and D is an iron cover, the magnetic circuit being D, F, M, F, and G. A similar arrangement to this was fitted on the controllers of the Hartlepool electric tramcars by the Electric Construction Company, Limited.

(*To be continued.*)

COST OF CENTRAL STATION PLANT.

(*Concluded from page* 867.)

Testing Instruments.—About £135 will cover the following instruments:—One portable testing set consisting of an ohmmeter reading up to 10 megohms, and a magnetic generator giving 200 volts; one small dial bridge with spare plug fitted with cylindrical ebonite handle and flexible lead for potentiometer test; one Kelvin electrostatic multicellular voltmeter reading up to 500 volts; one Siemens dynamometer to read up to 50 amperes; one resistance frame for meter testing with eight-way switch to vary the current from 5 amperes to 50 amperes at 200 volts; two standard Carhart-Clark cells with thermometer; two detector galvanometers; 100 dry cells; 100 yards of No. 20 S.W.G. wire insulated with pure and vulcanised rubber for connections. Whilst £240 will cover the above and the following additional apparatus:—One testing table complete with tray, bridge, resistance, galvanometer, lamp stand, shunts, carbon megohm, reversing key, battery switch, &c.; one Kelvin standard current balance.

Accumulators.—We now come to the battery, which is such an essential feature of the continuous current station. In deciding on the output it is usual to assume that the station is going to be worked by only two shifts and arrange for a battery to take on the lighting from midnight until eight the next morning. As the lighting system extends there will come a time when three shifts of men have to be employed or else the battery very considerably extended, but if there is a considerable amount of street lighting then three shifts are required almost immediately. Perhaps the best way to rate the first battery is to allow $2\frac{1}{2}$ ampere-hours per kilowatt of generating plant laid down, thus for 9,000 lamps fixed three 90-KW. steam dynamos are laid down and this gives

$$2\,5 \times 3 \times 90 = 680 \text{ total ampere-hours,}$$

that is to say, the battery should be capable of giving 85 amperes for eight hours, *i.e.*, from 12 midnight until eight the next morning.

The battery room should preferably be on the ground floor on account of the convenience in getting the cells and acid in and out, and the regulating cells should be arranged as near to the switchboard as possible because of the great expense of the connecting cables; these carry the full current

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from the battery and a foot or two makes a good deal of difference. In a battery, costing, say, £1,000, as much as £50 will be required for the connecting cables if connected up in the ordinary way, or £25 if connected to a Heath & Field patent regulator.* They are generally included in the switchboard specification, but in the writer's opinion, this heavy cable should be quoted for at so much a yard, the actual amount to be measured off when the switchboard and battery have been erected. One thing which has struck the writer as being essential in running a central station in which accumulators play an important part, is that at least one of the staff should have had intimate experience either in their manufacture or repair. Generally speaking, there are men in a central station who know all about engines, dynamos and switchboards, but nothing worth speaking of, about accumulators. Certain information is picked up after a while, but generally by that time the cells are well on the road to ruin unless there is a maintenance clause.

Workshop Tools, Oil Filter, &c.—A set of workshop tools to cost, say, £30, would consist of :—

Ratchet lever and drilling pillar with set of drills;
Two 6-inch parallel vices, one fixed to movable stand and the other fixed to a bench;
Two dozen assorted files;
Half-dozen assorted chisels;
Three engineers' hand hammers;
One striking hammer;
One lead hammer;
Three large screwdrivers;
One pipe wrench.

(Note.—A much fuller list must be allowed for abroad, and an 8-inch lathe and power drill should be included.)

An efficient filter and ample sized tank are very desirable as the yearly item for oil is a considerable one in central station work.

Station and Office Lighting.—This calls for no remark except to say that for advertisement sake the lighting should be carried out exceedingly well, and carrying out the wiring on various systems is useful for the purpose of showing prospective customers how the work may be done. An installation costing, say, £100, would consist of :—

Boiler house	9	16 c.p.	
Engine room	3	100-c.p.	
	4	32-c.p.	
Pump room	2	16 c.p.	
Switchboard	4	16 c.p.	
Engineer's office	3	16-c.p.	
Test room	4	16-c.p.	
General office	5	16-c.p.	
Battery room	4	16-c.p.	
Main entrance	1	10-amp arc lamp.	
Back entrance and yard	1	10-amp. arc lamp.	
Men's lavatory	2	8 c.p.	
Office lavatory	2	8-c.p.	

Condensing Apparatus.—We have now gone through the various items in the table, and there remains for consideration the question of the condensing apparatus, which presents a distinct problem of its own. Generally the engines are specified to work condensing or non-condensing, and a condensing plant is added after the station has been running for some time and the engines are beginning to be comfortably loaded. Where large quantities of fresh cold water are available then the ordinary type of surface condenser may as well be used and 13½ lbs. of vacuum obtained. It is well to remember, however, that unless the air pump is of the very best the vacuum may drop after working for a short time to about 11 lbs., which is a figure commonly obtainable with an ejector condenser. The absolute necessity of having a thoroughly efficient air pump is now being recognised, and the Edwards' patent air pump is an attempt to place it above suspicion. Many stations have been fitted with the ejector type of condenser because of its cheapness, and the small amount of space occupied. If kept in order it can be depended on to give a constant vacuum of, say, 11 lbs. per square inch. The price of an ordinary surface condenser is about £1·5 per kw. of plant installed, which is about 4½ times the price of the ejector type; the space occupied is in a still greater ratio.

Obviously, to put in a cheap condenser which only gives on the average the same vacuum that can be obtained from an ejector condenser is waste of money.

* Messrs. Erlacher & Besso, of Winterthur, Switzerland, have a similar switch, having for its object the lessening of the number of cables to the regulating cells.

Water Softener.—The question as to whether a water softener is required or not depends, of course, on the average quality of water throughout the year. An apparatus large enough to deal with the water for two Lancashire boilers, each 30 feet by 8 diameter, will cost about £200.

Total Cost.

It will be noticed from the Table that £47 per kw. of plant is about the average for 12,000 8-c.p. lamps fixed. To get at the total cost there must be added (1st) The cost of supplying and laying the feeders and distributors and house connections, which together average roughly 20 per cent. of the first cost of generating plant. (2nd) The cost of the site, which is naturally a very variable figure, but may be taken at 5 per cent. (3rd) The legal and other preliminary expenses, another 5 per cent. (4th) 2 per cent. to cover stores, &c.

From this we get :—

Cost per kw. of generating plant installed	£47
Add 20 per cent. of £47, to cover cables, &c.	9½
Add 5 per cent. of £47, to cover cost of site	2½
Add 5 per cent. of £47, to cover legal and preliminary expenses	2½
Add 2 per cent. of £47 to cover stores, &c.	1
	£62

A total of £62 per kw. of plant installed, which agrees fairly well with figures which have been published from time to time.

Readers will find the last two columns useful for estimating. They give the percentages which the various items bear to the whole, and the average prices per kw. of plant installed.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

23,077. "Electrical sewing machinery." H. Chapman. Dated November 20th.

23,096. "Improvements in recording apparatus for use on telegraph cables and other lines." J. A. L. Dearlove. Dated November 20th.

23,100. "Improvements in electric lamp supports." H. Long. Dated November 20th. (Complete.)

23,102. "Improvements in contact breakers especially applicable to induction coils." G. Weissmann and A. Wydts. Dated November 20th. (Date applied for under Patents, &c., Act, 1883, Section 103, April 25th, 1899, being date of application in France.)

23,119. "Improvements in and relating to electric illuminating devices." P. Jean and A. Bourchon. Dated November 20th.

23,188. "For determining the flow of liquids including gases and electricity within given times." W. P. Miles. Dated November 21st.

23,141. "Automatic controlling arrangements for switches for direct-driven cage hoists and general electric and motor work." J. Goddard. Dated November 21st.

23,153. "Improvements in switches for use with rheostats for starting and controlling electric motors for lifts or the like." H. Hirst and F. O. Hurt. Dated November 21st.

23,154. "An improved electrical indicator." A. Eckstein and H. J. Coates. Dated November 21st.

23,216. "An improved switch." H. O. Joedicke. Dated November 21st. (Complete.)

23,219. "Improvements in or relating to electric signal alarm and safety devices for railways." A. J. Boult. (F. Cumont, Belgium.) Dated November 21st. (Complete.)

23,235. "An improvement in secondary voltaic batteries." H. Leitner. Dated November 21st.

23,241. "Improvements in holders for electric lamps." R. Alexander. (A. B. Vanes, Cape Colony.) Dated November 22nd.

23,267. "An improved trolley and connections for overhead electric traction or similar uses." G. J. Ball. Dated November 22nd.

23,283. "Improvements in systems of electrical distribution." The British Thomson-Houston Company, Limited. (E. Thomson, United States.) Dated November 22nd. (Complete.)

23,284. "Improvements in electric circuit-breakers." The British Thomson-Houston Company, Limited. (E. Thomson, United States.) Dated November 22nd. (Complete.)

23,285. "Improvements in electric arc lamps." The British Thomson-Houston Company, Limited. (E. W. Rice, jun., United States.) Dated November 22nd, 1899. (Complete.)

23,288. "Improvements in enclosed electric arc lamps." The British Thomson-Houston Co., Ltd. (O. N. Wiswell, U.S.) Dated November 22nd. (Complete.)

23,289. "Improvements in controlling devices for electric motors." The British Thomson-Houston Co., Ltd. (W. B. Potter, U.S.) Dated November 22nd. (Complete.)

23,290. "Improvements in regulating rotary electric converters." The British Thomson-Houston Co., Ltd. (E. J. Berg, U.S.) Dated November 22nd. (Complete.)

23,291. "Improvements in systems of electrical distribution." The British Thomson-Houston Co., Ltd. (C. P. Steinmetz, U.S.) Dated November 22nd. (Complete.)

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23,292. Improvements in electric locomotives or motor cars for adhesion and rack railways." The British Thomson-Houston Co., Ltd. (The Union Elektricitäts-Gesellschaft, Germany.) Dated November 22nd. (Complete.)

23,293. 'Improvements in trolley stands for electric railways." The British Thomson-Houston Co., Ltd. Dated November 22nd.

23,294. 'Improvements in and connected with electrical, gas, and other fittings." H. J. Banks. Dated November 22nd.

23,315. "Improvements in and connected with electrolytic meters." A. Wright and The Mutual Electric Trust, Ltd. Dated November 22nd.

23,316. "Improvements in and connected with electrolytic meters." A. Wright and The Mutual Electric Trust, Limited. Dated November 22nd.

23,318. "Improvements in electrodes for medical applications of electricity." R. Houghton. Dated November 22nd. (Complete.)

23,319. "Improvements in artificial ear drums." L. B. Atkinson. Dated November 22nd.

23,327. "Improvements in electrical and magnetic apparatus such as transformers, dynamos, and other appliances and alloys for use therein." R. A. Hadfield and W. F. Barrett. Dated November 22nd.

23,371. "Improvements relating to switches, specially applicable to switches for electromotors and the like." R. A. Sloan and J. E. L. Barnes. Dated November 23rd.

23,381. "Cord shortener for electric light flexible cord pendants." L. Dakin. Dated November 23rd.

23,400. "Improvements in electrical anodes." A. F. Harris. Dated November 23rd.

23,403. "Improvements in and relating to electric igniting apparatus useful for lighting cigars or for similar purposes." H. H. Lake. (S. Abbott, U.S.) Dated November 23rd. (Complete.)

23,413. "Improvements in the construction of dynamo-electric machines." M. H. Robinson and M. H. P. R. Sankey. Dated November 23rd.

23,435. "Improvements in or relating to electrical contact makers and breakers." J. W. Milligan and F. Oldfield. Dated November 24th.

23,440. "An improvement relating to electric lamps." H. G. Mason. Dated November 24th.

23,448. "Improved automatic make and break for electric circuits." P. C. McFarlane of the Firm of J. White. Dated November 24th.

23,504. "Improvements in receiving apparatus for Hertzian radiations or electro-magnetic waves." J. C. Baviera. Dated November 24th. (Complete.)

23,522. "An improved automatic electric cut-out." E. C. St. John. Dated November 25th.

23,541. "Improvements in or relating to electric ignition apparatus for explosion engines." H. J. Lawson. Dated November 25th.

23,575. "Improvements in or relating to pulley blocks or lifting and lowering mechanism operated by electricity." E. W. Tangye. Dated November 25th.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1898.

5,208. "Improvements in electrically operated gas valves for burners." The Aktiengesellschaft für Fabrikation von Broncewaaren und Zinkguss, vorm, J. C. Spinn & Sohn and S. J. von Romocki. Dated March 3rd, 1898. Relates to gas valves for street lamps and other lamps or burners operated from a distance by means of electricity. Leakage is prevented and the appearance of the lamp or burner is improved, by arranging the conical or other valve, the electro-magnets and the spring armatures entirely within a casing. The valve is carried by the spring armature which holds it open until the armature is attracted by the electro-magnet. A catch on the spring armature then engages the armature and retains the armature and valve in the closed position until the catch is released by the attraction of the electro-magnet upon the armature, whereupon the spring armature lifts and re-opens the valve. In a modification the action is reversed, the parts being so arranged that the attraction of the electro-magnet upon the armature opens instead of closing the valve and the catch on the armature retains the valve in its open position. 8 claims.

5,423. "Automatic electric switch for hoists and cranes." J. Goddard. Dated March 5th, 1899. Relates to switches for hoists and cranes, applicable also for lighting purposes. A disc or drum is fitted with a series of contacts and a contact segment which rub against contact brushes fitted with springs. The segment (for a series motor) is connected to the positive main, the segments to the resistances and the segment to one terminal of the field coils, the other terminal being connected to the negative main. The brushes, which have square shafts, are removable, and are connected to the armature brushes. The various connections are made by flexible wire to allow movement of the disc. The spindle, which may be operated by hand or by a chain and chain wheel, is fitted with a stop to engage projections on the casing to limit the movement, and also with a pointer to indicate its position. The insulating segments may be so proportioned as to connect up either the armature or field magnets first. For lighting rooms or lamps in succession, the contacts are connected to the lamp circuits instead of to the resistances. 10 claims.

5,663. "Improvements in metallic conductors for protecting electric wires and cables." P. C. Middleton and F. Huggins. Dated March 8th, 1898. Relates to joining lengths of metal tubular conduits together and to angles, T pieces, and junction boxes. In the case of fitting tubes together, the end of the tube is reduced externally, and the end of the other tube is bored out to receive the end of the first. A sleeve with a central contracted portion may also be used to receive the ends of the tubes. In the case of angles, | 's, and junction boxes, the ends of the branches or projecting lugs are bored out to receive the tubes and to form internal shoulders. The T pieces may be formed in longitudinal sections held together by clips. 6 claims.

5,703. "Improvements in electrodes for secondary batteries or accumulators." H. Pieper, fils. Dated March 8th, 1898. The electrodes are of a hollow cylindrical shape, and are built up of tiers of plates shaped in the form of hollow truncated cones, which are open at the top and bottom. The cones are alternately plain and radially corrugated. One electrode surrounds the other, and the radial channels in one are inclined in an opposite direction to those in the other, this difference being produced by fitting the cones together in one electrode with their bases downward, while in the other electrode the cones are fitted together with their bases upward. This arrangement of channels has for its object the circulation of the electrolyte. The electrodes are separated by glass rods, which are held in place by grooves in the electrodes. 2 claims.

5,704. "Improvements in electrodes for secondary batteries or accumulators." H. Pieper, fils. Dated March 8th, 1898. The electrodes are of a hollow cylindrical shape, and are built up of tiers of annular plates which are alternately plain and radially corrugated. One electrode surrounds the other and they are separated from each other by glass rods which are held in place by grooves. 2 claims.

5,705. "Improvements in the manufacture and production of electrodes for secondary batteries." H. Pieper, fils. Dated March 8th, 1898. Hollow cylindrical electrodes are made from a flat lead plate, which has ribs or projections extending from top to bottom and standing at right angles to the plane of the plate. The spaces between the ribs are filled with active material, and the plate is then bent into cylindrical form, with the ribs on the inner side. 1 claim.

6,451. "Improvements in apparatus for electroplating pins and other small objects." J. S. Morrison. Dated March 16th, 1898. Pins and small articles are tinned or nickelled in a perforated drum having one removable end for charging and discharging. The drum is supported by a horizontal shaft (coated with a non-conducting material) carried by bent iron pieces, and is rotated in a tank containing the electrolyte and the anodes. The small articles form the cathode, the current passing by pins to horizontal copper strips, thence to a metal ring and a conducting strip to a conducting disc, from which two pins or bolts conduct the current to an insulated copper or like ring to which the conducting wire is attached. The wire and ring are enclosed in a water-tight vulcanite sleeve. 2 claims.

6,536. "Improvements in propelling barges and boats on canals and other waterways by electricity." W. E. Kenway and T. V. Hughes. Dated March 17th, 1898. Relates to means for applying the method of electric propulsion of carriages on tramways described in Specification No. 8,338, A.D. 1896, to barges and boats on canals and other waterways. Posts on the canal bank carry arms which support insulated electric wires on which a trolley runs and conveys the electric current by means of the inclined tube and telescopic standard to the motor on the vessel. The trolley is in two parts insulated by the disc and sleeve. The sleeve bears on the wire and delivers the current through the cap and insulated pin to the wire passing through the axial sleeve and the tube, and the sleeve bears on the return wire, and is in electrical communication with the sleeve and the tube. The paddle wheels are rendered buoyant by forming the central portions as drums, the depth of immersion being controlled by levers and the wheels are driven from the motor shaft by chain gearing and suitable clutches. In some cases the wheels may be lifted out of the water by a derrick. 5 claims.

6,605. "Improvements in telephone intercommunication system." W. Aitken. Dated March 18th, 1898. House or similar telephone systems are arranged with the circuit of any one station connected at all the other stations by means of branching or make and break jacks; in the latter case all intermediate stations are provided with double home jacks connected respectively to the right and left. The bell at each station is in a branch of a common line circuit including the battery. The branch is completed through the inner jack contacts, the called subscriber's line and the calling subscriber's plug through the instrument, home jack glasses; the pin is adjustable by means of a screw. The horizon pin is similarly adjustable. The pin carrying the pendulums is connected by a link with the index arm so as to move with it in the slot of a quadrant. A pawl on the pendulum can be engaged when desired with a rack to prevent the pendulum from swinging about. The pins have grooves in them to hold luminous paint for night work. In use, the object is observed directly, and the reflection of the pin brought into alignment with the object and the pin by moving the index arm. 2 claims.

6,633. "Improved apparatus for indicating the charge in a secondary battery." F. W. Cooke and T. Ireland. Dated March 18th, 1898. Quantity for indicating the available charge in storage batteries. A motor has its field windings in series with the battery and an armature connected by a commutator and brushes to the terminals of one cell of the battery, or other source of current. The armature thus rotates in opposite directions in charging and discharging. Its shaft is connected by a worm and gear wheels with a pointer in front of a dial marked "full" and "empty" or otherwise, to be intelligible to an unskilled attendant. The shaft carries a pin in engagement with a helical slot in a loose sleeve, arms of which support an iron ring above a stationary brake magnet, the windings of which are included in the armature circuit. When the shaft rotates in a charging direction, the ring moves nearer the brake magnet than when it rotates oppositely, thus varying the retardation to compensate for loss of energy in the battery. To prevent movement of the shaft owing to vibration, when no main current is passing, it carries a notched disc which is engaged by a spring-pressed lever, when an iron part of this is released by the adjacent pole pieces of the field magnet; this lever also opens the armature circuit. 8 claims.

6,646. "Improvements in dynamo-electric generators and motors." C. W. Atkinson and W. H. Johnson. Dated March 18th, 1898. Dynamos and motors. Relates to improvement in various details. Frames and casings. The frame is a spherical casting mounted upon a base plate provided either with a spherical recess struck from the centre of the casting or with a number of projections. The casting is secured by a screw, and to provide further adjustment the base plate may be slotted and be formed with a spherical surface, upon which fits an adjustable washer. Inspection openings formed in the frame are closed by pieces of glass, metal wire gauze or the like. Field magnets.—The magnets, which may be four in number, are formed upon the inner surface of the frame. The coils are wound upon the metal formers or bobbins stamped with projecting corrugations, and the ends of the wire are brought out through some of these corrugations. The bobbins are fixed in position by wedges of non-magnetic material driven in between adjacent pole-pieces, and pressing upon some of the corrugations on the bobbins. Armatures.—The core, which is built up of laminated plates in the usual way, is fixed to a shaft. One end of this shaft is mounted in bearings provided in a pocket which is formed at one side of the frame, and acts also as an oil holder. At the other side of the frame is an opening wide enough for the passage of the armature, and adapted to receive a cylinder which contains an oil well, and the bearings for the other end of the shaft. The armature and commutator are fixed in position by thin brass sleeves which are rolled into grooves in the shaft. The winding is of the drum type and the ends of the coils are carried round the ends of the armature upon thin cylindrical stampings or spinnings. Commutators.—An insulated sleeve receives in grooves parallel to the axis segments insulated from each other, and fixed in position by split rings of insulating material. These rings are clamped down by coned and screwed metal rings. The wires from the armature are attached to projections on the plates, and they are then enclosed by a metal stamping. Brush-holders and terminals, arrangement of.—The brush-holders are pivoted on metal supports fixed in insulating tubes which are cemented in the cylinder. The brush supports make contact with the magnet terminals, which are mounted in insulating tubes supported in recesses in the frame. 8 claims.

6,695. "Improvements in electrical measuring apparatus for use in regulating electric currents." R. E. B. Crompton and S. W. Ashley. Dated March 19th, 1898. Relates to arrangements for connecting voltmeters and ammeters so as to indicate the electrical pressure at any part of the circuit and also indicate the current. In one arrangement the generator supplies current through the mains to the translators at a distant point. The resistance box has three terminals. The terminal is connected to a point on the resistance. A switch is arranged in the circuit. Instead of employing one galvanometer, two or three may be connected so to the circuit as to give the required readings direct. 3 claims.

6,720. "Improvements in depressible rail systems for electrical railways." W. Grunow, jun., and Z. Goodsell. Dated March 19th, 1898. Relates to electric railways and tramways on a depressible rail system. The supply conductor is in the form of a third rail, which may be placed in a slotted conduit, and may be in insulated sections which are mounted so as to be depressed by the vehicle and thereby mechanically operate the switches. The conductor rails are carried in insulating U-pieces in yokes mounted on springs which are guided and protected, and their tension adjusted by bolts and casings. These supports are mounted on the switch boxes and also at intermediate points. Insulated wires attached to the rails are connected to V-shaped contacts which are carried by a plunger into contact with ears on a plate which is connected to the feeder. This plunger works through a stuffing box on the lid of the switch box, and is engaged by a lug on the depression rail. Or the rail may rest on the top of the plunger, the plunger being normally held by springs and being adapted to dip into mercury which is connected to the feeder. The rails may be in sections insulated from each other and laid with lap joints. Feeders may be introduced into the switch boxes, or the main conductor may be led through them, tubular extensions being provided and filled with insulating material which may also be used to secure the lids. A wheel for depressing the conductors and taking current is mounted in a spring held fork in a bracket. Or a pair of wheels are mounted on bent levers. They are operated by a bell crank lever and connections to the end of the vehicle. The wheels may have insulating material and wearing plates on their sides. Yokes shaped to straddle the sleepers, support plates or curved plates with external ribs and flanges are secured to the sleeper and support cover plates which form the slot rails. 26 claims.

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THE

ELECTRICAL REVIEW.

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THE

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1900

Edition

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PUBLIC ELECTRIC SUPPLY SYSTEMS.

SOME days ago a prominent London Vestry found it necessary to circularise its electricity consumers to the effect that it would be under an obligation if they would use as little light as possible between the hours of 4 and 6 p.m. In other words, it was a request to be sparing with the current when it was most needed for business purposes. It would be interesting to learn the precise result of such a notice, because, without minimising matters, it is tantamount to a declaration of weakness; but though one may deplore the necessity for such a step, the position of the Vestry in question is typical of that occupied by most of the electricity supply authorities in London, whether they be local bodies or companies. One might extend this statement, and say that it practically represents the position of electricity suppliers throughout the country. That such a condition is strongly suggestive of mis-management goes without saying, but before one attempts to apportion blame in the matter, some regard ought to be paid to the entire circumstances surrounding the growth of electric lighting in this country. When electric lighting first became a commercial operation, it was prescribed by the Board of Trade that there should be a certain amount of plant entirely set aside as a standby. In those days it was thought we knew nothing of the problems connected with the supply and distribution of electricity, and as engineers and managers gained experience, they came to look upon standby plant as an unnecessary luxury, until it may be fairly affirmed that to-day the practice of using standby plant has fallen, to some extent, into desuetude. We are quite familiar with the fact that it is difficult to lay down any hard and fast lines on the subject, and we can understand, and to some extent sympathise with, the desires of a central station manager to avoid lightly loaded plant. At the same time, the most important fact, from a public point of view, is continuity of supply, and this must be maintained, even if it means jeopardising the economical running of the works. In spite of the statements concerning the high cost of electric lighting, emanating chiefly from the Welsbach Company, electricity, as an illuminant, has increased in use to a remarkable extent during the past few years. It is evident, however, that the increase of consumers has not been attended with a corresponding increase of plant. It may be that many supply systems have been "hung up" by reason of the non-delivery of electrical plant, and probably the manufacturers may be to some degree saddled with the responsibility of the present difficulties; but if we are to offer excuses, something might be urged on behalf of the contractors, who have become almost submerged in orders during the past few months. While it may not be difficult to account for the position of electric supply companies, explanations, after all, provide poor consolation for the consumer who has been, in many districts, suffering from a drop in pressure. It is probable that many of the electric lighting concerns may muddle through the winter with their present plant; but if there should happen to be a bad breakdown in any of the London stations it may mean a

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serious source of loss for the consumers. Hitherto, in time of trouble, it has so happened that one company has been able to give a helping hand to another which was suffering from temporary disablement, but it is doubtful what help would now be available if any of the lighting concerns were to break down. We know that many of the responsible engineers are passing through an anxious period, and for their sakes, as well as for the well-being of the industry, we trust that they may be able to steer clear of difficulties; but in the event of a discontinuity of supply, electric systems might be saddled with restrictions which would probably press somewhat severely upon them. There is a very praiseworthy desire on the part of the managers of electricity undertakings to bring down their costs of production to a record figure, but we are afraid that the race for records would not encourage the adoption of spare plant. Continuity of supply is as important as, if not of greater importance than, efficiency, and in future there ought to be more regard paid to this matter.

One of our engineering contemporaries has recently treated this subject in a very able manner, and while in the main we are disposed to agree with its remarks, we think that on some points it somewhat overstates the case. It seeks to lay the blame, of being unable to meet the demand, at the door of managers and secretaries of electric lighting companies; but then, are the supplies conducted by local authorities any better off than those which are managed by managers and secretaries? Moreover, it is doubtful whether any ordinary business man who was managing an electric lighting concern would act without reference to his engineer. There is, we admit, a great difficulty in refusing custom, and we are afraid lighting authorities have added consumers in the hope that things would eventually come right, though they were perfectly cognisant that their present plant would not cope with sudden rushes. A policy of grab is, moreover, being adopted by some companies. They are not content with endeavouring to keep up the volts in their own district, but they must covet some other area which has been already exploited by another concern. Before extending its sphere of operation, a company ought to properly develop what lies to hand. Fortunately, the reckless connection of lamps has practically ceased, and, with luck, the demand may be met.

Amid the tremendous boom in all electrical matters, one is forcibly struck with the utter inadequacy of the London electricity works to meet anything like the probable demand; that has been recognised very fully by some of the greater concerns; and hence we see companies like the Metropolitan erecting huge buildings outside London, and transmitting current at high voltage to various sub-stations. Even a company like the Kensington and Knightsbridge, a noted adherent of the direct current system, is compelled to remove its generating machinery outside its area of supply, and utilise a two or three-phase system for the transmission part of the scheme. Apart from the question of overloading from which most works are suffering at the moment, one feels a little uneasy at the numerous breakdowns which have dislocated many public services of late. In the absence of extensive storage comparable with that of gas, we must expect interruptions to the public supply of electricity if there is not proper provision made in the way of spare plant. Sooner or later all running machinery will go wrong, but what we have recently witnessed in some electric systems is that if one part of the machinery goes wrong it is so frequently followed by the dislocation of other machines. It is difficult to see why this should happen, unless there is some inherently bad arrangement of the electric or mechanical details of the system. Unfortunately there are many works in this position, and their defects can only be repaired by a complete abandonment of the system. The difficulties of an electric supply are many, and they are not likely to be lessened by endeavouring to meet large demands with a minimum of plant.

A WORD TO MANUFACTURERS.

While English electrical manufacturing works are making extension upon extension, American works which have been doing so for years past are continuing to develop in the same way. The foreign trade of America is very largely responsible for this, while our own works find it difficult to meet, with reasonable promptitude, even the requirements of our home progress. Not that English electrical engineers are slow to canvass for the wants of foreign countries and the Colonies, for an enormous trade is being done in that direction; in fact, it is just possible that the foreign trade sometimes gets in the way of the execution of home orders, the capacity of works not yet being equal to the double demand. On the other hand, we have to admit that for obvious reasons American manufacturers are in a very favourable position for meeting both demands without their clashing. English works, by the extensions of the last few years, have been preparing to better meet the wants of the world's markets, but there is to some minds a question as to whether the rate of carrying out extensions has been so great as has the further development of electrical engineering in all its branches at home and abroad. We believe that the development has been, and is now, proceeding at a pace which has exceeded expectations, notwithstanding the fact that we witnessed American progress of the same kind, but upon a more insecure basis in some respects, years ago.

There are certain branches of manufacturing for which we are still dependent upon the States. Whether such need be the case we may have our doubts; but certainly, while we are bringing about the too long delayed works development, our American competitors may be reasonably allowed to share in the spoil. We believe we are right in saying that the recent steps taken by certain large manufacturers in the States in building works on this side of the Atlantic will, perforce, be followed by others of their American rivals; and we cannot feel that American or any other competition on these lines is to be objected to, where the capital and labour are British, and the management and works control are in the hands of American experts. There will, we feel, be plenty for all to do, and one effect will be to provide a number of object lessons for any ultra-conservative home works—if there be such; although there is a chance that it may be too late then to profit by such lessons. Another effect, however, should not be lost sight of; when American manufacturers have, with our financial and labour co-operation, established their works on this side, their States' factories will no longer be occupying themselves with the manufacture of installation or traction plant for this country. This will leave them freer still for extending their foreign connection, and will render Anglo-American rivalry on foreign soil keener than ever. It would thus seem that all the consequences of our backwardness have not yet made themselves felt.

Lord Charles Beresford has drawn attention to the great future that ought to be in store for English engineers in China. An esteemed contemporary, in this connection, remarks: "Where is the need to go to China, when our manufacturers are beaten by foreign makers, not only in our Colonies and dependencies, but also in our own country?" This kind of argument may commend itself to others, but we are inclined to think that to advocate this new policy is at once ill-advised and short-sighted.

Our American rivals have already planted themselves more or less firmly in the East, and while we quibble as to the wisdom or folly of expanding our electrical trade there, they are making their connection still more firmly established, and are carrying out orders and equipping electrical systems. British prestige may count for something, but there is a great deal in being first in the field. Possibly the real meaning underlying our contemporary's remarks is that home trade should not be allowed to suffer because of increased attention to foreign development. With this we agree, and all attempts to impress upon our manufacturers the necessity of shaking themselves free from the orthodox and hypercautious bands which have hitherto bound them, to the detriment of their own interests and of the welfare of national industry, are worthy of all the support it is possible to accord to them.

But rather than suggest staying a hand anywhere, we would advise the putting forth of a double or treble effort everywhere, and with discretion to energetically strive to recover at least some of the lost ground.

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SOME NOTES ON ROTARY CONVERTERS, WITH SPECIAL REFERENCE TO THE EXTENSION PLANT OF THE CHICAGO EDISON COMPANY.

By A. C. EBORALL.

(*Continued from page* 872.)

In addition to its principal use of serving as a connecting link between the high tension polyphase transmission lines and the low tension direct current distributing system, a rotary converter can be employed in other ways, for instance, to convert direct current into polyphase current. It sometimes happens that a direct current station desires to supply power to a point or locality quite outside its own sphere, and, in order to do this, some form of high pressure alternating current must be employed, if due regard to economy is to be paid. Either, then, a special unit must be put down, generating high tension single or polyphase current, preferably the latter, or use may be made of a rotary converter running as a direct current motor, and generating low pressure polyphase current, this being transformed up to a suitable value for the line. It will be found that the latter method is the better of the two, both with regard to first cost and to cost of running, if the amount of power to be transmitted to the outlying district is a definite quantity, and not likely to increase with time. On the other hand, if the demand is likely to grow, it is better to put down a separate unit. The reason for this is, because it is a most difficult thing to get rotary converters to run properly in parallel when running as motors from the direct current side; in fact, it is practically impossible, especially if the load consists partly or wholly of motors. Consider what happens for the case of a single rotary running under these conditions. The speed depends upon the direct current pressure supplied to it, which would be constant, and to the strength of the field system. At full load the field excitation will be adjusted to the correct value, and the speed of the rotary will be normal. Now, suppose the load on the motors deriving current from the rotary is reduced, or removed altogether, which would have the effect of greatly diminishing the power factor of the line. With diminished power factor, the reaction of the armature current upon the field magnets will greatly increase, weakening the latter, and causing the speed to go up, and under some circumstances it might quite well happen that the machine would race. In order to prevent such an occurrence, it is usual to fit a centrifugal device to rotaries used in this way, which will either cut out the machine altogether, if the speed exceeds a certain value, or will actuate a field regulator, and strengthen the field as the speed increases, but, of course, the latter means can only be used within very narrow limits.

It will now be clear that the operation of rotaries in parallel, when driven from their direct current sides, presents formidable difficulties, and consequently, as far as the writer knows, is never attempted in practice. It might be possible to do it successfully if an independent power-driven alternator was arranged to run in parallel with them, in order to fix the speed. In this case the centrifugal governors could be dispensed with, as the alternator would set and maintain the speed, but it is obvious that it would pay better, under these conditions, to dispense with the rotaries altogether; so that, for the case cited above, should it appear that extensions will be required, it would be far better to instal independent power-driven generators.

An instance in which a single rotary converter is used with great success to convert direct current into three-phase current may be cited by the writer. A certain small district in the south of Switzerland, having watchmaking as its main industry, was supplied with current for motive power purposes from a central power house generating direct current for several neighbouring districts. It was found that the direct current motors in the various workshops so affected the springs of the watches, that their employment became out of the question. The difficulty was completely solved by placing a sub-station in the district, and installing therein a rotary converter, which takes in direct current from the power mains, and furnishes polyphase current to the various workshops for driving three-phase motors. This incidentally brings in another advantage—the three-phase motors are considerably cheaper than the direct-current motors—a great point for small industrial work of this character.

Rotary converters, when driven by power, may also be successfully used as double-current machines, that is, they may be used to generate either direct current, or polyphase current, or both simultaneously. This may be an advantage in certain special cases, but if the machine has to furnish both currents at the same time, it must be not only carefully designed for the purpose, but great care must be taken with the connections, if several units are to be operated in parallel.

As far as the writer knows, the first use of "driven rotaries" as double-current machines was made by Messrs. Ganz & Co., of Buda-Pesth, some three years ago, in the installation put in by that firm at the works of the Danube Steam Navigation Company.

The workshops of this company are distributed over a length of about 1½ miles along one bank of the river, and are driven and lighted electrically, three-phase motors taking

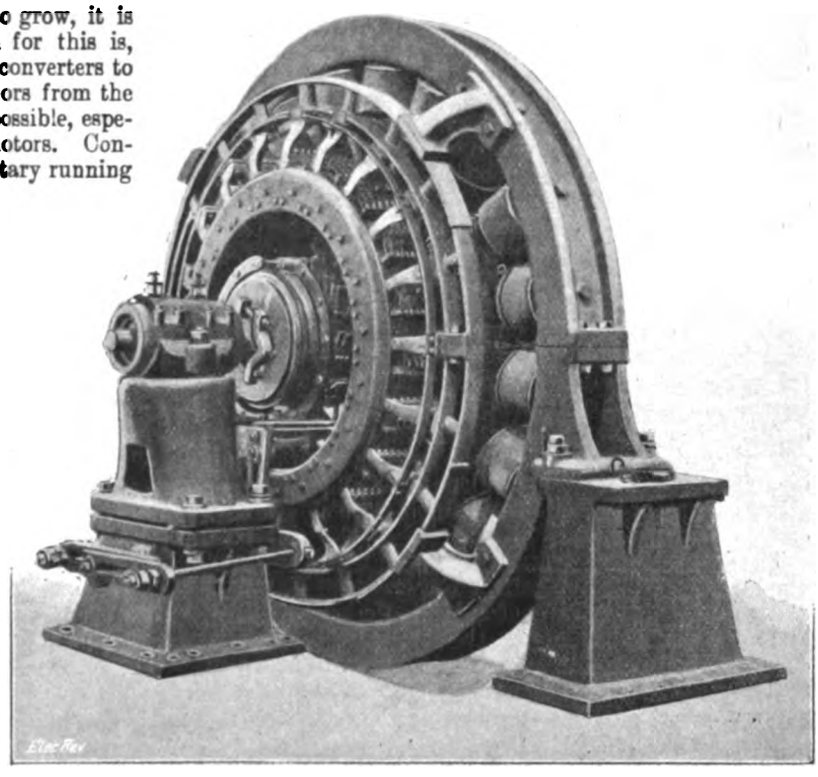

Fig. 1.

the place of the steam engines previously in use. As it was deemed advisable to retain the old shafting and arrangements, the speed of the motors had to be evaluated in accordance with this, motors of 1 H.P., for instance, having to run at a speed not exceeding 450 revolutions per minute. To obtain these low motor speeds economically, it became necessary to reduce the frequency of the three-phase currents supplying them to about 15 cycles per second—a frequency much too low for lighting purposes. Consequently, driven rotaries were installed, and these furnish direct current for lighting and three-phase current for the motors. A few details of the installation may be of interest.

In the power house are three direct coupled sets, two of 200-KW. each, and one of 100-KW., the engines being of the triple expansion marine type, running at 150 revolutions per minute for the larger generators, and a compound engine running at 225 revolutions per minute for the 100-KW. generator. The direct current lighting circuits (which, however, also supply six motors) are arranged on the three-wire

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system, with 290 volts between the outers, and are regulated for constant pressure. The three-phase circuits, supplying 48 motors varying in size from 1 to 50 H.P., are two in number, and are fed from the three-phase sides of the generators, which are not arranged, as far as the writer knows, to work in parallel. As the load on the three-phase circuits consists entirely of motors, it is not necessary to regulate the pressure, which varies within narrow limits according to the load.

Another installation, employing driven rotaries, and offering many points of great interest to the designers of central stations, has recently been completed and set to work for the Chicago Edison Company. The writer is indebted to the *American Electrician* for most of the details of this plant given below, and would refer those further interested in the subject to the current number of that journal for an excellent general description of the plant and its arrangements, switch gear, &c.

The central station of the Chicago Edison Company was originally laid down as a direct current station on the three-wire system, with about 120 volts between the neutral and each outside conductor. The city, however, extended so greatly, that the company found themselves called upon to supply current to an up-town district 3½ miles away. In order to cope with this distant demand, a three-phase 250-KW. rotary converter was installed in the station, arranged to run from the direct current bus bars as a motor, thus furnishing three-phase current at a reduced pressure. This was stepped up in the station to 4,500 volts, and sent over high pressure lines to a sub-station in the distant district, and there transformed down again, and fed into a three-wire direct current network by means of two 100-KW. rotaries connected on the direct current side.

But the demand in the up-town district grew so rapidly, that it soon became necessary to increase the capacity of the sub-station, and it is this extension plant that will be now described.

On account of the difficulty, already pointed out, of running rotaries in parallel when they are supplied by direct current, it was not deemed advisable to add other rotaries to the power station. And here an important point came in—the peak of the load in the up-town district occurred considerably later in the day than that in the district directly fed by the power station with continuous current. For this reason, instead of putting down three-phase generators to feed the up-town district, it was deemed expedient to instal driven rotaries, or double current generators, which could feed either the up-town sub-station with high pressure three-phase current, or the adjacent districts with direct current, or both simultaneously.

The double-current generators now installed are four in number, arranged in two pairs, each pair being driven by a 600-H.P. triple expansion condensing vertical engine, running at 150 revolutions per minute, the generators being directly connected to each end of the crankshaft. The general appearance of the generators is shown in fig. 1; each is of 200 KW. capacity (either as direct or three-phase current), and has 20 poles, giving a frequency, at the above speed, of 25 cycles per second. The commutator is mounted upon a cup-shaped spider, and is about 5 feet in diameter; the current is collected from it by means of 20 sets of block carbon brushes, arranged to be simultaneously adjusted by means of a hand-wheel. Within the commutator spider are three heavy collecting rings, from which current may be taken by means of 12 tangential copper brushes pressing on each ring.

The two generators forming a set have their direct current sides connected in series to feed the three-wire direct current network at 240 volts between the outers; the three-phase 80-volt sides of each generator may be connected together in parallel in the manner presently to be described, and in parallel with the rotary converter already referred to. The two sets of one engine and two direct connected generators are numbered No. 12 and No. 16 respectively.

Fig. 2 shows the switchboard circuits for *one* of the sets, namely, No. 12. The direct current sides of each generator feed into the bus bars (having 120 volts between the neutral and each of the two outers) shown at the top of the diagram, the fields of each being excited at 120 volts, and being provided with a switch and high resistance, in order that the field current may be broken without danger, if necessary. From the three slip rings of each generator, the three-phase currents are led to the terminals of an "induction regulator," whose purpose is to regulate the pressure on this side without altering the excitation, as this is adjusted to give the proper direct current pressure. The induction regulators are not in the immediate neighbourhood of the switchboard, but are nevertheless operated from it, in a manner to be described later. From the regulator the current passes to three single-pole switches, by means of which the two machines on one engine may be thrown together on the polyphase end, or disconnected from each other, or from the line. From these switches the current passes to six fuse blocks, which form the secondary terminals of three 150-KW. step-up transformers. Each of these transformers has two secondary (80-volt) windings, quite independent of one another, one winding belonging to one phase of the first generator, the second winding belonging to the corresponding phase of the second generator. This arrangement of a double low pressure winding per transformer is absolutely

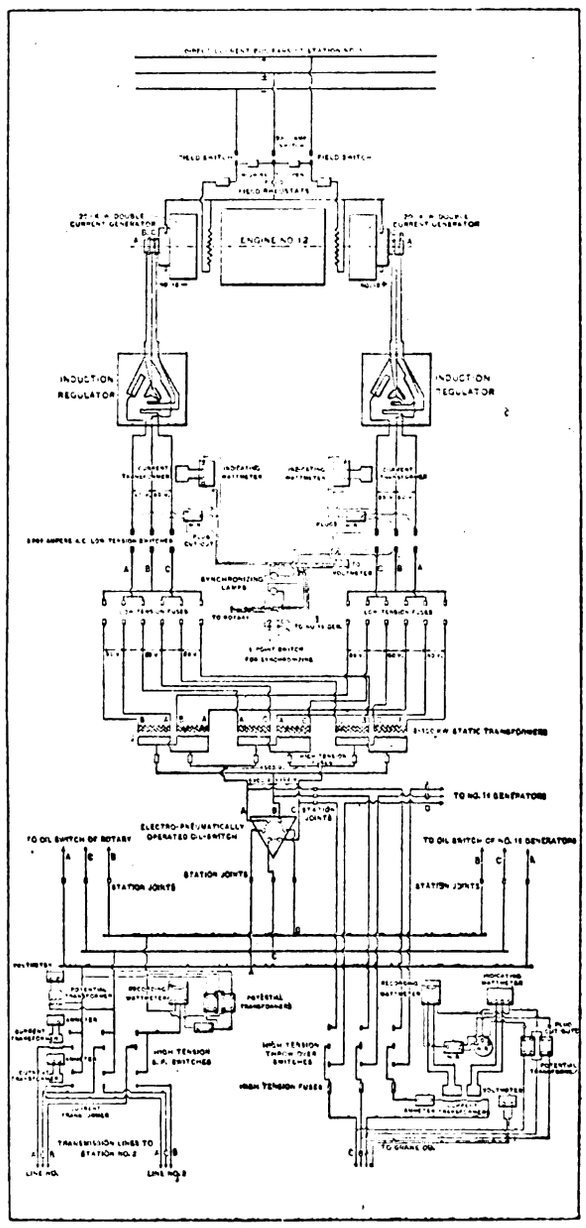

Fig. 2.

necessary, as the two generators of each set have to run in parallel; the three-phase sides cannot be directly joined, owing to the machines being already connected on their direct current side—if they were directly connected, a bad short circuit would, of course, result. The reason for providing each main conductor coming from the induction regulator with two fuse blocks is in order to give each of the three low pressure transformer windings, which are mesh connected, a fuse of its own at each of its terminals, so that if one transformer winding gives out, the other two will

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remain working, which would not be the case if there were only three fuses, one for each main conductor.

Each transformer has two high pressure windings, which can be connected in parallel or series, giving a potential of either 4,500 or 9,000 volts. At present 4,500 volts is used. The high pressure leads of the transformers are taken to six high pressure fuses of the "expulsion" type, and then away to the high pressure three-phase bus bars through a pneumatically operated triple-pole oil switch. But on the transformer side of this switch, a tapping is taken off each conductor to a separate switchboard, shown at the bottom right-hand corner of fig. 2. This board controls the supply of current to a single distant consumer, the Crane Company, to whom current is supplied in large quantities for power purposes. A triple-pole throw-over switch enables the Crane Company to be supplied with current from either of the sets, independently of the station high pressure bus bars; this consumer can be connected, in fact, directly to the high pressure terminals of either of the sets by means of his own switch gear, the actual connections being clearly seen from the figure.

From the high pressure bus bars in the power station the current is taken by means of two distinct three-phase feeder cables to the up-town sub-station. The feeder panel for these transmission lines is shown in the left-hand bottom corner of fig. 2, which gives the connections of the measuring instruments, single-pole high tension switches, &c. The synchronising arrangements for putting any of the four generators in parallel with themselves or with the rotary, are of the usual character, one phase being synchronised, and are shown in the centre of fig. 2. It will be noticed that the current coils of the wattmeters indicating the output of each of the machines are not in series with the main conductors, but are supplied indirectly through small series transformers connected into each main conductor. This is because the transformers are located at some little distance from the switchboard, and it would be obviously absurd to carry the heavy cables specially to the switchboard for such a purpose.

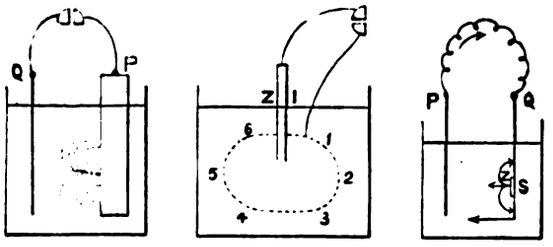
(To be continued.)

SOME EXPERIMENTS ON VOLTAIC CELLS WITH COMPOUND ELECTRODES.

By FREDERICK S. SPIERS, B.Sc.

(Concluded from page 912.)

6. To test this suggested explanation, a zinc-iron (Z I) couple, connected as shown (fig. 8), was suspended in the middle of a large glass breaker, so that a particular stream line of current followed approximately the course of the dotted line; and the potential at various points along that



Figs. 7, 8 and 9.

line was explored by means of the projecting tip of a brass wire that was sealed in a glass tube. Readings were taken with the brass tip at each of the six points marked.

Position	(1)	P.D. between couple and brass point		= 0·59	volt.
"	(2)	"	"	= 0·70	"
"	(3)	"	"	= 0·73	"
"	(4)	"	"	= 0·78	"
"	(5)	"	"	= 0·85	"
"	(6)	"	"	= 0·90	"

The E.M.F. of the brass-iron couple alone was 0·45 volt.
" brass-zinc " 0·94 "

The results were approximately the same, whether the plates forming the couple were connected inside or outside the liquid. When, however, the plates were connected outside the liquid, through a resistance of 10,000 ohms, the effect depended upon the plate to which the electrometer-quadrant was connected. In table (*a*) the connection was with the zinc, in (*b*) from the iron.

Position.	Table (*a*).	Table (*b*).
(1)	P.D = 0·88 volt.	P.D. = 0·45 volt (= brass-iron E.M.F.)
(2)	" = 0·90 "	" = 0·50 "
(3)	" = 0·90 "	" = 0·50 "
(4)	" = 0·92 "	" = 0·52 "
(5)	" = 0·94 "	" = 0·53 "
(6)	" = 0·95 " (= brass-zinc E.M.F.)	" = 0·53 "

This is as would be expected if the explanation given here is true, for in this latter case, when the 10,000 ohms was in circuit, the chief drop of potential in that local circuit is outside the liquid, so that the modification of potential, due to the current stream lines in the liquid, is very slight. Hence, in case (*a*), the electrometer reading is that of a zinc-brass couple, and in case (*b*) that of a brass-iron couple, both but slightly modified to the same extent by the stream line change of potential, and the extreme difference in each set of figures is therefore about the same, being 0·07 volt and 0·05 volt respectively.

7. The application of the above results is of some assistance in making clear the exact manner in which the presence of zinc in boilers, in metallic and liquid connection with the steel plates, diminishes the corrosion of the latter. This corrosion, in general, is due to the current of electricity which passes from the steel to any of the boiler fittings to which steel is electro-positive, usually brass. The conditions may be represented diagrammatically by fig. 9, where Z is a small piece of zinc attached to a large plate of steel, S and B a plate of brass metallically connected to S. In this cell there are three currents flowing from the zinc through the liquid to the steel, from the zinc to the brass, and from the steel to the brass. At first thought one would expect that these currents would be totally independent of one another, thus, that the presence of the zinc would not affect the value of the steel-brass current which flowed before the zinc was introduced, and hence that the same quantity of steel would be dissolved in both cases. Of course, the *distribution* (in the liquid) of this steel-brass current one might expect to be influenced by the presence of the zinc; for at every point where the zinc-steel current enters the steel from the liquid, hydrogen is deposited, hence at those points there would be no supply of oxygen to keep up the steel-brass current, and consequently it would be reasonable to suppose that this steel-brass current would be repelled from the neighbourhood of the zinc, and would leave the steel at points far removed from, or behind, the zinc plate. The total value of this current, however, one would not expect to be affected by the zinc, for it depends merely on the potentials of the brass and steel (resistances being supposed equal in the two cases). However, from the experiments described above in Section 4 (*a*) and (*b*) we deduce that the effect of the zinc plate will be to increase somewhat the P.D. between P and Q, so that a larger current will now flow from P to Q than would if the steel plate alone were present. This is equivalent to saying that the effect of the zinc is to *raise* the potential of the point, P, and, therefore, that of the whole brass plate, B, relatively to the point, Q, and thus to the whole steel plate, S. The consequence is that the brass plate is relatively more electro-positive than it was before, hence less current will flow through the liquid from S to B, and less steel will be dissolved.

8. Some engineers seem to have very vague ideas as to the actual way in which the presence of zinc prevents corrosion in boilers. Many think that the local current it produces is merely valuable indirectly, as it tends to purify the water from acids and such like impurities. Others believe that the zinc is beneficial directly by its influencing the potential of the various components of the boiler. (See Ewing's "Steam Engine and other Heat Engines," Section 215.) Both hypotheses may be true; the results arrived at here certainly confirm the latter supposition.

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THE POSITION OF THE ELECTRICAL HEATING INDUSTRY IN THIS COUNTRY.

The application of electrical energy for heating and culinary purposes has not made as much progress in this country as was expected of it some five or six years ago. It is therefore interesting to look into the matter, and see why this has not been the case, and further to ascertain whether a heating load, which was so strongly advocated about five years ago, as a possible means of improving the central station load factor, is still a desirable acquisition from the central station engineer's point of view.

One reason for the slow introduction of this class of apparatus into everyday use has undoubtedly been the fact that, until comparatively recently, both the electrical supply authorities and the wiring contractors have not considered it desirable to push the matter. They have looked upon any kind of heating by electricity as expensive, and likely to bring them trouble, and without going much further into the matter, have condemned it as such.

It is intended to show in the following article that whilst certain applications of electrical heating are undoubtedly expensive and extravagant, there are others which are not so, and which can be applied in such a way that any slight additional cost in working is more than counterbalanced by the advantages accruing from its use.

Each different application has to be judged upon its own merits, and whilst in some cases gas or other fuels may be found cheaper, in other cases, with different conditions prevailing, electricity will be found the cheaper.

It cannot be expected that, cost for cost, electricity will often be found a cheaper fuel than its rivals, but, when other advantages are taken into account, it can often be shown that the general savings to be made by adopting electricity are not to be despised.

The chief points to be taken into consideration in deciding whether to adopt electricity for heating or cooking purposes are the following:—

1. Cost of electrical energy available.
2. Commercial value of certain advantages which are only obtainable by adopting the electrical system, advantages such as cleanliness, simplicity, ease of working and manipulation, absence of dirt, &c.
3. In the case of private installations, whether it can be arranged to utilise the generating plant for heating purposes during those hours when it is not required for other purposes.

It is quite impossible to fix definitely the value of the advantages attending the use of electrical heating apparatus for manufacturing and commercial purposes, as these values are entirely dependent upon local circumstances; but it is intended to explain, as far as possible, the every-day uses to which electrical heating apparatus, already on the market, can be advantageously applied.

The application of these articles can be conveniently divided into three classes:—

1. Apparatus for use in manufacturing and industrial undertakings.
2. Apparatus for use for domestic purposes, either for heating or cooking—the apparatus performing the *sole* function of carrying on those operations.
3. Apparatus for use for domestic purposes, either for heating or cooking purposes; the apparatus being used as a supplement to the existing systems.

Taking the case of the manufacturing and industrial undertakings first, we have the following among the common applications:—

I. (*a*) *Flat irons* for laundry purposes. In addition to the ordinary laundry requirements, these irons are being used to a considerable extent for finishing off dresses, blouses, &c., in dye works. The advantages of electric irons for work of this description must be apparent to everyone, especially for purposes of finishing off dresses, blouses, &c., which are often of a very delicate and expensive nature, and where cleanliness and perfect control over the heat of the iron are of first importance.

The writer knows of an installation of nearly 200 irons, which have been used for this special purpose, and which have amply confirmed the opinion that the general cost of working is less than with similar gas irons.

The chief advantages found with these irons are the following:—

1. Always ready for use, and no waiting or going away to fetch a heated iron.
2. Very clean; in the case of gas irons, very often a dress, which has been thoroughly cleaned, and is being ironed for the last operation, gets a smut of dirt on it from the gas iron, which necessitates its being recleaned.
3. On account of these points, the work turned out by the factory hands, when using electric irons, is in excess of the work turned out when using gas irons, and the piece work rate can consequently be dropped.

It is difficult to arrange two degrees of heat in one iron, and consequently the irons are made up in two degrees of heat, 300 watts and 500 watts. The higher heating iron is liable to give trouble, if not switched off almost immediately when out of use, so, whenever possible, the lower heating iron should be adopted.

Stands have been made, with switches embodied in them, so that, when the iron is placed on the stand, the current is either entirely cut off or reduced through a resistance.

(*b*) *Electrically-heated Rolls* for laundry use:—Experience has shown that the heat from an electrically-heated laundry roll can be controlled to such a nicety, that the advantages in favour of using them are very great, and, when once installed, they continue to give satisfaction. Any of the rolls used in laundry work can be adapted for electric heating.

(*c*) *Goffering Iron Heaters* for heating the ordinary goffering iron, large numbers of which are used in laundries, dye works, &c.

These heaters consist simply of an electrically-heated tube, into which the goffering irons to be heated are placed. They are found very convenient, as they can stand on the workman's bench, without any risks from fire, and are always ready for use.

(*d*) *Hot plates and Glue pots* for woodworkers' shops; also for printers and bookbinders.

Of all the advantages, perhaps the chief point in favour of electricity for heating this class of apparatus is safety, from a fire insurance point of view.

The insurance premiums for any naked lights in a carpenter's shop, as also in a printer's and bookbinder's, are very high indeed, and these premiums can be saved very largely by the adoption of some electrical means of heating.

The hot plates and stoves used for heating printers' tools are also subject to this advantage, for they have usually to stand in the midst of paper and books.

(*e*) *Hot plates and Stoves* for lacquering purposes. These are coming into very general use, for it is found that, power for power, they consume less energy than the ordinary gas jet playing on to a steel plate.

A small current will suffice to keep a plate at lacquering temperature.

(*f*) *Goose Irons for Tailors' Use.* Numbers of these are being used by tailors, and by some of the large tailoring houses; the chief advantage in using them being the fact that they are always ready for use, and that a workman has not to leave his bench to go and get his iron reheated. The iron also keeps at a uniform temperature, whilst the old type of iron starts usually too hot, and finishes off too cold.

The gas iron is, of course, not open to these objections, but fire insurance risks come in here, and this, together with the necessary exhaust for carrying off the burnt gas, tends to give electricity the favour.

These are among the chief applications on a commercial scale, though many similar uses may be found to suit special circumstances.

It may be taken as a general rule that, if the degree of temperature required for an operation exceeds 500° F., there will be difficulty in making the apparatus durable and satisfactory for general working, though anything up to this point can be heated electrically as easily as by any other means.

Whether it is going to pay to do so, cost for cost, depends upon special circumstances, and each case has to be judged on its own merits.

II. The second class, namely, that in which the heating and cooking apparatus performs the sole function of carrying on these operations, can be dismissed in a few words. With current available at 1d. or 1½d. per unit, the cost of heating one's house or cooking one's meals throughout will not be

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excessive, provided some other means is adopted of heating the large quantities of water usually required for domestic purposes, such as for washing up, supplying baths, &c., which cannot easily be dealt with electrically.

The water for use in the saucepans, kettles, &c., would thus be drawn from the hot water supply, and would save a good deal of time, as these utensils cannot easily be wound for boiling up cold water quickly.

In the case of a complete cooking plant, the fact should, however, not be overlooked that the utensils are most of them liable to break down occasionally without any apparent reason, and this must be guarded against, by having a small supply of spare parts for use in cases of emergency of this description.

Provided this precaution is adopted, and provided power is available at the figure mentioned above, the use of a heating or cooking plant can be relied upon to give satisfaction, both as regards results and cost of working.

(*To be continued.*)

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The adjourned discussion on Mr. Holliday's and Mr. Crompton's papers was resumed at the meeting of the Institution of Electrical Engineers last week. Mr. Crompton added some particulars to his paper regarding the actual result of using cheap fuel under water-tube boilers. A careful trial recently made at Glasgow showed that the figures given in the paper were closely corroborated, although the losses were not brought quite so low as anticipated, and he did not despair in getting to the figures given in the paper, but to do so the setting of the boilers must be such as to reduce the existing very considerable radiation losses.

Some figures sent by Mr. Dickinson, of the Leeds station, were read. The Leeds station started in 1893, using slack coal at 7s. per ton, but in 1894, smudge, costing only 2s. 3d., was substituted. The price has, however, been gradually rising, and now it is found economical to return to slack. Different classes of smudge were tested, and the letter from Mr. Dickinson gave the calorific values and the financial results. He remarked that cheap fuels deteriorate very much by keeping in stock; thus, one sample having an initial value of 12,000 B.T.U. fell in six months to 7,700 odd B.T.U. The smudge generally used had a calorific value of from 9,766 to 9,428 B.T.U. per lb., with from 21 to 23 per cent. of incombustible matter, while special grades of cheap fuel had as much as 12,000 B.T.U. per lb. with 10 per cent. incombustible.

Prof. Perry congratulated the Institution upon having these papers presented to them as electrical engineers. Electrical engineers deal in and sell energy, and he thought economy of fuel was more important to them than to other engineers. In this country there are few waterfalls and cheap coal, and therefore the conditions are very different to the country so many of them visited a few months ago. He welcomed any paper giving actual figures, and agreed with Mr. Crompton in his remarks on furnaces in general. Theoretical notions are coming gradually to the front. At first they are usually presented in an incomplete form, and practical engineers complete them by carrying them out. He referred to Thornycroft's fire-brick lined combustion chamber, and pointed out that the heating surface is not the only important matter, but something analogous to the "hydraulic mean depth" of the water engineer. The surfaces to be heated must be scrubbed by the gases so as to convey the heat to the metal, and the water should scrub the inside of the plate or circulate so as to utilise the heat. In the old days of low pressure steam was not very dense; now, owing to the use of higher pressures, it is dense per pound of evaporation, and one wants something of the nature of a mechanical scrubber in the water of a boiler. Another difficulty in modern boilers is airless water, and a modern chemist had told him that airless water cannot be boiled; but of course one knows from practice it does boil. He noticed that in Mr. Holliday's case a very high load factor was the ruling condition, and pointed out that the load factor on a plant is very important. He had worked out some figures in the endeavour to compare Mr. Crompton's and Mr. Holliday's total costs, and no doubt when the printed discussion appears these will prove interesting, but as given it was not quite clear how they had been obtained or exactly upon what basis the comparison was made.

Prof. Perry's figures, as tabulated, are given below. They show the prices per unit generated with different load factors and varying cost per ton of coal:—

	Total cost of evaporation, Columns T. Cost per electrical unit. Cost of coal per ton.											
	Cost of coal only, Columns C.											
Load factor	8s. 6d.		5s. 4d.		7s. 6d.		10s. 6d.		14s. 6d.		17s. 5d.	
in per cent.	T	C	T	C	T	C	T	C	T	C	T	C
10	1·71	·20	1·66	·29	1·62	36	1·56	·45	1·52	·54	1·49	·60
18	·73	·14	·73	·19	·74	·25	·76	·31	·75	37	·76	·41
33	·35	·10	·37	·14	·39	·18	·42	·23	·44	·28	·45	30
66	·19	·08	·21	·11	·23	·14	·26	·18	·28	·21	·30	·24

Mr. Shoolbred referred to the almost ideal conditions of steady load under which the figures in Mr. Holliday's paper were obtained, and directed attention to the not so ideal circumstances under which electric light stations are worked. Some slack coals, although small, have very high calorific values, and low-priced coals are sometimes really cheaper than higher grades, as calorific value does not fall as rapidly as market value.

Mr. Horace L. P. Boot, of Tunbridge Wells, regretted that engineers had not made more public the results obtained in the past few years. He had been permitted to make experiments with different classes of coal, and gave, amongst others, the following comparative results:—

Nixon	1·02d.	Cost per unit generated of coal only in same boilers. Coke at 15s. per ton.
Ocean	·96d.	
Wayne's Merthyr ...	1·20d.	
Coke	·879d.	
Great Western	·810d.	

He remarked that the cost of fuel varies largely in different towns owing to the railway rate, and that it is obviously desirable, when that is high, to use the best class of fuel possible, because a fuel costing about 5s. at the pit may be charged 16s. or 17s. per ton at the works. Another advantage is, that with high grade fuels there is a smaller outlay on boilers; less ash or clinker to dispose of; one stoker may do work otherwise requiring two, and unloading costs less. A total difference due to these causes of ·184d. may be found. He had made some observations upon the deterioration of coal by storage, and found that one month's keeping might mean a loss of 25 per cent., and with 2½ months of 33 per cent. in the case of a particular coal. The effect of bad water on the cost of coal may be very serious, but the supposed disadvantages of tubular boilers had not been felt in any single instance at his works.

Mr. Geipel thought it was an appropriate time of year to discuss questions of steam raising, and stated that Prof. Perry had anticipated some of his remarks. Few engineers were fortunate enough to come across an almost constant load factor. Of the other factors than coal, he considered the number of boilers put down to produce steam had a very important bearing on costs. The more work there is for the boiler to do the better results obtained, and Mr. Holliday's figures went to prove this. He had, however, no such difficulty as raising steam daily for three or four hours, and it was in such cases that the Babcock-Wilcox boiler was important. Lancashire boilers are very costly to "raise" steam. The difficulty of circulation might be got rid of or met by mechanical circulation, and he showed a method of his own which consisted in fixing to the lower side of the flue a tee iron projecting downwards which carried heat down into the cold stagnant water and set up an induced circulation. In 25 minutes in a laboratory apparatus the water rose 25° F. without the rib and 115° F. with the rib.

Having made one or two remarks upon mechanical stokers and the boilers at Frankfort, Mr. Geipel gave place to Mr. A. J. Lawson, who referred to the necessity of economising fuel in view of the prices now being fixed for electrical energy in Bills before Parliament, and touched upon the relative value of small bituminous and Welsh coal. He also at some length detailed the importance of

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obtaining engines whose steam efficiencies have an inverse ratio to the cost of coal; if coal were 12s. per ton the engine used with the steam so raised should consume not more than 15 lbs. per I.H.P.-hour, if the price were 14s. then only 13 lbs. should be allowed, and so on.

Prof. R. H. Smith rather questioned the peculiar interest electrical, as distinct from other engineers, had in full economy. He put the case that there is less margin of profit in electrical engineering, and natural disabilities tell against it in competition. Thus electrical engineers are compelled to pay more attention to saving than other engineers. He again dwelt upon the number of boilers required to raise a given quantity of steam, cited the effect of feed heating, and condemned steam feed pumps as generally causing "a frightful waste of steam." He agreed with Mr. Crompton's use of a firebrick-lined furnace, and the reduction of amou of air admitted. Another speaker gave some general infor mation regarding the system of powdering coal, and burning it as fine dust. The three essentials he considered were a perfect mill, giving absolutely uniform powder, regularity in passing the dust into the combustion chamber, and the maintenance of a high temperature therein. There was no smoke, and but very slight slag, while fuels having fairly large percentages of incombustible matter could be so used. Major-General Webber wanted some particulars of the mill used to powder the coal.

Mr. Crompton replied on the whole discussion in Mr. Holliday's absence, and refused to be dragged off into side issues, such as relative advantages of different types of boiler. Mr. Ferranti had called attention to the lining of combustion chambers. Mr. Crompton had never seen it publicly stated what an enormous difference the character of the firebrick had upon the efficiency, and compared the conditions to those of incandescent gas mantles. He had found soft firebrick almost pipeclayey, not only not so easily melted, but most efficient. Long tests had the disadvantage over short tests, that the fires must be clinkered, but with his arrangement the fire was continuously clinkered. He regarded that Mr. Dugald Clerk was answered by Mr. Bertram Blount. Coming to Mr. Boot, he considered that the tests could not be fairly made with the same furnaces to get best results with each kind of coal, unless due care was taken to adjust draught, width of fire bars, &c., to suit each class. Slow oxidation was the cause of stored coal deteriorating. He had tried to force boilers by injecting oil fuel on the top of a coal fire, but, as might be expected, the supply of astatki ran out, and the experiment could not be continued. He considered Mr. Lawson's remarks thoroughly practical, but could not agree with Prof. Smith, as no one knew anything about cost of energy until electrical engineers published figures and located losses, and thought that "we have a monopoly" (a statement with which the meeting evidently thoroughly agreed). He wanted also to know if dust fuel or powdered coal was burned, where the incombustible went, either up the stack or in the flues, and flue cleaning might be a big item. With a remark that electrical engineers were purveyors of energy, the reply was closed, and the meeting adjourned, feeling that a very interesting and important subject has been fairly and somewhat fully dealt with.

THE ENCLOSED ELECTRIC MOTOR.

By SYDNEY F. WALKER.

The idea of the enclosed electric motor first arose from the reluctance of colliery owners to place electric motors, having in those days a visible spark at the commutator, in any position, such as near the working face of the coal, where an inflammable mixture of gas and air might be met with.

The writer pointed out repeatedly, in discussions on the subject at the different mining institutes, that the danger from this source was, at the utmost, very remote. Twenty years ago he had made careful and prolonged experiments with ordinary illuminating gas freely delivered at the surface of the commutator of a series wound Gramme dynamo, feeding arc lamps of the old Brockie commutating type, and, therefore, with plenty of sparking, but completely failed to produce ignition. It was also pointed out that there was far more danger from the spark which passes between the parted ends of a severed cable, but colliery owners would have none of it. Electric motors, they could see, would be of great service for pumping, especially from dip workings and for coal cutting, but if they were to be employed, the spark must be boxed in, so that the gaseous atmosphere could not reach it; and so the enclosed motor was gradually developed.

First, or nearly first, the writer believes, came Davis and Stokes's dynamo and motor, with the brushes carried in the cylindrical space inside the commutator, the outer end of the cylinder being closed by a glass disc. About the same time came various arrangements for enclosing the commutator only, with the brushes on the outside of the commutator cylinder for enclosing the field magnets separately, and finally for placing the whole of the motor in an iron box, a portion of which could be removed to regulate the brushes, make connections, &c. But none of these arrangements was really satisfactory, nor can it be said that the enclosed motor became a practical machine, until the problem was studied from first principles, and it was seen that the enclosing box itself could be made to form part of the magnetic circuit.

The enclosed motor designed on those lines is not only a very efficient apparatus in the sense in which efficiency is usually understood—viz., proportion of output to input—but it is also, when properly designed and properly constructed, a very efficient apparatus in the higher sense of the term, in the ability to keep on performing its work continuously, and of standing the strains that are brought upon it. It is also, other things being the same, and with proper machine tools for the purpose, a cheap machine to make.

Mines in which inflammable gas is present are not the only places where it is of advantage to have the working parts of both generators and motors protected from the surrounding atmosphere. In dip workings, in mines where no gas is present, and in which the great advantage of the electrically-driven pump consists in its ability to follow the water down as the workings recede, it occasionally happens that from a breakdown on the surface, from a strike or from other causes, the whole of the pumping plant, with its motor and gearing, is under water for a time, and it is then of great advantage to have the water kept away from the wire coils of the armature and field magnets. Again, in cotton and woollen mills, jute factories, rope works, foundries, and even in general engineering works, there are always a number of fine particles of the various materials dealt with in the works—cotton, wool, foundry sand, brass, iron and copper dust—floating in the atmosphere, and it is astonishing what a quantity of these particles find their way right into the interstices between the coils of the armature, into the spaces at the back of the commutator, on to the insulation of the brush holders, &c.

Now, these fine particles when first deposited and in small quantities are often undoubtedly quite harmless, so far as the dynamo or motor is concerned, but unfortunately they harbour moisture, oil of various kinds, copper and carbon dust, &c., and as the places in which they are deposited are always either directly in the path of the current, or in such positions as to form paths in parallel with some of the regular paths of the current within the dynamo or motor, shunts to some portion of the machine, the composition of the deposit is gradually altered by the passage of at first very minute currents through it, so that the insulation of the machine is broken down or so seriously reduced as to affect its efficiency, a very long time before this would happen if this deposit had not been present, and so the repairs bill is increased in consequence. Of course a good deal of this may be avoided by carefully blowing out these particles day by day; but usually it is not easy to get this done in a works devoted to the production of something quite different from electric currents, except in special cases, without extra expenditure on attendance.

And so the enclosed motor has naturally become a favourite. It can be fixed in all sorts of positions (all that is necessary being foundations, connection to the electric supply, and mechanical connection to the work) where one would hesitate to place an ordinary motor. One need not be so careful about keeping everything clear of the machine, so long as the terminals and pulley, or other mechanical connections, are protected.

But now as to the other side of the question. Doubts

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have been expressed as to whether the enclosed motor is such a boon as those manufacturers who have devoted themselves specially to it would make out. In the first place, there is a complete absence of ventilation for the armature. The air within the motor is churned over and over again, its temperature rising to a very much higher point than it otherwise would do; instead of there being a change of air, an air current, however feeble, created by the revolution of the armature itself. This means, of course, that unless the heat can be got rid of in some other way, a lower current density must be the rule in armature and field magnet coils, or not only will the insulation be gradually broken down, but the proper regulation of the machine will be interfered with, since there will be an undue increase of the electrical resistances throughout the machine, and the output will also be reduced.

As against that, however, we have the fact that the enclosing box itself, which is in metallic connection at several points with both armature and field magnets, and which is also in close thermal conductive connection with the air contained in the chamber, is itself a very good radiator, presenting a large metallic surface to the surrounding atmosphere that can be arranged to radiate freely; so that it is doubtful whether the increase of temperature of the wire coils, in a properly designed enclosed motor, in which full advantage has been taken of all physical features, is a very serious matter. But whatever this may be, it merely means that an enclosed motor to perform certain work must be larger than an open one to do the same work, and the interest on the difference in the cost, if any, must be set off against the amount of the repairs bill saved, from the absence of the troubles mentioned above; and the user will also generally be prepared to pay rather more for the undoubted convenience.

Next there is always the undoubted fact, that in the enclosed motor the matter of the brush gear and its regulation presents more difficulty than with the unenclosed motor. The brushes cannot be got at so readily for regulation, and if such arrangements are made that they can be, there is a great danger that the motor will not only cease to be enclosed, but that it may be worse off than if it had remained simply unenclosed. But this means, again, that with enclosed motors the brush gear must be so arranged that regulation and attention of any kind are only required at such times that they can be done by a properly skilled attendant. And it may be taken that if motors of any kind are to be generally successful, this must be so. Users of enclosed motors, or someone about the works, may take sufficient interest in the machine to attend to and regulate the brushes where there is only one, or while the thing is new; but in these days everybody about works of any kind is usually far too busy to give any time to things of that nature. Engine and shafting go by themselves. If the electric motor requires frequent attention it will probably be put on one side, except in those cases where there are a sufficient number to pay for someone to be constantly going round them. Even in those cases proprietors and managers would far rather pay more, in reason, for a machine that did not require attention; and as every dynamo maker knows, the arrangement of the brush gear, so that it shall not require attention except at long intervals, is merely a matter of design and careful construction.

Next there is the matter of the oiling of the bearings. If this is not carefully arranged, the oil works down into the inside of the case, and is thrown upon various portions of the insulation. In the majority of cases, with the greater number of oils employed in lubrication, if it remained as oil, it would be comparatively harmless, but a layer of oil forms a bed for copper and carbon dust, such as may be delivered from the commutator, and for any dust that may happen to have got in when the machine has been opened, and the minute current which passes transforms the material, reduces the resistance of the insulating material it is laying on, say that between the brush holder and its rocker, and then we have the usual spark thrown across, with all its attendant troubles. But this, again, only means that the oiling arrangements must be properly designed, and that the design must be carefully carried out—that the oiling arrangements must be such that under no circumstances — accident, of course, excepted—shall the oil be able to find its way inside the motor chamber. Proper guard rings or other arrangements must be provided, such that the oil cannot work back along the spindle towards the armature, and in designing the arrangements for oiling, note must be taken of the whole of the conditions as to pressure, temperature, &c., inside and outside the motor chamber, and as to the effect of capillary attraction. It must also be arranged that if any overflow or any leak does take place from the oil reservoir under each bearing, the only path open for the oil shall be the outside of the case, where it can do no harm beyond wasting oil, and that there shall be no path open for it, under any circumstances, by which it can find its way inside the motor chamber.

Again, careful attention must be paid to temperatures and pressures that will rule within and without the motor chamber under ordinary working conditions and under extreme conditions. In fact, in the writer's opinion, the matter of temperatures and pressures within and without the motor chambers of enclosed motors, under all possible conditions, are worthy of a careful and exhaustive study, as well as the matter of the capillary spaces present in different parts of the chamber. Capillary attraction is always a troublesome matter to deal with. The writer has seen many an otherwise well designed apparatus, intended to work in damp places, wrecked entirely by capillary action. A space existed that the human eye could not see, that probably no known instrument could measure without the aid of a microscope, and through this space water has penetrated. To conclude, then, the enclosed motor, in the writer's opinion, has come to stay, provided it is designed on the lines he has indicated and is carefully made. Further, consumers, once they see the advantages of the enclosed over the open type motor, will be quite willing to pay more for it.

LONDON COUNTY COUNCIL.

The Council at the meeting on Tuesday resolved to lend £10,000 to the Whitechapel District Board for electric lighting purposes and £24,720 to the St. Pancras Vestry for works of a similar character.

Light Electric Railways.—The Finance Committee reminded the Council that in October they reported upon the financial bearings of proposals to construct light railways at Highgate, Clapham, New Cross, and Deptford, and that the Council then decided to apply for orders to authorise the construction of the railways. Since then the revised estimates of the cost had been prepared for the Highways Committee, the total in each case being as follows:—

Archway Road, Highgate	£8,899
Clapham, Wandsworth and Kingston Road	186,608
New Cross, Lewisham and Eltham	145,626
Deptford, Shooter's Hill and Woolwich	173,687

The figures given above do not include the cost of street widenings, a portion of which was to be charged to the light railways. The aggregate of the revised estimates was from £15,000 to £20,000 in excess of that of the earlier calculations on which the Committee's forecast of the probable financial results of the undertakings was based, and that excess would involve an extra charge of about £1,400 per annum to be met out of the traffic receipts.

Electric Lighting Loans.—The Finance Committee reported upon an application by the Bermondsey Vestry for a loan of £16,500 to defray the cost of freehold land as a site for an electricity station, and a refuse destructor and other purposes. The Committee recommended that the application should be granted, the loan to be advanced at the rate of 3¼ per cent., repayable within 50 years.

Dr. Cooper, as an amendment, proposed that the recommendation should be referred back for further consideration. Colonel Ford having seconded the amendment, the Chairman of the Finance Committee expressed his willingness to take back the recommendation for the financial points to be placed before them by the mover of the amendment, and this the Council decided to agree to.

The Committee, in a further report, announced having had under consideration an application from the Newington Vestry for a loan of £15,500 for the extension of the plant at the generating station to meet the demand for current in excess of the original installation, and for an extension of the cables. The Vestry had asked that the loan might be repaid within 42 years, the repayment of the principal to be postponed and spread over the last 39 years. This method was adopted in the case of loans granted to the Vestry for the original installation, but as the money now required was for an extension of the initial expenditure, the Finance Committee thought that the commencement of repayment should not be postponed beyond the date when the repayment of the loan for the original installation commenced to operate, namely, two years from the present time. It was decided to sanction the loan on this basis, as recommended by the Committee.

Electric Traction.—Among the legislative proposals submitted by the Parliamentary Committee was the London County Tramways Bill. The Committee asked the Council to approve the Bill, to seal a petition for leave to bring in the measure in the ensuing session,

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and to deposit the Bill according to the Standing Orders of Parliament. Colonel Ford, in reference to the Westminster Bridge—Tooting tramway, asked whether there ought not to be some limit of time within which the works should be carried out. The attitude of the Council in regard to Bills promoted by others was to endeavour to secure the insertion of a time limit, and he thought that the Council should be treated in the same manner. If the chairman of the Committee would not agree to that being done the speaker said that he would have to take steps for that being done through another channel.

Mr. E. A. Cornwall, chairman of the Parliamentary Committee, expressed surprise that the member had not read the Council's Bill. One of the clauses provided that if the tramways were not completed within five years the powers for constructing the lines or otherwise would cease on the expiration of that period. Perhaps the member before attempting opposition in another channel would make himself acquainted with all the clauses contained in the Bill.

Colonel Ford said that such steps would be taken, because the period fixed was as long as five years.

The recommendations were adopted. It was subsequently decided without discussion to approve the London County Tramways (No. 2) Bill, which proposes to authorise the Council to introduce electric traction on all or any of the tramways of the Council, and to remove the proviso which prohibits the use of electric traction on that part of the North Metropolitan tramway system which is situated in the county of London. It was also resolved to lodge the Bill together with a petition asking for leave to bring in the measure.

CORRESPONDENCE.

Tested Lamps.

Your correspondent, Mr. A. W. Gattie, does a considerable amount of fencing, but avoids the point at issue, *i.e.*, vague statements of tests by a firm who apparently exist for the purpose of accurate testing, and to account for the extraordinary behaviour of a lamp consuming considerably more current at the finish of its life than at the commencement.

If Mr. Gattie reads the Electrical Review of 1st inst., he will observe he is quite wrong. I replied to a paragraph in your journal, and he pays you unintentionally the deserved compliment that the Electrical Review can be the only highly technical journal.

Mr. Gattie's argument is a retort that I have made erroneous statements; this, too, is vague; disprove them, or point them out to me, and I will gladly explain. I do not mind in the least the threat of that distinguished engineer in the background "flooring" me. I rather welcome my remarks being taken up.

I am, indeed, pleased to hear that 95 per cent. of their trade is in English goods, and sincerely hope it will remain so, but that paragraph did not convey that idea in the least, the opposite, in fact.

Reply to "T. P. S."

I am afraid his experience with incandescent electric lamps is very limited.

Surely he does not imagine a filament is flashed in gas in the lamp bulb; he may rely upon it that the operations are quite separate, so how can the gas get left in the bulb? Moreover, if there was flashing gas left, or gas got put in, the whole thing would explode on coming in contact with a blowpipe. No, sir; incandescent lamps of my experience have vacuums, as near as possible, perfect.

I agree with him that efficient lamps are not necessarily English. I have tested foreign-made ones of about 16-c.p. at 2 watts per candle; but how about life?

He, too, has missed the point of contention. It is not what the Tested Lamp Company sell, but their inexplicit report.

One more point: 100-volt lamps are mostly flashed, 200-volt lamps are often not flashed. Where does the gas apply here?

English Electrical Engineer.

December 8th, 1899.

[In justice to the Electric "Tested Lamp" Company, we must remind our correspondent that the paragraph which he discusses was our own abstract, condensed from a fully illustrated article in our contemporary.—Eds. Elec. Rev.]

High and Low Speed Motors.

Your correspondent's reply in the Review of December 1st on the above subject evades the direct issue by importing conditions of his own making; I therefore beg a little more of your space, and will take his points *seriatim*.

1. I do *not* advocate "extremely" slow speed motors. Your correspondent's conversancy with continuous current work apparently does not extend to the knowledge that motors of 150 revolutions are in common use. Doubtless he will consider it incredible that not the least important of the four eminent makers to whom he refers supplies motors of 100 revolutions. Such, however, is the fact. Instances on this point could be multiplied; but repetition of facts that are common knowledge to the majority is unnecessary.

2. There was no "catch" in my offer.

3. The "ordinary two-pole machine" does *not* "represent present practice in this country" for slow speed motors for direct connection. The firms instanced by your correspondent would probably not thank him for inferring that they can only compete in the ordinary two-pole type. By his reference (in what he is pleased to term a "specification") to the supposed necessity for open motors (a condition not previously mentioned) I take it he further suggests that these firms do not make enclosed motors; this is not the case. They all make these, three of them, and probably the fourth also, in considerable numbers.

4. To deduce the "market price" of a slow speed motor from list prices of a type designed originally for high speeds is a proceeding which I think requires no comment.

5. Nothing whatever was said about retail prices in the original article, and I should be surprised to hear that the retail price of a 4-h.p. high speed motor from any of the firms mentioned was as low as £43, which I believe was the price stated; even if it were, the addition of the ordinary discount would not bring the *net* price, which I gave for the slow speed motor, up to £90 to £110, your correspondent's assumed "market price."

I am obliged for the suggestion as to business resulting; I may say, however, that like most other makers, my firm has as much work in hand as is convenient, and that as we already supply many readers of the Electrical Review, they do not require enlightenment on the subject. Further, my contributions to correspondence columns are not intended as advertisement.

In conclusion, I would suggest to your correspondent that it is not quite fair to invent new conditions to suit his own arguments; he resembles the gentle Boer, in that he does not abide by the rules of war. When the British soldier is unexpectedly fired on by an individual who has previously been wearing the white flag of a blameless life he cannot decline further contest because his adversary does not "play the game." But I can!

Lente.

Electricity Supply in London.

I think I have read strong remarks in the Electrical Review anent the pressure at which the City Electric Light Company at times supplies its consumers with *light* (?), but, at any rate, that company generally leaves you the hope-inspiring red hairpin as a promise of better times coming. To the unfortunate dwellers within the area supplied by the Metropolitan Electric Supply Company things are not so pleasant. There, for over a year, we have got so used to our red hairpin during the hours of maximum demand, that the company, evidently fearing lest we should become boastful, and look upon it as our right, have taken to cutting off the current altogether at these times. As witness last Thursday, light cut off from 6.45 to 8.15 p.m. Saturday, 4.15 to 9.45. Monday 4.30 to 9.45, and now comes enclosed notice which informs us that we are to have no more evening light till next Thursday, "by order of the secretary." Having had some experience of central station work, I can make every allowance for unavoidable failures, but not when they are caused by months of overloading their plant, and then getting over the "peak" difficulty by promptly cutting off the supply. I enclose my card.

Baker Street.

December 12th, 1899.

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Signalling without Contact.

I have no desire to evade Mr. Boult's questions. My answers are :—

1. By landmarks, the presence of which can be felt even in a fog, such as bridges, cuttings, embankments, tunnels, points, catchpoints, stations, signal-boxes, sidings ; by the *feel* of the road ; by calculation and judgment.

2. A driver is supposed to know where a signal should be seen, but he is not expected to know whether it is at danger or at allright. The fogman with his hand-lamp and detonators repeats to the driver the position of the arm.

3. In the absence of a detonator, and in the absence of the fogman's green hand-signal at the point when it should be seen, the driver assumes that the signal is at danger.

4. I have not intentionally set up praise of the old method as a criticism of the new. What I have tried to point out is that the old system has not received fair play. It is not *dangerous, barbarous, and irregular ;* a driver does not blindly trust to the detonator. The old method is a good one, and gives excellent results. I have not said it is the best that can possibly be devised, but it will take a lot of beating.

5. A driver can read signals on the road, and at the same time keep a look out on his own road, on the opposite road, and look out for tail lamps and obstructions.

6. On every trunk line. I am sure Mr. Boult is sufficiently intimate with railways to know that there are many large station yards where the signal boxes are often not more than one-eighth of a mile apart.

I am sorry I have failed to drive home my points about the route indicators and single line signalling, but, after all, perhaps these are refinements which would be settled after the general principle of Mr. Boult's system had been accepted or otherwise.

In conclusion, I should like to add that if the present system is to be superseded, I am prepared to give it as my opinion that Mr. Boult has got hold of the right principle. However, I think the system he has built up will require considerable modification before it is generally acceptable, and if Mr. Boult should not be too closely attached to his system to see anything in it but perfection, I should be pleased to indicate to him the lines on which I think he might proceed, in order to give, not an ideal system of railway signalling, but a practical fog signal.

C. M. J.

[We have received a letter from Mr. J. W. Still on the subject of "Tested Lamps," which appears to have been roughly and inaccurately copied ; we should be glad if Mr. Still would let us know his address, in order that we may obtain a correct version.—EDS. ELEC. REV]

THE ELECTRIC LIGHTING OF HEREFORD.

No small historical interest attaches to this ancient city on the Wye, which yesterday switched on its electricity supply with due formality. Quoting from an interesting account of the city and its lighting, prepared by Mr. J. Parker, the city engineer :—

Hereford was the capital of Mercia during the Heptarchy, and was fortified by Athelstan with walls and six gates. In 1055, Griffith, a Welsh king, defeated Ranulph, slew the bishop, seven canons, and the inhabitants indiscriminately, and burnt the Cathedral and city.

Stephen is said to have been crowned in the Cathedral, and during his reign the castle was constantly the scene of pillage, massacre and conflagrations. From its close proximity to the Principality it has always been exposed to the inroads of the Welsh, but within recent years these invasions have consisted of nothing more formidable than armies of ponies and droves of cattle, for which the extensive cattle market provides a convenient outlet to the other large centres of population.

The bishop's see was created in the time of Penda, King of Mercia, A.D. 680. Ethelbert was murdered here at the instigation of Offa, who, in expiation of his crimes, built the Cathedral, which was subsequently rebuilt by Bishop Athelstan in the eleventh century, but burnt by Griffith, a Welsh prince ; the present Cathedral was commenced in A.D. 1107, and added to by other prelates from time to time.

The library contains some rare manuscripts, and a map of the world said to be the oldest in existence.

In Saxon times the bishops exercised civil jurisdiction, possessing many rights, taking tolls, &c. The first Charter of Incorporation dates from 1189, and was granted by Richard I. In 1382, the title of chief magistrate was changed from bailiff to that of mayor.

It is recorded that before the conquest of Wales, any alderman found riding without an attendant at a distance exceeding seven miles from the City was liable to a heavy fine, the chance of his capture by the Welsh, involving the risk of heavy ransom being demanded for his restoration.

In 1774 a special Act of Parliament was obtained for paving, cleansing, and lighting, the rate not to exceed 1s.

In 1816 another Act was passed for the above purposes and also for establishing markets.

The history of improvements in lighting repeats itself. Early in the century it appears that strong opposition was encountered to the introduction of gas ; so at the close of the century the electric light could not be adopted without much opposition, considerable misrepresentation and some prejudice being overcome.

In 1820 a private company was formed for lighting the City with gas, at a cost not exceeding that of oil ; the capital not to exceed £6 000. To this there was much opposition by the tallow chandlers of the City, one of whom declared at a town's meeting, "That if the City discontinued using Russian tallow, there would be no sailors for the Navy, and we should be invaded." So strong was the opposition that at a meeting of the Town Commissioners, held on December 18th, 1821, the following resolution was passed :—

"It is the unanimous opinion of this meeting that the City should not be lit with gas."

This unanimity evidently began to decline, for at a meeting held on December 24th, 1822, it was—

"Resolved to light the City with gas, provided it can be done at the same price as with oil."

The Act of Parliament was obtained in 1824, and Hereford lighted with gas in 1826. The City has not yet been invaded, as was predicted by the worthy tallow chandler.

The Town Council acquired the gas works in 1872, and erected new works soon after ; further additions have been made, bringing the whole capital cost at the present time up to nearly £114,000. Doubtless the success obtained with gas has encouraged the Corporation to carry out the present undertaking.

The Corporation and City Magistrates having assembled in the Council Chamber at the Guildhall on Tuesday, the party formed a procession to the Electricity Works, where the Mayor having started the machinery and switched on the light, formally declared the works open in a short speech.

An adjournment was then made to the large room in the Market Hotel where luncheon was provided by the Mayor. The guests present numbered between 70 and 80, including Sir H. Croft, Sir James Rankin, M.P., Mr. Radcliffe Cooke, M.P., the members of the Corporation and the principal consumers.

The toasts included the following :—"The Mayor and Corporation and success to their new undertaking," proposed by Mr. Radcliffe Cooke, M.P. ; "The Engineers," proposed by Councillor Hewitt, and responded to by Mr. John Parker (City Engineer) and Mr. Stuart A. Russell (Chief Engineer of the Silvertown Company) ; "The Visitors," proposed by Sir James Rankin, M.P.

To commemorate the opening ceremony, a brass tablet was fixed on the wall of the engine room, stating that the works was opened on December 14th, 1899, by the Right Worshipful the Mayor, W. J. Humfrys, Esq., while the following names of the members of the Committee were appended :—

Aldermen H. C. Beddoe, T. Carver, T. Llanwarne, and J. R. Symonds ; Councillors T. W. Clarke, J. Davies, and W. Hewitt ; J. Carless, town clerk ; J. Parker, A.M.I.C.E., city engineer ; F. G. Poulton, electrical engineer.

In the evening of the same day the Mayor entertained the whole of the Corporation employés to dinner at the Drill Hall, the party numbering over 250.

Fatal Accident.—At the resumed inquest on the body of A. J. Barnes, who was killed recently at the Metropolitan Electric Supply Company's Works at Willesden, the jury found a verdict of accidental death, but added a rider to the effect that the machinery was not properly fenced in, and that there had been negligence on the part of the company in not protecting the machinery as provided for by the Act, and that greater supervision in the erection of machinery should be exercised by the Government.

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BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending Dec 13th, 1898		Week ending Dec. 12th, 1899.	
Adelaide	Value £44	Adelaide	Value £19
Auckland	115	„ Teleg. mat.	100
Bombay	10	Amsterdam	60
Boulogne	84	Auckland	58
Brisbane	12	Bangkok	126
Brussels. Teleg. mat.	200	Buenos Ayres. Teleg. mat. ..	1,278
Buenos Ayres. Teleg. mat. ..	512	Calais. Elec. batteries	60
Calcutta	62	Calcutta	31
Christiania. Teleg. mat. ..	494	Cape Town	259
Colombo	50	Chinde. Teleg. mat.	611
„ Teleg. mat.	1,397	Colombo. Teleg. wire	84
„ „ cable	84	Constantinople. Teleg. wire ..	85
Durban	25	Copenhagen. Teleg. mat. ..	180
Gothenburg	88	Durban	677
„ Teleg. cable ..	308	„ Teleg. mat.	3,202
Hamburg	285	East London	14
Launceston. Elec. meters ..	700	Fremantle	20
Liban	45	Hamburg	405
Madras	64	„ Teleg. mat.	290
Melbourne	533	Hong Kong	180
North Atlantic. Teleg. cable ..	4,500	Kobe	106
Ostend	51	„ Teleph. cable	396
Otago	62	Liban	35
Penang	58	Melbourne	38
Port Elizabeth. Elec. cable ..	158	Odessa	151
Reval	48	Perth	250
„ Teleg. mat.	312	Port Elizabeth. Teleg. wire and mat.	322
Rosario. Teleg. mat.	616	Port Said	20
Rotterdam. Teleg. mat. ..	388	Reval	210
Stockwell. Teleg. mat. ..	156	Rotterdam. Teleph. cable ..	100
Sydney	291	Shanghai	79
Yokohama	120	Singapore	17
Zanzibar	81	Stockholm. Teleg. wire ..	810
		Sydney	392
		Tokio	99
		„ Teleph. cable	691
		Townsville	45
		„ Teleg. wire	220
		Trinidad	46
		Wellington	67
		„ Teleph. mat. ..	1,234
Total ..	£11,781	Total ..	£12,352

Foreign Goods Transhipped.

Brisbane. Telep. apprts.	Value 909
Melbourne. Elec. motor ..	9
Yokohama. Teleph. apprts. ..	63
Total	£981

Bankruptcy Proceedings.—A receiving order has been made, on a creditor's petition, against W. Dalziell (W. Dalziell & Co.), electrical engineer, Newcastle-on-Tyne.

The first meeting of creditors and public examination in the failure of W. Rowbotham, electrical engineer, Teddington, are to be held on December 15th and January 9th respectively—the former at 24, Railway Approach, S.E., and the latter at the Court House, Kingston, Surrey.

In the failure of H. L. Howard (Thompson, Howard & Co.), electrical and mechanical engineer, York, similar proceedings will take place at York on December 19th and January 5th respectively.

Notice is given in the *London Gazette* of intended dividend in the case of W. A. Charles and J. S. Blackwell (Central Electrical and Engineering Company), Leicester and London. December 22nd is the last day for receiving proofs; trustee, W. M. Richards, 22, Belvoir Street, Leicester.

A sitting of the London Bankruptcy Court was held last week before Mr. Registrar Hope for the public examination of Edward Canning Glass, electrical engineer, lately carrying on business at 6 & 7, Nevill's Court, Fetter Lane, E.C., under the style of George Forrest & Son. The accounts show liabilities £1,098, and no available assets. In the course of his evidence the debtor stated that he purchased the business in 1896 for £2,000, and he had since spent a further £2,300 in extending it and putting down new plant. The business was still being carried on, but witness had no interest now in it. His sister had lent him from time to time sums amounting to £3,000, and in November, 1898, being unable to continue for want of further capital, he transferred the business to her in payment of the debt. Witness ascribed his failure to loss sustained in connection with the business, interest on borrowed moneys, and excess of personal expenditure over income. The examination was concluded.

Notice of intended dividend is given in the case of A. G. Inrig (Globe Electrical Company), electrical engineer, Victoria Park, London. December 27th is the last day for receiving proofs. Mr. E. H. Hawkins is the trustee, and his address is Offices of the Wholesale Traders' Association, 3, Barbican, E.C.

Liquidations, Dissolutions, &c.—At meetings held on October 30th and November 16th, the Bournemouth and District Electric Supply Company resolved to wind up voluntarily, and appointed Messrs. A. H. Sanderson and H. B. Renwick, liquidators, to carry into effect an agreement with the Bournemouth and Poole Electricity Supply Company, Limited.

Creditors of Vril Launches, Limited, should send particulars of debts, &c., to the liquidator (Mr. A. L. Dickinson, 19, Coleman Street, E.C.) by January 23rd, 1900.

A petition for winding up the Phœton Electrical Company, Limited, (presented by A. Vandam and T. H. Marsh, trading as A. Vandam and Co.) is to be heard before Mr. Justice Wright on December 20th.

A meeting of the Northern Electric Wire and Cable Manufacturing Company will be held at Barum House, Harrison Road, Halifax, on January 17th to hear an account of the winding up from the liquidator, Mr. J. E. Whitham.

Westinghouse Direct Current Switchboards.—The offices of electric current are multitudinous, and its manipulation constantly assumes complex proportions, which make it extremely difficult to standardise the manufacture of switchboards, but this task has been grasped by the Westinghouse Electric and Manufacturing Company. Fig. 1 shows the front and fig. 2

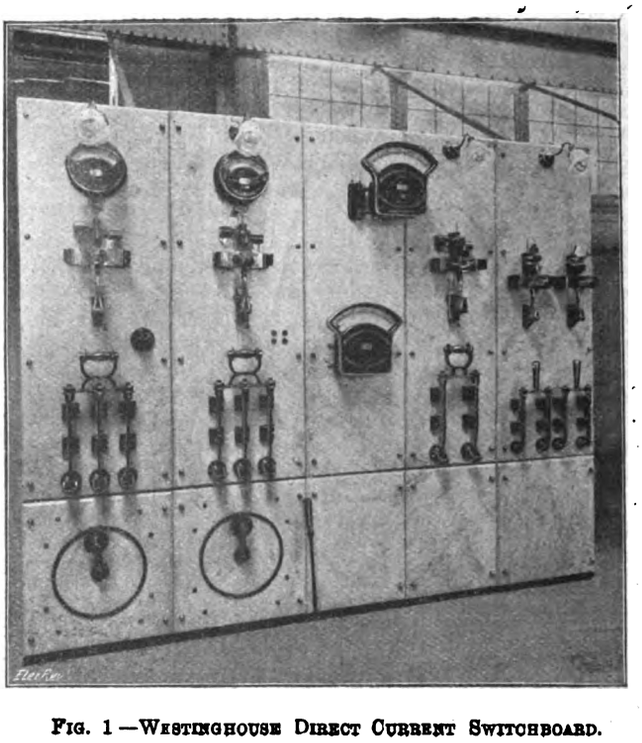

Fig. 1.—Westinghouse Direct Current Switchboard.

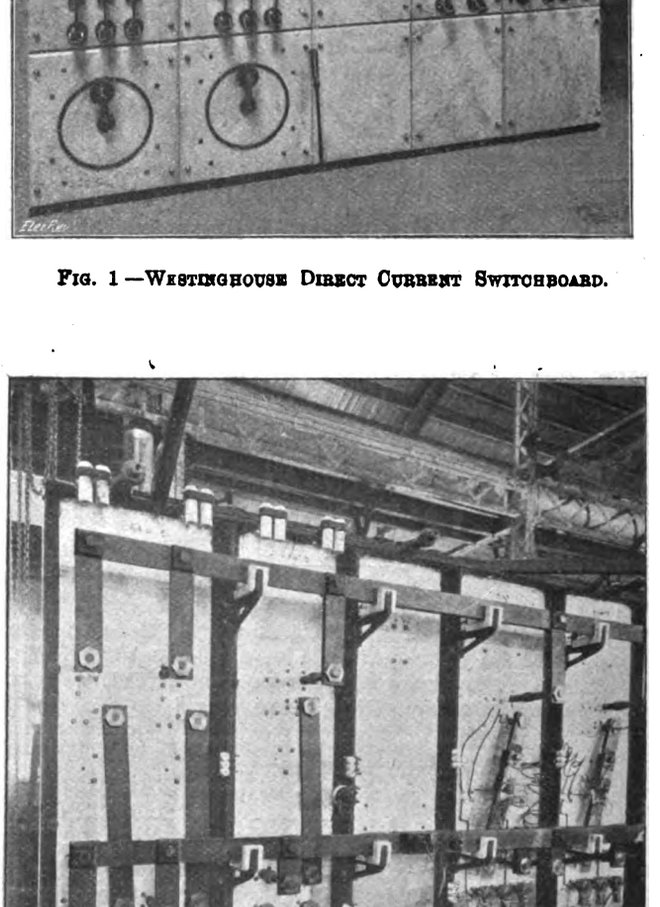

Fig. 2.—Westinghouse Direct Current Switchboard. Rear View.

the rear of a five-panelled Westinghouse switchboard for direct current lighting and power, erected at the works of the Park Gate Steel and Iron Company, Liverpool. The standard Westinghouse practice is well illustrated by this switchboard, which is for 250-volt service, but the type provides for the requirements usually arising for potentials not exceeding 750 volts.

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The two panels to the left of fig. 1 control the two generators which are run in multiple, the middle panel is for the load, and the two to the right are feeder panels. The first generator panel is equipped with a single-light bracket, lamp and shade; an ammeter; a single-pole circuit breaker; a voltmeter plug receptacle; a triple-pole switch. The rheostat panel carries the resistance box, contacts and contact arms. The second generator panel provides for the operation of the other generator. The load panel carries an illuminated dial ammeter and an illuminated dial voltmeter, which swing on a hinge and can be readily seen by the operator when adjusting the generators for parallel running. The first feeder panel contains a single bracket, lamp and shade; a single-pole circuit breaker; and a double-pole switch. The second feeder panel contains two single-pole circuit breakers and two double-pole switches. As additions are made to a plant, extra panels for controlling generators and feeders can be added to the switchboard without interfering with the service. Flat conducting bars are used to connect the different instruments and the switches mounted upon each panel; each of these bars is of 300 amperes capacity. For very heavy currents a larger unit bar is used, a ventilating space being left between successive bars. The connections for the bus bars are arranged on each panel, and can be attached without difficulty. The Westinghouse standard adjustable jaw switches are used. The range of the ammeters exceeds the normal rating of the corresponding panels from 25 to 50 per cent. The switches, circuit breakers and all connections and terminals, carry the currents corresponding to their normal ratings continuously for an indefinite period, and without dangerous rise of temperature will carry temporary overloads not beyond the range of adjustment of the circuit breakers and the scales of the ammeters. The range of adjustment of the circuit breakers varies somewhat between the different sizes, but in general they may be set for any predetermined current between the limits of 75 per cent. and 150 per cent. of their normal ratings. Fuse panels with eight fuse holders are provided when required; they can be mounted in the space below the standard panels. These fuses are supplied for potentials not exceeding 250 volts, and for currents up to 600 amperes. For voltages exceeding 250, the fuses are not mounted upon the face of the board.

Bullock's.—The Bullock Electrical Manufacturing Company, of Cincinnati, whose motors and generators are well known, were compelled by increasing business to build new works in 1898, and these were occupied in January, 1899; but we are given to understand that the present prospects point to still further enlargement very soon. The company is now making electric street railway generators up to and including 800 KW. These generators possess new features among which may be mentioned a scheme for oscillating the brush holder mechanism in a direction parallel with the shaft. The movement is very slow and results in constantly changing the line of travel over the commutator face, and thus removes all tendency to cut or groove the latter. The action is the same as secured by the end play of an armature in a belted generator or that produced by the electro-magnetic device used at the end of shaft on rotary transformers, and which is recognised by engineers as a means of greatly prolonging the life of the commutator. The pole pieces and coils may be removed without disturbing the yoke or armature, and with two of them removed, it is possible to remove one or more armature coils should repairs be necessary. The armature coils are made of continuous bars of copper without joints between the commutator connections, which materially adds to the life of the machine. These coils are all thoroughly insulated, pressed and baked, before being placed on the core, no additional core insulation being necessary. All armatures are thoroughly ventilated by slots perpendicular to the shaft through which the air rushes when the machine is in operation. A liberal rating permits of constant operation at full load with low temperature rise. An 800 KW. machine recently supplied to the Oakland Rapid Transit Company, of Oakland, Cal., is shown in fig. 1. This machine operates at a speed of 80 revolutions per minute, and at this speed develops 550 volts at no load. It is over-compounded for a rise of 50 volts at full load making the full load voltage 600. In fig. 2 we show a 28-inch swing screw cutting engine lathe driven by "Bullock" type "N" motor. As will be seen, the motor is placed directly on the spindle in the head stock, taking the place of the cone pulleys. The armature spider is built directly upon the hollow spindle of the lathe. By means of a new system of variable speed control, the motor is given a greater range of speed, without loss of torque, than is ordinarily given by the cone pulley, having 16 speeds in either direction including the back gear. The controller is placed upon the leg of the lathe directly under the head stock, and is operated by a splined shaft running along the bed of the lathe, and a handle which travels with the carriage. The slowest speed is 60 and the highest about 250 revolutions.

Brockie-Pell Arc Lamp, Limited.—We are informed that in consequence of the great demand for their patent Brockie-Pell arc lamps this company will shortly be removing from Tabernacle Street to larger and more suitable premises in Worship Street, Finsbury, E.C. Amongst the orders on hand are arc lamps for the street lighting of St. Pancras, Shoreditch, Poplar, Gloucester, Stirling and South Shields. The arc lamps employed in connection with the Greenock electricity undertaking just completed were also supplied by this company.

Catalogues and Lists.—The British Westinghouse Electric and Manufacturing Company, Limited, of Westinghouse Building, Norfolk Street, Strand, W.C., send us copies of their "November, 1899," lists as follows:—No. 1,000, polyphase induction motors; 1,001, belt-driven railway generators; 1,002, generators and rotary converters for electrolytic work; 1,003, direct current engine type generators for lighting (125 volts); 1,004, direct current ditto for motor driving, &c. (250 volts). All of the lists are excellently illustrated.

In a new catalogue just issued by the United Asbestos Company, Limited, the whole of the various branches of the company are, for the first time, brought together into one volume. These embrace asbestos goods, rubber manufactures of every description for mechanical purposes; lubricants; boiler and pipe coverings in various forms; and engineers' sundries. Among the latter will be found many useful specialities as well as all those ordinary stores, tools, and requisites which are an everyday necessity to the steam user. Packing and jointing materials are exhaustively treated. These cover not only the asbestos in all its forms, but rubber, gutta-percha, fibre, canvas, hemp, metallic packings, &c., facilitating selection of whatever special packing or jointing materials are best adapted to the particular requirements of the customer. This company has held Admiralty contracts for 14 years in succession.

The Universal Electric Supply Company, of Manchester, have sent out a new edition of their illustrated price list of electric bells, alarms, medical coils, cycle lamps, and sundry electrical fittings and accessories for lighting and other work.

Messrs. A. J. Beaumont & Co., of York, send a small pamphlet of their projectors and arc lamps for theatre, stage, cinematograph and other scientific purposes.

Exhibition in Crete.—It has been arranged to hold an international industrial and commercial exhibition at Canea in April, 1900, under the patronage of Prince George of Greece. The object of the exhibition is to promote both import and export trade. Mr. Arthur Gobiet, Prague-Karolinenthal (Böhman), has been appointed manager of the exhibition. A committee, which consists of members of the consular body and other distinguished representatives of Cretan trade, is presided over by Mr. D. Constantin M. Foumis, Chancellor of Finances to Prince George.

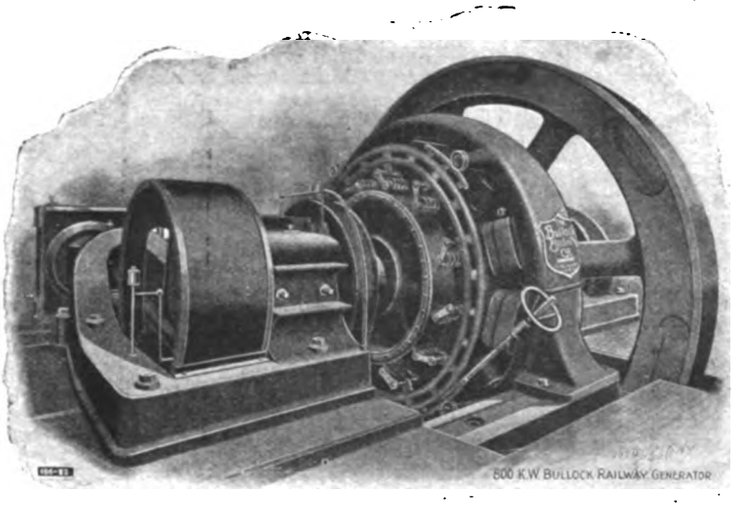

FIG 1.—BULLOCK GENERATOR

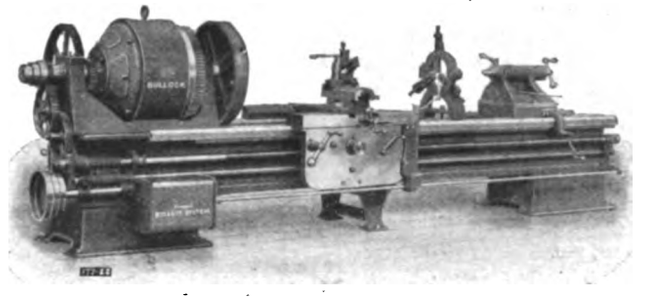

FIG. 2.—BULLOCK MOTOR ON LATHE.

Foreign Competition.—The ninth annual dinner of the officials and foremen employed by Messrs. John Fowler & Co., Limited, at Hunslet, was held on Saturday at the Great Northern Railway Station Hotel, Leeds. Mr. W. Fowler, in responding to a toast, alluded to the competition of the United States and Germany. He was told that they were going to have a lot more competition from Germany, but he was not very much afraid of it. If they still did the work well and kept up their character, they would not be beaten either by the Germans or the Americans. If the employed and the employers were united in the common interest, they would have no need to fear. Only they must get their work out quickly and well.

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The Americans were proud of the fact that they paid the highest wages with the lowest total cost of production of any country in the world. They ought to aim at that themselves. The Americans were also proud because they had sent some locomotives over here, but he did not hear a very good account of them. The secret of the expedition with which the Americans turned out work was the vigorous use they made of labour-saving machinery. The more talent and skill we showed in this matter the better it would be for everybody concerned. In response to another toast, Mr. Eddison said that they might depend upon it that the battle for engineering supremacy was about to begin, and we should have to fight our way along with other countries. The system of standardising the products of machinery was coming very much to the front, and it was a matter they ought to pay attention to, together with the organisation of shops.—Mr. R. H. Fowler also responded. Last year they made a new type of engine for electric lighting, and they had just supplied a large engine to the Leeds Corporation. It was running very satisfactorily.

Hereford.—Messrs. Read & Jenkins, of Hereford, who have been busy during the last three months on installation work here, have secured contracts under the Corporation for the lighting of the new electricity works and the Markets, also the wiring of the Shire Hall for the Herefordshire County Council. They are putting in a complete installation at the Green Dragon Hotel and are also fitting up several business premises, shops and private residences, &c.

Salmony v. Pitard.—In the Westminster County Court on Thursday last week, Messrs. Salmony, electrical engineers, sued Mr. Pitard for the cost of some electrical fitting. Defendant said the fitting was delivered to him for the purpose of making others like it for the plaintiffs. It was necessary to take it to pieces and send those pieces to different firms for making. This was done, and with the exception of the parts they themselves made, they had not any other portion of the fitting. The estimate was too high so that they never obtained an order. There was no contract to pay, and it was not usual to pay for things sent in this way.—His Honour said there was no contract to pay, and plaintiffs' clerk was not able to do more than produce a book showing the delivery, and Mr. Pitard said no account was sent him until nearly two years after.—Judgment was given for the defendant.

Smoke Persecution.—At the Bow Street Police Court on 7th inst. the Metropolitan Electric Supply Company, Limited, were summoned before Mr. De Rutzen for allowing the chimney at their electric lighting station in Sardinia Street, Lincoln's Inn Fields, to send forth black smoke in such a quantity as to be a nuisance on the 23rd and 24th ult. Mr. Muir said the defendants had taken every precaution to prevent nuisance. They had entered into a contract with a well-known firm to supply them with smokeless coal under any circumstances; but owing to the enormous demand for coal of this class in consequence of the war in South Africa, an inferior article had been sent in. The defendant company strongly protested, and after buying coal of the proper quality from other persons were supplied with coal of the specified quality from their own contractors. He knew that a penalty must be imposed, but the defendants had done all in their power to comply with the Act, and he thought that the circumstance he had mentioned was of a mitigating character.—Mr. De Rutzen: The public have a grievance against you. You have apparently a grievance against the coal contractors. I have nothing to do with that. I must order the defendants to abate the nuisance and pay £2 2s. costs.

Theatre Lighting.—Messrs. Sax, Slatter & Co. have carried out the electric light installation and fittings at the newly-erected Holloway Empire Theatre of Varieties.

Trade Announcements.—Messrs. Wilhelm & Co. have removed from 11 and 12 to 3, Westmorland Buildings, Aldersgate Street, E.C.

Messrs. Estler Bros. have removed from 27, Leadenhall Street, E.C., to larger and more convenient premises at 25, Laurence Pountney Lane, E.C.

Woodhouse & Rawson United.—But for the following, which appeared in the *Financial Times* of 7th inst., we should have continued under the impression that the last had been heard of Woodhouse & Rawson United:—

> Sir,—Can anybody tell me anything about the estate of Woodhouse & Rawson, Limited, or give me the name of someone who can? I am sorry to trouble you, but I have heard nothing of the matter since June 25th, 1897, when I had a notice from the Official Receiver to say that he had £104,000 in hand, and that he was going to apply for his release, and that if I had any objection to his release, I must notify it to the Board of Trade. I suppose he got his release in due course, but he might have told us what he did with our money.—I am, &c.,
> A Debenture Holder.
>
> *December 5th, 1899.*

Workmen's Compensation.—At Paisley a decision has been given by Sheriff Henderson in an action taken by a joiner, residing in Stockton-on-Tees, against Messrs. Paterson, Cooper & Co., electrical engineers, Paisley. Pursuer was employed in erecting the woodwork in connection with a contract which they held for putting in an installation of electric light into an unfinished ship which had been launched from the yard of Sir Raylton Dixon & Co., Limited, at Middlesborough. He fell down an opening in the ship's deck and fractured his pelvis, and the action was raised under the Workmen's Compensation Act. Defenders urged that the employment at which pursuer was engaged at the time of the accident, not being an employment to which this Act applies, they should be assoilzied with costs. His Lordship held that pursuer was at the time when he was injured employed in working in a factory in the sense of the Act. He accordingly found defenders liable to pursuer in compensation for his injuries, but in the respect that their extent and the probable duration of pursuer's incapacity to work have not yet been ascertained, continued the cause on the roll until such time as the same should be reported on.

ELECTRIC LIGHTING NOTES.

Alfreton.—A committee of the District Council has been gathering information on the subject of electric lighting, and has instructed an engineer to report on the matter.

Ballycastle.—The District Council have the question of electric lighting under consideration.

Bangor.—The City Council has decided to confirm an agreement with the National Electric Wiring Company, dealing with the free wiring of premises for electric light.

Bath.—The half-yearly report shows an increase of £111 in the income for the six months ending September 30th last, as compared with last year, and a deficit on the whole of about £1,300.

Beverley.—The Town Council intends to obtain expert advice as to the adoption of electric lighting within the borough.

Bolton.—Some inconvenience has been felt at Bolton lately through a temporary failure of the electric light. At the last meeting of the Borough Council the chairman of the Electricity Committee stated that the mains had been overloaded in some districts to the extent of 50 per cent. He asked for the consideration of consumers on that account, adding that the additional plant now being laid down would *relieve the pressure* early in the new year.

Bradford.—The Council has adopted the recommendation of the Electricity Committee to accept Mr. Gibbings's resignation from March 31st next, and will advertise for a successor at £500 per annum. The recommendation retaining Mr. Gibbings as consulting engineer is, it appears, to be further considered by the Committee. It is proposed to retain him until a qualified successor is appointed.

Brecon.—The Town Council on Tuesday affixed its seal to a memorial to the Board of Trade for a provisional order.

Cardiff.—At a meeting of the Town Council on Monday it was stated, with reference to the action brought by the Corporation against Messrs. Ferranti, that the sub-committee was prepared to settle the action on the payment of £2,500 and costs. The action was now ripe for trial, and £1,500 had been paid into Court by the defendants.

Cheltenham.—The Town Council is about to obtain the sanction of the Local Government Board to a loan of £17,500 for electric lighting extension purposes.

Chichester.—Mr. Price, of Portsmouth Electricity Works, has submitted a report to the Chichester Town Council on a scheme for the establishment of a refuse destructor, electricity works, and waterworks pumping plant near the city, which has been prepared by Mr. J. Saunders, the city surveyor. The estimated expenditure on the electric lighting department is £22,000, and Mr. Price anticipates an immediate annual profit of £167, while he strongly recommends the adoption of the scheme as an admirable one.

Deal.—The District Council has under consideration the question of supplying electricity for lighting and traction in the district.

Dumfries.—The Provost's Committee of the Town Council has decided to make inquiries from other burghs concerning the cost and working results of electric lighting.

Durham.—The City Council has approved of the sealing of an agreement between the Corporation and the representatives of the County of Durham Electric Power Distribution Company for the transferring of the electric order to that company.

Eastbourne.—A Local Government Board inquiry was held on the 7th inst. by Col. A. J Hepper, D.S.O., R.E., with respect to an application by the Corporation to borrow the sum of £88,635 for the purchase of the electric lighting installation of the borough. The town clerk, in stating the case for the Corporation, said a resolution was passed by the Council on August 2nd, 1899, to apply for sanction to borrow the sum of £82,135 for purchasing the undertaking. Of this sum £80,135 was for the purchase, £2,000 compensation to officers, and £6,500 had been added for new plant and machinery. The subject had been before the Council since 1897, when they instructed Mr. Hawtayne to ascertain the cost of providing electric light for public purposes in the borough. Whereas the Corporation lighting bill was then £5,923 per annum, Mr. Hawtayne advised them that to put down their own plant for light equal to that then received would cost £3,671 per annum, which would result in a considerable saving per annum on the lighting of public buildings and lamps. A provisional order, both for public and private purposes, was obtained, and negotiations were entered into with the company for the purchase of their undertaking. At first there was considerable difference between the company and Corporation, but the former ultimately agreed to come to terms. The company's profits for 1898 amounted to £4,574 5s. 6d., and they had based their calculations on an 18-years' purchase. The gross profits of the company in 1896 were £3,141, in 1897, £3,619, and in 1898, £4,574, and for three-quarters of the present year the profits had been £1,164 more than for the corre-

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sponding period of 1898.—Mr. Allcock subsequently pointed out that the estimated increase in the profits for 1899 over 1898 would be between £1,700 and £1,800.—Proceeding, the town clerk said that notwithstanding the high charge of the company, namely, 7½d. per unit, which they thought could and ought to be reduced to 5d. or 6d., even if this reduction took place, there was every reason to believe that the increase in the profits would not only be maintained, but be still farther augmented. There was a small amount of opposition to the proposal.

Dundee.—The electricity rental from May 15th to the present date amounted to £2,824 13s. 5d., showing an increase compared with the same period last year of £697 0s. 4d. During November the number of new consumers had been 30, the number of new lamps connected 1,773, the units generated 115,000, the coal used 372 tons, or 7·24 lbs. per unit generated. Exhaust pipes were ordered to be procured from Messrs. Cooper & Greig at 14s. 4d. per cwt.

Edinburgh.—The Electric Lighting Committee recommends the resident electrical engineer for an advance of £150 a year.

Electric Lighting in the Far East.—The East Chinese Railway authorities in St. Petersburg have just placed a contract with Messrs. Ganz & Co., of Buda-Pesth, for the establishment and equipment of a large central power station at Port Arthur to supply the electrical energy for the lighting of the port and for the operation of the dock cranes, &c.

Epsom.—The District Council has received a communication from Messrs. Baker, Lees & Co., giving notice that the Cobham Gas Company intends to apply to the Board of Trade for a provisional order to authorise the company to supply electricity within the whole of the parishes of Cobham, Stoke d'Abernon, and so much of the parish of Byfleet as lies to the east of the river Wey navigation canal. The matter was adjourned for a fortnight to enable the Cobham Parish Council to consider the proposal.

The Local Government Board has written to the District Council sanctioning a loan for £16,100 for the purpose of carrying out the electric lighting of the town, the money to be repaid in 25 years.

Festiniog.—The District Council has decided to drop the proposition to apply for powers for electric lighting, and will negotiate with a company which is already supplying portions of the district.

Garston.—The opposition to the transfer of the Council's electric lighting order to the Garston Electric Lighting Company has been withdrawn. It is stated that a company, "practically the same as the lighting company," has in hand a scheme for electric tramways, and the Council seems inclined to favour the keeping of the two concerns under one control. It is proposed to construct an electrical line from Osterspool to Garston, thus connecting with the Liverpool tramways.

Gateshead.—The Town Council has received notice from the County of Durham Electric Power Supply Company of its intention to apply to Parliament for powers to supply electricity in bulk to lighting authorities and others within the Poor Law Union of Gateshead. The Tyneside Electric Power Company is also in negotiation with the Council.

Germany.—A large central station is approaching completion in the town of Essen. The plant, which is being installed by Messrs. Lahmeyer & Co., of Frankfort, will have a capacity of 4,500 H.P.

Glossop.—The Corporation notifies in the *London Gazette* its intention to transfer the 1899 provisional order to the Urban Electric Supply Company on specified conditions.

Grantham.—The Town Council have adopted the recommendation of a committee to the effect that consent be given to the application of the Urban Electric Supply Company, Limited, for powers to supply electricity in the district.

Heysham.—The Lighting Committee of the District Council is negotiating with the Morecambe Electric Lighting Committee for the supply of electricity in Heysham.

Howth and Sutton.—On Thursday last week, Dr. Edgar Flinn, Local Government Board inspector, held an inquiry into the application of the North Dublin District Council for powers to supply electricity in the districts of Howth and Sutton. The ratable value of the districts is £10,058, permanent population 2,500, rising to 5,000 in the summer. Evidence was had both for and against, several ratepayers, including the Earl of Howth, favouring the use of *oil lamps!*

Inverness.—The Town Council has resolved to introduce the electric light on the low tension system, as the radius to be covered will not extend over two miles.

Leek.—The District Council have received a report on an electric lighting scheme from Messrs. Burstall & Monkhouse. The cost of the plant is estimated at £9,300, exclusive of buildings, and the total cost at £13,000.

Limerick.—The Board of Trade have postponed the consideration of the question of revoking the Corporation's provisional order for six months.

Leith.—The Treasurer's Committee's report to the Town Council shows that the capital expenditure for electric lighting purposes to date amounts to £35,634, and that in view of the extensions which are constantly required it will be necessary to borrow a farther sum of £10,000.

London.—In reply to several letters which have recently appeared in the *Times* on the subject of interruptions in the supply of electricity in certain portions of districts of the Metropolitan Electric Supply Company, Mr. E. Cunliffe Owen, secretary of the company, has written to that journal, making the following explanation:—

More than two years ago the company, finding it impossible to enlarge their existing stations in London, commenced the erection of large generating works at Willesden. These works have been equipped with machinery of unusual magnitude and of the most modern construction, but owing to delays in the delivery of ironwork, they have only recently commenced to run. When it was found that this delay might prejudicially affect a portion of the general supply, arrangements were made for obtaining help from a neighbouring undertaking, but this assistance failed when most required. The machinery at Willesden promises to give every satisfaction both mechanically and electrically, but as only one of the three 4,500-H.P. engines is as yet in working order, it has not been considered prudent to work this machine to its full power. It is, however, confidently anticipated that the second machine will be available in the course of a few days, and the third machine very shortly. With the help obtained by the partial working of Willesden, the company would have been able to meet all their demands with satisfaction had it not been for the sudden stoppage of supplies of the best quality of Welsh coal owing, it is understood, to the requirements of the Government for the South African transports. Every effort has been made to obtain deliveries regardless of cost, but practically without success, and the coal at present being received renders it almost impossible to maintain a proper pressure of steam at times of greatest demand. I am, in conclusion, to state that every effort is being made, and no expense is being spared, to restore an adequate supply, and it is confidently believed that this will be possible in the course of the next few days.

Among other letters on the subject appearing in the *Times* is one from "Zetetes," who ends thus:—"In conclusion, I should like to ask the secretary to state whether there is any, and if so, what, foundation for the rumour that the new cable connecting the local with the Willesden works has been found to be defective and to require replacing, so that even if the machinery at Willesden were all in order, the supply could not be efficiently transmitted to London for months yet."

To this the company's secretary replies as follows:—"In reply to the question asked as to the condition of the mains which connect our works at Willesden with our London works, I am instructed to say that since the time that the Willesden works commenced supplying current there has been no trouble of any description with the mains. These mains are of ample capacity to transmit all the current which will be generated at these works on the completion of the present plant."

To this "Zetetes" again replies. He says that the secretary should have added a postscript "as to why the mains 'of ample capacity' were not used to supply us from the Willesden works which have 'commenced supplying current' during the execution of these repairs. It will be noted that the secretary does not say that there has not been any trouble with the cable, though he might easily have added that its insulation is perfect, and that there is no present expectation that any part of it will have to be replaced." He advocates united action on the part of consumers.

The Paddington Vestry is threatening the Metropolitan Electric Supply Company with legal proceedings on account of the alleged frequent failures of the electricity supply in the parish. This district is now, we believe, being supplied from the new works at Willesden. No doubt things will run more smoothly when time has been allowed for them to settle down.

It is stated in the daily press that on the morning (?) of the same day, the Foreign Office, Colonial Office, and other Government buildings in Whitehall suffered inconvenience from a failure in the supply of electric current. A short circuit on the main was located shortly after.

Loughton.—On the recommendation of the Gas and Electricity Committee the Town Council agreed to instruct the gas manager to prepare the necessary plans and specifications in connection with electricity supply in the borough.

Much Woolton.—The District Council has had under consideration the application of the Liverpool District Electric Lighting Company for power to transfer its order with respect to Much and Little Woolton and Allerton to a new company called the Garston District Electric Supply Company. It was stated that the probable result of the transfer would be that the charge for electricity would be reduced, because the new company would supply a much larger area. Although the Council did not pass any resolution, it was understood that no opposition would be offered.

Plymouth.—The demand for electrical supply has increased so rapidly, that although the works was only opened in September last, it has already been found necessary to prepare a scheme for extensions of the plant and buildings to about double their present capacity.

Poplar.—The Board of Works has approved of an expenditure of £4,370 on the buildings of the electricity works in addition to the sum already sanctioned.

Rawtenstall.—The Corporation has now under consideration the advisability of erecting electricity works in the borough with the view to the town being lighted by electricity. The conversion of the local steam tramways to electric traction is also being discussed.

Redcar.—The District Council has adopted the recommendation of the Electric Lighting Committee to the effect that the District Council should borrow £10,000 for electric supply purposes.

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Sale.—The District Council is discontented with the slow progress of the negotiations with the Manchester Corporation with regard to the supply of electricity, and intends to consult the Stretford Council on the subject.

Seaham Harbour.—The District Council has received a letter from the County of Durham Electrical Power Distributing Company, stating that it was the intention of this company to seek powers to supply electricity in the Council's district.

Spain.—A company has just been formed at Bilbao, with a capital of £200,000 and with the title La Sociedad General de Centrales Electricas, to acquire and carry on as joint concerns the central stations in the towns of Torrevieja Real Sitio de San Lorenzo, Escorial de Abajo, Nava del Rey, Medina de Rioseco, Lorca, Almaden Marchena, Arahal, Paradas, Cebreros, El Tiemblo, San Martin de Valdeiglesias, and Santander.

Stirling.—The Police Commission has appointed Mr. A. C. Hanson (27), Smithfield Markets Electric Supply Company, London, resident electrical engineer, at £200 per annum.

Tiverton.—The Town Council, having considered a report on the electric lighting question prepared by the borough engineer, Mr. J. Siddalls, has resolved to carry its provisional order into effect at an estimated initial outlay of £6,000.

Tonbridge.—The Electric Lighting Committee has decided to confer with Mr. Hammond with a view to his acting as consulting engineer in connection with the proposed electricity works.

Torquay.—The Corporation has received the sanction of the Local Government Board for a loan of £7,145 out of £10,000 applied for, £200 being deducted in respect of rectifiers and the balance in respect of the central station. The Board is to be asked to sanction the balance, a statement showing the particulars of the excess expenditure over £22,300, the amount of the original loan for the installation of the electric light having been supplied by the consulting electrical engineer.

The electricity works are now almost fully loaded; the engineer has been instructed to prepare a report on the necessary extensions.

Tunbridge Wells.—On Friday last Colonel Hepper held an inquiry on behalf of the Local Government Board in regard to the proposed new loans for electric light extension purposes. The town clerk explained that the present population of the borough was 32,000, and it was proposed to extend the borough boundary by the inclusion of districts on the east and west. The total amount of the loan at present required was £25,000, and it was likely that as the borough developed another loan would be wanted. The present outstanding loan for the borough stood at £368,840, and the electric lighting loans so far borrowed had been £40,000. The present application was purely for extension purposes, the lamps at present numbering 24,000. The electrical engineer, Mr. Boot, explained the machinery needed, and the arrangements made, the cost of which would be covered by the loan of £25,000, and there being no opposition, the inquiry closed.

Tynemouth.—The Town Council on Tuesday passed a resolution to borrow from the Public Works Loan Board the sum of £34,850 for the electricity works and the purchase of land.

Walsall.—At a meeting of the Town Council on Monday the town clerk was instructed to make application to the Local Government Board for their sanction to the Council borrowing £15,000 for the purposes of the electric lighting undertaking, and to defray the cost of providing and erecting an additional engine and boiler, with the necessary transformers, condensing and other plant, at the Wolverhampton Street generating station, in order to enable the Electric Lighting Committee to meet the increased demand for current, which by the winter of 1900 will exceed the capacity of the present works.

Mr. Brownhill, chairman of the committee, explained that the demand for electricity had in one year increased by 50 per cent., with the result that the plant was now working at its fullest capacity.

Warrington.—The electric light is being introduced into the union workhouse at Warrington. The Guardians have accepted the tender of Messrs. Killick & Cochran, of Liverpool, to supply certain machinery, &c., at a cost of £510.

West Bromwich.—The Council have approved a contract which the Electric Lighting Committee have entered into for the purchase of five acres of land for £1,250 for the site of the generating station.

Whitechapel.—The *Contract Journal* says that four or five weeks ago the Whitechapel District Board invited tenders for the construction of a portion of the electrical supply station at Osburn Street. Fourteen different firms tendered, and the tender of Messrs. Griffiths at £4,950 was accepted. Messrs. Mather & Platt were also invited to contract with the Board for the supply of three new engines and dynamos of 275 KW. capacity at the price already agreed to be paid (£2,465 per engine and dynamo) by the Board under their present contract with that firm, but that no spare armature be ordered, and, if assented to by the company, that the necessary contract be prepared—total cost, £7,395. It was also decided that a contract be entered into between the Board and Messrs. Babcock & Wilcox, Limited, for the supply of two new boilers, each capable of evaporating 11,000 lbs. of water per hour, at 180 lbs. steam pressure per square inch, and one feed pump capable of discharging 10,000 gallons per hour at the above-mentioned pressure; in the event of Messrs. Babcock & Wilcox, Limited, being willing to enter into an agreement for such supply upon the same conditions as they are supplying boilers and feed pumps to the Board under the contracts which they entered into with this Board in April last; estimated cost, £2,660.

Wigan.—The Council has empowered the engineer to proceed with the arrangements for lighting the baths electrically. He is also to prepare estimates for wiring the municipal buildings.

Yeadon.—The District Council has received notice from the Board of Trade that as the Council has engaged an expert to advise it on the carrying out of the electric lighting order obtained in 1894, it would defer the consideration of the revoking of the order for a period of 12 months.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Blackpool and Fleetwood.—At Liverpool last week a farmer named Swift recovered £700 damages for personal injuries caused by a car of the Blackpool and Fleetwood Tramroad Company. Plaintiff's milk cart was standing by the roadside when defendant's car frightened his horse. In the result plaintiff was thrown from the cart and the car wheels went over his left arm so that it had to be amputated. Plaintiff had previously lost his other arm in a shooting accident, hence the enhanced value of the one of which the tramway company deprived him.

Bury (Lancs.).—At their last meeting the Bury Tramways Committee discussed at length the position of the borough in relation to tramways, and agreed upon the desirability of appointing a consulting electrical engineer.

Cinque Ports.—The Dover Town Council had the Cinque Ports electric tramway scheme before it last week. The town clerk reported that the suggestions so far as the scheme concerned Dover were that the line should be brought down Castle Hill, Castle Street, and into the Market Square, where it would join the Dover electric tramways, and thence run over the Maxton line and on to Folkestone. The town clerk added that it was an important matter so far as the Council was concerned that anyone should be granted power to lay rails through the streets and obtain running powers over the local tramways, thus upsetting the service. He would suggest that the surveyor and himself should be instructed to consult Mr. S. Sellon, the Council's electrical expert, previous to making a report on the matter. This course was adopted by the Council.

Darlington.—The Imperial Tramways Company desires to drop for the present about 4½ miles of line which formed part of its original Darlington electric tramway scheme. The Town Council, however, does not seem to fall in with the proposal, and it last week notified the company that it does not intend to in any way depart from the original proposals. The Tramways Committee met on Monday to consider the matter, and received a deputation from the company, including Mr. J. Clifton Robinson, Mr. Holmes, the local engineer, and the solicitor. The Committee came to no decision, but will call a meeting of the General Purposes Committee. The company proposed laying cables from the Stockton generating station for supplying the Darlington lines, but the local authorities want extortionate wayleaves. The Light Railway Commissioners recommended the promoters to take supply from the Darlington electricity works when completed. It is now hinted in a Darlington paper that if the Council insist upon the whole of the lines being laid down now, the company may either drop the whole scheme or apply to the Board of Trade for authority to erect a power station of their own in the town.

Dover.—It is stated that in response to petitions from the working people, cars are to be run at special hours on the municipal electric tramways at a fare of a ½d. over the three miles of track. The ordinary fare is a 1d. for the same distance, and this has realised a profit of £2,000 a year.

Dublin.—In the Southern Police Court on Saturday last week, Mr. Swifte gave judgment in the case brought by the Corporation against the Dublin United Tramway Company for not sanding the portions of the streets run over by the electric trams. Mr. Swifte convicted on both summonses, and fined the defendants £5 and £10 costs in each case.

A span wire broke in College Green on 7th inst. It was soon removed, but not before a young man who was passing received a shock.

Gomersal.—The District Council has passed a resolution assenting to the tramway scheme of the British Electric Traction Company, but assent to the Liversedge Council's electric lighting scheme has been withheld so far as regards the lighting of any portion of the Gomersal district.

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Holderness.—The Hornsea Urban Council has received a letter from the Manchester Industrials Company, Limited, stating that the proposed light railway for the district will be constructed on the electric trolley system. Further details were given showing the company's proposals regarding goods and passenger traffic.

Litherland.—The Liverpool Tramway Committee have written to the District Council to the effect that they consider it desirable that they should come to some better understanding with the Council before incurring the heavy expenditure incidental to the construction of electric tramways within their district. An interview is sought.

Liverpool.—An electric car collided with a cart on Saturday. Results: horse down, cart overturned, driver fractured ribs and severe shock to system.

Runcorn.—The District Council has received a letter from Messrs. Bennett & Ward Thomas, consulting engineers, Manchester, with reference to promoting a scheme of electrical trams under the Light Railways Act, between Weston, through Runcorn, Norton, Acton Grange, Moore, Walton Inferior, and Warrington. They asked whether such a scheme would receive the assistance of the Council in any application which might be made to the Board of Trade. The Council decided to support the scheme.

South Lancashire.—This tramway scheme was referred to at a meeting of the Worsley District Council on Monday. The General Purposes Committee reported that they had passed a resolution approving of the proposal. The Council endorsed the Committee's report, and will support the scheme subject to terms.

South Staffordshire.—On Tuesday, at the Board of Trade, Sir Courtenay Boyle heard an appeal against an order of the Light Railway Commissioners for the construction of the South Staffordshire Light Railways, about 4 miles in length, connecting with the Wolverhampton tramways. The objectors to the scheme were the Corporation of Wolverhampton, represented by Mr. Lloyd, Q.C., the town clerk of Wolverhampton, and Mr. Pritchard, and the promoters by Mr. Sydney Morse and Mr. W. Sellon. Mr. Lloyd, Q.C., said the objection was on the preamble of the order, on the ground that the provisions of the Light Railway Act had not been complied with. There were numbers of tramways within the borough, and amongst them was the Dudley and Wolverhampton line. The policy of the Corporation had been, in recent years, to obtain control over the tramways within their borough, and they were now negotiating for the purchase of those tramways. Negotiations had also taken place with the promoters of the South Staffordshire Light Railway, who had got the present light railway order against the opposition of the Corporation.—Sir Courtenay Boyle: But you have had a hearing before the Light Railway Commissioners, and how can you object now?—Mr. Lloyd: Because they have introduced junctions which were not in the order before the Light Railway Commissioners.—Mr. Morse: The line would be no use without these junctions.—Sir Courtenay Boyle decided that there was no power under the order to make a physical junction with the Wolverhampton Corporation Tramways, and therefore it could not be done without the consent of the Corporation. If special application should be made to the promoters afterwards, the Corporation would be heard as to whether junctions should be made, but there was no power under this order to make physical junctions with the tramways without the Corporation's consent.—Mr. Sydney Morse mentioned that the promoters were supported by the Bilston and Coseley local authorities against the contention of the Wolverhampton Corporation.—The appeal of the Corporation was upheld, and any future negotiations between the parties as to junctions must be confirmed by the Board of Trade.

Walsall.—At Tuesday's Council meeting the town clerk was instructed to make formal application to the Staffordshire County Council, the Urban District Councils of Brownhills, Handsworth, Perry Barr, and Willenhall, and the Parish Councils of Bentley, Great Barr, and Rushall, for their consent to the Corporation laying the tramways in their districts, as proposed by the Walsall Corporation Bill, and a committee was appointed to deal with any matters arising in connection therewith.—The General Purposes Committee submitted to the Council for approval the agreement entered into with the various companies concerned for the acquisition of the tramways by the Council. The substance of this agreement was published in the Electrical Review of last week. The Mayor moved a formal resolution for the purchase of the tramways at £18,500. The resolution was carried.

Warwick and Leamington.—The Tramways Joint Sub-Committee recommends the respective Councils of Warwick and Leamington to exercise their powers with a view to the purchase of the Warwick and Leamington tramway, and working the same by electric traction, either by the Corporations themselves, or under lease to a company. The Leamington Council adopted the report on Monday.

Worcester.—The City Council has now voted by 29 votes to 10 in favour of granting a lease of the tramways to a company. The British Electric Traction Company has been in the field for some time past.

TELEGRAPH AND TELEPHONE NOTES.

Cardiff Telephones.—Some correspondence has passed between the town clerk and the Postmaster-General with reference to the taking over of the Post Office telephone system. A letter has been received from the manager of the National Telephone Company calling attention to the reductions which they proposed to make in the charges from January 1st next. The Postmaster-General referred to the efforts made by the National Company to secure new subscribers, and, therefore, the question of the Corporation taking over the National system for the Cardiff area, including, if necessary, the Rhondda and Monmouthshire Valleys, was a matter of urgency. A special meeting of the Parliamentary Committee has been called to consider the question.

Dover Telephones.—The Corporation has been invited to a conference of municipalities, called by the Municipal Corporations Association, to consider the question of the facilities for municipal telephones granted under the new Act, and also to a conference of towns in Kent and Sussex, at Hastings.

French Cable Projects.—The French Press is at present much exercised and grieved to find that, in communicating with the French colonies, in almost every case English-owned cables must be used. Various charges of injustice are brought against the English companies owning these lines, and as might be expected from the quarter from which these charges spring, they are not warranted by fact. That the need of a French network of cables is seriously felt, and is being taken up by influential people, there can be no question. A well-supported *projet de resolution* was presented to the Minister for the Colonies, inviting him to study the question; and when replying to M. Etienne in the Chamber, the Minister, M. Decrais, presented his assurances that a Bill on colonial cables would shortly be submitted.—The *Bulletin Hebdomadaire des Postes Telegraphes et Telephones*, in its issue of the 7th inst., says: "Great Britain will probably have cause to regret the censorship that has been established to prevent South African news from arriving in Europe. In France, as well as in Germany, public attention is becoming more drawn to the monopoly of extra European telegraphy which Great Britain possesses. On the 27th ult. M. Henrique Dulac, and several of his colleagues in Parliament, brought before the Chamber of Deputies a resolution to the effect that the Chamber of Deputies should invite the Government to immediately consider the state of telegraph communication now existing between France and her Colonies. The proposed Bill is accompanied by documentary statements on the actual state of the French submarine telegraph system, and with these statements are others pointing to the urgent requirements of the country. These requirements may be shortly stated, taking them in their order of importance and urgency, as:—

"1. An arrangement for a line between France and Senegal.

"2. The establishing of an independent system between Europe and Madagascar.

"3. The connection of French Indo-China with the lines of the Great Northern Telegraph Company.

"And later—

"1. The establishment of lines connecting Senegal with the French possessions of West Africa.

"2. The construction of a line from Indo-China to Djibouti."

The *Evening Standard* of last Saturday stated that in the Chamber of Deputies (on the preceding day) a debate took place on the Colonial policy of France. M. Etienne, referring to the fact that all the submarine cables are in the hands of English companies, said this placed France in an inferior position, which was unworthy of her. It was indispensable that the country should have direct telegraph communication with the French colonies. Mr. Decrais, the Colonial Minister, interposing, said the Government would very shortly present a Bill to Parliament concerning the creation of these lines of telegraphic communication. This announcement, which was heartily applauded, would, M. Etienne declared, calm much patriotic uneasiness.

Glasgow Telephones.—The town clerk of Glasgow has sent to the Postmaster-General a general specification of the outline of a telephone system suggested for employment within the Glasgow telephone area.

Grantham Telephones.—The *Municipal Journal and London* states that Major-General Webber has been appointed "consulting engineer for telephones" to the Town Council of Grantham.

Imperial Telegraphic Communication.—At a meeting convened by the Liverpool Chamber of Commerce on Monday, Sir Edward Sassoon, M.P., delivered an address on "Imperial Telegraphic Communication." Since 1894 the Chamber has taken an active part in the agitation for a reduction of the cost of cables to India and other parts of the Empire. It maintained that the reduction of rates to India should be 1s. per word. Half measures would not do at all.

A resolution was passed recommending that support should be given to the action which the Imperial Telegraph Committee of the House of Commons proposes to take with the view of placing the important matter of communication between the United Kingdom, India, and the British colonies and dependencies on a footing commensurate with the greatly altered conditions of Imperial and colonial relations. The Mayor suggested that, in order to reduce Indian rates 50 or 75 per cent., the Indian Government should guarantee cable companies against loss.

Sir E. A. Sassoon delivered an interesting speech, the following report of which is abstracted from a fuller report in Tuesday's *Times*. He

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said that their presence was a protest against one of the most gigantic impositions to which, perhaps, any civilised community had yet had to submit. For a great many years past the burden of the excessive charges had been felt by all the constituent portions of the Empire. At the instance of Mr. Henniker Heaton, 50 members approached the Chancellor of the Exchequer. It was he who granted the subventions which had enabled the associated group of telegraph companies to acquire the powers which they had, and which enabled them to impose their terms upon a long-suffering community. They laid the matter of onerous tariffs before him, and he expressed himself in absolute agreement with them, and admitted that, at any rate with regard to India, there is a very considerable grievance in the cost of telegraphic communication, and a good deal might be done in various ways to improve the position. He had an interview with the French Minister of Posts and Telegraphs, who assured him of his personal adhesion to the principle for which they were contending—viz., that the full inland rates of the two countries should not be exceeded. He gave the following instances of the charges he protested against. A good many messages for India and even for Australia *viâ* India were despatched through the landlines abutting on the Persian Gulf, and a word to Fao, at the head of the gulf, cost 6½d., but from there to the Indian frontier the charge went at a bound to 3s. 6d. London to Gibraltar, the same distance as Fao to Karachi, 3½d.; to Vancouver, 6,000 miles, 1s. 6d.; to Accra (Gold Coast), same distance, 6s. 3d.; to Alexandria, same distance, 1s. 7d.; to Perth (W. Australia), 11,100 miles, 4s. 7d; to Bombay, 6,300 miles, 4s.; to Borneo, 9,500 miles, 5s; to Lagos, 5,200 miles, 7s. 1d.; to Tunis, 1,400 miles, 2d.; to Bermuda, 2,900 miles, 2s. 6d. The working expenses were now so low, thanks to the duplex and Morse systems, which economise time, that in Queensland they could telegraph 3,000 miles for 1d. Another instance—St. Petersburg to Vladivostock, 6,000 miles, 4½d., whereas to Shanghai, a few hundred miles farther, they paid 5s. The charge to Australia only a few years ago used to be 9s. per word, but after the reduction to 4s. and 4s. 9d. per word, all the preliminary sacrifice of revenue was recouped in three years. In South Africa, the dread of competition brought about a wholesome change in the attitude of the companies. In the case of India, the telegraph companies, he said, held India paralysed in their grasp, so that, however willing the Indian Government might be to meet reasonable demands, it could not be done, as that Government was apparently the bond-slave of these all-powerful companies. Why had the Indian Government remained passive and quiescent spectators for so long? Why was the landline connecting Constantinople with Cairo so inaccessible to the public? Why were the Turkish landlines along the Euphrates Valley equally inaccessible to them? If they could not have free trade in telegraphic communication, if they must suffer from the effects of some necessary protection to the companies, let them not sit still and, with folded hands, submit to this pernicious and all-absorbing system of bounty-fed lines and cables. They were very much in the dark as to the nature of the conventions entered into by the associated companies with the Turkish, Persian, Egyptian, and Indian Governments; and the Foreign Office refused information, on the ground that the permission of the companies would have to be previously obtained. This permission did not appear to be forthcoming. What was it they were afraid of divulging to the public? Why all this sinister and nebulous concealment, if everything was plain and aboveboard? Was it right or proper that on a matter affecting the welfare of their commerce, their shipping, and their industries, arrangements should be concluded and kept secret? They were consequently driven to grope in the dark in their efforts to wrestle with powerful corporations thus bolstered up and protected. He instanced the strong position to which the companies had attained, and their disregard of the public interest. Before the Folkestone Chamber of Commerce he had referred to the breakdown of the cable between Delagoa Bay and Mozambique—one of a system for which the proprietary company had received over £1,300,000 from the State in the shape of subsidies. This cable, although laid 20 years ago, had not been duplicated, and was interrupted from October 31st till November 15th last. A few days after its restoration came the news of another interruption of more than a week's duration between Aden and Zanzibar, to another unduplicated cable laid 20 years ago. Both of these were lines upon which they had to depend for the rapid transmission of news from the seat of war, and when these were interrupted they were only able to get news by the long landline through Natal to Cape Town, and so home along the West Coast of Africa cables. Were they not entitled to ask to what uses those public funds, so lavishly supplied, had been devoted? Was it understood that these subsidies were to be applied, however indirectly, towards buying out or expropriating accessible landlines in other parts of the world for the deliberate purpose of smothering and strangling competition, instead of being employed to keep the cables so freely subsidised in a state of efficiency by timely duplication, so that in the hour of need they might be of service to the nation? The rates of the companies, though they were reasonable when the enterprise was in its infancy, were now, in view of the phenomenal increase of traffic, wholly antiquated and intolerable. With the awakening of the constituent elements of the Empire to the necessity of drawing closer together to the mother country, a demand had arisen for facilities for the transmission of messages of a social character. A good deal of the toleration shown by the public towards these companies was undoubtedly attributable to the belief:—(1) that they were in possession of "all-British" cables; (2) that these cables were altogether beyond the reach of danger in time of war. He was afraid that the intelligent British public had lulled themselves into a false sense of security, for not only were these companies' cables not "all-British," they were not even mainly fixed on British landings, the bulk of them were switched on at Lisbon, Madeira, St. Vincent, Egypt, Java, and other foreign territories, and, as regarded their vulnerability, he had pointed out in letters to the *Times* that several cables were easily cut by the American men-of-war, and in some cases, as in the case of Hong Kong to the Philippines, cable communication was wholly interrupted, Admiral Dewey having had no difficulty in performing the operation. In the House of Lords, Lord Carnarvon stated in 1885 that "the Russian Government had a carefully elaborated scheme for taking measures against our submarine cables in Eastern waters." Sir John Ardagh, Director of the Military Intelligence Department, distinctly pointed out "that in the event of our losing Egypt, or anything happening in that country averse to our interests, the Mediterranean cables to Australia, India, and the East generally would be cut at once." This actually did occur during the bombardment of Alexandria. So much for these two pleas. The scheme which they proposed for immediate consideration, and for which they claimed their support, was not an ambitious one. A very simple way of overcoming the difficulties was pointed out in an excellent paper read before the Society of Arts by Mr. E. O Walker, C.I.E., who was lately in the service of the Indian Government Telegraph Department, and this project it was which they recommended to their attention. The map showed that the Russian landlines to Merv were continued until they reached the north-west frontier of Afghanistan at Kouschk (about 70 miles north of Herat); from Kouschk *viâ* Herat and Kandahar and Afghanistan, Chaman in British India (in the vicinity of Quetta) was reached, a total distance of, say, 450 miles. A landline could be erected between Kouschk and Chaman, which latter formed part of the Indian telegraph system, for about £30,000. Now, the cost of a telegram from London to Kouschk was only 6d. per word if sent direct *viâ* Russia, and the cost of a telegram from any one part of India or Burma, to any other part was 2d. per word; to this total of 8d. they had to add the amount due for transit through Afghanistan, say, at most 4d., and in this way they could hope to see the rate to India reduced to 1s. per word. This line would meet the conditions of the Meshed to Herat route, of the possibilities of which Lord Curzon, from his experience of the country, spoke favourably, as since the time of his visit the Meshed line, which formed portion of the Persian landline system, had been connected with Merv, and thus with Kouschk. Authorities were also united as to the facility with which the Persian Gulf cables, which formed such an expensive link in the chain to India, could be reinforced by the establishment of a landline from Shiraz to Jask, in Persia, which, if erected (and its erection was estimated to cost about £36,000), would complete the overhead line from London to Calcutta, with the exception of the short cable across the Channel. It was in this way that they might hope to see the present high rates to India reduced. Having thus reached Burma at the rate of 1s. per word, let them turn their attention farther East. Here they found that the Burmese lines reached down the Malay Peninsula as far as Margin. A gap of 200 miles existed between this point and Penang, from whence a line runs south to Durian Sarai, followed by a gap of 60 miles to Jelebu. From Jelebu the line to Malacca already existed, and a distance of 150 miles from Malacca to Singapore was still unbridged. Thus, by the erection of some 450 miles of landline, Singapore could be reached for about 1s. 6d. per word, provided that the Afghanistan line also were established. It was to the accomplishment of the project sketched out above that he earnestly directed their attention and claimed their support. All they asked for was fair play and bare justice. The fates were propitious, the arguries encouraging, and with their intelligent sympathy, aye, with their earnest, strenuous, and unfaltering support, they should before long record a great and a beneficent triumph.

A second resolution passed on the motion of Lord Darby was:—"That copies of the resolution be addressed to the Premier and other Ministers, urging that an early day be set apart for discussion in Parliament of the position of the telegraph companies in relation to the Government, with a view to remedying serious grievances, and that the members of Parliament for Lancashire be invited to support this action."

The Pacific Cable.—Last Tuesday the *Times* correspondent in Ottawa telegraphed that considerable impatience is manifested by the Canadian press respecting the inaction of the home Government in the Pacific cable question. It is pointed out that the colonies have chosen their representatives on the board of control, but nothing has been done because the Imperial members of the board have not been appointed. The Toronto *Globe* attributes the delay to the action of the Eastern Extension Telegraph Company. We are inclined to agree with this latter opinion. Delay is of great advantage to the Eastern group of companies, as in this way they not only retain the very large revenue derived from Australian traffic, but may hope to obtain the right to establish collecting offices of their own throughout Australia. The effect of such an establishment would, of course, to a very large extent, give the Eastern Extension the right of sending all telegrams not marked *viâ* Pacific over their own lines, and it is this right which they are so anxious to obtain. It is to be hoped, however, that the colonies concerned can easily understand how much the granting of such a right would damage the receipts of the Pacific cable, which these colonies have agreed to support. We notice that the Postal Commission of Western Australia does not appear to be entirely satisfied with the service given by the Eastern Extension Company, if we are to judge by one of the principal recommendations which they laid before the Assembly; it runs as follows:—"That the Government approach the Eastern Extension Telegraph Company with a view to improving the West Australian service, so as to remove the causes of complaint as to mutilation and delay in the transmission of cables."

Reading Telephones.—The Reading Town Council is asking for additional trunk line telephonic communication with London. There are at present two trunk lines to Reading.

(*Continued on page* 971.)

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HEREFORD CORPORATION ELECTRICITY WORKS.

Owing to several applications having been made by private companies, in the year 1897 the question of applying for a provisional order for the electric lighting of the city of Hereford was considered by the Gas Committee, whose report in favour of such a step being taken was adopted; subsequently the Finance and General Purposes Committee on December 14th, 1897, submitted to the Town Council a preliminary report by Mr. T. L. Miller, A.M.I.C.E., of Liverpool, estimating the cost of an installation to meet the present requirements at £24,196, including generating plant for 6,000 8-c.p. lamps connected, with the requisite feeders, distributing mains, service connections, and road work.

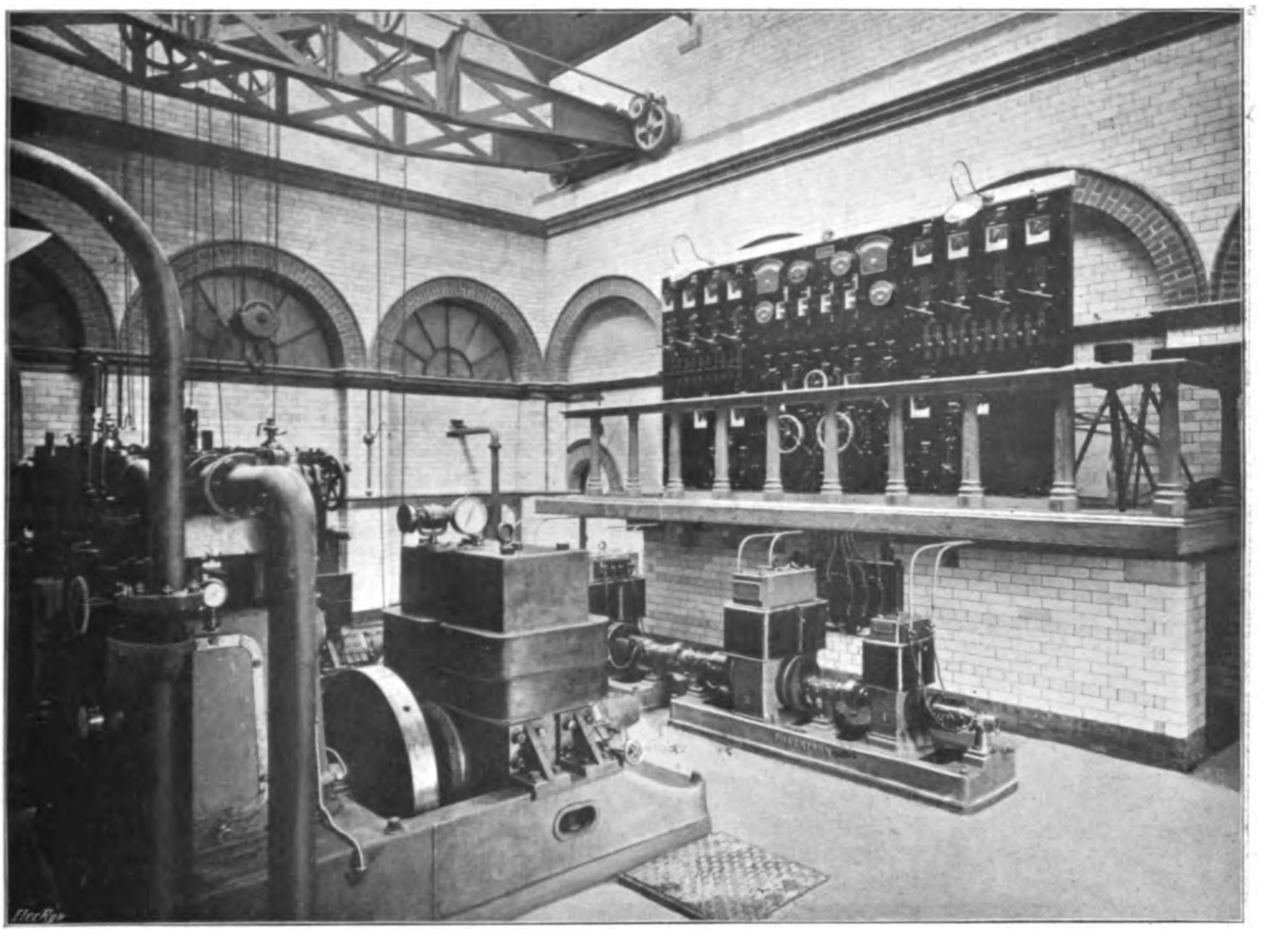
A provisional order was applied for and duly obtained in 1898, when a Special Committee was appointed to consider the matter, of which Councillor W. J. Humfrys was elected chairman. Upon its recommendation it was decided to introduce a municipal supply of electricity in the compulsory area (High Town) and in several other central streets.

Numerous works were visited, including those at Westminster, Shoreditch, Leyton, &c., by the Committee, which, it is needless to say, received every courtesy from the various Councils and their officials.

From information it was able to obtain, the Committee unanimously came to the conclusion that the low tension system of distribution was the most suitable for Hereford, provided that a central site could be obtained for the generating station at a reasonable cost.

After many inquiries it was ascertained that a plot of land near the Cattle Market was for sale, and in view of its central situation and exceptional suitability for the purpose, a purchase was effected at the satisfactory price of £1,650.

The city surveyor was then directed to prepare plans and specifications of a scheme, the details of which were fully considered by a sub-committee consisting of the chairman (the present Mayor) with Alderman Symonds and Councillor Hewitt. Tenders were invited, and it was decided to accept that of the India-Rubber, Gutta-Percha and Telegraph Works Company, of Silvertown, to supply and fix the entire generating plant inclusive of boilers, engines, dynamos,



Engine Room, Looking towards Switchboard.

switchboard, battery and cables, but exclusive of buildings, trenching and brickwork, for the sum of £11,230 12s. 5d. The accepted tender for the buildings was that of Messrs. W. P. Lewis & Co., Hereford, for £2,241; chimney, £461; and lightning conductor, £50; that of Messrs. Alexander and Duncan, of Leominster, being accepted for the constructional ironwork for £394. The formation of the roads, the drainage, laying cables, &c., were carried out by the Corporation workmen; together with the cost of site, meters, legal charges, &c., this involved an outlay of £5,600, bringing the total up to £19,926 12s. 5d.

The station buildings have been erected from the designs and under the supervision of the city engineer and surveyor,

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Mr. John Parker, A.M.Inst.C.E. They comprise a boiler house 50 feet × 44 feet; engine room, 30 feet × 39 feet; and an accumulator room 30 feet × 44 feet, an old printing works being converted into offices, testing room and workshops.

The boiler house faces the main entrance from Widemarsh Street, and is substantially built of local pressed facing bricks, with Ruabon terra cotta dressings. Space is provided for three Lancashire boilers, two only of which are included in the present installation.

The chimney, which is octagonal in shape, is situated at the south-east corner of the buildings, and is 85 feet high. It is 5 feet internal diameter, and the outside measurement of the square base is 12 feet, the foundation being of cement concrete 23 feet square and 3 feet deep. The firebrick lining extends 33 feet high, with a ventilated air space between the firebrick and the outside shaft. The cornices and capping are of terra cotta. The lightning conductor is in duplicate, with a corona, to which are attached eight points and a rod of copper 5 feet long, with four points. The vertical tapes are $1\frac{1}{2}$ inches × $\frac{1}{8}$ inch, earthed in pits 20 feet clear of the buildings.

Throughout the buildings the roof trusses are of mild steel, and the covering is of Portmadoc slates on battens, with felt laid on diagonal boarding, the skylights and lanterns being glazed with Hopes' patent glazing.

The steel boilers, which were supplied and erected by Messrs. R. Taylor & Sons, of Marsden, Yorks, are of the Lancashire type, 30 feet long, and 7 feet 6 inches diameter, and are fitted with Meldrum's patent forced draught furnaces. The working pressure is 160 lbs. per square inch; the feed water is obtained from two three-throw pumps, driven by Silvertown motors, in addition to which one injector is provided. The feed water tank has a capacity of 600 gallons.

The economiser is of Green's standard 96-tube type, and is fitted with a patent self-acting triple scraper, which is driven by a motor through worm gearing.

The engines, two in number, are of the Belliss compound two-crank type, 9 inches and 5 inches × 9 inches stroke, each capable of developing 150 B.H.P., with a steam pressure of 155 lbs. at the engine stop-valve, when exhausting into the condenser or the atmosphere, and at a speed of 450 revolutions per minute.

Each engine is fitted with a throttle valve governor, worked direct off the crankshaft, and at the official test, when the full load was suddenly removed, the permanent variation was only 11 revolutions on No. 1 engine, and 8 on No. 2.

Each engine is coupled direct to a Silvertown undertype shunt wound dynamo, with drum bar armature, giving an output of 200 amperes, 440 to 500 volts, at the normal engine speed.

The dynamos when tested after a six hours' run at full load showed no signs of sparking at the brushes, and the maximum increase of temperature was found to be considerably under the specified rise of 70° F. The steam consumption of each of the combined sets at full load when condensing did not exceed 22 lbs. per E.H.P.-hour.

General View of Engine Room.

The main steam piping is of lap-welded steel, 8 inches diameter, with flanges forged on solid, the subsidiary steam piping being of wrought-iron, and the last bends to the engines of solid drawn copper 4 inches diameter.

The drain pockets on the main steam range, two in number, are provided with steam traps of the "Sirius" make. The exhaust pipes are carried in a trench below the floor level. The main exhaust, which is 10 inches diameter, is divided into two mains, each provided with a valve; one leads to the condenser, the other to the atmosphere, the latter running up outside the engine room wall to about 4 feet above the roof.

The condenser is of the "Ledward" evaporative type,

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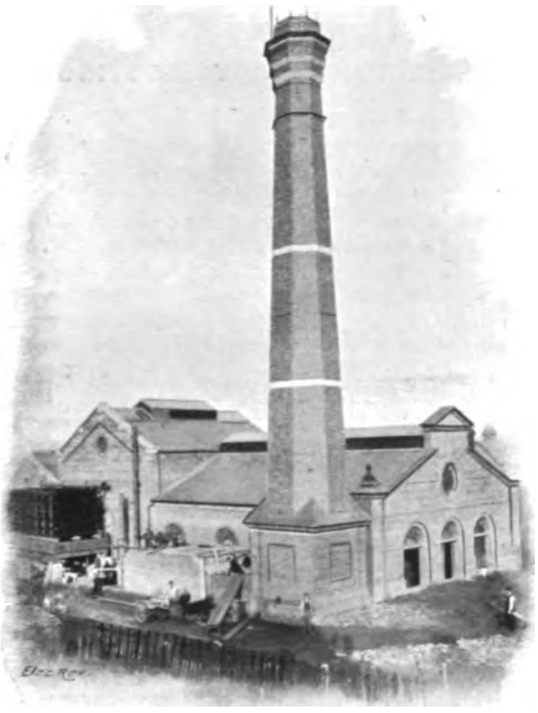
and is capable of dealing with 6,000 lbs. of steam per hour; it consists of 160 tubes, and is built outside the engine room upon girders, resting on a cast-iron water tank 25 feet × 13 feet × 2 feet deep, to which are connected the electrically-driven air and circulating pumps inside the engine room.



Hereford Electricity Works.

All steam, hot feed, and exhaust pipes in the engine and boiler rooms are covered with sectional magnesia covering.

A 10-ton crane, by Messrs. Marshall, Fleming & Jack, of Motherwell, is provided to run the whole length of the engine room.

The balancer is made by the Silvertown Company, and is of their S D 40 type, capable of supplying 100 amperes to either side of the three-wire system at any voltage between 220 and 270 volts.

On either end of the balancer is coupled a booster of S D 10 type, capable of carrying a current of 90 amperes at any voltage between 20 and 90 volts. The combined set runs at a speed of 800 revolutions per minute, and is capable of working for any length of time without stopping, being fitted, as are the main dynamos and all the motors, with an arrangement for automatic continuous lubrication.

The switchboard is arranged for a three-wire supply at a pressure between the outers of 440 to 500 volts, and consists of three enamelled slate double panels carried by an iron frame measuring 14 feet × 8 feet. On the two outer panels are mounted the dynamo automatic cut-outs, with double-pole fuses, ammeter omnibus bars, feeder ammeters, and duplex fuses; and on the middle panel are mounted the battery regulating switches, balancer, double-pole starting switches, throw-over switches, and ammeters, and the voltmeters and multi-way switches.

Provision is made for four feeders, of which three only are in use at present; each feeder has both positive and negative duplex fuses with mica screens, ammeter and bus bars common to all feeders.

A middle-wire bus bar, provided with terminals for the battery, feeder, and balancer, is fitted, as well as an ammeter to indicate the amount of current flowing in the middle wire. Arrangement is made for connecting the middle wire to earth through an ammeter reading up to 50 amperes. Weston voltmeters are fitted on the feeder circuits, and Kelvin multi-cellular instruments for the dynamos, batteries, and boosters.

For starting the balancer and booster a double-pole switch is provided on the switchboard, with suitable starting resistances, and shunt resistances for the dynamos, balancers, and boosters are fixed under the platform, with their regulating switches on the switchboard hand-rail. A separate switch for breaking the exciting circuit of each booster is also provided.

The shunt circuit of the main dynamos is so arranged as to be interlocked with the automatic cut-out, so that the latter cannot be closed until the shunt circuit is made, and the shunt circuit cannot be opened before the main circuit is broken by the automatic cut-out.

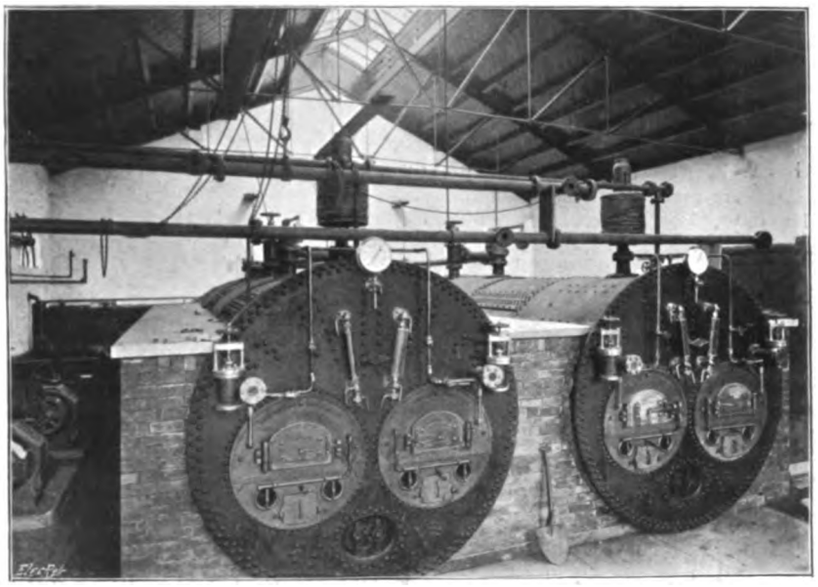
The accumulators are of the Chloride R type, in glass boxes, 270 in number, and have a capacity of 660 ampere-hours when discharged in nine hours; the battery is capable of discharging at the rate of 250 amperes without injury to the cells. It is fixed in two tiers in a spacious accumulator room, very lofty, and well ventilated; 40 cells in each half of the battery are connected by means of lead-covered cables with a 21-way regulating switch on the main board, so that the cells are cut in or out in pairs. The floor of the battery room is of cement, and is drained to the centre for cleaning purposes.

The main feeders and distributors were all made and supplied by the Silvertown Company. There are at present three feeders, "A," running to Commercial Street, 450 yards long, ·25, ·15, ·25; "B," running to the end of Broad Street, 750 yards long, ·25, ·15, ·25; "C," running to the corner of Eign Street and Victoria Street, 650 yards long, ·2, ·1, ·2.

There are 11 disconnecting boxes at various points in the city, some of which are provided with fuses.

The cables are insulated with vulcanised India-rubber, protected with tape all over, and are laid under the roadway in wooden troughing filled in with bituminous compound. They are designed for a pressure of 220 volts at the lamps, and are of such capacity that the rise and fall in pressure shall not exceed 4 per cent. in the distributing mains when the proposed full load of 10,000 8-c.p. lamps is attained.

The length of the three feeders is approximately one mile, and distributing mains have already been laid to the extent of about 2½ miles. On commencing the work of cable laying the Corporation issued a circular expressing their willingness to make free service connections for all consumers who made application while the mains were being laid, and as a result they have already connected up premises representing 3,006 8-c p. lamps.



Boiler House.

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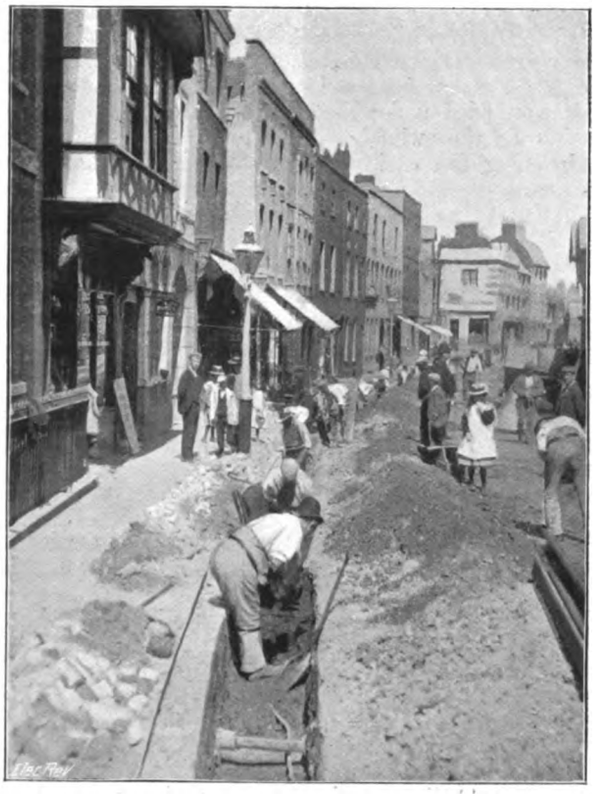
The scale of charges has been fixed at 6d. per unit for the first two hours and 4d. afterwards on the maximum demand principle, the uniform charge for power being 3d. per unit.



Laying Cables in Widemarsh Street.

Although some disappointment has been felt at the impossibility of opening the works at an earlier date, it is interesting to note that after the plans had been examined by the Committee and finally approved, it was only on April 28th in the present year that the sanction of the Local Government Board was obtained to the necessary loan, thus leaving an interval of only 7½ months between this date and the formal opening yesterday.

The time occupied in construction, although exceeding the time specified, is almost a record one; the only instance in which an electrical installation of this magnitude has been erected in so short a period of time being that of Greenock, which was carried out by the same contractors in seven months 10 days, and which was opened on November 30th.

As it was, the result would have been better had not some delay arisen due to the difficulty in obtaining materials.

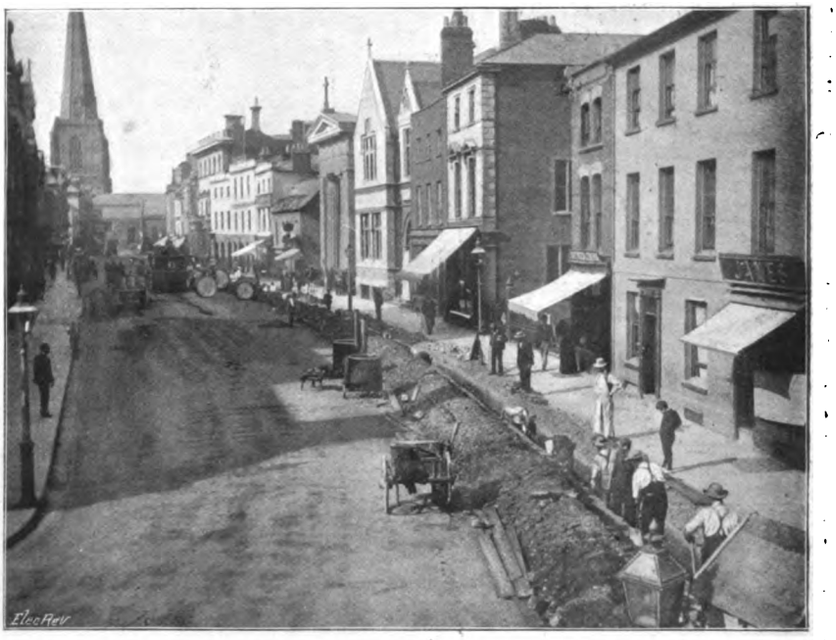
The whole of the work, excluding buildings and excavation, has been carried out by the India-Rubber, Gutta-Percha and Telegraph Works Company, of Silvertown, under the supervision of Mr. Stuart Russell, their local representatives being Messrs. Ely and Whitmee.

The Electricity Committee, whose able and energetic chairman is now Mayor, is to be congratulated on having been able to avail itself of the services of its engineer and surveyor, Mr. John Parker, who has already carried out many improvements in the town, amongst others a sewage works and a refuse destructor, which gives most efficient results; Mr. Parker carried on the work of the electricity supply unaided until Mr. F. G. Poulton was appointed to assist him.

We have to thank Mr. Parker for the photographs of the works which we have here reproduced, as well as for copious information regarding the electrical works and the city itself. We are indebted, also, to the Silvertown Company for particulars of the plant with which they have furnished us.

PHYSICAL SOCIETY MEETING.

The last meeting of the year was held at the City Guilds' Technical College, Finsbury, when Prof. S. P. Thompson was both host and lecturer. His paper on "Cylindrical Lenses" was listened to with a great desire on the part of the audience to follow the mathematical argument, and no doubt Lord Kelvin succeeded in doing it. But the majority of those present certainly did not. For when a mathematician has been pegging away at a problem, perhaps for weeks, and has become familiar with its various aspects and equations, so that he knows the physical meaning, and can predict the consequence of each step in the process, it's no good trying to keep pace with him during those brief and breathless moments when he is "explaining" it on the blackboard. Indeed, it is not courtesy to him to attempt to do so. Of course, it would be kinder of him merely to give you the results of his labours, and to leave you to follow the arguments when they are published in printed form; but if he insists upon making the grand tour, you have nothing for it but to sit still and wait till he is satisfied. Prof. Thompson's paper was concerned with the case of obliquely-crossed cylindrical lenses, such as are used by opthalmic surgeons for detecting and for correcting astigmatism. By a very neat application of a geometrical principle, and a graphic construction, Prof. Thompson arrives at a simple solution whereby he can determine the equivalent sphero-cylindrical combination for almost any system of obliquely-crossed cylindrical lenses. His paper should be much appreciated by the recently organised "Optical Society." As the result of an observation made by one of his students, Prof. Thompson then exhibited a crystal of naphthaline, and demonstrated that it had a refractive power far in excess of Iceland spar. The double image, however, is rather "fluffy," so that it could scarcely be used for instruments of precision. Gas shares, therefore,



Laying Cables in Broad Street.

will probably not go up much on account of this discovery. Prof. Blakesley's paper was also upon "Optics"; indeed, it is probably one of the most important contributions that this branch of Physics has received this year. It is a continuation of his work, published in June, 1897,

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on "A New Definition of Focal Length," but so far as could be gathered from his short account on Friday, he has arrived at some most valuable generalities, especially as regards the focal lengths of telescopes and the measurement of the refractive indices of liquids. The last item on the programme was a dynamometer exhibited by Prof. Dalby, chiefly interesting to us as an indication of the good work that is being done at Finsbury Technical College. The discussion on these papers might have been brilliant, but the readers of papers were determined to talk out the time. And they did.

TELEGRAPH AND TELEPHONE NOTES.

(*Continued from page* 966.)

The Interruptions to the Cape Cables.—Our readers will recollect that Mr. Chamberlain in receiving a deputation representing the Eastern group of cable proprietors, pointed out that when any trouble arose in South Africa their cables were sure to break down. A proof of this is that last month the Mozambique-Delagoa cable was interrupted for a fortnight, and after its restoration the Aden-Zanzibar cable broke down for a week, thus for three weeks last month the East African route was useless to us. When addressing the Liverpool Chamber of Commerce last Monday Sir Edward Sassoon pointed out that neither of these cables, although they were laid 20 years ago, has been duplicated, and that the Eastern and South African Company which owns these cables has, besides its earnings, received State subsidies to the amount of £1,300,000. Yet Lord Tweeddale before the Pacific Cable Committee insisted on the necessity of duplications and triplications as instanced by the action of his own companies. This was meant to show that it was absolutely necessary that the Pacific cable if laid must be duplicated. During the present month the East Coast of Africa lines being fortunately restored, we find that the West Coast cable broke down last Monday, and we can only hope that the East Coast route will hold out till the cable at present broken (St. Thomé to Loanda) is put in working order.

A representative of the *Globe*, on inquiry at the offices of the Eastern Telegraph Company on Tuesday last was informed that there was no occasion for alarm at the present time. The break being on the West Coast route, it did not affect the company to the same extent as when it was on the East Coast, which line was now working satisfactorily, and was capable of doing more work than the other route. In reply to further questions, our informant could give no possible reason for the recent breaks, but added that it was merely extreme bad fortune. However, he was hoping that the line would soon be repaired, as the repairing ship, which was fortunately near San Thomé when the interruption was reported, left last evening for the scene of the break, and is expected to be on the spot by Friday. On inquiry whether the interruption was likely to cause any considerably delay in the receipt of telegrams from the seat of war, our representative was informed that there would probably be some delay in Press telegrams, but not in official messages.

The Postmaster-General and the Telephones.—A sitting of the Railway and Canal Commission was held in the Glasgow Court of Session on 5th inst. for the purpose of giving judgment on the difference which had arisen between the Postmaster-General and the Corporation of Edinburgh in connection with the request of the former for the latter's consent to the laying of underground telegraph lines under certain streets within the city of Edinburgh. The Corporation refused their consent, and the matter was remitted to the Sheriff of the Lothians, who decided in favour of the Postmaster-General. The Corporation appealed to the Railway Commission, who have now affirmed the decision of the Sheriff, and given consent to the proposal of the Postmaster-General. The Commissioners held that the case was substantially ruled by their decision given against the Corporation of Glasgow.

Salford Telephone Service.—The Town Council last week passed a report of the Finance Committee on the subject of telephones, in which it was recommended that—

In continuance of the support previously given to the Mutual Telephone Company, Limited, with a view to creating competition in the telephone service of the borough, the Council should undertake that in the event of a license being granted to the company, they will grant to the company wayleaves for underground wires, provided the company will within three months enter into an agreement with the Corporation to accept all such clauses and conditions as may be considered necessary or desirable by the Corporation.

The Finance Committee wrote to the Manchester Corporation asking whether Manchester would form a joint sub-committee with Salford to consider the desirability of establishing a municipal telephone service. The only reply was a note from the town clerk enclosing a copy of the resolution passed at the last meeting of the City Council referring the telephone question to a special sub-committee.

South African Telegraphs.—The report of the British South Africa Company issued at the end of last week contains the following references to the telegraph system:—

The telegraph system is being rapidly extended. On September 30th, 1899, 62 telegraph offices were open. Of these 17 were in the Bechuanaland Protectorate, 12 on the African Trans-Continental Telegraph Company's lines, and 12 on the British South African Police Telephone lines. At the same date the Rhodesia telegraph system, including the African Trans-Continental Telegraph line, consisted of 2,635 miles of line with 3,613 miles of wire. New telegraph lines are in course of construction. The African Trans-Continental Telegraph line has already proved of great value, both to the Imperial Government and the British South Africa Company, in assisting to maintain an effective control over the administration of the territory north of the Zambesi. The Imperial German Government has recently agreed to the extension of the line from Abercorn northwards through German territory to British East Africa.

The Telegraph Wire Export Trade.—Although the figures are not quite so large as was recorded a month ago, quite an unusual state of activity is just now prevailing in the export trade of this country in telegraph material and apparatus connected therewith. The returns just to hand for November show a total of no less than £260,239 which compares with £369,243 in the preceding month, and only £39,837 in November, 1898 The unusual heavy returns of the past two months have largely swelled the export figures for the 11 months ending with November last, these showing a total of £1,360,811, which compares with only £976,558 in the corresponding period of last year, and £828,962 in the first 11 months of 1897.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies:—		
Jamaica-Colon	June 30, 1899 ...	...
Trinidad-Demerara (1871 original)	Oct. 20, 1899 }	Nov. 9, 1899.
Do. do. (1891 duplicate)	Oct. 6, 1899 }	one cable restored.
South African:—		
Zanzibar-Mombasa	Oct. 27, 1899 ...	...
Saint Thomé-Loanda	Dec. 11, 1899 ...	...
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Latakia-Cyprus	June 20, 1899 ...	...
Landlines.		
West Indies:—		
Cuban Government lines... ...	Oct. 30, 1899 ...	Dec. 9, 1899
Communication with Les Cayes (Haiti)	Nov. 22, 1899 ...	...
South African:—		
Communication with Mafeking...	Oct. 13, 1899 ...	...
Communication with all offices beyond Orange River	Oct. 18, 1899 ...	...
Communication beyond Burghersdorp, Cape of Good Hope, and Estcourt, Natal...	Nov. 7, 1899 ...	...
Communication with north of Mooi River (Natal)	Oct. 22, 1899 ...	...
Colombian Government lines to Bogota	Oct. 21, 1899 ...	...
Communication with interior of Colombia, excepting Amalfi, Ambalema, Buga, Cartago, Ibagua, Manizales, Medellin, Palmire, Pasto, Popoyans, Reimedos, Sonson, and Santo Domingo... ...	Nov. 6, 1899 ...	...
Communication with Valentia (Venezuela)	Nov. 18, 1899 ...	...
Indo-European lines between Odessa and Kertsch	Dec. 11, 1899 ...	Dec. 11, 1899
Indo-European lines between Odessa and Kertsch	Dec. 12, 1899 ...	...

Telephonic Communication on the Continent.—Telephonic communication will before long be established between Vienna and Constantinople, according to the Vienna correspondent of the *Chronicle*. The Hungarian and Servian Governments have just arranged for a telephone wire between Buda-Pesth and Belgrade, which is expected to be working at the end of January. From Belgrade the Servian Government has granted two more telephone wires, one to Sofia and another *viâ* Uskub to Constantinople. There is a telephone already working between Buda-Pesth, Vienna, and Berlin. It may be expected that the German capital will soon have telephonic communication with Constantinople.

Wireless Telegraphy.—At the meeting of the Technical Society of Naval Architecture in Berlin last week, Prof. Slaby delivered an address upon "The Application of Wireless Telegraphy in the Navy," which was illustrated by many interesting experiments. Prof. Slaby paid a tribute to the French inventors who were the originators of the system, to the Russian, M. Popoff, and to Signor Marconi. The lecturer described how he had been enabled to observe the results which Signor Marconi had obtained two years ago, and how, working on that basis, he had succeeded in obtaining independently practically the same results Prof. Slaby has been supported in his investigations by the Emperor, the Aeronautic Society, and the Imperial Marine Department. The lecturer stated that the consideration of the tactical value of these discoveries must be left to professional sailors, but pointed out that there were no serious difficulties in the way of their practical application.

Worsley Telephones.—The District Council has approved of the application of the Mutual Telephone Company to establish telephones in the Council's district.

CONTRACTS OPEN AND CLOSED.

OPEN.

Bedford.—The Electric Light Committee wants tenders for one 420 B H P. inverted compound double-acting engine, and one 250-kw. alternator. See "Official Notices" this week.

Bermondsey.—January 13th. The Vestry wants tenders for the construction, &c., of a dust destructor, with furnaces, water-tube boilers, economiser, fans and forced draught appliances, in connection with the electricity supply undertaking. See "Official Notices" to-day.

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Blackburn.—December 23rd. The Corporation wants tenders for overhead trolley line equipment. See "Official Notices" November 24th.

Blackpool.—December 15th. The Corporation wants for the electricity works four boilers and accessorial steam plant; two 600-KW. steam alternators (or one 1,200-KW.), switchboard, mains, transformers, and battery. See "Official Notices" November 24th.

Denmark.—December 28th. The Corporation of Aarhus is inviting tenders for water-tube boiler plant, steam dynamos, switchboard, and accumulators for electricity works. From our "Official Notices," November 3rd, further particulars may be obtained.

Gloucester.—December 28th. The Electricity Committee wants tenders for extension plant including Lancashire boiler, &c., one 300-KW. steam dynamo, switchboard work, condensing plant. See "Official Notices" November 24th.

Hackney.—January 2nd, 1900. The Vestry wants tenders for the supply of accumulators. See "Official Notices" December 1st.

Hull.—December 28th. The Electric Lighting Committee wants tenders for two 750-H.P. high speed three-crank vertical engines; and two 460-KW. continuous current dynamos (2,250 volts) for the Sculcoates Lane electric lighting station. See "Official Notices" December 8th.

Ilford.—January 20th. The District Council wants tenders for water-tube boilers, economiser, pumps, pipe work, two 200-kw. and one 100-kw. dynamos, motor boosters, battery, switchboard, 15-ton traveller, mains and road work, arc lamps and posts, and station lighting. See "Official Notices" to-day.

Manchester.—December 16th. The Corporation Tramways Committee wants tenders for steel tie-bars, bolts and nuts for permanent way work. See "Official Notices" December 1st.

Manchester.—December 30th. The Tramways Committee wants tenders for 450 electric tramcar bodies. See "Official Notices" to-day.

The Midland Corporation.—December 18th. From an "Official Notice" Nov. 24th, particulars may be obtained of certain plant and machinery and conductors, for 10,000 B.H.P. output, required for the new power house to be erected by the Midland Electric Corporation for Power Distribution, Limited. There will be 16 water-tube boilers, six sets of Corliss engines and three-phase generators, transformers, switchboards, mains, batteries, &c.

Mistretta (Sicily).—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Palermo, stating that tenders are invited by the Municipality of Mistretta, not later than December 31st next, for the establishment of a service of electric lighting in that town. Such particulars as have been received may be examined on personal application at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 5 p.m.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

St. Annes-on-the-Sea.—December 21st. The Urban District Council wants tenders for mains, street arc lighting (enclosed globes), and street incandescent lighting. See "Official Notices" December 8th.

Shoreditch.—December 19th. The Vestry invite tenders for the construction of two underground transformer stations in Great Cambridge Street and Queen's Road respectively. Particulars and forms from Mr. J. Rush Dixon, Town Hall, Old Street, E.C.

Wallasey.—December 20th. The District Council wants tenders for a Lancashire boiler for the electricity works. See "Official Notices" December 8th.

West Bromwich.—December 22nd. The Corporation wants tenders for boilers, steam dynamos and condensers, switchboard, mains, and storage battery, for electricity supply. See "Official Notices" December 8th.

CLOSED.

Bootle—In connection with the laying of a double line of tramways in Knowsley Road, the Town Council gave Messrs. R. W. Blackwell & Co., Limited, the order for the complete equipment of the overhead trolley line, and Callender's Cable and Construction Company, Limited, London, were entrusted with the supply and laying of the cable for the Knowsley Road lines.

Boston.—Mr. J. E. Lester, electrical engineer, Leicester, has received orders for a private electric light plant of 225 8-C.P. lamps, with accumulators, in the new factory of the Boston Cigar Manufacturing Company, Lincolnshire.

Glasgow.—Messrs. D. Bruce Peebles & Co. have secured the contract for the whole of the electrical equipment for the motors for driving condensers, air pumps, circulators, &c., at the Corporati n tramways station. This contract was placed by Messrs. Mirrlees, Watson & Yaryan.

Llandudno.—The following is a list culled from *Tenders and Contracts* of some of the estimates submitted to the District Council for the supply of three 150-KW. high speed engines and dynamos, motors, and boosters.—

Lancashire Dynamo Company	£3,682
India-Rubber Company (Allen Engines)—(*accepted*)	4,022
Thames Ironworks Company	4,197
General Electric Company	4,427
J. H. Holmes & Co.	4,848
Scott & Mountain	4,894
W. H. Allen, Son & Co.	4,9 7
Smith & MacMillan	4,971

Sixteen other tenders were received ranging from £5,028 to £6,606.

Wolverhampton.—*Tenders and Contracts* gives the following list of tenders submitted to the Corporation for the supply of two 500-KW. direct coupled generating sets for the electricity works:—

T. Parker, Limited (Parker-Belliss)	£10,681
Ditto (Parker-Willans)	10,582
Ditto (Parker-Allen)	9,974
Electrical Construction Company (E.C.C.-Belliss)	10,189
Ditto (E.C.C.-Willans) (*accepted*)	9,920
Ditto (E.C.C.-Allen)	9,541
Ditto (E.C.C.-Peache)	9,777
Willans & Robinson (E.C.C.-Willans)	10,028
Siemens Bros. (Siemens-Willans)	10,410
Brush Company (Mordey-Raworth)	10,981
Scott & Mountain (own)	9,637
F. Suter & Co. (Willans)	8,710
Ditto (Allen)	8,104
F. Nell (Ball & Wood)	9,897
C. A. Parsons (Parsons turbo-generator)	8,718

Wrexham.—The following is a list of the tenders submitted for the municipal electricity and dust destructor works. Consulting engineer, Mr. W. H. Trentham:—

SECTION A.—BOILERS AND DESTRUCTOR.

	£	s.	d.
Sterling Boiler Company	4,262	0	0
Morrin Climax	5,029	1	3
*Babcock & Wilcox	5,900	0	0

SECTION C.—SWITCHBOARD.

*Brook, Hirst & Co.	589	10	0
Edwards Electrical Company	598	10	0
Crompton & Co.	687	0	0
Luna Electric Works	750	0	0
Moon, Loughlin	750	0	0
James White	790	10	6
General Electric Company	803	10	0
Dorman & Smith	807	0	0
Veritys	819	0	0
Cowans	830	0	0
Fowler, Lancaster	875	0	0
Edison-Swan Company	915	0	0
Electric Construction Company	1,025	0	6
British Thomson-Houston Company	1,128	8	0
Heywood	1,141	0	0

SECTION D.—MAINS.

*St. Helens Cable Company	4,499	11	7
Callender & Co.	5,290	4	7
General Electric Company	5,486	18	4
Brooke, Hirst & Co.	5,411	0	0
British Insulated Wire Company	5,446	19	6
Western Electric	5,526	7	6
Henley's Telegraph Co.	5,582	17	5
Glover & Co.	5,726	4	10
Sidge, Ryman & Graesser	6,488	12	9

SECTION B.—STEAM DYNAMOS.

Lancashire Dynamo Co.	Allen engines	6,471	10	0
" "	Alley-Maclellan engines	7,260	10	0
* " "	" "	7,422	10	0
" "	Belliss "	7,829	10	0
" "	Reavell "	6,697	10	0
* " "	Willans "	7,786	10	0
Reavell	Lawrence-Scott dynamos	6,658	10	0
"	Thames Ironworks "	6,878	10	0
"	G. E. C. "	6,961	10	0
"	Thos. Parker "	7,056	10	0
W. H. Allen & Co.	Allen engines	7,031	0	0
Thos. Parker	" "	7,459	0	0
"	Alley-Maclellan engines	8,338	0	0
"	" "	8,307	0	0
"	Belliss engines	8,627	0	0
"	Willans "	8,759	0	0
Blackwell	Parsons "	7,661	15	0
Crompton	Peache "	8,047	0	0
Electric Construction Co.	Allen "	8,201	0	0
" "	Belliss "	9 518	0	0
" "	Willans "	9 659	0	0
Ashton, Frost	Belliss "	8,3 0	0	0
Ernest Scott & Mountain	Own "	8,610	0	0
Johnson & Phillips	Peache "	8,660	0	0
British Thomson-Houston	Belliss "	8,711	8	0
Sandycroft Foundry Co.	Willans "	9,076	0	0
Mather & Platt	" "	9,147	0	0
" "	Belliss "	9,177	0	0
Silvertown India-Rubber Co.	" "	9,540	0	0
" " "	Willans "	9,795	0	0
Brush Electrical Eng. Co.	Raworth "	9,66	0	0
Maclure & Whitfield	Reavell "	9,644	17	0
Alley-Maclellan	Own "	10,339	0	0

SECTION F.—ACCUMULATORS.

*Chloride Company	991	0	0
Marquand	1,162	18	6
Electrical Power Storage Company	1,550	0	0
Hart Battery Company	1,663	0	0
Tudor	1,812	0	0
D. P. Battery Company	2,035	0	0

SECTION G.—CRANE.

*Carrick & Ritchie	140	0	0
Watford Engineering Works	149	0	0
Carrick & Sons	150	0	0
Jas. Spencer	150	0	0
Higginbottom & Mannock	168	0	0

* Recommended for acceptance.

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Hospital Lighting.—We understand that dynamos by Bruce Peebles & Co. and Willans engines have been adopted for the generating plant for Guy's Hospital.

FORTHCOMING EVENTS.

Tuesday, December 19th.—At 8 p.m. The Institution of Civil Engineers. Further discussion on "Combined Refuse Destructors and Power Plants," by C. Newton Russell, Assoc.M.Inst.C.E.

Thursday, December 21st.—At 2 p.m. The Institution of Civil Engineers. Students' visit to the Generating Station of the Westminster Electricity Corporation, Eccleston Place, S.W.

RE OUR ARTICLE ON ACCUMULATORS AND VEHICLES.

The Electrical Power Storage Company, Limited, the owners of the Faure-King patents and the manufacturers of accumulators of that type, which were supplied to the London Electrical Cab Company, Limited, complain of the following statements in our article headed "Accumulators and Vehicles," of last week.

> They (the Cab Company) seemingly took up a cell which, according to their own tests, was quite inadequate to the needs of a cab service. Presumably the reasons that led the directors to adopt this accumulator were the somewhat handsome terms for maintenance offered by the Accumulator Company. Whatever the reasons may have been, it is said that the conditions of maintenance were not fulfilled, and, with the absolute failure of the accumulators, it was only a matter of time before the cabs were taken off the streets.

The E.P.S. Company assure us that the above statements are erroneous, that their accumulators worked satisfactorily, and were, in fact, at work, and were fulfilling the terms of the contract at the time when the operations of the Cab Company ceased. It is, therefore, incorrect to suggest that the failure of the cab company was due to any failure of the accumulators, or to any failure on the part of the Electrical Power Storage Company to fulfil the conditions of maintenance. Accepting this information as *bonâ fide*, we have pleasure in publishing this correction, and in expressing our regret that this paper has been the medium of circulating the injurious statements referred to.

NOTES.

Electric Motors and Printing Machinery.—During the course of his presidential address to the Newcastle Association of the Students of the Institution of Civil Engineers some days ago, Mr. J. H. Holmes gave some interesting notes on the application of electric driving in printing works. The *Newspaper Owner*, in an abstract, says that Mr. Holmes had been assured by one firm of letterpress and general printers and lithographers, who had adopted the system of driving independent machines by separate electric motors, and who had 74 such motors at work, that the output from their works had increased at least 20 per cent. since the introduction of electric driving. Mr. Holmes attributes this increase of output to six different causes:—

> (1) The readiness of an electric motor, as compared with other prime movers, to respond to any demand made upon it for power above its normal load. (2) Its uniformity of speed ensures more perfect register of the printed matter, and wastes are few and far between. (3) The absence of spoilt sheets caused by drops of oil from the overhead shafting and bearings, or by dirt carried round by the belting. (4) The more accurate adjustment of speed, which is possible with a motor (by means of a regulating switch), than with the usual three or four step cone pulley for belt driving. (5) Electric driving of machines is so much steadier, that they can be run at higher speeds without excessive vibration. (6) The main engine, which is usually a slow running one, invariably decreases its speed somewhat when there is a sudden increase of load, caused by more machines being started, or by the running machines happening to get into step and synchronising. In such cases, also, he says the main driving belt is sure to slip.

The Enclosed Arc Lamp.—Those who followed the open and enclosed arc lamp controversy a few years ago will be interested in an article by Mr. L. B. Marks in the *Electrical World and Engineer*, in which he gives statistics showing the relative use of open and enclosed arcs supplied from 36 central stations, including those of the New York, Boston, and Brooklyn Edison Companies. Most of the arcs installed by these companies are operated on direct current constant potential circuits. In some cases a separate service is maintained for constant current high tension lamps. The relative use of the two types of lamps by eight lighting companies is graphically represented in curves. The progress of the enclosed arc lamp is notably marked in the cases cited, which include New York, Chicago, Brooklyn, Boston, Detroit, New Orleans, Washington and Indianapolis. Mr. Marks says:—

> 1. That the year 1895 marks a notable turning point in arc lamp practice, brought about by the introduction of the enclosed arc lamp.
> 2. That the use of the open arc type of lamp is rapidly declining.
> 3. That the enclosed arc is superseding the open and also greatly extending the arc lamp field. This is borne out by the fact.
> 4. That the total number of arc lamps in use in each year shows a remarkable increase over the preceding year.

The statistics show that the progress of the enclosed arc was relatively slow up to 1896. The number of open arcs in use that year was greater than in 1895, but dropped rapidly in 1897, and more rapidly in 1898 and 1899. The records for 32 cities in 1896 and 1899 respectively are as follows:—

Number of open arc lamps in use 1896	23,605
Number of enclosed arc lamps in use 1896... ...	1,203
Total	24,808
Number of open arc lamps in use 1899	16,010
Number of enclosed arc lamps in use 1899	20,848
Total	36,858

Decrease in three years, open arcs ...	over 32 per cent.
Increase in three years, enclosed arcs	over 1,600 "
Increase in three years, total arcs ...	almost 50 "

It is estimated that there are now in use in the United States about 150,000 enclosed arc lamps, of which more than half have been installed within the past two years. This record, says Mr. Marks, is probably unequalled in the annals of arc lamp installation the world over. Statistics obtained from reliable authorities show that the total number of enclosed arc lamps in use in Europe (Great Britain and the Continent) is approximately 55,000, or only a little over one-third of the number credited to the United States. It should be stated in this connection, however, that the first commercial use of enclosed arcs abroad began about a year later than in America. Although the output of enclosed arc lamps during the past two years has been phenomenal, there are no indications of diminishing popularity. On the contrary, now that the transmission of electrical energy by alternating currents is coming more and more into favour, the field for arc lamp use will, Mr. Marks believes, be correspondingly enlarged. The output of enclosed alternating arcs during the coming year promises to greatly exceed that of the past, and in time to equal if not surpass that of the direct current type.

Appointments Vacant.—The Bradford Corporation wants an engineer to take charge of the electricity department at £500 per annum. See "Official Notices" to-day.

The Plumstead Vestry is inviting applications until 21st inst. for the appointment of electrical engineer to design and take charge of electricity works at £400 per annum.

The Brighouse Corporation wants applications for the appointment of consulting electrical engineer for the borough. The Doncaster Corporation wants various hands for the electricity works. See our "Official Notices" this week.

Royal Institution.—The Friday evening meetings for 1900 will begin on January 19th, when a discourse will be given by Lord Rayleigh on "Flight"; succeeding discourses will probably be given by the Hon. C. A. Parsons, Prof. J. H. Poynting, Prof. Dewar, and a number of other gentlemen.

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The Berrenberg Lamp.—Our readers will remember some correspondence which appeared in our pages about a month ago, in which we were scolded for criticising certain statements issued by the makers of the Berrenberg lamp. At the time, the Berrenberg Lamp Company sent us a dozen lamps, in order that we might form our own conclusions as to their merits. We have submitted 10 of these to an absolutely impartial test of initial candle-power and efficiency, with the results given below :—

BERRENBERG LAMPS.

Tested at 100 volts.

Maker's stamp.	Candle-power.	Amperes.	Watts per candle.
100 volts, 16-c.p.	9·8	0·38	3·88
"	9·8	0·38	3·88
"	9·8	0·38	3·88
"	10·5	0·40	3·81
100 volts, 32-c.p.	21·7	0·80	3·69
"	22·4	0·78	3·48
"	25·2	0·80	3·17
"	25·2	0·80	3·17
"	21·7	0·77	3·55
"	21·6	0·76	3·52

It will be noticed that the candle-powers obtained are in each case about two-thirds of the marked values ; perhaps, if these lamps were run at about 106 volts, they would give their marked candle-powers at, of course, higher efficiencies. To do this, however, is irrelevant ; the consumers, who are most interested in the matter, have to take what is supplied to them as regards both the voltage at their terminals and the lamps they use, and hope for the best. As it is, we fail to see where the two watts per candle superiority over other lamps comes in.

Of other five lamps of the same make marked 200 volts, 16 c.p., tested at 200 volts, the best gave 11 c.p. at 3·45 watts per c.p., the worst 7·8 c.p. at 5·0 watts per c.p. These results were, however, communicated to us, and we take no responsibility for them.

Newcastle-on-Tyne Local Section of the Institution of Electrical Engineers.—A meeting of the local members of the Institution, and of others interested in electrical science, was held in the Durham College of Science on Wednesday evening, December 13th. The president of the Institution, Prof. S. P. Thompson, D.Sc., F.R.S., several members of Council, and the secretary of the Institution, Mr. W. G. McMillan, who had travelled down from London, were present. Mr. J. F. C. Snell, the temporary honorary secretary, read letters regretting inability to be present from the Duke of Northumberland, the Marquis of Londonderry, Sir David Dale, Bart., Sir Lindsey Wood, Sir Andrew Noble, K.C.B., the Bishop of Durham, the Dean of Durham, Prof. Weighton, C.E., Prof. H. G. Brady, Mr. John W. Swan, F.R.S., Mr. W. C. Mountain, the Mayors of Newcastle, Sunderland, and Darlington, and several other gentlemen, all of whom expressed the wish that the local section may be launched and be a success in every way. The President explained the objects of the association and the desire of the parent Institution to further the interests of district sections. Mr. John Holmes proposed, and Mr. J. A. Jeckell seconded, that a memorial be signed to forward to the Council. This motion was carried unanimously. There were 68 members present, and a provisional committee was formed, consisting of Hon. C. A. Parsons, Messrs. Holmes, Mountain, Heaviside, Snell, Jeckell, and Burnett. Votes of thanks to the Rev. Principal Gurney and the President concluded the proceedings.

Railway Station Lighting.—The L. C. & S. E. railway stations at Snow Hill, Ludgate Hill, and Holborn Viaduct are now lighted by arc lamps. The first named is probably the most villanous hole in the United Kingdom, but it is something to have lived for to see Jandus lamps installed there, making the platforms light as day, except when a G. N. train goes through. *Then*, and only then, are the arcs totally obscured by the smoke these engines leave in their wake. Anyhow, passengers have something to be thankful for since the almagamation of the L. C. and D. and S. E. companies have made it possible to at least clearly see one's way about the three stations named, two of which are a standing disgrace to London from a builder's or architect's point of view, while the third is not much better.

The Majert Accumulator.—In this accumulator the characteristic feature is the very large surface of the positive plate, which is of the Planté type. The negative plate is of the usual Faure type, in which red lead is plastered into the interstices of a lead grating. The surface of the positive lead plate is increased 12 to 14 times by forming on it a number of fine deep parallel ribs by means of a machine resembling the ordinary shaping machine. The tool of this machine acts like a plough, cutting from the lead plate a thin furrow at an angle, and bending it up into a perpendicular position. The surface of the plate when finished resembles the underside of the top of a mushroom. The durability of the plates of the Majert accumulator is very great. Twenty thousand positive plates have been in constant use for a year on the Great Berlin Street Railway, and only 18 of these have had to be replaced, *i.e.*, less than 1 per 1,000. Considering the wear and tear on accumulators used in electric traction, this is a remarkable result. The maximum charging and discharging currents of these batteries is also very high. A battery weighing about 20 lbs. has a capacity of 15 ampere-hours ; it can be discharged in a quarter of an hour with a current of 60 amperes, and can be charged with a constant current strength of 24 amperes, or at a constant voltage of 2·55 with a current of 84 amperes. A full account of this accumulator and its performances will be found in the *Elektrotechnische Zeitschrift*, November 9th, p. 783.

The Wehnelt Interruptor.—Starting from the experimental fact that the heat developed in a single cycle of a given Wehnelt break is constant, Dr. Simon deduces (*Wied. Ann.*, Vol. 68, p. 273) the following approximate formula for its action :—

$$T = \frac{3}{2}\frac{L}{r} + C_1\frac{r}{E^2} + C_2;$$

where L is the self-induction of the circuit, r the resistance of the layer of liquid surrounding the anode, which is converted into steam, E the impressed electromotive force, T the time of one cycle, and C_1 and C_2 are constants. The truth of this formula has been experimentally verified, partly by Dr. Simon himself (*Elektrotechnische Zeitschrift*, Vol. 20, p. 440), and partly by Ruhmer (l.c. 20, p. 786). To investigate the relation between the periodic time, T, and the working electromotive force, E, the above formula can be written in the simplified form $T = A + \frac{B}{E^2}$. The numbers calculated from this formula agree very closely with experimental results obtained by Simon. Ruhmer has made experiments to test the formula for the relation between T and the self-induction L. The simplified form of the formula in this case is $T = AL + B$. Ruhmer's experimental results also agreed remarkably well with those calculated by the formula.

Asylum Lighting.—An imposing range of buildings has recently been erected near Hendon by the board of the Central London Sick Asylums, the architects being Messrs. Giles, Gough & Trollope, of Craven Street, W.C. The whole installation for the lighting of the building was carried out by Messrs. Hampton & Sons, Limited, of Pall Mall East, who obtained the contract in an open competition to the specification of Messrs. Owen, Lucas & Pyke. There are about 900 lights at the asylum, the plant consisting of two steam dynamos, 37 KW., each driven by a Willans & Robinson's compound engine of 60 I.H.P. The dynamos are of Easton, Anderson & Goolden's make. There are two sets of 45 K 27 E.P.S. cells in parallel, coupled in series with 10 regulating cells of capacity equal to double the output of the K 27's. The main switchboard was made by the G.E.C., and consists of three separate panels—one panel for the "A" dynamo, one panel for the "B" dynamo, and the other panel for the battery. It is so arranged that either dynamo can charge the battery or run direct on to the lights. It is fitted with recording ammeter (Kelvin), Ferranti wattmeter, Prentice maximum and minimum cut-outs and three ammeters, three voltmeters, and regulating switch. We understand this is the first board to be fitted with the newest form of G.E.C. switch.

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The Cost of Electricity from Isolated Plants.—It is generally assumed, says the *Engineering Magazine*, that electricity can be supplied to buildings more cheaply than it can be generated by isolated plants; but that this is not always the case is shown in a carefully prepared paper read before the American Institute of Electrical Engineers by Mr. Percival R. Moses. Mr. Moses has collected information from more than 100 buildings of various sizes and types, and from these he has selected those from which the information was furnished with such a degree of detail as to render the conclusions reliable. The buildings selected include hotels, office buildings, loft buildings, department stores, and apartment houses, all in the city of New York, and since liberal access to the books of the establishments were permitted, the data are of much interest. In the investigation of the buildings, the hourly variations in the demand for light and power were plotted in the form of curves, and in each case a proportional allowance made for depreciation, interest, and other fixed charges. A typical building was taken in each case, and as these cases include actual records of the cost of supplying the same buildings, under the same conditions, with electricity, both from their own isolated plants and by the central station, it certainly appears as if the comparisons have been made upon a fair basis. In considering the isolated plant it must be remembered that in nearly, if not all, such buildings a steam-power plant must be maintained in any case, or at least steam must be used for heating, and if the steam-power does not provide sufficient exhaust steam to warm the building, live steam must be used. The installation of an isolated electrical plant is therefore only a partial increase in operating expense in such cases, and not so great as it would be if the entire power plant had to be placed solely for the operation of the electrical machinery. We give here only the conclusions which Mr. Moses draws from each building considered by him, and the full data in each case will be found in his original paper. Taking a table which Mr. Moses has prepared for buildings using approximately from 825,000 KW.-hours per annum down to 40,000 KW.-hours, he shows that the costs per KW.-hour for isolated plants are as follows:—

Large hotel	1·66 cents.
Small hotel	2·45 ,,
Apartments	4·70 ,,
Department store	2·85 ,,
Small store	4·10 ,,
Large office building	4·37 ,,
Small office building	5·06 ,,
Loft building	2·60 ,,

When it is understood that the charges by the central station company, taken from the published reports, are, on an average, 10·6 cents per kilowatt-hour, and that the cost of production is about half this, it appears that under existing conditions in New York the private consumer can generate electricity at about the same cost, or even less cost, than the central company, and that there is a manifest economy in the installation of the isolated electric plant.

Electric Light Companies and Consumers.—Not content with issuing a circular dated 11th inst., regretting the necessity of discontinuing the electric supply to consumers on the following Tuesday and Wednesday during the hours of greatest demand, the Metropolitan Electric Supply Company followed this up by another on 13th inst., telling their customers it would not be possible to resume the supply at this period of the day until next Sunday, *it being impossible to complete the temporary repairs before that date.* It would be interesting to learn what these repairs are, and why they have become necessary, but on this point we can gather no information. We shall, however, deal with the whole question of electric lighting companies and consumers in our next issue on quite impartial grounds.

A Generous Grant.—Principal Reichel, of the Bangor University College, has received an intimation that the Drapers' Company, London, have resolved to make a grant of £600 towards the maintenance of the department of electrical engineering at the college.

Electrical Mishap at Westminster.—At a quarter to five on Tuesday evening an explosion occurred in the electric light culvert of the Westminster Electric Supply Corporation in Great Smith Street, Westminster, blowing up the pavement for several yards. The paving stones falling into the culvert caused the short circuiting of all the copper conductors, these, unfortunately, being several of the main feeders from the Millbank Street Station. The corporation men were on the spot shortly after this happened, and the short circuited mains were disconnected as quickly as possible. In the meantime, owing to the excessive current thrown on, the feeders running to Parliament Street, these caught fire, but there was no explosion, and *no* boxes were blown up. As soon as it was heard that smoke was issuing from the ventilators men were sent round to remove the covers, and the fire from the burning insulation on the cables was extinguished as quickly as possible. This is the first occasion since the Westminster Company commenced supplying that it has had an accident so serious as to practically extinguish the lights.

Personal.—We learn that Mr. Ernesto Danvers, M.I E E., of Buenos Ayres, has been elected president of the Institution of Engineers of the River Plate. He is shortly to read a paper on the "Progress of Electrical Enterprise in the River Plate."

Mr. J. J. Smith, of Altrincham, has been appointed resident engineer of the new electricity works of the Stockton Town Council at a salary of £250 per annum.

We are informed that Mr. C. P. Sparks (hitherto with Messrs. S. Z. de Ferranti, Limited) has joined the County of London and Brush Provincial Electric Lighting Company as chief engineer.

Lectures.—On 5th inst. Mr. Robert Hammond lectured at the Town Hall, Rathmines, on "Electricity in Relation to Public and Domestic Use." The lecture was delivered under the auspices of the Rathmines and Pembroke Councils.

On Thursday, January 10th, Prof. C. A. Carus-Wilson, M.A, M.I.E.E., will commence a course of lectures to the students of the Electrical Standardising, Testing and Training Institution upon "The Construction and Use of Motors."

Greenock Electricity Works.—From the wording of the third paragraph of the report of the opening of these electricity works, some of our readers have gathered the impression that the works in Greenock have been carried out from a report and designs prepared by Mr. Teague, of Paisley. This, we are given to understand, is an error, as Mr. Teague was not retained as consulting engineer at Greenock, although he gave a preliminary report. Mr. Fedden is the burgh electrical engineer.

The Royal Society.—Among the papers down for reading yesterday were:—Prof. J. A. Fleming, F.R.S., "A Note on the Electrical Resistivity of Electrolytic Nickel," and Dr. C. Chree, F.R.S., "Investigations on Platinum Thermometry at Kew Observatory."

The War Funds.—A most successful concert was given by the employés of Messrs. Siemens Bros. & Co. at the Drill Hall, Woolwich, on Wednesday last week, in aid of the Transvaal War Fund.

Electrical Haulage on Canals.—An installation of electric haulage over a distance of eight kilometres on the Charleroi Canal, Belgium, has just been completed and put in operation.

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American Machinery in the United Kingdom.—The American Consul in Edinburgh is reported in a contemporary to have stated that many American machines are much more efficient than British machines as regards output, and he states that he has found large numbers of American machines at work. Certain printing or folding machinery is instanced, also some rope machinery, but he appears to have fallen into the error so common with all American writers, that we ought to do so much better here in competition, because American wages are so very much higher—he states 70 to 90 per cent. We are much inclined to doubt this. We have made comparisons when possible, and have often found the reverse to be the case without making any allowance for the greater cheapness of living here than in America. On this point also the difference is becoming less, and comparing towns of about equal size, we think that comparatively little difference exists either way. Our home manufacturers have not, therefore, the advantage of low wages so frequently stated, but there appears a desire on the part of American writers to magnify the prosperity of the workman in America. At one time, this was done by the tariff men to a ridiculous extent, but at the present moment even Americans are a little tired of the cry that they can beat the world in open market, and yet the high tariff is necessary to do this. The high-tariff trick is seen through, and American competition would have come much sooner than it has done if high tariffs had not existed. Considering their large areas, the immense natural resources of coal, iron and copper, and other things, it requires the high tariff to be used as an explanation why America has not done more. The vested interests which are such bars to progress here have no counterpart in America. Land is in plenty, and new towns will offer special facilities and endowments in the shape of freedom from taxes to people establishing works.

The New York Metropolitan Railway.—In describing last week the 3,500-KW. generators at present being installed at the power station of the Metropolitan Street Railway Company, New York City, we omitted details of the engines driving these. These engines were made by the E. P. Allis Company, of Milwaukee, for whom Messrs. R. W. Blackwell and Co. are the European representatives. The principal dimensions are: cylinders, 46 inches and 92 inches diameter; stroke, 60 inches. The total weight of the engine is approximately 625 tons. The fly-wheel is 28 feet diameter, constructed in 10 segments, and weighs approximately 100 tons. The crankshaft weighs 41 tons. The engines are designed to consume 13 lbs. of steam per I H P. per hour.

Car Mileage.—The proper estimation of car mileage was one of the subjects dealt with at the recent Chicago Convention. Most companies computed mileage from the conductor's reports, and fully half the replies to a circular letter showed that the mileage of every car was kept. In computing mileage, there is a doubt as to the propriety of including or excluding the distance from the car shed to the line of traffic, the dead mileage which tells against a road if it be not included. The author of the paper discussed was Mr. Mackay, of Milwaukee, and he would include this dead mileage if only that it would tend to discourage badly placed car sheds. The car day is usually 18 hours, which corresponds with English practice. It appears from the discussion that the car-mile basis of accounting is not quite universal, and that there is a basis of car hours. The treatment of trailers also is not standard. Some count trailer mileage; some take no account of the trailer, and generally with all the experience that has been gained on American tramways, the methods of accountancy appear far from fixed. It appears to us difficult to take speeds into account. Comparing a city and a suburban line, each showing 1·0256 per car hour, the car-mile cost would be ·1282 and ·0427 respectively for speeds of 8 and 24 miles respectively, the speeds, of course, varying the results very much. The question admits of a good deal of argument, no doubt. There is some reason in accounting on the time basis, for is not interest on capital based on time; but again, receipts from passengers are based on distance. There is a desire evidently to secure some common basis for comparison that shall embrace all conditions. Cannot the car-mileage be multiplied by a speed coefficient to bring to a common basis? Obviously a rapidly moving car is earning more upon its cost than a slow car, and the car-mile basis, though so commonly used, may possess merely the fact of its being so easy to obtain as an excuse for its existence. At the same time, it seems to us that the car-mile basis is necessary in many ways. It is not of much use to know the car-hour earnings, it does not tell us much as to the condition of the car in regard to passengers. The car-mile figures do tell us this, and the car-mile will probably remain in English work at least to be a basis of computation.

NEW COMPANIES REGISTERED.

Adelaide Development Company, Limited (64,393).—This company was registered on December 2nd, with a capital of £25,000 in £10 shares, to adopt an agreement with the British Westinghouse Electric and Manufacturing Company, Limited, of the first part, Callender's Cable and Construction Company, Limited, of the second part, and H. Noyes, E. Noyes, and Noyes Brothers of the third part, and to carry on in Adelaide, South Australia, or elsewhere the business of tramway proprietors, electrical engineers, suppliers of electricity, &c. The first subscribers (each with one share) are:—L. H. Grundy, Claremont House, South Hampstead, N.W., solicitor; S. E. Appleton, 4, Haseldene Road, Harlesden, clerk; J. W. Ward, 14, Marney Road, Lavender Hill, S.W., gentleman; T. C. Richards, 23, Ingate Terrace, Queen's Road, S.W., gentleman; E. E. Ford, 12, Kylemore Road, West Hampstead, N.W., secretary; G. E. Eggleton, 10, Cheriton Square, Upper Tooting, S.W., secretary; and A. Booker, 19, Porters Road, Paddington, W., clerk. The number of directors is not to be less than three nor more than four; two are to be nominated by the British Westinghouse Electric and Manufacturing Company, Limited, one by Callender's Cable and Construction Company, Limited, and one by Noyes Brothers; qualification, one share; remuneration, £300 per annum, divisible. Registered office, Westinghouse Building, Norfolk Street, Strand.

Electric Light Insurance and Maintenance Company, Limited (64,399).—This company was registered on December 4th with a capital of £10,000 in £1 shares, to acquire the business of the Electric Light Insurance and Maintenance Company, Limited, to supply electricity, to lay down and maintain wires, cables, &c., and to carry on the business of an electric light company in all its branches, and any guarantee and insurance business (except life assurance). The first subscribers (each with one share) are:—A. Lood, 100, St. Martin's Lane, W.C., manager; H. E. Lowry, 100, St. Martin's Lane, W.C., clerk; J. B. Evans, 15, Douro Place, Victoria Road, W., engineer; D. Millist, 3, Norfolk Villas, Crouch End, Willesden, insurance agent; G. E. Wellington, 23, Ebury Street, Easton Square, engineer; F. Flower, 54, Silchester Road, Wormwood Scrubbs, W., clerk; and H. H. Lyde, 21, Gloucester Gardens, Hyde Park, W., solicitor. The number of directors is not to be less than three nor more than five. The subscribers are to appoint the first; qualification, £100; remuneration, two guineas each per board meeting attended (maximum, 50 guineas). Registered office, 100, St. Martin's Lane, W.C.

SUPPLY STATION ACCOUNTS.

Hull Corporation Electricity Accounts.

The accounts of the Kingston-upon-Hull electricity supply undertaking show very favourable results. The new station is probably the reason for the increase alike in capital expenditure, output, and revenue. The original, or Dagger Lane, works were opened in January, 1893, and were described in our columns at the time. The new, or Sculcoates Lane station was opened at the end of October, 1898, so that it assisted in coping with the heavy winter load. A temporary auxiliary plant in North Street dealt with the continually and rapidly increasing demand during the winter months of 1897.

GENERAL STATEMENT.

	1897.	1898.	Increase.
Total capital expenditure ...	£61,739	£94,959	£33,220
Number of units sold	467,352	749,690	282,338
Maximum KW. demanded... ...	687 KW.	1,075 KW.	388 KW.
Gross revenue	£10,419	£16,333	£5,914
Gross profit	£4,968	£8,328	£3,360
Average price per unit sold ...	5·12d.	4·98d.	−·14d.

Hull is one of the towns in which the price has been maintained so as to effectively cover the cost of production, but the rapidly increasing load will, no doubt, reduce it this year well below the 5d. at which the unit approximately stands.

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Revenue Statement.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current	£9,967	5·12d.	£15,546	4·98d.	−·14d.
Meter rents	329	·17d.	456	·14d.	−·03d.
Supply of lamps, &c. ..	...	...	...	...	...
Sundry	123	·06d.	331	·11d.	+·05d.
Gross revenue .	£10,419	5·35d.	£16,333	5·23d.	−·12d.

In the "costs" the increase in the "coal" item is no doubt due largely to the generally enhanced price of coal. The rise in "wages" may be accounted for by the fact that two stations are running, and the same remark might be made about "Establishment charges." Oil, waste, &c., remains unchanged, but, curiously enough, "rent, rates," and "salaries" have both fallen, the collective drop being nearly ½ d.

Costs of Production.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Coal	£1,096	·56d.	£2,034	·65d.	+·09d.
Oil, waste, water and engine room stores.	170	·09d.	298	·09d.	...
Salaries and wages incurred in generation and distribution.	897	·46d.	1,581	·51d.	+·05d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	1,469	·75d.	1,688	·54d.	−·21d.
Works' cost ...	£3,632	1·86d.	£5,601	1·79d.	−·07d.
Rent, rates, and taxes ..	756	·39d.	845	·27d.	−·12d.
Management expenses, salaries of managing engineer, secretary, clerks, &c.	738	·38d.	965	·31d.	−·07d.
General establishment charges, stationery and printing, law charges and insurance.	335	·17d.	594	·19d.	+·02d.
Other expenses	...	...	...	...	...
Total costs ...	£5,451	2·80d.	£8,005	2·56d.	−·24d.

The gross profit has increased from approximately £4,970 to £8,330. Whereas in 1897 the interest and sinking fund charges amounted to about £2,970, these now absorb over £4,820, but the net profit has risen from £2,000 to £3,500, an increase of no less than £1,500, which indicates a particularly satisfactory state of affairs, and especially so if the capital charges on the new station have been fully paid.

Profit Statement.

	1897.	1898.
Interest on loans	£1,496	£2,267
Sinking fund for repayments	1,467	2,555
Net profit, carried forward	2,005	3,506
Gross profit	£4,968	£8,328

CITY NOTES.

Electric Light and Traction Company of Australia, Limited.

The statutory meeting of this company was held at Winchester House on Monday.

Mr. J. B. Braithwaite, jun., who presided, went briefly over the progress which had been made in the three months which had elapsed since the offer of the capital to the public. The whole of the 20,000 preference shares were allotted, the subscriptions being in excess of the amount offered. At a distance of 12,000 miles some time must necessarily elapse before they could get things into working order. They had appointed an engineer (Mr. F. W. Clements) whom they believed to be a man of exceptional ability, in whose hands the Australian operations would be perfectly safe. He is now in Melbourne actively working in the company's interests. The arrangements for the purchase of the two existing Melbourne supply companies had involved some delay, owing to the time occupied in communication with this colony, but that matter they believed had been carried safely through. The board last week cabled out the money to pay out the shareholders in the two companies, and by the end of the present month they would be actually in possession of the two stations in Melbourne, and Mr. Clements would be able to commence at once the concentration of the two works and the introduction of the various economies which it was believed would be effected by working the two concerns at one station. The prospectus stated that the Melbourne Corporation had come to an agreement to purchase the electric cables within their own boundary, and to pay some £40,000 in cash therefor. That arrangement is in course of being carried out. The Corporation had already fulfilled their part of the bargain, which was that in consideration of that they would use their influence to obtain for the company, and give their consent to, orders to light the exceedingly important suburbs of Melbourne for 25 years. The board had received information that this consent had been given and the orders granted, so that they might take it that they had now got the necessary legal rights for lighting those suburbs, and the payment of the £40,000 they were advised would take place in the course of the present month. By the beginning of 1900 they would be in possession of the two properties. The plant was already loaded to its fullest capacity, so that they were not in a position to supply additional lights at present. The board had taken time by the forelock, and had placed orders for an additional two 500-kw. generators, and those they hoped would be ready in time to enable them to push actively the suburban lighting. For a certain time they were to supply current to the Corporation, but they hoped that before that supply was taken off the company would begin its active propaganda in the suburbs, where the demand for current was great, in fact, unprecedented, for the engineer could load up his machines at once if he had them. This company was entitled to the profits, such as they were, of the two companies for the current year, and that would give an immediate source of income. Next year those results ought to be considerably improved. They had taken active steps to commence the Geelong supply at once. Plans for the lighting station had been approved, and authority given for the erection to be commenced. Orders had been placed for the plant, and they had fortunately secured plant exactly suited to their requirements. This plant had been ordered for a South American town some time ago, but owing to a hitch in the arrangements, this company was able to secure it and save several months in the time of delivery. The plant was nearly completed, and would probably be shipped in the current year, or early in 1900. The Geelong winter supply (May, June, and July) would be met by the company. Since the company was formed they had taken a rather important step. They had the opportunity of acquiring the property of the South Australian Electric Lighting Company, which had obtained rather exceptional legislative powers from the Colony of South Australia, including the right to light Adelaide, a city of some 200,000 population. This had been obtained, and formed a very important addition to the rights of this company. There was already a small station in operation at Port Adelaide, supplying a few lights, but that would probably be closed down and current would be furnished from Adelaide itself when the station was in working order. Thus they had the lighting of Adelaide, of "Greater" Melbourne, and of Geelong. Further, they were constantly having offers made to them of concessions in various other parts of Australia, and it looked as though their company was regarded as the most stable company in Australia, and they would have the offer of any concessions worth having. The statements of the prospectus were strengthened by the addition of the Adelaide lighting. Arrangements have been nearly carried through for securing a quotation on the Stock Exchange, and such would be obtained early in the new year.

Volenite, Limited.

The first annual general meeting of this company was held on 5th inst. at Dublin. Lord Lurgan, who presided, said that seven-eighths of the shareholders resided in Ireland. He referred to the balance-sheet and to the delay which had occurred in the completion of the works and the erection of the machinery. Mr. Lamplough, the inventor of volenite, had consented to take over the entire management of the business. Questions had also been addressed to them with regard to electrical volenite. They were now executing orders in connection with this branch of the business, but in order to deal with it fully they should have a large increase of capital. The present intention of the directors, owing to the reports which have been circulated and the distrust which apparently they have aroused, was not to come to the shareholders for further working capital until they proved to them what volenite was. They had been asked questions as to the cost of volenite, but owing to the numberless uses to which it was applied they could not tell the cost, and he did not think they would be justified in doing so. They had been criticised in the press in reference to volenite and as regards the non-existence of works. Well, he was afraid that the press had been misled. For the short time they had been running they got more orders than they could execute, and to enable them to deal with larger orders they would increase their plant, and that, of course, would involve further expenditure. That was a question which was giving the directors considerable anxiety. They wanted to avoid asking for further capital at present, and they had arranged with their bankers for an overdraft, so as to enable them to execute these orders. It might be necessary later on to ask the shareholders for further capital, but they intended not doing so until they had proved what they were doing. He had little doubt that the shareholders would then come forward with the necessary capital. If the shareholders expressed a general wish the directors were willing to increase the capital to £100,000 by a further issue of £20,000, but that rests entirely with themselves.

The report was passed unanimously without discussion.

Mr. Lamplough having handed round photographs of the works, and a catalogue containing a list of the articles they were turning out, said some people had been kind enough to write to him hoping they would see him standing in the dock. Well, that might be amusing, but it was not very encouraging. They had lately purchased additional plant, and were it not for that they could never have undertaken the large orders they had got. He was arranging with the people offering them to finance the venture by paying for the work as it was turned out.

The Chairman said they had received orders for volenite, in which a certain amount of rubber was required. Volenite, in its original state, had not a particle of rubber in it. Fish oil was used in the manufacture of volenite.

A Shareholder said it was stated by the late manager at the last meeting in Dublin that it was not.

Mr. Lamplough said considering that their late manager never made volenite, he did not see how he could know. They had an unlimited amount of raw material to work upon.

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Calcutta Tramways Company, Limited.

The directors' report states that the negotiations with the Corporation regarding the proposed agreement for electric traction have now been brought to a successful conclusion. The principal conditions of the new agreement provide (*a*) that the company shall remain in undisturbed possession of their tramways for 30 years from January 1st, 1901, in consideration of the company converting the system from horse to electric traction within three years; (*b*) that the track rent payable to the Corporation for all lines now existing within their jurisdiction shall be the fixed sum of Rs.35,000 per annum from the date of completion of the electrical equipment; (*c*) that, in lieu of all existing rights of purchase, the Corporation shall have the right of acquiring the undertaking at the expiration of the above-mentioned period of 30 years upon paying 25 year's purchase of the average annual profits for the preceding seven years. If the right of purchase is not exercised at the expiration of the period of 30 years, it can only be exercised at the expiration of successive periods of seven years. The great difficulty in the way of satisfactorily working the undertakings hitherto has been the inadequate means of traction afforded by horses. The climatic conditions, the uncertainty of prices of forage due to recurring periods of dearth and famine, and the inability of the horses themselves to do the work required of them, have made it almost impossible to meet the requirements of the public. Now, however, the introduction of electric traction will obviate these difficulties. The directors propose to create an issue of £950,000 of 4½ per cent. first debentures, which they estimate will suffice (*a*) to redeem the existing £100,000 5 per cent. debentures; (*b*) to pay for the conversion to electric traction; and (*c*) leave a margin of capital available for extensions or for the general purposes of the company.

National Telephone Company.—The transfer books of the 3½ per cent. debenture stock of the National Telephone Company, Limited, will be closed from the 18th to the 30th inst., inclusive, for the preparation of the warrants for the half-year's interest due January 1st.

W. T. Glover & Co., Limited.—The debenture stock transfer books of this company will be closed from Saturday, December 16th, to Saturday, December 30th, both days inclusive, for the preparation of interest warrants.

Chelsea Electricity Supply Company.—The books will be closed from December 18th to 31st for payment of the interest on debenture stock.

Eastern Telegraph Company, Limited.—An interim dividend of 1½ per cent. on the ordinary stock, free of tax, for the quarter ended September 30th, is announced.

City Meeting.—A meeting of the India-Rubber, Gutta-Percha and Telegraph Works Company was held yesterday, and a report will appear next week.

Electrolytic Alkali Company.—Letters of allotment have been posted.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending December 9th, 1899, were £127 1s. 1d.; December 9th, 1898, £137 2s. 1d.; aggregate for half-year to date, £19,864 14s. 1d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending December 8th, 1899, were £2,630 19s. 7d.; corresponding period, 1898, £2,558 8s. 10d.; increase, £72 10s. 9d.

Buenos Ayres Tramways.—The receipts for the week ended November 18th show a decrease of £312.

The City and South London Railway Company.—The receipts for the week ending December 10th, 1899, were £1,110; December 11th, 1898, £1,117; decrease £7. Total receipts for half-year, 1899, £23,650; total receipts corresponding period, 1898, £23,753; decrease, £103. Miles open, 8½.

The Dover Corporation Tramways.—The receipts for the week ending December 9th, 1899, were £145 6s. 5d.; December 9th, 1898, £142 9s. 5d.; increase, £2 17s. 0d. Total receipts to date, 1899, £9,608 0s. 7d.; corresponding period, 1898, £8,069 11s. 7d.; increase, £1,538 9s. 0d. Miles of track open, 1899, 8; 1898, 8. Car miles run, 1899, 4,714; 1898, 4,181. Number of cars, 1899, 11; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, December 8th, 1899, were as follows:—D. U. T. Co., horse cars, £129 5s. 10d.; ditto, electric cars, £2,814 19s. 3d.; D. S. D. Co., electric cars, £672 9s. 8d.; total, £3,616 14s. 9d.; corresponding week last year—D. U. T. Co., horse cars, £2,281 7s. 7d.; ditto, electric cars, £481 10s. 6d.; D. S. D. Co., electric cars, £650 11s 10d.; total, £3,363 9s. 11d.; increase, £253 4s. 10d. Aggregate to date, £96,450 8s. 4d.; aggregate to date last year, £91,499 14s. 0d.; increase to date, £4,950 9s. 4d. Worked:—The mileage open is 40 miles electrically, 4 miles by horses, as against 16 miles electrically, and 28 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways. — The receipts for the week ending December 10th, 1899, were £581; December 14th, 1898, £285; increase, £296. Number of cars, 1899, 28; 1898, 10. Total receipts to date, from April 1st, 1899, £21,727; 1898, from June 29th, 1898, £6,302. Miles of track open, 12; 1898, 8¼.

Hobart Electric Tramway.—The receipts for October show an increase of £45.

The Liverpool Overhead Railway Company.—The receipts for the week ending December 10th, 1899, amounted to £1,458: corresponding week last year, £1,388; increase, £70; total increase for half-year, £1,883.

The South Staffordshire Tramways Company.—The receipts for week ending December 8th, 1899, were £670 10s. 9d.; December 9th, 1898, £599 17s. 4d.; aggregate receipts for 49 weeks £32,651 1s. 8d; 1898, £30,949 18s. 8d.

STOCKS AND SHARES.

Wednesday Evening.

Many people are asking why it is that war with the South African States should cause flatness in shares of Home industrial undertakings, or in companies whose operations are perhaps carried on at the other end of the world. Brokers are constantly receiving inquiries as to why electrical securities should be flat, or what has caused the fall in some of the telegraph descriptions, seeing that the companies' lines run to the Eastern hemisphere, right away from the theatre of war. The stereotyped answer is that the weakness is attributable to dearer money, a reply which means little or nothing to the average outsider, who can trace no connection between the Transvaal war, the dearness of money, and the dwindling away of the prices of his investments. We will venture to attempt a more comprehensive reply to the query than the busy broker has time to dictate.

War, like most other things nowadays, costs money, and is, in fact, the most costly luxury in which a nation can indulge. To raise the money recourse must be had to the nation, and in October last, when eight millions sterling was voted as a preliminary grant to the War Office, three-eighths of the amount was readily obtained from the money market and the Stock Exchange. This was the beginning of the dear money scare, which has now developed into a squeeze. The Bank Rate was doubled in very little more than a month, and as the news from the front gave evidence that the campaign would last considerably longer than was at first expected, it became apparent that considerably more money would also be wanted. This is the time of year when all the world's money markets are eager to obtain gold, and as the banks are now offering handsome rates for money on deposit, many people are selling their investments to place the proceeds with the banks. But a stronger reason for the fall is that dear money invariably induces a feeling of apprehension, which causes free selling in speculative departments, and losses incurred thereby have to be met by forced sales of higher class securities at the very time when dealers are nervous and have no buyers. There are, of course, other causes at work which lead to a decline in electrical and industrial shares at such a time as this, but those which we have outlined are the main factors. They are responsible, for instance, for the weakness in the supply market. However well the companies may be doing, their shares cannot withstand the effect of entirely foreign influences, and under the circumstances, an upward reaction cannot be expected until some idea is obtained as to when hostilities will be over, with a consequent relief to the money and stock markets generally.

Metropolitans are a particularly dull spot in the electrical supply section. There seems to be a muddle over the company's new works at Willesden, and the buyers who came along in November have got all the shares they required. The carrying-over rates in this department on Tuesday averaged from 7 to 9 per cent.

Electrical railway stocks naturally suffer badly in days of flatness, owing to the narrowness of the market. City and South Londons continue weak. We cannot say we are particularly surprised, for it must be remembered that the new branch to Moorgate Street, although on the point of completion, is not yet open, but the capital required for its construction has already begun to rank for dividend, which will naturally make a difference to the amount available for distribution on the old stock. Waterloo and City has lost strength on the fear that the agitation now on foot with regard to the overcrowding on the system may lead to the line losing traffic, which, we venture to think, is a needless apprehension.

In the country division, Bournemouth and Poole New Ordinary shares, issued at £1 premium, are quoted at £1 premium above the issue price, while the new Preference are nominally about 10s. premium. Seeing that the existing issue of Preference shares stands at 10½, there is certainly not much to be gained by subscribing for the new issue at the same price. The last day for applying is Thursday, December 21st.

Telegraph stocks are moving in the same direction as everything else. The fall in Anglo-Americans has been accelerated by a smart slump in Yankee rails. Eastern Ordinary was scarcely affected by the declaration of the usual quarterly dividend, but the money market has exercised the regular depressing effect. Moreover, the stoppage on one of the company's lines from South Africa was not an encouraging item for the bulls, who also were mulcted pretty heavily for contangoing their stocks to the end of the year. In other telegraph issues scarcely anything is doing, and business, on the whole, in the electric market is very slack.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	Name.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Dec. 6th.	Closing Quotation, Dec. 13th.	Business done during week ended Dec. 13th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 12s	3 %	£3 9s	65 — 68	65 — 68	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	115½—116½	115½—116½	116⅜	115½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	17 — 17½	16⅞— 17½	17 5/16	16⅞
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	15 — 15½	14⅞— 15⅛	15⅛	14⅞
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	198 —202	198 —202	...	...
1,382,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	103 —105	103 —105	104	103
294,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛— ¼	⅛— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	9 — 10	8½— 9½	9⅜	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	...	...
12,981	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½ %	3½ %	11⅜— 12¼	11⅜— 12¼	12	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101 —104	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½ %	7 %	7 %	154 —159	150 —155	156	152½
1,795,000	Do. 3½ % Pref. Stock	100	...	...	...	98 —101	98 —101	99⅞	98½
89,900	Do. 5 % Debs., repayable August, 1899	100	5 %	5 %	...	... ...	... ...	...	...
1,482,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	116 —121	115 —120	116	...
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	15½ — 15⅝	15 — 15½	15 5/16	14⅞
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
320,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	117 —122	116 —121	...	...
25,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
800,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
800,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—6,000	25	4 %	...	...	101—104%	101 —104%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5½ %	11¼— 11⅝	11¼— 11⅝	11¼	11¼
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15½— 16	15½— 15⅝	15 13/16	15 9/16
150,000	Great Northern Telegraph, of Copenhagen...	10	10 %	10 %	...	31 — 33	31 — 33	...	...
89,500	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	50	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000	1	...	...	...	¼— ⅜	¼— ⅜	...	...
64,000	Do. do. 5% Pref., Nos. 1 to 64,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	5 — 5½	5 — 5½	5⅛	...
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	14⅜	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼— 5½	5¼— 5⅝	...	...
1,239,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —102	100 —102	100⅜	100
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	¾— 1	¾— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	...	102 —105	102 —105	103½	..
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	7½	...
3,351	Submarine Cables Trust	Cert.	...	...	...	127 —132	126 —131	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5¼	4¾— 5¼	...	...
151,723£	Do. do. 5 % Debs.	Stock	...	..	...	105 —108	105 —108	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	%	...	99 —102	99 —102	101⅛	100
80,008	West Coast of America, Nos. 1—80,000 and 53,001—53,008	2½	...	...	...	⅛— 1	⅛— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Brss. Sub. Tel.	100	...	...	...	102 —105	102 —105	...	...
369,531	Western and Brazilian Telegraph 4 % Deb. Stock Red.	Stock	...	...	...	104 —107	104 —107	...	...
88,831	West India and Panama Telegraph	10	1 %	2%	...	¼— 1½xd	¼— 1½	1	...
84,568	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	9½— 10 xd	9½— 9⅝	9 11/16	9½
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	7½— 8½xd	7½— 8½	...	...
89,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	106 —109	106 —109	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7½— 8½	7½— 8½	...	...
12,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	...	9 — 10	9 — 10	...	...
80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	10 — 11	10	...
20,000	Do. do. do. do. Nos. 20,001—50,000	5	...	...	...	9½— 10½	9½— 10½	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5⅝— 6¼	5⅝— 6¼	...	...
84,000	*Chelsea Electricity Supply, Ord.,	5	5 %	6 %	6 %	8 — 9	7½— 8½	8¼	...
100,000	Do. do. do. % Deb. Stock Red.	Stock	4½ %	4½ %	...	111 —113	111 —113	113	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000	10	7 %	10 %	6 %	11½— 12½	11 — 12	11½	11¼
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 14	13 — 14	13⅜	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10½— 11½	10 — 11	10½	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	...	111 —114	111 —114	111⅛	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5½	5 — 5½	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	2⅞— 3½	2½— 3	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	6 — 6½	5⅝— 6¼	5⅞	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	104 —106	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	14 — 15	13½— 14½	14½	13⅝
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	13½— 14½	13½— 14½	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½— 16½	15½— 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	15½— 16½	15½— 16½	15⅝	15½
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	4½— 4¾	4½— 4¾	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	9 %	12 %	12 %	14 — 15	14 — 15	14⅜	14

* Subject to Founder's Shares.
Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.
† Quotations on Liverpool Stock Exchange.
§ Dividends paid in deferred share warrants, profits being used as capital

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Dec. 6th.	Closing Quotation Dec. 13th.	Business done during week ended Dec. 13th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2⅜— 3¼	2⅜— 3¼	2⅞	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
80,000	British Electric Traction	10	...	...	6 %	16½— 17	16½— 17	16⅞	16½
80,000	Do. do. 6 % Cum. Pref. 80,001—60,000	10	...	...	...	12½— 13½	13 — 13⅝	13⅝	13
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	126 —129	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11½— 12½	11½— 12½	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6⅝	6½— 6⅝	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅞— 2⅛	1⅞— 2⅛	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —115	110 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13 — 14	13 — 14	...	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	113 —116	113 —116	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10⅜	10¼— 10⅜	10⅜	10⅜
178,808	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,083	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5½	4⅜— 5½	4⅜	...
71,447	Do. do. Def. do.	5	...	...	...	5½— 5⅝	5½— 5⅝	...	...
630,000£	City and South London Railway	Stock	1 9/16 %	1⅞ %	2⅛ %	61 — 64	61 — 64	62½	61
37,000	Do. do. Ord. shares, Nos. 22,501 to 60,000	4½	...	...	...	3½— 4½	3½— 4½	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	3⅝	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛ %	6 %	6 %	2 — 2⅛	2 — 2⅛	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛ %	6 %	6 %	3½— 4⅛	3½— 4⅛	4⅛	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2 — 2¼	2 — 2¼	2⅛	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	2⅜— 3¼	2⅜— 3¼	...	...
140,800	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	104 —107	104 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅜— ⅝	⅜— ⅝	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	11 — 13	10 — 12	10⅞	...
80,000	Henley's (W. T.) Telegraph Works, Ord.	5	10 %	12 %	14 %	12½— 13½	12 — 13	12⅛	12
15,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	7 %	5½— 5⅝	5 — 5½	5 5/16	5¼
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	21	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3½ %	3½ %	8⅜— 9	8 15/16— 9 1/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13¼— 13⅜	13¼— 13⅜	...	...
37,850	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	36 — 40	36 — 40	38	36
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9 — 10 xd	9 — 10	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	101 —104	...	...

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‡ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½% Debentures of £100, 103—106.
National Electric Free Wiring, 10s. paid, 4s.—5s.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 18—19.
Do. do. Pref. (£10 pd.), 10½—11.
Smithfield Market Electric, 1—3.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6%, £5 (fully paid), 7½—7⅝. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
Kidderminster and District Electric, Pref. (£6 pd.), 6—6½ xd.
*T. Parker, £10 (fully paid), 18⅜.

* From Birmingham Share List.

Bank rate of discount 6 per cent. (November 30th, 1899).

MARKET QUOTATIONS, Wednesday, December 13th.

CHEMICALS, &c.		This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) ..	per ton	£29	£29	..
a „ „	per ton	£27	£27	..
a Bleaching powder	per ton	£6 10	£6 1	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£16 10	£16 10	..
a Bensole (90 %)	per gal.	7/-	7/-	..
a „ (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25 10	£25 10	..
a Lead, Nitrate	per ton	£25	£25	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks ..	per lb.	4½d.	5¼d.	¾d. inc.
a „ Caustic (75/80 %) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£25	£25	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£7 10	£7 10	..
Crystals	per ton	£3	£3	..
a „ Bichromate, casks ..	per lb.	3¾d.	3¾d.	1d. inc
METALS, &c.				
Aluminium Wire, in ton lots ..	per ton	£224	£224	..
b „ Sheet, in ton lots ..	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£90 to £160	£90 to £160	..
c Brass (rolled metal 9" to 12") basis	per lb.	8d.	8¼d.	¼d. dec.
c „ Tube (brazed)	per lb.	10d.	10d.	..
„ Wire, basis	per lb.	8¼d.	8¼d.	¼d. dec.

METALS, &c. (*continued*).		This week.	Last week.	Inc. or Dec.
f Ebonite Rod	per lb.	8/-	8/-	..
f „ Sheet	per lb.	5/-	5/-	..
g Copper Bars	per ton	£85	£85	..
g „ Wire (basis price) ..	per lb.	10½d.	10½d.	..
g „ Sheet	per ton	£85	£85	..
g „ Rod	per ton	£85	£85	..
m German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha, fine	per lb.	7/-	7/-	..
h India-rubber, Para fine ..	per lb.	4/6½ to 4/7½	4/6½ to 4/7½	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants)	per ton	66/8	68/4	1/8 dec.
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 ..	per ton	£14 5	£14 5	..
g Lead, English Ingot	per ton	£17 10	£17 10	..
g „ „ Sheet	per ton	£19	£19	..
m Manganin Wire No. 28	per lb.	8/-	8/-	..
g Mercury	per bottle	£9 12 6	£9 10	2/6 inc.
d Mica (in original cases), small	per lb.	2d. to 8d.	2d. to 8d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large	per lb.	3/6 to 7/6	3/6 to 7/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ fl'd str'p & sheet	per lb.	From 1/2½	From 1/2½	..
c Platinum	per oz.	£3 11	£3 11	..
p Silicium Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/	..
i Steel, Magnet, acc'd'g to desc'p'n	p. ton	From £15	to £40	..
i Steel, Magnet, in bars		£58	£18	..
g Tin, block	per ton	£124 5 nom.	£124 5 nom.	..
g „ foil	per lb.	1/7	1/7	..
m „ wire Nos. 1 to 16	per lb.	1/10	1/11	1d. dec.
p White Anti-friction Metals— "White Ant" brand ..	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles	pr lb.	7¾d.	7¾d.	..
j „ Best Flax, 6 lea. ..	per lb.	5d.	5d.	..
j „ Hemp, 8 ply 10 lbs. ..	per lb.	8¾d.	8¾d.	½d. inc.
j „ „ Russian, 10 lbs.	per lb.	4¾d.	4¾d.	..
j „ Jute, 180 lbs. rove ..	per ton	£14	£14	..
k Zinc, Sheet (Vielle Montagne bnd.)	p.t.	£25	£25	..

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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NORTHERN SOCIETY OF ELECTRICAL ENGINEERS.

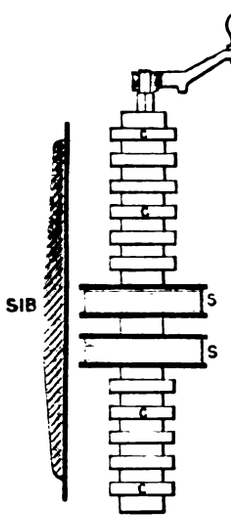
METHODS OF SUPPRESSING ARCS IN SWITCHES, FUSES, &c.

By ERNEST KILBURN SCOTT, A.M.I.C.E.

(*Read at Manchester, Tuesday, December 5th.*)

(*Continued from page 946.*)

The Oerlikon Series Parallel Controller.—In this controller the magnetic field is set up by two stationary solenoids which surround the main contact cylinder. The centre of this cylinder is of iron and the return circuit is formed by a metal backing to plate carrying



B 1 B, Soft iron backing; C, Contacts; S, Solenoid.

FIG. 7.—OERLIKON MAGNET BLOW-OUT CONTROLLER.

the valcabeston partitions. The arrangement is said to be very effective, and, as will be seen from fig. 7, it takes up very little space.

Car Lighting Switch and Fuse.—The General Electric Company, of America, make a very neat car lighting switch and fuse in which is incorporated the magnetic blow-out idea. The arrangement is shown

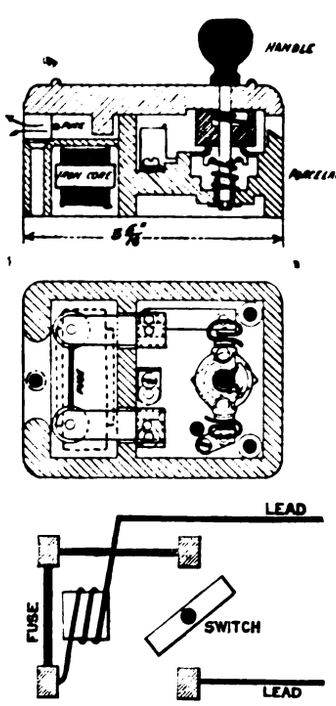
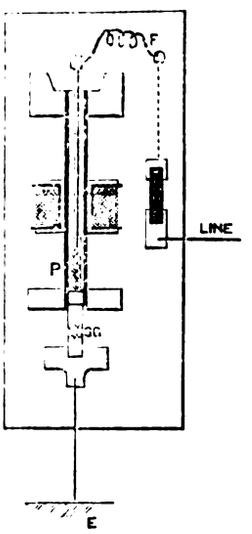


FIG. 7A.—CAR SWITCH AND FUSE, WITH MAGNETIC BLOW-OUT.

in fig. 7A, and it will be noticed that there is a small electro-magnet immediately below the fuse wire. Although only $\frac{1}{2}$-inch is allowed between the terminals, yet this is found sufficient for a 500-volt car circuit when the blow-out device is used.

Combined Solenoid Blow-out and Fuse.—A clever combination of the solenoid blow-out and fuse has recently been devised. It consists of a fuse wire carried round a porcelain block many times and attached to terminals at either end. The fuse wire itself thus forms a solenoid, and when a heavy current passes the magnetic field given by the spiral is sufficient to deaden the arcing, the direction of the magnetic field being such that what arcing does occur is driven outwards from the centre support.

Circuit Breaker and Shunted Fuse.—Circuit breakers which have been so uniformly successful for voltages of 500 or so, failed with several thousand volts even when the break was increased to several feet. This fact and the inconvenience of operating very large switches, therefore necessitated some special method of using this



F, Flexible; P, Plunger; S G, Spark gap; E, Earth.

FIG. 8.—GARTON-DANIELS LIGHTNING ARRESTER.

valuable appliance for high tension work. This was found in the addition of a thermal device in the form of a shunted fuse, as first suggested by Mr. Mordey in 1888. The circuit breaker contacts are arranged to give a comparatively short opening, and when the breaker is opened by the usual magnetic device, current is thrown on to the fuse, which being enormously overloaded goes off with violence, sufficient time having, however, elapsed to enable the circuit breaker contacts to get a fair distance apart.

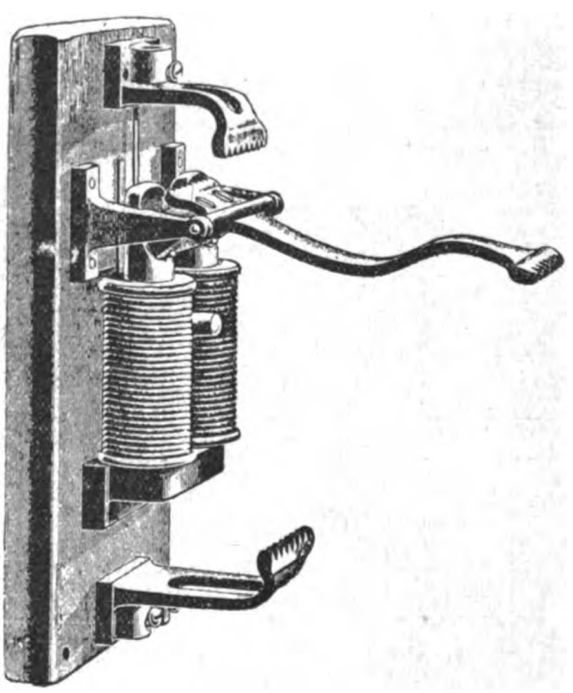


FIG. 9.—WOOD'S LIGHTNING ARRESTER.

It is interesting to note that one of the principal arguments with those advocating circuit breakers has always been that the employment of circuit breaker saved the cost of fuse renewals, and also the time necessary to get a new fuse into place. The addition of the shunted fuse nullifies these points, and it is a question therefore whether it would not be cheaper and better to employ a fuse only.

The writer does not propose to describe lightning arresters * in

* The name lightning arrester is a misnomer, as its purpose is to give the lightning the shortest possible path to earth. Its *arresting* properties are only necessary for stopping the arc which follows after the lightning flash, and which arc is apt to be kept up by the machinery working on the circuit.

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detail, but there are forms in use which are so nearly akin to circuit breakers, that it may be interesting to briefly refer to them.

The Garton-Daniels Arrester is shown in fig. 8. The lightning discharge enters at the lower end of the graphite resistance (shaded black), and from there passes through the flexible cable to a soft iron plunger, which normally rests on the top of the upper discharger. It then jumps the spark gap and goes to earth, but if current follows, the drop across the graphite resistance, with which the solenoid is in shunt, sends current through the solenoid, and the resulting magnetism draws up the soft iron plunger several inches, thus breaking the arc inside the tube.

Wood Arrester.—The wood arrester, as made by the Fort Wayne Corporation, also depends on a mechanical movement to break the arc. Fig. 9 shows the device. Both line and machine terminals are connected to the lower part of the arrester. Earth is connected at the top, and the lever thus forms the path for the lightning discharge, there being a spark gap at either end. In its normal position the lever is vertical, but when a discharge occurs the dynamo current

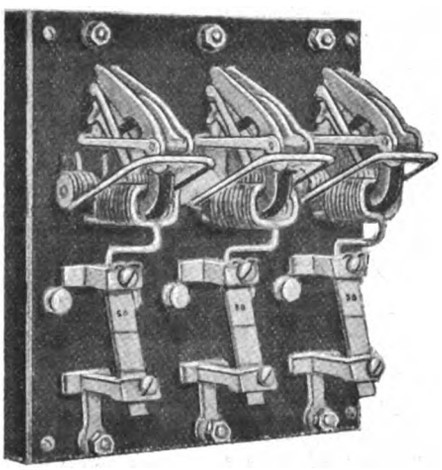

Fig. 10.—Sentinel Automotor Circuit-Breaker.

momentarily following the discharge energises the coils, thus drawing the plungers, and tilting the lever into the position shown in the figure. Directly the arc is broken, the coils lose their magnetism, and the lever falls by gravity into its normal position again, ready for the next discharge.

The Brush Electrical Engineering Company supply a somewhat similar apparatus.

Sentinel Circuit Breaker.—An interesting if somewhat complicated automatic circuit breaker is made by the Sentinel Electric Company, of Wilmington, Delaware, U.S.A. The arrangement is indicated in fig. 10, which shows the triple-pole type. A bar of brittle metal

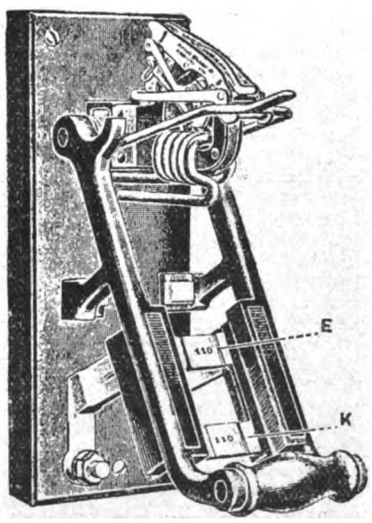

Fig. 11.—Sentinel Circuit Breaker Switch.

is mechanically broken out by a spring released by a trigger, this latter being actuated magnetically as in the I.T.E. and other circuit breakers.

Unlike a fuse which first melts at the centre and gradually burns away towards the terminals, the piece of metal in this case is removed mechanically in its entirety, and there is thus exceedingly little arcing. There are no moving electrical contacts, the apparatus is not affected by electrolytic action and does not become jammed, which is sometimes the case with the ordinary circuit breaker.

Fig. 11 shows the idea applied to a switch, E and K being the pieces of metal placed ready for breaking out.

(*To be continued.*)

INSTITUTION OF MECHANICAL ENGINEERS.

Contrary to ordinary practice, a non-technical man has given an address before the Institution of Mechanical Engineers in the person of Lord Charles Beresford, who had much to say on China as a field for mechanical engineers. Some of our contemporaries appear to have taken his remarks as illustrating a phase of Chinese character very different from that of the European. We fail, ourselves, to see very much point in this. For example, the speaker saw a big gun which had been loaded with the wrong powder, and the breech had blown out and killed some men. Untaught by this experience they tried the same powder in another gun, and more men were killed. This is looked on as carelessness of life. In what is this different from the English? We ourselves, mere outsiders, had information that the British Army was short of guns. It was notorious in the Army itself. The Government must have known of it. Yet nothing was done to make good the deficiency, and the Government were forced into war without guns or cavalry, and only by borrowing from the Navy, and risking to such extent our first line of defence, have we been able to make the stand we have made at Ladysmith. Has not our Government been far more careless of life than the derided Chinese Government? So while the Chinese trained guns in a way to both hit the enemy and kill their own men, our English Government, for lack of proper appliances, are killing our own men, even if they are hitting the enemy.

Paraphrasing the old adage, "What is the use of temptation unless you fall into it?" British generals seem to carry out their masterly strategy by asking themselves, "What is the use of an ambush unless we fall into it?"

Again, it was found difficult to persuade the Chinese that China was not being robbed when the foreigner was allowed to make investments in the country. Is not this exactly the attitude of the protectionists and tariff mongers of America and most European nations, too, though to a less extent? And is not the same spirit equally rampant in this country, though only in the matter of local politics, for in Imperial politics we seem to have left the rest of the world behind us a very long way. Lord Charles gave an instance also of the weak and foolish policy pursued by the British Government, who when some of Mr. Kinder's engineers were maltreated by rioters—Mr. Kinder being the engineer of a 300 miles railway—simply called a conference of the whole of the foreign ministers, by whose united action the rioters were whipped, just as were some other men who had damaged a pump handle. Lord Charles aptly terms this skulking behind foreigners, many of whom doubtless were not sorry to see British subjects maltreated. What would Palmerston have done? It was safe in his days for an Englishman to go anywhere. China is likely to be a large factor in the near future. The coal fields of Shansi have seams 80 feet thick, and generally the mineral wealth of China is incalculable. Manchuria is a white man's country climatically, resembling Vancouver, B.C., in soil and in resources. With such immense resources and so enormous a population the time will come when China must be a power in the world. At one time the Japanese were quite as averse as the Chinese are now to any outside influences. Indeed, we believe the Japanese were even more persistently hostile than the Chinese. But Japan woke up, and to-day one European power—Russia—is sorry that she did so. China has 300 or 400 millions of inhabitants. This number of people cannot be exterminated. They live in a fruitful country, and some day they will become the equivalent in power to 10 or 15 Japans, and probably all the world will be sorry that they were wakened up, and only the United States will be powerful enough and numerous enough to withstand them. Lord Charles, though he does not look so far forward, sees the potentiality of the Chinese Empire, and entertains hopes that, in conjunction with America, Japan, and Germany, we may preserve the open door. He does not mention other countries, for their trade is practically *nil*; Russia, for example, only sending two cargoes of seaweed to Manchuria during last year. Undoubtedly China will be a huge consuming nation when wakened up to the desire to live differently, and made capable, by the development of its wealth, of becoming an outside buyer.

THE STEAM ENGINE FOR ELECTRIC TRACTION POWER HOUSES.

In no department of high-class power generation is economy so much sacrificed as in traction work, if measured by the weight of coal burned per kw. Writing on the subject in the *Engineering Magazine*, Mr. C. A. Hague calls attention to the growing size of power units which already bid fair to become as large as 10,000 h.p. in a single unit. Seven or eight years ago direct connection was little known—no doubt he is referring to traction work, not to English electric light practice—instead there were belts and clutches and countershafts, and few plants with five or six units of 1,000 or 1,500 h.p. To-day three-phase alternating plant might be carried up to the 10,000 h.p. limit. When steam roads come to be electrically operated, the variable load due to the passengers will be a much less proportion of the fixed load than is the case with street car work.

In selecting engines for traction work the great load variation is an important factor, and that engine must be chosen which gives the best commercial economy. With steam engines higher types of engine in respect of multiple expansion demand the closer adherence to the most suitable conditions. With a plain slide valve engine a

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wide variation with throttling governor will cause quite a comparatively small effect upon economy, but as the organism of the engine is raised in complexity, so will departure from ideal conditions reduce the economy. This has so far put a check on any serious development beyond that of the compound engine.

Comparing traction with other work, the author gives the following figures for different types of engine under steady load and the ordinary load of a power house, the figures showing relative steam consumptions:—

Type of engine.	Steady load.	Power house.
Simple non-condensing	100	130
Simple condensing	100	145
Cross-compound condensing ...	100	125
Triple-condensing	100	150

The cross-compound engine hardly bears out the initial statements, but it is just for this reason that this type of engine has been so much used, for it is well suited to its work, especially if fitted with variable expansion gear on each cylinder. The compound engine is, in fact, fairly free from complication, and is a fair compromise of power load and temperatures. Variable load is held to be the obstacle to multiple expansion; the author looks to using as many as eight cylinders on a quarter-crank engine to produce 15,000 H.P. in a single unit, but he would still retain the compound engine. The trouble with a load varying from zero to 50 per cent. overload is, he thinks, less a matter of the total range of expansion than of the use of steam in so many cylinders in series. He suggests that engines should be governed directly by their voltage rather than by speed. Let the speed take care of itself and look after the voltage, is what he suggests. Why, also, should we be so saddled with the old idea of producing pretty indicator cards?

In his own experience he has found it useful to apply automatic expansion to the first two cylinders of a triple expansion engine, and fix the third cylinder cut-off well out, as many engineers now do in two-cylinder compounds, fixing the L.P. cut-off at seven-sixteenths of the stroke. His idea, evidently, is to use the clearance volumes throughout the engine as a means of keeping back steam from the large final cylinder, and of letting it out freely to this cylinder as and when the power demanded decreases or increases. English tramway practice, so far, has been along rather difficult lines. Taking any one power station as an example it will generally be found serving one long line of communication. If the output of such a station be compared with that of a station serving several routes the difference observable will be found to be very great. In the one case the variation is rapid and wide. In the other case the output as shown by the feeder panel ammeters will be of the same unsteadiness as the station ammeter in the former case, but the station ammeter in the latter case will be found steady, its movements being the mean only of the movements of the various line ammeters, which balance one another for long periods of time at a stretch. This is, of course, only what might be expected, and the more varied and numerous the branch lines the steadier will be the station load. Experience alone can show what the anticipated mean load of a station may be taken to be, but it will certainly not vary under usual circumstances with such enormous rapidity and frequency as has too frequently been claimed. We are promised a review of the forms of engine adopted in large installations of typical form both as to general arrangement and constructive features.

BRITISH AND AMERICAN MACHINE TOOLS.

An article in the *Engineer* endeavours to draw comparisons on this vexed subject. Attention is specially directed to the American practice of confining a works to the manufacture of one, or at most, a very few machines. Unlike our own shops, the American shops do not make lathes and planers under one roof, and even the man who makes lathes will confine his energies to one class of lathe, or even to one size of that class. In this way, of course, men become expert, if narrow, and the writer considers that the convenience of working tools is well thought out. In many cases, too, he does not think that the reproach of lightness can be held against American tools, for they actually weigh more than English tools so recently denounced by Americans as clumsily heavy. But American tools are still, in many cases, light. With lathes, for example, of the same size, the American head stock gearing is not above two-thirds as wide as in English practice, and the American slide rest is very paltry. An English user of American machines recently informed us that he found American machine tools were good so far as the machine work was concerned, but that they were most unsatisfactory in all points where hand work came in, as, for example, the fixing and alignment of brackets, &c., all which is what we should expect, the Americans being *par excellence* machinists rather than handicraftsmen.

We need hardly again refer to the great difference of conditions here and in America, more particularly in the matter of materials, on the softness and tenderness of which under the tool the Americans pride themselves more, we believe, because Americans are so wrapped up in the idea of rapid manufacture rather than of the durability of the thing manufactured. Evidence is accumulating every day of the fact that this idea is carried to an unwise extent by American manufacturers.

The writer of the article is particularly struck with the large use of vertical boring and turning mills, which have superseded the large lathe, and are a source of economy in many ways. Thus the overhead traveller can dump down the work on the table of a vertical tool and go off on other work, whereas it must remain in attendance on an ordinary lathe until the work is fixed.

We think the author is possibly a little out of date in his knowledge of English shops, for he rather exaggerates the neglect of tool-grinding machines, and he states that special tool grinders are not to be obtained from any English makers. As one of our American contemporaries recently pointed out, the very best American works have been compared with the tail end of our own shops, to the obvious disadvantage of the latter. While there is a good deal of truth in the arguments advanced, there is a great deal of exaggeration, for our best English workshops do not get into print, and, as a fact, do not, to say the very least, compare badly with the best American shops. It was from one such shop, large users of both English and American tools, that we learned that though the American tools were so good as regards the machine work upon them they were so poor in adjustments. In all cases of American machine tools they had found it necessary to readjust everything, and they had also found that their production as worked on English methods was greater than American rates, and Americans would not even credit the fact.

PHYSICAL SOCIETY.

At the meeting held on December 8th, Prof. W. E. Dalby exhibited a friction dynamometer. The torque to be measured produces a twist in a spiral spring, and the object is to determine the amount of this twist. Side by side upon the shaft are two pulleys, one keyed to the shaft and the other fastened to the end of the spring. The lead of one pulley upon the other, therefore, measures the twist. Two other pulleys are mounted upon a slide and are joined up to the first ones by means of a continuous band similar to a Weston's differential pulley block. When the shaft is at rest the two pulleys on the slide are touching, but any motion of the shaft produces a twist in the spring, and, therefore, a lead of one of the shaft pulleys on the other. This produces a separation of the slide pulleys, which is proportional to the lead and therefore to the torque, and so from a knowledge of the constants of the dynamometer and its number of revolutions per second the power transmitted is at once determined.

SMOKE.

There are three distinct forms of smoke turned out of chimneys, using the term smoke as indicative of imperfect combustion, although in one case there is no colour of which to complain.

The first class of smoke is that which consists of numerous particles of soot carried in otherwise transparent furnace gases. The second class is not, strictly speaking, smoke, but consists of impure hydrocarbon gases distilled from coal freshly thrown upon the fire. Its colour is a dirty green or yellow. The third class of smoke is that colourless product of imperfect combustion known as carbon monoxide.

Before any attempt can be made to prevent smoke, its formation must be studied. We will deal first with the second class, the green and impure gas driven off bituminous coal when placed upon the fire. This kind of smoke consists of the hydrocarbons of the coal, the ethylenes, butylenes, methanes, and other heat and light producers of coal gas mixed with tars and water and ammoniacal products. The ordinary house fire is a producer of this kind of smoke, because it is usual to feed fresh fuel upon house fires from above, and in comparatively large quantities at once. The evolution of gas from a solid must of necessity cause an enormous absorption of latent heat, and such gases are cold, and will usually not ignite by application of a lighted match. As the under bed of the fire acquires heat the gases are liberated at a higher temperature, and when an opening is made through the upper coal, admitting air through or over the glowing fuel, the green gases will ignite, first in little bursts of flame and later in continuous flames of considerable length. To prevent formation of green smoke the fresh fuel thrown upon a fire might be applied continuously. One way of doing this is to have a deep hopper below the fire with a movable bottom which can be raised by a rack and pinion gear, the top of the fire being thus maintained at or near the same level, and the evolution of gas being continuous and steady and not so great as to overtax the temperature maintaining capacity of the incandescent mass of superincumbent fuel. When continuous top feeding is practised—a practical impossibility in most houses—the coal is constantly dribbling upon a flaming fire, and there is sufficient temperature and sufficient air to maintain continuous flaming combustion. But the fire is contained between three walls of firebrick and no boundary is water cooled. The ordinary house conditions are, however, as above stated, alternate periods of heavy firing and rapid gas evolution with insufficient temperature.

The third class of smoke is not possible, we should imagine, in a house fire. Carbon monoxide gas is formed whenever air is passed through a thick mass of incandescent coke. When a large household fire has become bright and red throughout this gas comes off at the surface of the fire, but as the surface is freely exposed to the draught of air that is moving towards the chimney it rapidly unites with the fresh air and burns with the characteristic purple flame of monoxide upon the surface of the fuel. Carbon monoxide is formed in closed coke stoves, and has the property of passing through red-hot cast-

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iron. It is possibly due to this property, combined with its remarkable affinity for the hæmoglobin of the blood, that people who use such stoves become pale and anæmic.

When we come to apply observations made upon a house fire to the larger furnace of a steam boiler, we shall discover that the conditions very closely parallel themselves, and results must be sought along similar lines. The green smoke from fresh fuel is the cause of the worst ingredients of a yellow fog, which can be closely paralleled by closing the chimney of a house fire when freshly coaled. In a boiler furnace, heavily fired, these impure hydrocarbons are given off, and find themselves surrounded—below by the cold fresh charge of coal, and above by the water-cooled furnace. They have no source whence to gain an accession of temperature, and they escape at the chimney top unburned, and absolutely wasted. Very occasionally it will happen that a volume of such gas gets as far as the main flue, and acquires temperature from the hot brickwork, and being mixed with the correct proportion of air, a flue explosion takes place, sometimes of considerable severity. Ordinarily, with care in stoking, or by the mere accident that the process of stoking is not instantaneous, the evolved gases ignite with the first shovelful, and the fresh fuel not smothering the fire beneath, flame is continued, and more or less combustion takes place. But hydrogen unites with oxygen more easily than does carbon, and it usually happens that the hydrogen burns, and the nascent carbon is set free unconsumed as soot, and forms black or grey smoke. The reason for this smoke is, that there has been an admixture of air either insufficient in quantity or improperly intermixed, or the temperature has been too low for perfect combustion, the surroundings of the furnace, *i.e.*, the water-cooled plate, exercising a chilling effect.

It has been found by experience that, with careful stoking, a Lancashire boiler can be fired smokelessly without loss. The conditions necessary are a velocity of draught of 30 feet per second, which is not excessive; an intimate admixture of the gases driven off the fire with fresh air admitted in fine streams above the fire; a temperature sufficient to ignite the mixed gases at the bridge when they have all swept over the length of the fire and become well mingled, and a free space in which combustion can complete itself. The first condition of draught velocity is easy to obtain. It represents a fair draught only. The second is obtained by an air opening in the furnace door of about 1½ inches per square foot of grate, and a perforated inner plate. The fourth condition can be provided structurally, but the third is the critical condition, which is sometimes obtained and often not secured. It is obtained by the better stokers who do not make smoke, and it can be obtained in furnaces wholly or partially lined with firebrick. Because these conditions have not been understood by them, too many engineers have gone to the length of saying that bituminous fuel is of necessity smoke producing. We have long pointed out that the common form of water-tube boiler, from the fire surface of which all the gases rise directly between cold tubes without the mixing action necessary or the space for combustion, must inevitably be a smoke producer. In the furnace proposed by Mr. Crompton the refractory furnace lining is provided, but Mr. Crompton has, apparently without recognising the effect, also provided the almost equally important point, viz., the sweeping action over the length of the fire of the products of combustion and freshly admitted air.

Mr. Crompton appears to object to our expression as to the *tardy* recognition of bituminous fuels and means of using them, but we really cannot see why he should object, for he is quite a recent convert himself, and has for many years had access probably to the Reports on the Wigan Coal Trials often referred to in our columns, and his furnace, as illustrated, is nothing more nor less than what we have often advocated—not originally, by any means, as an ill-natured critic has professed to believe we claim. Messrs. Adams & Co., of the Ant and Bee works, at West Gorton, over 15 years ago used an entirely external brick furnace to a multitubular boiler, and we believe they could not make smoke when they tried to do so. There is, therefore, nothing new in Mr. Crompton's discovery, but merely, as we said, a tardy recognition of old practice. Unfortunately, the craze of the modern engineer for crowding the maximum possible amount of machinery into the minimum of space is responsible for the difficulty of doing very much to established boilers in the way of external additions.

The difficulty with all forms of revolving grate is obviously that the back of the grate is too thinly covered with fuel, and admits far too much air. It might be possible to place a deadplate below and close up to the underside of such grates in order to cut down the volume of air having access to the grate under its less thickly covered area. This does not appear insurmountable, though we are not aware of its having been attempted. Certain it is that combustion is a purely chemical process, only to be carried out above a certain minimum of temperature, and smoke is evidence of improper conditions. But the dictum that smoke is inevitable is not true, except so far as it is due to the use of unsuitable apparatus.

We might add that a common error in practice is the entire use of flue dampers for regulating combustion. The flue damper not merely checks the draught below the grate, but above it also; it checks the flow of air when the door-grids are open, and deprives the gases from green fuel of the necessary excess of air.

The flue dampers ought to be nearly wide open, and combustion should be regulated by dampers at the ashpit to shut off the air from beneath the bars. In this way no check is placed on the admission of air at the doors. Of necessity the door-grids should close soon after the fresh charge has been fired. Assuming each ton of coal to yield 10,000 cubic feet of gas, the average charge of ½ cwt. of coal in a Lancashire boiler demands air sufficient to burn 500 cubic feet of gas. If three minutes are required to drive off this volume, we may assume that 150 feet come off the first minute, 200 feet the second minute, and the remainder during the third minute, after which the air admission totally ceases.

Automatic air admission by means of louvres in the furnace door should thus commence with louvres above the horizontal position; they gradually open to the full, being then horizontal, and slowly close. In the continuous firing of a machine stoker the gases are not thus intermittently evolved, and it ought to be much easier to prevent smoke than with hand firing. An inspection of a mechanically-fired furnace generally reveals too red a flame, indicative of insufficient temperature and pointing to the need of a refractory lining. No success will ever be permanent and economical until temperature conditions receive better recognition.

THE NORTHAMPTON INSTITUTE CONVERSAZIONE.

On Friday evening last Sir Henry Roscoe, LL.D., F.R.S., presented the certificates and prizes awarded to students during the 1898-99 session. The list of awards is made up mainly of those who have made successful passes in telegraph and telephone subjects, while there were also numerous awards given to Post Office telegraphists and others for successes in magnetism and electricity, mathematics, electrical and mechanical engineering, applied physics, &c.

Dr. Mullineux Walmsley, principal of the Institute, in reviewing the work of the session, said the number of enrolled students and members had increased 53 per cent. on the preceding session, and the educational work showed remarkable development. In outside examination successes the Institute had secured from the City and Guilds Institute 383 passes and eight medals, and from the South Kensington examinations for Post Office telegraphists 368 passes. Among the developments of the year the greatest was the transfer of the Telegraphists' School of Science from the General Post Office to the Institute.

Sir Henry Roscoe delivered an address on secondary and technical education. He argued against the appointment of a newly-established body for the administration of these branches of education which he declared to be inseparably connected. It was not advisable to increase the number of local educational authorities by a new and untried body. They ought rather to keep to lines already established and develop the system which had worked well. In relation to the Northampton Institute, there was one point upon which he had a word to say. Especially in Clerkenwell, a knowledge of the principles and practice of electrochemistry was of great importance, and the principal had drawn up an interesting report on the advisability of setting up in the Institution a new department, new in the metropolis, and even in the country. He cordially agreed with the proposal, but warned all concerned that this was a difficult subject.

For the edification of the many thousands of students and their friends who were present, there was an elaborate programme of arrangements prepared, both for amusement and instruction. Sir H. Roscoe's address seems to have received little attention from the visitors. Perhaps not unnaturally, the greater crowd was to be found witnessing exciting polo matches, Balaclava melées, &c., by the Swimming Club, or gymnastic displays in the gymnasium, listening to Madame Sophie Davies' Mandoline Band in the Hall, or whiling away the time in some such innocent way. It seems almost a pity that gymnastic and swimming displays, each of which took some hundreds of the audience, were being held simultaneously with Sir Henry's part of the arrangements. Notwithstanding the many attractions, however, quite a respectable party put in an appearance at Dr. Mullineux Walmsley's half-hour lecturette on "Alternating Currents." The lecturer endeavoured in popular language to explain the difference between continuous and alternating currents, and made some remarks as to their measurement, &c. He proceeded to describe the Duddell oscillograph, which would have interested his audience considerably more if the pre-arranged experiments had only "come off," but neither at the bidding of the Doctor's assistants or the inventor himself could any satisfactory results be obtained. It was explained that the motor was responsible for the failure of the experiments which were to have been made with this "tricky" apparatus, as the lecturer termed it. Dr. Walmsley said nice things about Mr. Duddell, and this drew from the audience a well-deserved round of applause which signified appreciation, and as usual on such occasions, sympathy. The lecturer, in the presence of the inventor, genially disclaimed all responsibility for the failure. The audience therefore dispersed with the promise that at intervals during the evening demonstrations would be given "if" the motor could be moved from its obstinate determination not to work.

At a later hour Mr. A. W. Martin delivered a lecturette on "High Speed Telegraphy." The other special demonstrations included the liquefaction of air, mortising by machinery, colour photography, &c. In all of the laboratories and workshops there was great activity, and this remark applies particularly to the electrical engineering laboratories and the exhibits of electrical instruments, the mechanical laboratory with its automatic machine tools, the engine room with its steam turbine and lighting apparatus.

Electric motors were employed upon a dozen or so occupations in the several departments. There was a collection of Postal Telegraph apparatus, and to mention briefly a few other things which were prepared:—Parsons' steam turbine exhibit, X rays, and Tesla apparatus, electric brazing, electric wiring, technical chemistry, and last, but not least, an Armstrong quick firing gun (12-pounder), which perhaps excited as much attention as anything, save the swimming contests, and proved that even within the dry walls of a technical institute the war spirit runs high.

Altogether, we cannot help saying a good word for those who have so assiduously worked upon, and so successfully carried through, a very elaborate programme. They must have been well rewarded by the interest and enjoyment with which the great multitude of visitors gave evidence of their appreciation.

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REVIEWS.

Practical Magnetism and Electricity. By J. R. Ashworth, M.Sc. Second Edition. London: Whittaker & Co. 1899.

This truly practical laboratory manual has been revised and corrected; we need only say that the very favourable opinion which we formed of the book on its first appearance remains unchanged. The instructions to students are excellent, while the hints intended for teachers are of a helpful character. We may take exception to the author's modest remark that "the whole book is, of course, to be treated as supplementary to the theoretical teaching of the class room and class book;" on the contrary, we are most strongly of opinion that the theoretical teaching ought to be regarded as subordinate to the practical lessons of the laboratory, which *stick*—lectures don't.

The Principles and Practice of the Valuation of Gas, Electricity, and Waterworks for Assessment. By Thomas Newbigging, M.I.C.E., and William Newbigging, A.M.I.C.E. Second edition, 8vo., pp. 104. London: Walter King, 11, Bolt Court, Fleet Street. Price 5s.

This handy little volume is a reprint of certain articles which were published in the *Journal of Gas Lighting*. "Owing to numerous requests," the authors have dealt with the rating of water and electricity works, the previous edition having been confined to the valuation of gasworks.

In their laudable endeavour to deal with this somewhat dry and difficult subject in a popular manner, the authors may be said to have met with success. After adverting to the history of rating, and to the robbery to which gasworks and other undertakings of a public nature are exposed at the hands of the rating authorities, the authors proceed to explain, by reference to typical examples, the general principles upon which gasworks are rated for assessment. In the space of about two pages (see p. 12) a very succinct explanation is given of the method by which the *ratable value* is arrived at, and a little later on the authors explain the principle of rating upon the basis of percentage, concluding their observations at page 17 by saying that "It is clear that to take a percentage usually reckoned on ordinary property would not always represent the fair rent of a gasworks, and therefore an assessment based upon such an ascertained gross rental value would not, in many instances, bear equitable assessment."

We have no reason to criticise the arrangement of the work as it stands, except to say that more careful sub-division of the matters dealt with would render it more easy for the man of business to find his way about in its pages. Although the index is good, it is more convenient to have the different subjects dealt with in separate chapters.

The good wine, so far as electrical engineers are concerned, is reserved to the end of the work, where the rating of electric supply works is dealt with. In dealing with this portion of their work, the authors were troubled with the usual difficulty, namely, lack of authority. No case appears to have arisen with regard to the rating of electric works of any kind; but it is important to observe that the rules applicable to gasworks can, in a large measure, be used when the assessment committee have to determine the liability of an electrical company. An important question arises with reference to electric supply companies, with which the gas companies are not troubled. The compulsory purchase of the undertaking by the local authority under the provisions of the Electric Lighting Act, 1888, naturally diminishes the prospective value of the works. Can this be taken into consideration in estimating the value for rating purposes? The authors say "this is a point which should have consideration," and a reference to the case of the London Street Tramways Company *v.* the London County Council (1894) 1 Q.B., 489, will show that although not expressly decided for the purpose of the Electric Lighting Act, the expression "value" has been subjected to the scrutiny of the Court in connection with the Tramways Clauses Acts, 1870. The result of that decision was that the value of materials is their value without reference to the past, present, or future profits derived or to be derived from the undertaking. Mr. Edward Boyle in his "Law of Rating," p. 510, also appears to be of opinion that the risk of being "taken over" is not one which should be allowed to lessen the value of the undertaking.

Not the least important part of the work is the digest of cases which may be found at the end. With regard to the case of Southwark and Vauxhall Water Company *v.* Hampton Urban District Council, (1899) 1 Q.B., 173, we understand that an appeal is pending to the House of Lords. The book can be recommended to those who wish to obtain some idea of the principles of rating.

THE UTILISATION OF BLAST FURNACE GASES IN THE GENERATION OF ELECTRICITY.

Preliminary Considerations.—In considering the applicability of blast furnace gas for the development of power for the generation of electricity, it will be necessary to make some investigation into the thermal and chemical qualities of the gas, and also its physical properties.

The operation of smelting iron consists of charging into a suitable furnace a mixture of iron ore, fuel, and flux, and applying air blast to bring about the necessary combustion of the fuel, so as to supply the reducing environment and the high temperature required to melt the reduced iron and the slag formed by the combination of the flux with the earthy matter of the ore and fuel.

The furnace in which iron is smelted consists of a cylindrical shaft from about 45 feet up to 80 feet or 90 feet in height; the older furnaces being from 45 feet to 50 feet in height, while those of more modern construction are increased up to from 80 to 90 feet high.

The process of smelting iron is carried on continuously during the life of the furnace, which has been known to extend to considerably over 100 years, if circumstances will permit, and the stack is at all times full of material almost up to the top.

Iron ore consists of iron in combination with oxygen, associated with more or less earthy matter. In the smelting operation the oxygen is removed from its combination with the iron chiefly by the action of carbonic oxide gas, leaving the iron in the metallic state, while, through the influence of the high temperature, the earthy matter of the ore, as well as that which constitutes the ash of the coke, combines with the flux and forms a liquid slag. Whatever class of fuel is employed, the essential constituent is carbon.

Briefly stated, the chemical action occurring in the blast furnace is as follows:—

Air blast entering near the bottom of the furnace comes in contact with highly heated carbon, and forms carbonic acid gas, at the same time generating an intense temperature; then the carbonic acid gas is almost immediately converted into carbonic oxide gas through coming into contact with more carbon. The iron ore parts with its oxygen to a certain portion of the carbonic oxide, changing it back to carbonic acid, but this reaction can only occur in the presence of an excess of the latter gas, so that there passes off from the top of the materials in the furnace gas consisting of nitrogen from air, carbonic acid, carbonic oxide, and small percentages of hydrogen, marsh gas, &c.

Having so far shown that a certain proportion of the gas evolved from a blast furnace is combustible, a little further consideration will show that this proportion cannot vary through any large range, owing to the depth of the materials in the furnace, the regularity of the mixture of the materials, and of the charging of the same, and the continuous production of large volumes of gas.

Whether the furnace be only 45 feet, or as much as 90 feet in height, the evolved gases have a high temperature, ranging from about 250° F. to over 1,000° F.

Besides being at a high temperature, the gases also carry, in mechanical suspension, a considerable quantity of dust and fume.

The Evolution of Attempts to Economise the Gas.—Prior to the utilisation of the so-called waste gases for the produc-

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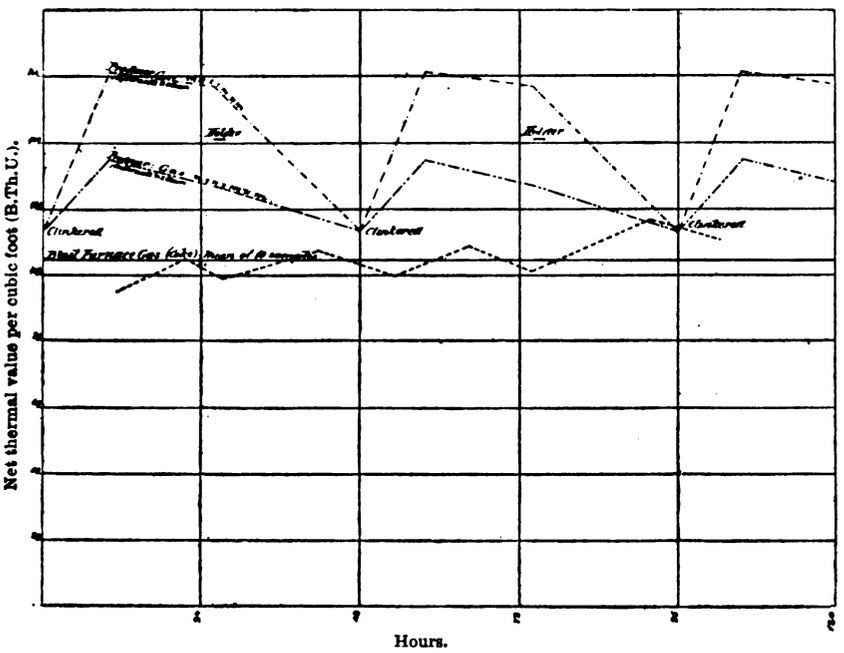
tion of steam and heating of the air blast, the mouth of the furnace was not closed in any way, but the gas was allowed to escape in a burning state into the atmosphere.

Then followed methods by which a considerable portion of



Comparative Diagram, showing the Variation in Thermal Value of Producer Gas and Blast Furnace Gas.

the gas was drawn off by chimney draught, and used in place of coal for heating stoves and raising steam in boilers, by means of tubes connecting with chambers near the top of the furnace, or a tube projecting down centrally some distance into the furnace, allowing the fuel, ore, &c., to be charged round the tube. These methods, though not recovering all the gas, have the advantage of permitting the materials to be freed from moisture without its passing into the gas, and are still retained in many of the old furnaces.

The most general method now employed for the recovery of the gases is the cup and cone, or bell and hopper device.

By this arrangement the top of the furnace is closed, except at such times as the cup or bell is lowered to admit the charge. The gas is conveyed through tubes from the top of the furnace to the boilers and stoves.

The Fuel Used in Blast Furnaces.—The fuel used for smelting iron is charcoal, splint coal, coke, and in some few cases anthracite.

Whatever the fuel used, the essential constituent is the fixed carbon, and the value of fuel for the smelting of iron depends upon the proportion of this constituent, as well as the weight of fuel required to produce unit weight of pig iron.

In general modern practice coke is the principal fuel, though in some furnaces splint coal is employed, and in others anthracite, or anthracite and coke mixed.

Typical Analyses of Blast Furnace Gas.
Percentage by Volume.

—	Charcoal.	Splint coal.	Coke.		Coke & Coal 1.
Carbonic acid...	11·22	6 58	8 78	4 7	4·80
Carbonic oxide	24·20	26·09	29 93	35 0	34·62
Hydrogen ...	4 11	4·56	1·61	1 8	3 63
Marsh gas ..	2 14	2 29	...	1 5	...
Nitrogen ...	58·33	60 48	59 68	57 0	56·95
	100 00	100·00	100 00	100·0	100·00
Thermal value per cubic foot measured at 60° F. Products of combustion, 217° F.	108 BThU	117 BThU	100 BThU	130 BThU	120 BThU

In a furnace using a certain class of fuel, ore and flux, the composition of the waste gases varies only slightly during the working of the furnace, and only a few analyses of the gas are required to fix the average composition and thermal value. Moreover, with the same fuel, the product of the blast furnace may be spiegeleisen, basic pig, or foundry iron, each requiring very different weights of fuel per ton of product without having any very considerable effect upon the composition of the gases.

The volume of gas given off varies with the class of fuel and its constitution, thus splint coal gives about 130,000 cubic feet of gas, measured at 60° F., per ton of coal. Coke averages about 170,000 cubic feet per ton charged. Mixtures of coke and coal will, of course, give a quantity in proportion.

British blast furnaces produce, on the average, about 23,000 tons per annum each, and if we allow an average of 1 ton of coke to produce 1 ton of pig iron, each furnace consumes 23,000 tons of coke each year, which is equivalent to 2·625 tons per hour, and 446,250 cubic feet of gas will be given off in that time.

The Extremely Dirty Character of the Effluent Gas.—Blast furnace gas has, however, one very important disadvantage, owing to the fact that it always carries along with it a considerable amount of dust and fume. The quantity and composition of this dust is very variable, obviously depending upon the materials charged into the furnace.

It is found that when making ferro-manganese, spiegeleisen and basic pig-iron, the quantity of dust very much exceeds that resulting from the production of Bessemer pig and foundry iron.

Mr. A. S. Keith, of Middlesborough, has stated that the quantity of dust per week from a furnace, making from 600 to 700 tons per week (Cleveland ore), amounted to from 2 to 5 tons per week, though in another case only about 1 ton per week of dust was obtained. However, in all cases, a large portion of the dust is in a very fine state of division, and while the heavier part is deposited all along the tubes and flues, and in the boiler furnaces and flues, there is still a large amount of suspended matter, which is so light, that it is even carried out of the top of the high chimneys usual where the gases are used for raising steam and heating the hot blast stoves.

At Seraing, the flues of gas-fired boilers have to be cleaned every four days.

In a Derbyshire iron works, lately visited by the author, where two blast furnaces were in operation, making together about 460 tons per week, the estimated weight of heavy dust per week amounts to about 2½ tons. This dust accumulates in the flues and tubes, and is removed about every three months.

In the United States there are blast furnaces capable of producing as much as 690 tons in 24 hours, with a fuel consumption (coke) of 15·4 cwt. per ton of iron made. This is equivalent to 22·137 tons of coke consumed per hour, and 3,763,290 cubic feet of gases would be evolved during that period. If the whole of this gas could be employed in gas engines to produce power at the rate of 130 cubic feet of gas per hour to develop one I.H.P., the equivalent power of the gas from such a furnace would amount to a continuous development of 28,948 I.H.P.

It need hardly be pointed out that this enormous power cannot be obtained for many reasons, though the realisation of the value of each cubic foot of gas will, no doubt, bring about a reformation in the views of blast furnace managers with regard to preventing the escape of any of this gas uselessly into the atmosphere.

The Efficiency of the Blast Furnace when Considered as a Gas Producer.

Splint Coal.—

1 lb. splint coal in furnace, 14,091 B.Th.U.

I.—58 cubic feet of gas at 117 net units per cubic foot at 60° F., 6,786 B.Th.U.

II.—58 cubic feet of gas at 126·5 net units per cubic foot at 60° F., 7,337 B.Th.U.

Efficiency (I.) $= \frac{6.786}{14,091} = 48\ \%$. (II.) $= \frac{7.337}{14,091} = 52\ \%$.

Coke.—

1 lb. coke in furnace, 12,960 B.Th.U.

I.—75 cubic feet of gas at 100 net units per cubic foot at 60° F., 7,500 B.Th.U.

II.—75 cubic feet of gas at 130 net units per cubic foot at 60° F., 9,750 B.Th.U.

Efficiency (I.) $= \frac{7,500}{12,960} = 57\ \%$. (II.) $= \frac{9.750}{12,960} = 75\ \%$.

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The efficiency of the blast furnace as a power gas generator, as shown by the foregoing figures, is very high, considering that the object of the furnace is to smelt pig iron, and that at one time the so-called waste gases were allowed to pass away into the atmosphere, while even nowadays a very considerable quantity of gas is wasted.

Before going into the question of the utilisation of blast furnace gas, we may summarise its general qualities:—

1. The gas is given off, more or less continuously, in large volumes.

2. The temperature at which it is evolved is *always* high.

3. The gas *always* carries a considerable quantity of heavy and light dust.

4. The hot gas generally contains a considerable quantity of water, in the form of steam, of course, derived from the combined and hygroscopic water of the mixture charged.

5. The thermal value of the gas, though low, is more constant than that of producer gas.

The Utilisation of Blast Furnace Gas.—The gas evolved from the blast furnace is usually conducted away from the top of the furnace by tubes lined with brickwork, and, owing to the large volume passing through the tube and the brick lining, the temperature does not fall much, even when taken to a considerable distance from the furnace. Where, as is very common, the gas is taken directly into brickwork flues underground, the heat is even more completely retained.

This high temperature assists the combustion of the gas when it is applied to heating air stoves and boilers, and, of course, adds to its thermal effect. However, when thus utilised, the gas carries with it, as previously explained, a very considerable quantity of dust, and all apparatus in which it is employed as a heat agent must be so designed that the accumulation of dust, which settles in all places where the gas travels or is burned, can be removed at stated intervals.

The dust and moisture present in the gas cannot be removed without reducing the temperature to about that of the atmosphere, the lower the temperature below 212° F. the drier the gas, but when the gas is thus freed from dust and moisture, and at atmospheric temperature, the heat of combustion in air is so low, that the unprotected hand can be slowly passed through the flame without any inconvenience, and the difficulties of maintaining its combustion in boilers and stoves are very much increased. Even when burning the gas in its hot condition there is frequently great difficulty in keeping up the supply of steam from the boilers, &c.

The Invention of the New System of Power Utilisation.—As the result of experience in blast furnace construction and of very extended research and experiments on the application of various classes of producer gas to internal combustion engines, the metallurgist, Mr. B. H. Thwaite, filed patents in 1894 for the treatment of iron-making blast furnace gas for rendering it available for driving gas engines, or for direct combustion in internal combustion engines. He found that in suitably-designed gas engines, in which a proper amount of compression was arranged, excellent results could be obtained by the explosion of this gas after its treatment by his patented process.

Continental newspapers, including *La Rappel*, gave an account of this innovation—in the last-named in its issue of September 24th, 1895; Thwaite's invention was also referred to in Richard's 1895 edition the *Gas Engine*—as a result, foreign plagiarists are much in advance of British engineers; certain Continental engineers have made experiments in more or less flagrant imitation of Thwaite's invention, and in all cases very satisfactory results have been obtained, although some of the more dishonestly unscrupulous of the imitators are very loth to acknowledge their indebtedness to the British metallurgist. In 1897 designs were submitted by request to important German and Belgian works, of the Thwaite-Gardner system; these have constituted the basis of subsequent work in those countries, and a discreditable advantage has been taken of them.

The pioneer plant in Great Britain, commenced in 1894, and which has been working since, is that at the Wishaw Works of the Glasgow Iron and Steel Company, Limited, providing electric current for arc and incandescent lamps. The blast furnaces at these works use splint coal for fuel, and the gas is previously treated for the recovery of bye products.

Since the conception of the utilisation of blast furnace gas in internal combustion engines by Mr. B. H. Thwaite, and the publication of its practicability, Belgian and German engineers have rapidly made progress with its application, and now they are putting down plants of thousands of horse-power. In this country the more conservative blast furnace owners, engineers, and managers have been slower to avail themselves of this great source of cheap power, but even now its conspicuous economic advantages have been proved, and installations are being projected on extensive scales.

(*To be continued.*)

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this Journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

23,617. "Turbine dynamo-pneumatic (motive machine)." J. F. M. Riffard. Dated November 27th. (Complete.)

23,621. "Improvements in apparatus for adjusting electro-magnetic ignition in gas or oil engines." E. Bolbrinker. Dated November 27th. (Complete.)

23,663. "Armature for alternating current motors." J. Burke. Dated November 27th. (Complete.)

23,656. "Improvements in and relating to electric alarm systems for the protection of buildings, or for like use." A. G. Brookes. (E. F. Woodman and H. A. Fiske, United States.) Dated November 28th. (Complete.)

23,718. "Improvements in or relating to electrically illuminated advertisements or signs." H. Tripp, G. E. Stephenson, and W. C. Chartz. Dated November 28th. (Complete.)

23,728. "Improved manufacture of lead plates for secondary batteries." M. Wellot. Dated November 28th. (Complete.)

23,734. "Improvements in or relating to electric lighting or heating apparatus." J. Boutillet. Dated November 28th.

23,737. "Improvements in pneumatically operated contact shoes for third rail electric railway systems." The British Thomson-Houston Company, Limited. (S. H. Libby, United States.) Dated November 28th. (Complete.)

23,738. "Improvements in compounding electric alternators." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated November 28th. (Complete.)

23,739. "Improvements in electric railway systems and cars." The British Thomson-Houston Company, Limited. (W. B. Potter, United States.) Dated November 28th. (Complete.)

23,740. "Improvements in controlling alternating electric current motors." The British Thomson-Houston Company, Limited. (C. P. Steinmetz, United States.) Dated November 28th. (Complete.)

23,753. "Improvements in maximum electrical current indicators." E. C. Remington. Dated November 28th.

23,755. "Improvements in electrolytic apparatus." J. D. Darling and C. L. Harrison. Dated November 28th. (Complete.)

23,781. "Improvements in and in relation to trolley heads for electric tramcars." L. B. Powderly. Dated November 29th.

23,818. "Improvements in galvanic batteries." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany.) Dated November 29th. (Complete.)

23,834. "Improvements in or relating to telegraphic apparatus." A. C. Crehore and G. O. Squier. Dated November 29th.

23,869. "Improvements in incandescent electric lamps." R. B. Ransford (A. W. W. Miller, United States.) Dated November 30th.

23,870. "Improvements in apparatus for electric telegraphy." S. G. Brown. Dated November 30th.

23,877. "Improvements in or relating to electric gas lighters." Henri de Thiersant and H. J. Norballe. Dated November 30th.

23,879. "Improvements in and connected with electric incandescent lamps." F. M. F. Cazin. Dated November 30th.

23,905. "A new or improved alternating current electro-motor." F. M. Lewis. Dated November 30th.

23,918. "Improvements in the manufacture of electrically conductive incandescent filaments and the like." L. de Somzee. Dated November 30th.

23,925. "Improvements in starting regulating and reversing switches for electric motors." J. M. Hewitt and W. G. Rhodes. Dated December 1st.

23,960. "An improved electric switch or governor." E. Cros. Dated December 1st.

24,049. "Improvements in inter-communication telephones." L. E. Wilson. Dated December 2nd.

24,058. "Improved means for carrying off the gases generated in electrolytic apparatus." W. Bein. Dated December 2nd.

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

28,116. "A conduit and aerial electro locomotor, primarily for laying or drawing in electric mains or other cables for any service." E. L. Benjamin. Dated November 10th, 1897. Relates to an apparatus for traversing tubular or skeleton conduits in the form of three or more rods held in position at intervals by rings. The apparatus is described as being applicable to the haulage of cables or ropes for laying electric conductors, metal rods, or ropes in such conduits; for depositing any objects at predetermined positions in conduits; for drawing through cleaning brushes or scrapers, for sewage, water, gas, and other pipes and conduits; or for cleaning tubular boilers. The apparatus is also applied for overhead or elevated railway systems, whether for goods, parcels, or passengers, or for cash railways. The motive power may be electricity, gas, steam, compressed air, or an endless rope. As described in the specification, the motor is electric, having the field magnet yoke curved in section to correspond with the conduit. The pole-pieces are similarly curved, enclose the armature, which is built up of a spider mounted on the shaft, and having three webs. Core discs

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are slotted to engage with the webs. These are clamped in position between a shoulder at one end and a screwed-up clamping disc at the other. The armature shaft is shown driving a wheel by means of worm gear, the commutator and feed terminals being at the other end. The feed may be either from live wires in the conduits, or from trailing wires attached to the locomotor. The motor is maintained in a central position, and in frictional contact with the pipe, by three or more wheels at each end. The wheels are mounted on bell-crank levers, the inner ends of which engage in a collar held in position by a spiral spring or by separate springs. The locomotor may be enclosed in a waterproof case, and may be provided with visible or audible signals. 9 claims.

1898.

6,773. "Improvements in and relating to street lanterns for the reception of incandescent electric lamps." J. E. Stewart. Dated March 21st, 1898. Supporting lamps for street lighting. One or more incandescent lamps are attached by a coupling to a joint piece. This is connected by a bent copper tube with an upright tube in a supporting post, the conductors being passed through these tubes. An opal cover rests on a ring of T-section, carried by three supports on a ring which is bolted to the post. The cover is held under a rubber ring in a cap attached to the joint-piece by a bayonet joint. Ornaments may be applied, such as a band surrounding the ring. The invention is applicable especially in place of gas lamps on existing posts. 1 claim.

6,634. "Improvements in safety devices for use in connection with high tension electric conductors." C. H. Wordingham. Dated March 21st, 1898. Test boxes, in which concentric or other multiple high tension cables are employed, have the conductors of each cable attached to connecting plates which are separated by insulating material. The corresponding plates on the two cables are connected by strips. The plates and the earth connection are surmounted by carbon studs. Levers pivoted carry each at one end a plate, the other end of the levers bearing against studs on the inside of the lid. On the removal of the lid the plates fall and rest on the studs, so as to short-circuit and earth the cables. 3 claims.

6,665. "Improvements in electric conductors and in appliances for making connection with same." J. D. F. Andrews. Dated March 21st, 1898. The wires forming the core of an electric cable are separated by means of insulating material to form two or more separate cores. The ends of the cores to be united are soldered together and a porcelain thimble placed over each. Three forms of cut-out are described in which the fusible wires are embedded in cement or china, and in two of which fine wire bridges are employed which fuse after the main wire. 4 claims.

6,902. "Improved details of electric tramways and railways on a road surface sectional contact system." W. Aldred and G. Carr. Dated March 22nd, 1898. Electric railways and tramways on a road contact sectional conductor system with electro-magnetic switches. Relates to improvements on the switches described in Specification No. 5,391, A.D. 1894, and the collectors, &c. Current is taken from the switch box covers which are made removable with the magnet cores and the necessary contacts attached. These contacts consist of a spring armature and a pair of spring contacts attached to an insulating plate on the underside of the cover. Corresponding contacts are fixed on an insulating base in the box. A number of the contacts are connected in series to the main feeder by a single lead. The circuit to the motor is completed through the armature spring and the lid of the box, when the magnets are excited by a battery circuit from the vehicle through the contacts and springs which are connected to the coils. Similar switch boxes and connections are used for the return only; one contact and spring are dispensed with, as one terminal of the magnet coil is connected to the lid of the box from which the current returns to the battery. The exciting current in alternate vehicles may be caused to flow through the switches in different directions to obviate sticking. The boxes are arranged in two rows parallel with the rails. Long collector bars are carried by vertically sliding bolts in wooded cross bars supported on longitudinal bearers attached to the axle boxes. 5 claims.

6,903. "Improvements in electric plug connectors." A. E. Tanner and G. W. Lewcock. Dated March 22nd, 1898. Relates to a form of coupling in which the insertion of the plug makes contact with certain terminals and a further movement operates a switch to complete the circuit. Within a cast-iron casing formed with bosses for the cables is fitted a porcelain base. On it are secured the fuse terminals, switch arms and spring contacts. The plug is fitted with contact plates which first engage the contacts, then on further movement, the shoulders engage the tappets connected to the switch arm, and so complete the circuit. On removing the plug the shoulders strike the tappets and the springs give a quick break. A cap is carried by the plug and screws on to the boss. Caps may be provided for screwing on the boss when the plug is not in position. 3 claims.

6,944. "A method of and furnace for the continuous melting of glass by electricity." F. H. Becker and L. Schreyer. Dated March 22nd, 1898. An arc furnace for continuously producing glass is constructed as shown in vertical section. The materials from a hopper pass down a stepped channel under a pair of electrodes at each step, and into a divided receptacle which is heated by arcs between pairs of electrodes at the corners of the furnace. 8 claims.

6,966. "Improvements in electrical measuring instruments." E. Weston. Dated March 22nd, 1898. Relates to current and energy meters. Electro-dynamometers, applicable as volt and wattmeters for alternating currents, are constructed as shown by a vertical section of a voltmeter for use on a switch-board. A coil is carried by a vertical shaft in bearings on two bridges which are supported by insulators on two vertical rods carried by lugs screwed to four projections on a lid. The lugs also support two spools wound with the fixed coils of the instrument; in a wattmeter open coils of a thick uninsulated conductor are supported by their end connections only, without spools. The movable coil is connected through two spiral springs with arms on the insulated bridges. The coils are connected with terminals carried by pillars of hard rubber on the lid. In order to prevent the action of light on these, they are covered by caps of opaque material. The shaft also carries a pointer bent down in front of a curved scale and balance weights. Another pointer is carried by a pin in the lid, in line with the shaft and in contact with a friction spring, and can be turned to any desired position by a handle. The lid which carries all these parts, except the scale, is attached to a casing which is attached by side lugs and bolts to the switchboard. The casing has a curved part stiffened by ribs to carry the scale and supports a frame carrying a curved glass front. The casing is provided with a removable bottom plate which supports a cell containing light petroleum oil or other non-viscous liquid; this covers the coils and serves mainly to damp the movements of the coil, rendering the instrument dead beat. Light springs carried by the casing limit the motion of the pointer. 20 claims.

6,991. "Improvements in electrical measuring instruments." E. Weston. Dated March 22nd, 1898. Current meters having pivoted coils movable about fixed cylindrical cores between the pole-pieces of permanent magnets, are provided with several improvements in details of construction. The pivots to engage in bearing jewels are supported on the movable coil. Each support is made by turning down the end of an aluminium bar to two smaller diameters drilling the end to receive the pin which is forced into it, screw-threading the smallest part to receive a nut and milling flat sides on the intermediate part to receive a pointer; a thin piece of the end of the bar is then cut off, forming a plate which can be cemented on the coil. The jewels are carried in insulated non-magnetic bridges on the pole-pieces. The nuts secure plates which are bent and split to hold the inner ends of the connecting springs and are soldered to the ends of the coil. The outer ends of the springs are attached to arms on the pole-pieces. The coil is wound on a thin aluminium frame. In order that the air gap between the pole-pieces and cylindrical core may be made very small, the core is grooved, so that the coil can be turned into place upon it without distortion. The core is carried by screws on a non-magnetic plate attached to the magnet. 11 claims.

7,057. "Improvements relating to plug switches and plug connections for the control and distribution of electric currents." H. F. Proctor and J. R. Stabler. Dated March 23rd, 1898. The socket or tubular part of a plug switch or connection is fitted with a spiral spring or the like which is compressed when the plug is inserted. Adjustment for wear, &c., may be obtained by screwing up end cups or the like. Instead of a spiral spring, an "accordion" folded metal ribbon or stamping may be employed. 3 claims.

7,058. "An improved method of preventing the corrosion of electric battery connections." W. R. Underhill and P. W. Marthey. Dated March 23rd, 1898. Connections, especially those of the screw and nut type, are prevented from corroding by covering the exposed surfaces with a cap of non-corrosive material such as lead-antimony. The cap may be secured in place by various means. 4 claims.

7,128. "An improved means of generating electrical energy." T. Holmes, A. Holmes and G. S. Holmes. Dated March 24th, 1898. In order to utilise the current existing in rivers, streams, and tidal waters, for the purpose of generating electricity, a number of pontoons carrying paddle wheels are moored in the flowing water, and motion is transmitted from the shaft to the dynamo by means of a spur wheel and pinion, toothed gearing and a belt. The current is directed towards the floats of the wheels by plates, and the races between the pontoons are provided with bottom plates. Instead of paddle wheels, an endless chain or chains carrying floats or buckets may be employed. 1 claim.

7,169. "Improved wall socket and plug for electrical fittings." L. G. Tate. Dated March 24th, 1898. Relates to a wall socket and plug. The base of the socket is formed with a central raised bridge or partition which separates the metallic connections. These are fitted with binding-screws for the leading-in wires, and with a socket for the split pins of the plug. The cover is suitably perforated, and is screwed to the bridge. The plug is also fitted with a partition and cover, holes being drilled for the passage of the conducting wires. 2 claims.

7,233. "Improvements in miners' lamps, and apparatus for electrically lighting the same." S. Harrison. Dated March 25th, 1898. Relates to apparatus for electrically lighting these. A gastight box containing the accumulators and induction coil, has a recess into which the base of the lamp fits. An ebonite disc rests on springs which complete the primary circuit, through terminal contacts, when the lamp is inserted into the recess. The secondary circuit wires from the induction coil are connected to the stud and to the spring respectively. A guide or staple is provided, so that when the lamp is inserted into the recess the insulated contact piece touches the stud, and the primary circuit having been automatically completed, a spark passes from the bridge piece to the wick, which contains copper wire strands. The return current passes through the body of the lamp, and thence to the induction coil through the spring contact. The lower part of the wick is covered with an insulating tube. The provisional specification mentions the use of a current from a high tension dynamo, the use of a wick provided with copper foil, and a platinum wire terminal fused in the glass in the case of a glass lamp. 3 claims.

7,333. "Improvements in the construction of plates for electrical accumulators or storage batteries." E. Morian. Dated March 26th, 1898. The electrode is made up of two or more plates with projecting horizontal strips, which are held together by little projections, and are soldered together. Raised edgings or ribs are formed on the plates, and holes are made through them. Each part of the plate may be made by casting, cores of plastic material representing the active material being used in the mould, and this plastic material is subsequently removed by the action of water. 4 claims.

7,397. "Improvements in or relating to electric indicators or annunciators." A. J. Boult. (The Antwerp Telephone and Electrical Works.) Dated March 26th, 1898. An indicator for telephone stations, &c., consists of a core with two coils and two pivoted armatures, the whole being carried in a suitable casing. The coil is in the subscriber's circuit, the effect of a call being to attract the armature, an ebonite block on an arm on the armature causing a local battery circuit to be completed through contacts. This circuit includes the coil, causing the core to be further energised to attract the armature towards a projection on the core, raising a flap to disclose a number on the piece. The armature also completes a night call or indicator circuit by bringing a rod into contact with a second rod. The local circuit is broken by the operator to restore the parts. Projections or screws of gun metal, &c., prevent the armatures from adhering to the core. The contacts are made of long flexible strips, and have a slight relative sliding motion when bent downwards, ensuring the contacts being kept clean. 4 claims.

7,467. "Improved means applicable for use in operating electrically illuminated signs, advertising media, or the like." W. T. Bell. Dated March 28th, 1898. Incandescent lamps, arranged on an advertisement or sign board, are lighted to represent the advertisement or sign. The drum, which is preferably of rectangular section and is provided with conducting face-plates, is covered with jacquard cards arranged on a flexible carrier. The drum is reciprocated by means of a cam towards and from spring contact bars, connected with the lamp wires, and thus certain lamps determined by the jacquard will be lighted while the front plate of the drum abuts against the contacts. On withdrawing the drum from the contacts, it is rotated to a quarter turn to bring the next face into operation. To prevent sparking, a cut-out is used which breaks the circuit slightly before the retreat of the cylinder from the contacts. This consists of a disc or cam of non-conducting material, provided with flanges, on which are mounted rings, placed in metallic connection with one another by a strip. Brushes of the main circuit make contact with these rings, and, one ring being formed with a gap, the circuit is thus broken. 6 claims.

7,471. "Improvements in electrolysis." W. L. Wise. (Solway & Co.) Dated March 28th, 1898. For the purpose of obtaining the maximum output in the electrolysis of an alkaline chloride by means of a mercury cathode, the electrolyte is composed of two layers. The lower one, of great density, lies on the mercury and is practically free from chlorine. The upper one, of small density, lies on the former layer, contains the anode or anodes, and becomes saturated with chlorine. 1 claim.

7,593. "Improvements in and connected with electrical switches." H. C. E. Jacoby and White, Jacoby & Co., Limited. Dated March 29th, 1898. Relates to switches for controlling electrically-operated lifts, &c. A shaft is rocked by a rope and pulley or other suitable means, and, in turn, directly operates the reversing switch, and through an eccentric connecting rod and other gearing the arm of the resistance switch. The arm thus always moves in the same direction from the starting point. The connecting rod is fixed to a pulley loose on the shaft. The pulley is connected by a cord on which is a weight with the pulley fast on the shaft. The switch arm is also carried by the shaft. To prevent too rapid a movement of the shaft arm a checking device is employed. In one arrangement this consists of a pendulum rocked by an eccentric carried on a shaft driven by gearing. The wheel is loose on the shaft, and carries a pawl engaging with a ratchet wheel connected to the pulley by a pin having a certain amount of play in a slot. The ratchet wheel is thus driven by a pulley after it has moved through a certain space. Lugs are fitted on the pulleys, so that, when the loose pulley is moved back, it also carries back the fast pulley without actuating the checking mechanism. 2 claims.

7,751. "Improvements in lifts worked by electricity, with hydraulic braking apparatus." La Societe Guyenet et de Mecombie. Dated March 31st, 1898. (Date claimed under Patent, &c., Act, 1883, Section 103, November 12th, 1897, being date of application in France.) Relates to electric lifts in which the descent of the cage under gravity is controlled hydraulically. The usual handing-rope operates a lever pivoted and connected by an arm and link to the starting-switch. A parallel bar with a rolling weight is fitted below the lever. When the lever is in the at-rest position the weight is near the pivot, so that, when the handing-rope is acted on sufficiently to lower the lever below the horizontal position, the weight rolls forward and completes the second position, the time being regulated by a dash-pot. When the lever is raised to the third position, it raises a valve to allow the water to escape from the cylinder, the ram of which is connected to the cage. The descent under gravity is thus controlled. 1 claim.

7,760. "Improvements in and relating to protecting shields for incandescent electric lamps and the like." J. Dewar. Dated March 31st, 1898. Lamps used in ships' passages or elsewhere are each provided with two or more segmental guards constructed to fit together and enclose the lamp. Each segment is provided with one or two projections and supported by a pin on the base plate. Springs and screws are provided to hold the segments up or down. The inner surfaces of the segments are enamelled or painted white, to serve as reflectors when the segments are raised. 3 claims.

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THE

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ELECTRIC LIGHTING COMPANY AND CONSUMER.

CERTAIN letters recently published in the columns of the *Times* disclose the existence of difficulties between a prominent Metropolitan lighting company and some of its customers. If we are to believe the statements there made by the various correspondents, it would appear that the particular company, "owing to a rapidly increasing demand for supply," has chosen to break its contracts with some of its old customers instead of its recent contracts, made prematurely, with the new ones. Other counts are added to the indictment. Thus it is alleged that whereas in some districts the light never fails, others are plunged in total darkness, while the devoted company is also unblushingly accused of pandering to consumers whose claims for breach of contract (*sic*) would be heaviest! The letter which contains the above accusations was written subsequently, and in answer to an explanation which was published by the secretary to the company (Mr. E. Cunliffe Owen) in the *Times* of December 7th. He there, at the request of his employers, took the trouble to explain that more than two years ago the Metropolitan Electric Supply Company, Limited, owing to a rapidly increasing demand upon their resources, commenced to erect a large generating works at Willesden. The non-delivery of iron prevented the completion of such works until a comparatively recent date, arrangements being made in the meanwhile for obtaining help from a neighbouring company—succour which failed to prove beneficial in the hour of need. Yet another excuse—and as it appears a most plausible one to those who know no better, is advanced on behalf of the supply company. With the help obtained by the partial working of the plant at Willesden, one of the engines having been completed, they would have been able to meet all reasonable demands, had it not been for the lack of Welsh steam coal, owing, it is stated, to the requirements of the Government for the South African transports.

Readers of the REVIEW, however, need no reminder of the numerous articles which have recently appeared in our columns to show that this excuse ought not to avail any company whose works had been planned on proper lines.

Does the *Times* correspondent gravely argue that it is the duty of a supply company to foresee such a catastrophe? Can they refuse (if, indeed, they have statutory powers in that behalf) to lay additional wires because some *force majeure* may intervene to prevent them from completing the plant wherewith to furnish an increased current?

"Every effort," says Mr. Owen, "has been made to obtain deliveries regardless of cost, but practically without success, and the coal at present being received renders it almost impossible to maintain a proper pressure of steam at times of greatest demand."

While we think that every allowance should be made to a

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company, when beset with misfortunes which no human foresight can prevent, the fact that they are unable to run at full power owing to an alteration in the quality of the fuel at their disposal, should not be allowed to prejudice the consumer. As was pointed out in a recent issue of this journal, there is no reason why every lighting station should not have been equipped with furnaces designed so as to be capable of consuming the most bituminous of coal. It appears that the real difficulty with which the Metropolitan Electric Supply Company have had to contend, is the smoke which issued forth in such volumes that an order was made to compel them to alter their furnaces so that bituminous coal could be burnt without causing a nuisance. Doubtless public attention has been forcibly called to the matter within the last few months, owing to the formation of a society whose object it is to wage war against smoke; but it would be idle for any company to excuse themselves from meeting the demands of the consumers, by referring to the disastrous result of recent police court proceedings—proceedings, moreover, which if they have the effect of compelling the company to lay down smoke-consuming furnaces, may bring about economy of fuel in the long run.

The correspondent to whose complaints we have already alluded, states that several years ago the company obtained power, which was practically exclusive, to supply a certain district upon certain conditions, one of which was that it should supply electricity efficiently and continuously to all who required. Without having the company's provisional order before us, it is somewhat difficult to deal with the points which are raised against it. We may, however, safely assume that the provisional order was in the form in common use before the Electric Lighting (Clauses) Act, 1899, came into force. Although that Act has no application to London, its provisions embody the common form of nearly every provisional order. To traverse "Zetetes's" allegations *seriatim*, he implies, in the first place, that the company has no right to supply new customers before it had the means of supplying all. A reference to an article, entitled "The Liability of a Supply Company to Meet the Demands of Consumers," which was published in the ELECTRICAL REVIEW for December 8th, at p. 910, clearly shows that there is nothing in the usual form of provisional order to prevent a company from refusing to supply electricity upon the ground that its plant is not sufficiently powerful. This should be qualified by saying that there may be special terms inserted in the provisional order or special Act defining the amount of electricity which the company must be prepared to furnish to all comers. The statement that the company endeavours to show favouritism among its customers is a bare statement, and nothing more. We venture to think that no company would risk the consequences of such a course of conduct, especially when we bear in mind that an exclusive monopoly of the electrical supply in a district is no longer possible. With regard to the liability for default in making a supply, no penalty is inflicted if the Court are of opinion that the default was caused by inevitable accident or *force majeure*, or was of so slight or unimportant a character as not materially to affect the value of a supply. [See Section 28 of Form of Provisional Order, Laws of Electric Lighting, by Shiress Will, Q.C. (1898), p. 159.]

The Standardisation of Copper Constants.

THE report of the Committee on Copper Conductors, which we reproduce elsewhere, will, we trust, put an end to the confusion which has reigned up to the present with regard to the so-called "Matthiessen's standard." The report is not quite correct in stating that "everyone" assumed that Matthiessen had settled the constants of copper in his invaluable researches; the question has often been raised, and we believe that Prof. Ayrton, who is a member of the Committee, thoroughly sifted the matter some years ago and came to the conclusion that "Matthiessen's standard" was a myth! Now, however, thanks in great measure to the efforts of Mr. A. H. Howard, who was largely instrumental in the formation of the Committee, of which he is honorary secretary, the difficulty is in a fair way of being removed. We may recall the fact that the Institution of Electrical Engineers, in its "Wiring Rules" of 1897, fought shy of the question, and fixed its own standard of conductivity, which, curiously enough, is almost always expressed in terms of *resistance*, and should be called resistivity. This standard was stated as follows:—"The resistance of a copper wire, weighing 100 grains, 100 inches long, should be 0·1516 ohm at 60° F." Comparing this with the present report, we find that the Institution's standard is almost exactly the mean between the values given by the Committee for hard drawn and annealed copper; the former, therefore, was more favourable to the cable manufacturers. The temperature coefficient which has been adopted will meet, we think, with general approval. It is well known to those who have had occasion to go into the matter that the value commonly accepted is far too low, and that the purer the copper the higher is the coefficient. It must be borne in mind that not even the value named by the Committee will be quite correct for all samples of pure copper. We sincerely trust that in their revised tables of resistance, weight, length, &c., the manufacturers of cables will refrain from presenting an absurd array of figures, extending as some do to seven significant figures! Seeing that one could not hope to find the actual measured values identical with the tabulated values even to the fourth figure (the Committee allow for a variation of *2 per cent.!*), what is the use of such fictitious "accuracy"? We are glad to note an improvement in this respect in some recently issued tables.

The Secor Kerosene Motor.—In the *American Machinist*, a paper of sound mechanical ideas and the best exponent of American shop practice, we find a description of a new oil engine. *Apropos* of this and of other motors utilising stored energy, the following figures are given, showing the number of foot-pounds of energy which can be stored by different media:—

Source of energy.	Foot-pounds stored per pound of medium.
Good storage battery	15,000
Liquid air from 2,000 lbs. pressure down to atmosphere	139,100
Coal of 14,600 B.T.U. in steam plant of 12½ per cent. overall efficiency	1,408,000
Kerosene of 20,700 B.T.U. in oil engine of 35 per cent. overall efficiency	5,593 000

This is a telling commentary on the limitations of storage batteries and on the nonsense claimed for compressed air. The pound of oil is equal to 400 lbs. of storage battery. In the Secor engine the kerosene is fed by a ball valve into a small tank, whence it falls by gravity through the admission cock into the air admission pipe; the air and oil admission valves are controlled by the governor, equal and uniform mixture being aimed at. Governing is thus effected by reduced charges, and the initial compression is less with feeble charges, which are wire-drawn into the cylinder. Not an economical system, perhaps, but one which it seems desirable often to adopt even at the price of reduced economy. The engine illustrated in our contemporary is of vertical type with electric ignition from a six-cell battery and coil. The speed is 350 per minute, the cylinders are water jacketed, and the cost of power is said to be ¼d. per H.P.-hour. The valves are driven by cam gear with friction roller in a double path cam, and the governor is of fly-wheel type in a rim pulley. The crank cheeks have fan tails and the piston is of trunk form. The Otto cycle is employed.

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THE UTILISATION OF BLAST FURNACE GASES IN THE GENERATION OF ELECTRICITY.

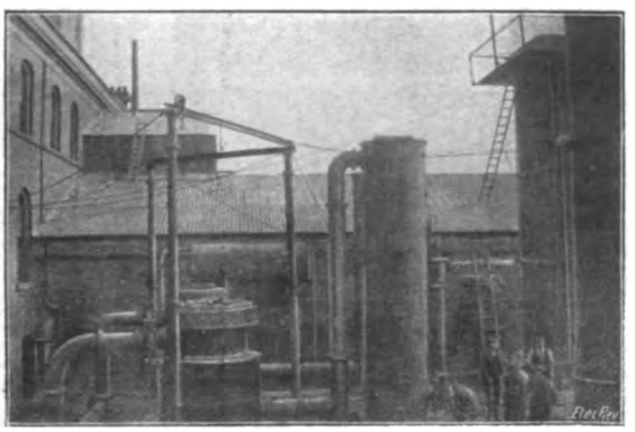
(*Concluded from page* 987.)

The Application to Blowing Engines.—The chief power required in connection with the blast furnace is that necessary for actuating the blast furnace blowing engines, and the substitution of the economical gas-power for the far from efficient steam-power obtained by burning blast furnace gas in the flues of steam boilers, will, of course, have the greatest attraction for blast furnace managers.

Blowing engines driven by blast furnace gas are being made in this country, Belgium, and Germany, and will be working before many months have passed, when the perfection of the greatest advance in the economical production of pig-iron of the century will have been made.

So as to avoid the intervention of gearing, the blowing piston is made to travel faster than has usually been the practice with steam, gas engines being found to work best at speeds varying from 80 to 200 revolutions per minute. The air admission and discharge valves have therefore to be designed to admit of this increased speed.

In the case of gas engines working upon town gas, there is always an available supply of gas in the large gas holders; but in using blast furnace gas there is no necessity for this expensive adjunct. The very large volumes of gas produced by the blast furnaces are not stored in gasometers, but, by means of a fan arranged for exhausting and delivering the gas, a regular supply of gas is obtained in some excess of the requirements of the gas engine at any time, the excess of gas being allowed to pass back to the exhaust side of the fan.



Physical Purifiers for Cleaning Blast Furnace Gas.

Advisable Precautions.—To obtain the highest efficiency when using gas engines driven by blast furnace gas for the generation of electrical current, it is an advantage to arrange the units of power to suit the required loads, instead of allowing the engine at times to be running at half power.

By grouping two or four cylinders around one main shaft the ignitions can be regulated to give one or two impulses each revolution, in which case the fly-wheel does not require to be so heavy in proportion to the power as when a single cylinder is employed, and the use of multiple cylinders permits of the direct connection of the dynamo to the gas engine shaft.

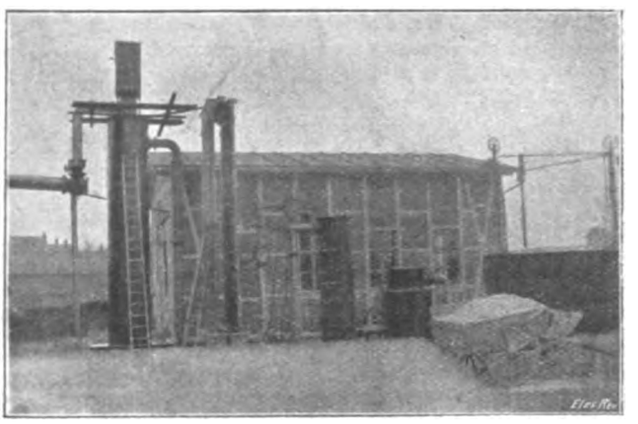
Blast furnace gas, when used in the cylinders of internal combustion engines, has a considerable advantage over town's gas. Engines designed to use town's gas are generally governed upon the hit-or-miss principle, in which case, on the speed being accelerated, the governor cuts out the charge of gas and no explosion takes place, but with furnace gas the admission of the gas can be graduated so that an explosion of less violence can take place, thus making the running of the engine more regular.

Power of Blast Furnace Gas in Gas Engine Cylinders.—Mean pressures in the cylinder with furnace gas can be obtained as desired from 38 lbs. per square inch up to 60 and 70 lbs. per square inch, and this without any risk of a miss in the ignition, the higher pressures, of course, being obtained where the gas is of superior thermal quality. (See diagrams on page 992.)

Electrical power generation has been effected by the use of blast furnace gases from both coal-fed and coke-fed furnaces with very considerable success.

Scotland's pioneer plant at the Wishaw Works of the Glasgow Iron and Steel Company, Limited, where splint coal is employed in the blast furnaces, though not very large, has been working successfully for about four years, see p. 992. The gas in this case is previously treated for bye-products, afterwards being treated for the removal of the dust.

The engine develops a little over 20 I H P, and drives a

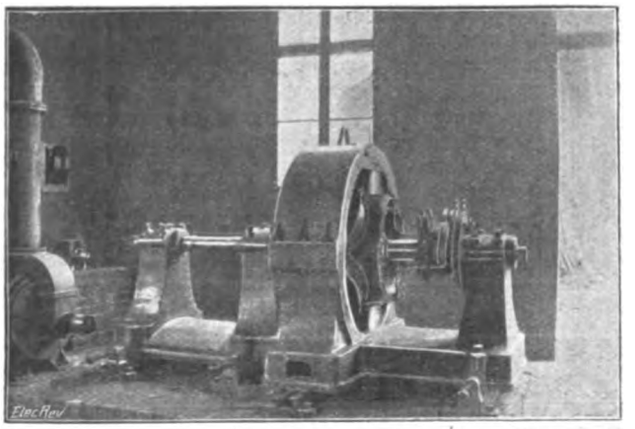


Calcic Carbide Installation.—Gas Treatment Plant.

dynamo which supplies current for both arc and incandescent lamps, thus instead of, as in the olden times, the gas being allowed to burn at the mouth of the furnace and in a very ineffectual manner lighting up the surrounding district, it is now scientifically applied for economically lighting such localities as require illuminating.

The gases issuing from coke-fed furnaces are the poorest in thermal value, and therefore the successful application of this quality of gas to the generation of electricity is of especial interest.

In the Westphalian iron district in Germany, a Thwaite-Gardner installation was put down for treating the gases from coke-fed furnaces, with the object of applying the power to the production of electrical energy for the manufacture of calcic carbide. The success which has resulted from the application of acetylene gas to illuminating purposes has caused a considerable demand for calcic carbide, and as this can only be economically produced by electric current generated in the least costly manner, water-power had the monopoly until the Thwaite-Gardner patents admitted the utilisation of blast furnace gas to enter the field as a competitor. The comparison of cost of electric energy by steam-power and water-power has been dealt with on more than one occasion, but besides the low cost of electric current when produced by blast furnace gas, there are the many advantages



Calcic Carbide Installation.—Alternator and Fan.

of associating the manufacture of calcic carbide with that of pig-iron making.

In 1898 the plant was started. The gas had a thermal

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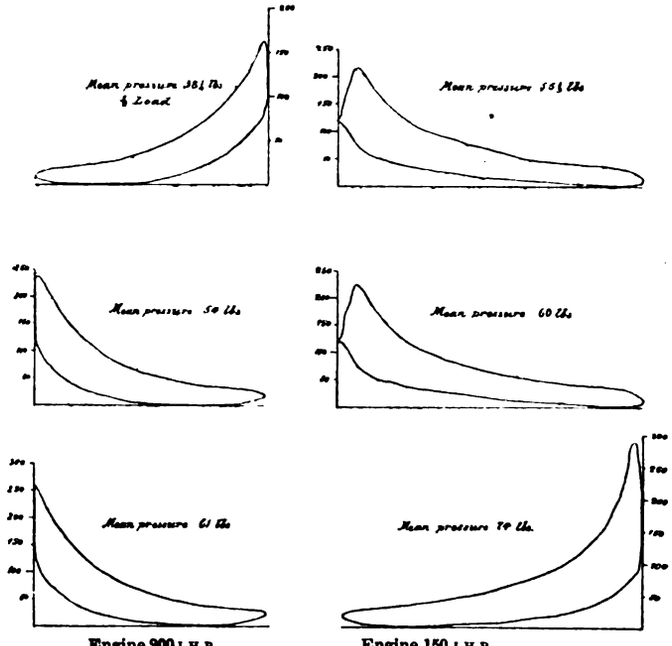
value of about 112 British thermal units, and was applied to a gas engine capable of developing 150 I.H P. The engine was of the twin cylinder (side by side) type, and was governed



Engine 200 I.H P.
Gas 105 B.Th.U. per cb. ft.

Engine 150 I.H.P.
Gas 190 B.Th.U. per cb. ft.

Diagrams with Blast Furnace Gas, Using Coke Fuel.

on the hit-or-miss principle. The alternator was belt driven, and supplied the electric current for a calcic carbide furnace. The engine is readily started by a small gas engine by means of suitable gearing.

In the Lancashire district, where the thermal value of the gas was only about 100 British thermal units, an engine of larger size was applied.

The gases were about as low in thermal value as can result from the manufacture of pig iron by coke. In this case the power was required to produce electrical energy for electric lighting and power purposes.

During five days' *continuous working* test it was found that the engine developed a maximum of 180 I.H.P. when carrying about three-quarter load, with a consumption of 132 cubic feet of gas per I.H P.-hour, the engine, therefore, giving an efficiency on the thermo-dynamic production of 19 per cent., and on a production of 170,000 cubic feet of gas per ton of coke charged into the blast furnace for *pig iron smelting*, the actual practical efficiency amounts to 11·25 per cent., which is certainly a remarkable result, considering that under the same conditions good steam engine practice only returns to about 5 per cent., and gas engines working with producer gas give 15 per cent. on fuel burned *only* for the production of this gas.

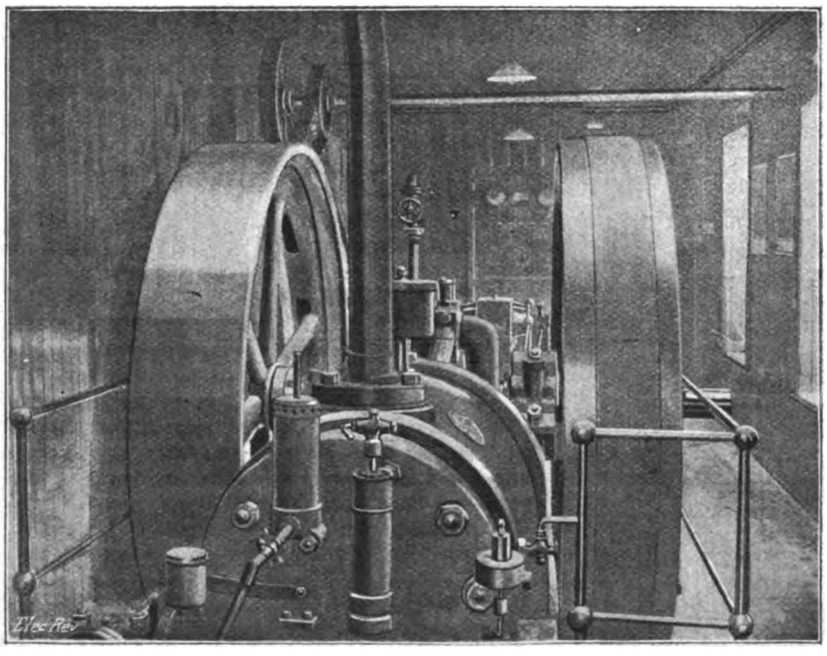
The same quality of gas, when employed in boiler flues for raising steam, is computed to require at least 700 cubic feet per I.H P., or over five times as much as when exploded in the cylinders of a gas engine.

The efficiency of the engine and dynamo during the above trial was found to be 71½ per cent.

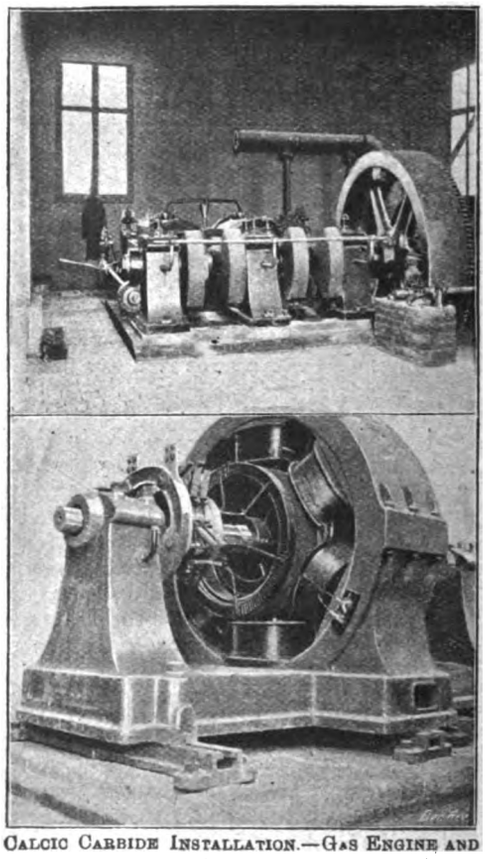
Financial Considerations.—It is not very easy to give an estimate of the money value of blast furnace gas in comparison with other fuels, as at most blast furnaces there could be a considerable sized installation running continuously, using only gas which was prevented from going to waste, in which case the fuel cost of the installation would be *nil*, while, of course, its value would be represented by the cost of fuel which would otherwise have been required.

The Rapid Advancement of the New System. — Rapid advances in the application of blast furnace gas to power purposes are being made in this country and on the Continent, and the driving of iron and steel works' machinery by electric motors is one of the important incentives to managers to adopt this method for the cheap production of electric power, for at most ranges of blast furnaces there is little difficulty in arranging for a sufficient supply of gas being available for the production of all the electrical energy necessary for driving the machinery of adjoining steel works, as far as the application of electric motors has been possible up to the present.

Nothing has been said so far as to the advantage of doing away with the very inefficient steam boilers, with their low pressure steam, and liability to explosion, not to mention the difficulties so frequently incurred in keeping up even the low pressure steam through bad draught, &c., but this will be obvious to all professional men.



Pioneer Plant at Wishaw.



Calcic Carbide Installation.—Gas Engine and Alternator.

Greenock.—At a private meeting of the Police Board last week, it was decided that the Greenock and Port Glasgow Tramways Company, Mr. W. M. Murphy, Messrs. Dick, Kerr & Co., the British Schuckert Company, the British Thomson-Houston Company, Limited, the Drake & Gorham Electric Traction Company, Limited, and the English Industrials, Limited, these being the firms which had applied for copies of the heads of conditions—should be invited to offer for the leasing of the lines on their own conditions.

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SOME NOTES ON ROTARY CONVERTERS, WITH SPECIAL REFERENCE TO THE EXTENSION PLANT OF THE CHICAGO EDISON COMPANY.

By A. C. EBORALL.

(*Concluded from page* 953.)

Fig. 3 illustrates the external appearance of one of the induction regulators, whose duty is to regulate the pressure

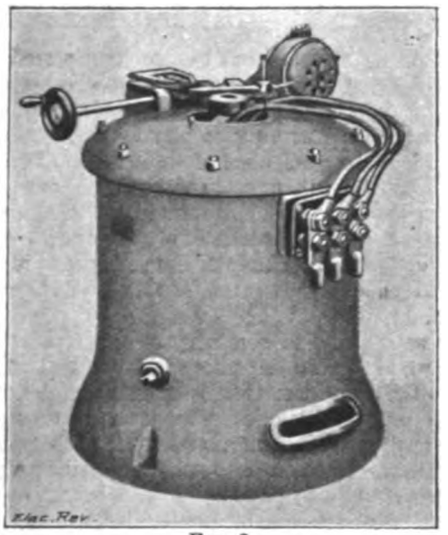
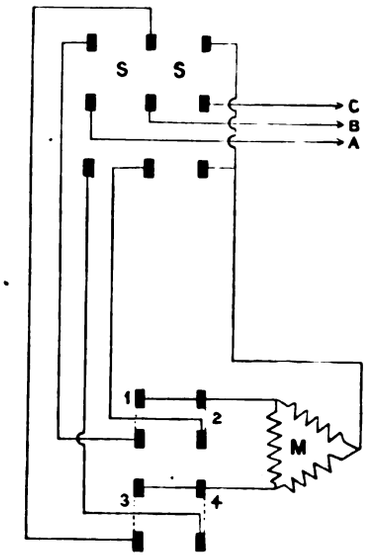


Fig. 3.

of the feeders. These regulators have no sliding contacts, but are adjusted by moving an iron core, which varies the inductive effect of a shunt winding upon a series coil. This core may be moved by hand, but, for convenience in operating from a distance, the core of each regulator is moved by means of a small three-phase motor geared to it by worm gearing, and mounted upon the top of the regulator. The three-phase motor is controlled from the main switchboard in the following manner:—

A small triple-pole throw-over switch is mounted on the switchboard for each regulator, connections being taken from it in the manner shown in fig. 4, from which it will be seen that



S S, Double-throw motor control switch on switchboard; M, Small induction motor geared to shaft of I.R.T. regulator; 1, 2, 3, 4, Limit switches open automatically at end of travel; A, B, C, To A.C. side of generator.

Fig. 4.

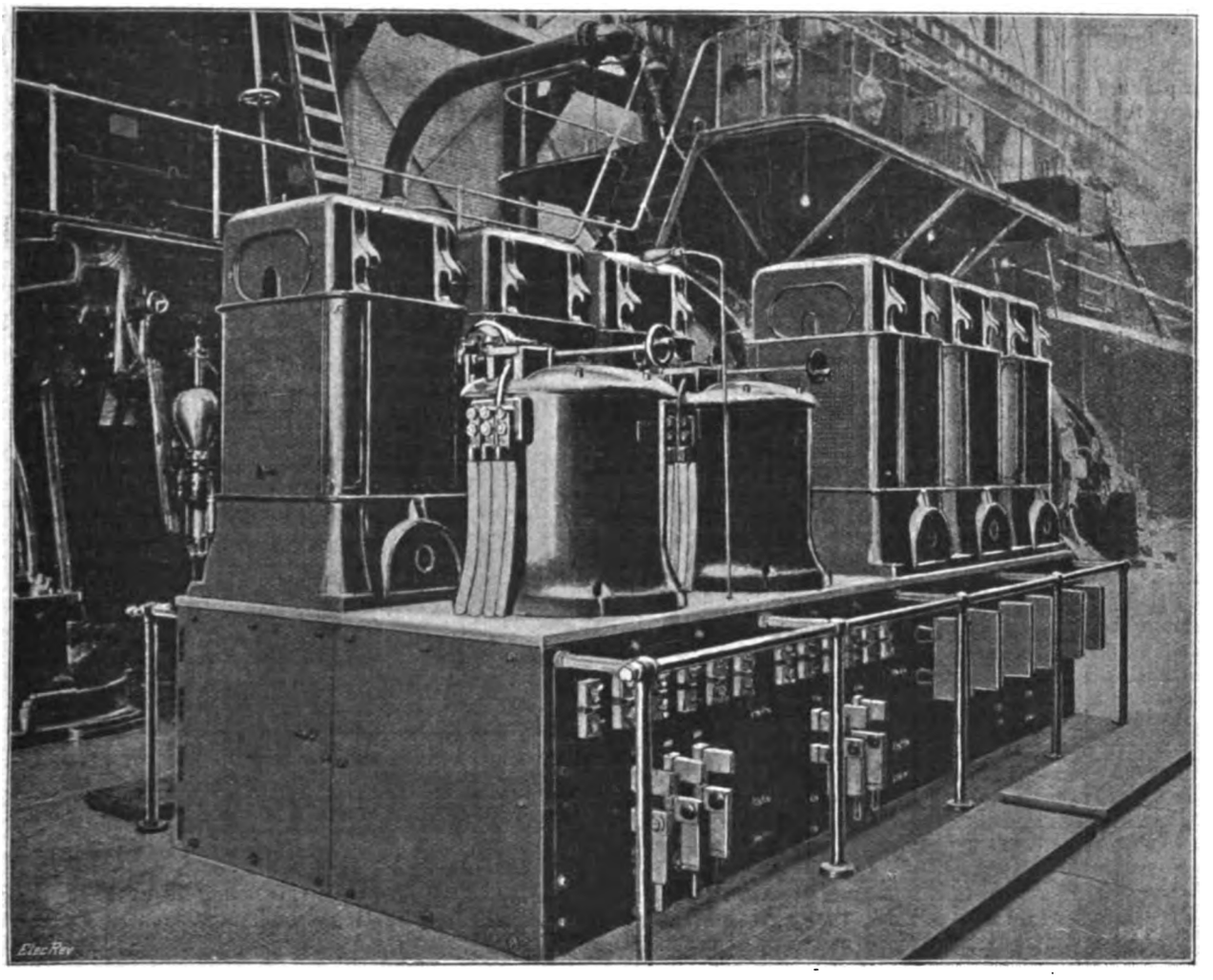


Fig. 5.

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if the switch is up, the motor will run in one direction, thus raising the pressure by moving the core out, while if the switch is thrown down, the motor will run in the reverse direction, and thus lower the pressure. Referring to the figure, the three-phase current enters through the leads A, B, C, to the hinges of the throw-over switch. One lead, C, goes right through to the motor whether the switch is up or down. Leads A and B go through other switches located on the regulator, and numbered, respectively, 1, 2, 3, and 4 in the diagram. These are "limit" switches, which prevent the small motor from moving the core too far, in case the switchboard attendant tries to raise or lower the pressure beyond the capabilities of the regulator. In case he leaves his switch in the upper position, switches 1 and 3 are opened automatically when the regulator reaches its highest boosting position, thus stopping the motor, but it is obvious that this does not cut it out of circuit when the attendant throws his switch over to the downward position, when the circuit of leads A and B is made through switches 2 and 4. These, however, open when the regulator is lowering the pressure by its maximum amount to prevent the motor running too far in that direction. The extent of the arc through which the movable part of the induction regulator may be turned is thus limited automatically. The total range of each regulator is 15 per cent. of the initial pressure—that is, it will regulate the pressure 7½ per cent. up or down.

Fig. 5 shows the arrangement of the step-up transformers and induction regulators in the power station. The six transformers and four regulators of the four generators constituting the two sets stand on a platform in the middle of the floor space between the two sets, and are all air-cooled. Under the platform, and enclosed by marble sides, is a large air chamber in which all the electrical connections between transformers, regulators, and fuse panels are made. Air is forced into this chamber by a blower driven by a direct-current motor, whose speed is controlled by a speed regulator, so that the proper volume and pressure of air may be maintained in the chamber. The transformers and regulators are provided with dampers, which regulate the amount of air passing through them individually, and may be adjusted according to the division of the load between them. On the sides of the chamber, mounted directly on the marble, are the high pressure fuse blocks already referred to, and the low pressure fuses and switches, the former being away from, and the latter facing, the units to which they belong. There are thus no leads to the switchboard panels carrying heavy currents; all such leads run directly from the generators to the transformer stand, and are very short. Moreover, there are no high pressure leads on the switchboard, as the switch gear is at a distance from it, and operated pneumatically.

At the receiving end of the line, in the up-town sub-station, are the necessary apparatus and appliances for reducing the pressure, changing the current to direct, and distributing it over the feeders of the three-wire network. This installation in general consists of the following:—

A high tension switchboard, with switches and fuses for each set of transformers; three sets of three 150-KW. air-cooled transformers; five induction regulators; two 100-KW. 125-volt rotary converters; two 200-KW. 125-volt rotary converters; one 250-KW. 250-volt rotary converter; with the necessary low-tension switchboard for regulating and controlling both the polyphase and direct current sides of the rotaries.

All the details of the double-current plant and system described above have evidently been thoroughly worked out, and reflect considerable credit upon the engineers of the General Electric Company, of America, who carried out the work.

Before concluding these notes, the writer would like to cite another and recent case where rotary converters are to be employed in a special manner, this time by his own firm. The tramway installation laid out by Messrs. Electricité and Hydraulique, Limited, of Charleroi, for the town of Sofia, is to have a generating station driven by water-power at a considerable distance from the town. Here high pressure three-phase currents will be generated, and sent over aerial lines to a sub-station in the town. In this station, the high pressure current will be transformed into direct current by means of stationary transformers and over-compounded rotary converters. But, as the water-power available is very variable, and might, under certain circumstances, fail altogether, these rotaries will be direct coupled to vertical engines, so that, if necessary at any time, the rotaries can be used as ordinary railway generators to supply the tramway system wholly or partly with current. Of course, suitable clutches will be arranged between the engines and the rotaries occasionally to be driven from them.

THE SCIENTIFIC PRINCIPLES OF PUBLIC LIGHTING BY ARC LAMPS.

By F. W. CARTER, M.A.

PUBLIC lighting by arc lamps has so long passed its experimental stages that it may be questioned whether any further study of its underlying principles can be fruitful at this date, and whether anyone wishing to plan an installation need do more than look up particulars of similar installations already in existence. But though hard bought experience will remain the chief guide in this matter, for it alone will take account of all the circumstances of the case, nevertheless a study of underlying principles may suggest modifications tending to the improvement of the system under consideration.

Whilst we are able to compare our artificial lighting with daylight, we are forced to confess that our best efforts are in general so far from ideal that it remains a debatable question, and a matter of opinion, what is the best distribution of light for any particular circumstances; some would prefer the illumination to be as uniform as possible, whilst others would advocate having patches of very bright light, even if other parts have in consequence to be left in comparative darkness. Another particular in which artificial light must fall short of daylight, at any rate out of doors, arises from the fact that the light proceeds from discrete sources, so that whereas in daylight an object will be illuminated in almost any position, by artifical light its illumination depends on how it is turned towards the sources. This has given rise to some differences as to how we should judge of the value of a system of lights, whether by their illumination of horizontal objects, of vertical objects, or of objects otherwise inclined. Whilst it is necessary to be able to see the roadway or ground as plainly as possible, it is also useful to be capable of easily distinguishing persons and objects standing vertically on the ground, so that a light that is too high up may illuminate the ground well, but be unsatisfactory on account of its nearly vertical rays only just grazing vertical objects. Again, one wishing to examine anything by artificial light naturally turns the object so that it shall be as highly illuminated as possible, so that, from this point of view, the maximum illumination is important. Since the horizontal plane is symmetrical with respect to the axis of the lamps, the illumination thereof is easy to deal with, the effects of the several lamps being additive. With but one lamp there is no difficulty in finding the illumination of the vertical plane turned towards it, as well as that of the plane inclined so as to have as great an illumination as possible. These, perhaps, include the most important cases, as one who has something to examine, or who wishes to stay to converse with another, or whatnot, naturally does so in the neighbourhood of a lamp where the effects of distant lamps are unimportant.

In street lighting the illumination will be increased somewhat by the reflections from neighbouring houses and walls, and this effect may be considerable in narrow streets and other places where the lamps must be on the sidewalks.

The use of such powerful sources of light as the electric arc gives rise to a physiological effect that may be noticed here. This is the partial blindness experienced when the eye catches sight of a very bright light. For ordinary street lighting, for instance, arc lamps with globes on are far more satisfactory than naked arcs, although the globes usually absorb from 30 to 40 per cent. of the light of the arc, for the naked arc so dazzles the eye that the illumination seems much less than it is. For this reason the naked arc can only be tolerated for lighting open spaces, such as goods yards and market places, or for very wide streets, where the lamp can, without detriment, be put at a much greater distance from the ground than is usual in ordinary street lighting.

It will be seen, then, that many considerations enter into

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this subject, and we must be prepared to find that the results of applying some scientific method to the solution of the problem of finding a system of lights to satisfy specified conditions, require considerable modification to make them practically useful.

Before proceeding further with the subject, let us define some of the terms which we shall use. The unit of intensity is the "candle-power," or the intensity of the light given out in a horizontal direction by a certain standard sperm candle, which does not differ very much from an ordinary paraffin or tallow candle. The standard candle will not give out light of the same intensity in every direction, but let us suppose we have a unit source whose intensity of emission is 1 C.P. in every direction; then the intensity of *any* source in any particular direction is the number of these unit sources that we must put in the place of the light considered, in order to have the same luminous effect as the light in question has in that direction. It would seem almost unnecessary to give this definition, but there appears to be an idea in some quarters that the intensity of a

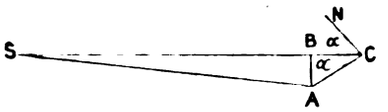

FIG. 1.

source of light has something to do with the law of inverse squares—an impression arising from the usual method of measuring it. The definition strictly applies only to point sources, but as we shall consider the luminous effect always at distances which are great compared with the size of the source, we need not complicate it with generality. It should be noted that, in treating of an arc with a globe on, the combination of the arc and globe form the source, and not the arc only. The intensity of a source will generally be different in different directions. If from the source of light we draw lines in every direction, each of length numerically equal to the intensity of the light in its direction, the surface on which the ends of these lines lie is called the "photometric surface" of the source, and the mean length of the lines, supposing them equally distributed, is called the "mean spherical candle-power" of the source. If the source is symmetrical about an axis, as is usually the case with arc lamps, the photometric surface is one of revolution, and all sections by planes through the axis are identical; any such section is called the "photometric curve" of the source. The photometric curve then, of which we shall hereafter make considerable use, is a curve drawn in any plane containing the axis of the lamp, and having its radius vector in any direction numerically equal to the intensity of the light in that direction. The illumination of a surface at any point is proportional to the quantity of light falling on unit area at the point. It is measured in terms of the "candle-foot," which is the illumination of a surface facing a standard candle, and at a distance of 1 foot from it. At a distance of 2 feet, the same amount of light, assuming that it comes from a point, has to cover four times the area, so that the illumination is ¼, at 3 feet it is ⅑, and so on. This is the law of inverse squares. The illumination, of course, varies directly as the intensity of the light. Hence, if the intensity in a particular direction is I candle-power, the illumination of a surface situated in that direction, distant r feet from the source, and facing it, is $\frac{I}{r^2}$ candle-feet. If the surface does not face the source, we have also to multiply by the cosine of the angle through which it is turned from its position facing the source, or, what is the same thing, the angle between the direction in which the source lies, and the normal to the surface. This can be seen as follows:—Let S (fig. 1) be the source, A C a section of the surface on which the light falls, A B a section of a surface S and intercepting the same amount of light as A C; let the angle CAB = α = BCN. Then the area AB = the area AC × cos α.

Since the same amount of light falls on A C as on A B, the amount per unit area on A C is to that on A B inversely as the area A C to the area A B, that is as cos α is to 1. Thus the illumination of A C = the illumination of A B × cos α.

$$= \frac{I}{r^2} \cos\alpha, \text{ candle-feet.}$$

If the source of light is not a point, the law of inverse squares is not true, but in the cases we shall consider the distance from the source will always be great compared with the linear dimensions of the sources, and we shall make no great error in assuming that the source is a point.

We are now in a position to see what these quantities reduce to in the particular cases we are considering.

Let A (fig. 2) be an arc lamp, AB, the vertical, being its

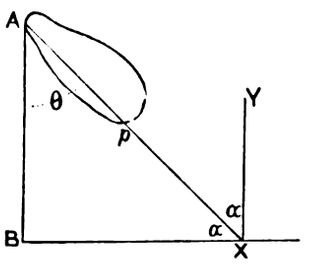

FIG. 2.

axis. Let A P Q be the photometric curve of the lamp, the vectorial angle (θ) being measured from the vertical. Let B X be a horizontal, and XY a vertical. The illumination of a plane at X turned towards the arc; *i.e.*, the total illumination at X, is $\frac{I}{r^2}$ candle-feet, where A P = I candle-power and A X = r feet, the illumination of the horizontal plane at X is $\frac{I}{r^2}\cos\alpha$ or $\frac{I}{r^2}\cos\theta$ candle-feet, and that of the vertical plane facing the lamp-post is $\frac{I}{r^2}\cos\alpha'$ or $\frac{I}{r^2}\sin\theta$ candle-feet.

Now A B = $r\cos\theta$, whence

$$r = \frac{AB}{\cos\theta}$$

Thus the total illumination $= \frac{I}{r^2} = \frac{I\cos^2\theta}{AB^2}$ candle-feet.

The horizontal illumination $= \frac{I}{r^2}\cos\theta = \frac{I\cos^3\theta}{AB^2}$ candle-feet.

The vertical illumination $= \frac{I}{r^2}\sin\theta = \frac{I\cos^2\theta\sin\theta}{AB^2}$ candle-feet.

When X is on the ground, A B is the height of the lamp, which we will call h feet. If X is at a height h' feet above the ground, A B = $h - h'$ feet. Thus if the height of the arc above X (*i.e.*, $h - h'$) is given, the most convenient expressions for the total, the horizontal, and the vertical illuminations are respectively—

$$\frac{I\cos^2\theta}{(h-h')^2}, \quad \frac{I\cos^3\theta}{(h-h')^2} \text{ and } \frac{I\cos^2\theta\sin\theta}{(h-h')^2} \text{ candle-feet,}$$

since all are expressed in terms of one variable θ. We shall perhaps best meet the demands of utility if we consider the horizontal illumination at the ground ($h' = 0$), and the total and vertical illuminations at a height of 4 or 5 feet above the ground ($h' = 4$ or 5).

(To be continued.)

[ERRATUM.—The angle α^1 (PXA) is marked α in figure.—EDS. ELEC. REV.]

Northern Society of Electrical Engineers.—On Tuesday last, 19th inst., at Manchester, Mr. Ferranti, the president of the above Society introduced for discussion the subject of the difficulties encountered in "The Use of Multiphase Plant in Conjunction with Continuous Current Systems of Supply."

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SPEEDS AND STANDARD PERIODICITIES.

By E. KILBURN SCOTT.

In March last the Uniformity Committee of the Institution of Electrical Engineers published its report on the adoption of a standard of periodicity in alternating current working. The Committee was unanimous in recommending 50 periods per second for all ordinary work, 25 periods per second for power transmission on a large scale, and 100 periods for exceptional cases of house-to-house transformer supply.

Total number of poles of alternator or motor.	Periodicity per second.	Revolutions per minute of alternator or synchronous motor.	Revolutions per minute of induction motor with 7½ % slip.	5 % slip.	2½ % slip.
4	25	750	694	712	731
	50	1,500	1,388	1,425	1,462
	100	3,000	2,776	2,850	2,925
6	25	500	462	475	487
	50	1,000	925	950	975
	100	2,000	1,850	1,900	1,950
8	25	375	347	356	365
	50	750	694	712	731
	100	1,500	1,388	1,425	1,462
10	25	300	277·5	285	292
	50	600	555	570	585
	100	1,200	1,110	1,140	1,170
12	25	250	231	237	243
	50	500	462	475	487
	100	1,000	924	950	974
14	25	215	199	204	209
	50	430	398	408	419
	100	860	796	816	838
16	25	187	173	178	182
	50	375	347	356	365
	100	750	694	712	731
18	25	166	153	157	162
	50	332	307	315	324
	100	664	614	630	648
20	25	150	138	142	146
	50	300	277	285	292
	100	600	555	570	585
22	25	136	125	129	132
	50	272	251	258	265
	100	544	502	516	530
24	25	125	115	118	121
	50	250	231	237	243
	100	500	462	474	486
26	25	115	106	109	112
	50	231	213	219	225
	100	462	426	438	450
28	25	107	99	102	104
	50	215	198	204	209
	100	430	396	408	418
30	25	100	92	95	97
	50	200	185	190	195
	100	400	370	380	390
32	25	94	87	89	91
	50	188	175	178	183
	100	376	350	356	366
34	25	88	81	83	85
	50	176	163	167	171
	100	352	326	334	342
36	25	83	77	78	81
	50	166	153	157	162
	100	332	306	314	324
38	25	79	73	75	77
	50	158	147	150	154
	100	316	294	300	308
40	25	75	69	71	73
	50	150	139	142	146
	100	300	278	284	292
42	25	71	65	68	69
	50	143	131	136	139
	100	286	262	272	278
44	25	68	63	65	66
	50	136	125	129	132
	100	272	252	258	265
46	25	65	60	62	63
	50	131	120	124	127
	100	262	242	248	255
48	25	62	57	59	61
	50	125	115	119	122
	100	250	231	238	244
50	25	60	55	57	58
	50	120	111	114	117
	100	240	222	228	234
52	25	57	53	54	55
	50	115	106	109	112
	100	230	212	218	224

There are some who think it would have been wiser to have adopted American practice of 60 and 30 periods per second, but, generally speaking, electrical manufacturers have readily fallen in with the suggestions of the Institution Committee.

There is one point, however, which makes the adoption of standard frequencies somewhat awkward, and that is the speeds of prime movers. Practically all generators are nowadays coupled direct either to turbines or Pelton wheels, or else to steam or gas engines. The speed of the turbine or Pelton wheel is governed by the height of the fall, whilst the speed of an engine appears to be mainly a matter of chance. In this country we have to deal almost entirely with engines, but so far, not a single engine firm has adopted a line of speeds which fit in with the suggested standard periodicities.

Take Messrs. Willans & Robinson for example, their standard engine speeds are as follows:—

2 F's 3 F's	470 revs.	2 Q 3 Q	340 revs.
2 G's 3 G's	460 „	2 R 3 R	320 „
2 H's 3 H's	*380 „	2 S 3 S	*300 „
2 I's 3 I's	350 „	2 T 3 T	270 „
2 O 3 O	450 „	2 V 3 V	*230 „
2 B 3 B	400 „	3 W	210 „
2 P 3 P	360 „	3 X	*200 „

Whilst the speeds of Belliss & Morcom's engines are:—

Two-Crank.		Three-Crank.	
E C_1	*600 revs.	T E C_1	*500 revs.
E C_2, E C_3	575 „	T E C_2	450 „
E C_4...	550 „	T E C_3	420 „
E C_5...	*500 „	T E C_4	*380 „
E C_6, E C_7	450 „	T E C_5	360 „
E C_8...	400 „	T E C_6	340 „
E C_9 E C_{10}	*380 „	T E C_7	*330 „
E C_{11}, E C_{12} ...	350 „	T E C_8	320 „
		T E C_9	310 „
		T E C_{10}	*300 „
		T E C_{11}	280 „

Now, a reference to the table shown in the left-hand column of this article shows that only those sizes of engines marked with an asterisk fit in with the standard periodicities (this being inclusive of 380 revolutions, which is included because it is only five revolutions faster than standard speed).

If the other engine makers' lists are gone through, they will be found to present the same difficulty. It is seen, therefore, that if we are to adopt standard periodicities at all, the initiative must come from the engine makers, at any rate, from such as make *high* speed engines.

Curiously enough, the discrepancies become less and less important as the speed is reduced, or in other words, as the number of poles of the alternator are increased (there must, of course, always be an even number of poles). For example, the difference between, say, 40 and 42 poles, which would be suitable for a slow running horizontal engine, is only 5 per cent., whereas between 14 and 16 poles, which are commonly employed for high speed engines, the difference is nearly 15 per cent.

Induction motors are now coming largely into use, and the three last columns are added to the table as they form a ready guide for approximate speed. On full load the speed of an induction motor, whether it be single, two, or three-phase, is lower than synchronous speed by an amount which is termed "slip." The slip varies with the design and output, but it is generally somewhere between 2½ per cent. for the large sizes and 7½ per cent. for the small.

Although the three last columns are filled in complete, it should be noted that there are mechanical and electrical (magnetic leakage) reasons why the number of poles for a given size of motor cannot be exceeded with a given output. For example, the synchronous speeds and the most convenient numbers of poles to use for a periodicity of 50 per second are as follows:—

	Synchronous speed revs. per minute.	Number of poles in stator.	Probable slip per cent.
Up to 7 B.H.P. ...	1,500	4	7½
7 B.H.P. to 35 B.H.P.	1,000	6	5
35 B.H.P. to 120 B.H.P.	750	8	2½

A 7 B.H.P. motor could be built with eight poles, in which

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case the synchronous speed would drop to 750 revolutions per minute, but it would not be advisable to go much beyond that number.

The writer has pointed out elsewhere the necessity of the speeds of centrifugal pumps agreeing with the speeds of induction motors if the two are to be direct coupled, and here again, as with engines, the adoption of the Institution's suggestions for standard periodicities really lies with the centrifugal pump makers. They have got out certain lines of pumps running at various speeds, and the question is, is it going to be worth while going through the work again and adopting speeds which will suit the electrical engineer?

THE INSTITUTION OF ELECTRICAL ENGINEERS.

The paper read and discussed at the meeting of the Institution of Electrical Engineers last week was on the rather unusual subject of "Electrical Time-Service," in which the writer, Mr. F. Hope-Jones, gave a full account of the various proposals and inventions connected with electric clocks, and particularly described his own ingenious devices of the kind. As was to be expected, the discussion was largely contributed to by rival clockmakers and inventors.

The first of these was Mr. A. J. Lund, who demurred at the division given in the paper, of electric clocks. Mr. Hope-Jones gave:—

1. Independent, self-contained, self-wound clocks.
2. Systems of clocks connected together by a line.

But Mr. Lund preferred to take three classes:—

(*a*) Impelled clocks, driven by a current sent from a central station.

(*b*) Controlled clocks, not allowed to go wrong.

(*c*) Synchronised clocks, set exactly right every hour.

He urged the advantages of clocks of class (*c*) which (1) did not leave the public without an indication of time if the line went wrong or batteries failed, and (2) could be re-synchronised without trouble when the current was again able to pass along the line. When a signal did arrive the hands were set right. He gave some amusing stories of experience with classes (*a*) and (*b*), and cited the objection many people had to the noise of a click—the tap, tap, every half minute; also referring to the "terrible question of battery power," which would be all the more acute if one had to "peg, peg away at the battery every half minute or less, instead of only once or twice an hour." Some reference to Pond's system, and the best position for a battery, closed his remarks.

Mr. H. T. Harrison spoke as having had some practical knowledge of the subject when electrical adviser to the company operating the Lund system. He said it took all available time to keep the lines in order, and thought it absolutely hopeless to use overhead lines in London for impelled clocks, while, if the question of permission to lay underground lines was disposed of, there remained the problem, would it pay to lay such lines for use with, say, 200 volts on a circuit with large self-induction, and, therefore, requiring good insulation? He was seriously doubtful whether the matter could be put on a financial basis, for the rental asked was equal to the interest on the money which would be spent on a very high class clock, which could be guaranteed to keep very nearly to time. If the system of hourly synchronisation only could be worked with a little more expenditure on the lines, accurate time service could be effected

Mr. J. S. Raworth, in his usual amiable form, contributed the most amusing speech in the discussion. When we can get rival old-fashioned clocks rather than the modern system of the other inventor, it was, of course, obvious that it should be criticised, but he was not so pessimistic as Mr. Harrison. In large hotels there were often 500 or 600 clocks, and it was extraordinary how the clock winder ill-timed his visits. He had some experience of these clocks in Paris, and the noise of the thing was a drawback. When thinking "how wicked Paris was, and how good I was in comparison with it," the ceaseless click-click led to counting the ticks and wondering "if the thing ever stopped, the final result being a descent upon the switch placed in circuit," and peace. ["Could there be anything more ridiculous than a switch in an electric clock circuit?"—Mr. Hope-Jones in his reply.]

Mr. A. H. Bateman told the story of a clock he got for a Parish Hall at Lewisham, which has been working for two years. One 18-inch dial, one 12-inch dial in room 300 feet away, and other two smaller, have been in use, with Obach batteries as source of power, and they have worked "absolutely well, keeping admirable time," their only failing being to spoil "very pathetic love-making scenes in some theatricals," leading to "sulphurous language," and the threat that "if that thing was not stopped——!" A piece of felt carpet behind the clock reduced the click so much that it was quite inaudible. One of the smaller clocks had fallen from its fastening, and Mr. Bateman found it "hanging by its head" and everyone afraid to touch it, fearing they might get a "shock," but, "true to time," it had "gone on merrily, and very few ordinary clocks would have stood that ordeal." Altogether the experiences recounted were a good testimony to electric clocks, if not very dry science.

Mr. J. Stockall returned to the horological aspect of the question and went far deeper into the trade mysteries of the whole thing than we fear our readers would care to follow him. Then came Prof. S. P. Thompson, who referred to the Institution of Mechanical Engineers and the Surveyors' Institute as examples of recent buildings fitted with Mr. Hope-Jones's system. The slight troubles experienced there were due to causes which had nothing to do with the clocks even if they had not gone absolutely perfectly, was the remark of Mr. Worthington on being asked to give his experience with these clocks.

Prof. W. E. Ayrton asked the author whether the rate of going of the master-clock was affected by the time-constant of the circuit. Mr. G. W. Frodsham thought that the history of 30 or 40 years showed that an electrically-driven clock was not to be countenanced, for although, no doubt, those views might be modified, sometimes in practice such clocks failed. In Glasgow some years ago trouble was found. After describing an arrangement of his own for taking accurate time intervals recorded on paper, Mr. Frodsham gave place to Captain H. D. Acland, who thought it must be a source of satisfaction to Mr. Hope-Jones that there had been so little real criticism of his paper. He personally was interested as an amateur in the measurement of time, and gave an account of his own experience—a very favourable one—with Mr. Hope-Jones's clocks; even when on returning from a holiday he found the clock the home of earwigs and spiders, it had not stopped. His experience in experimental work—chiefly on gun ballistics—taught him that in case of obstacles the proper course was not to invent new things, but to remove the difficulty, and he was quite certain that the tap, tap of electric clocks, which at one time threatened to drive him perfectly mad, could be done away with if the cause of the noise was discovered. The altered movement of his own clock was now so silent, that it gave no annoyance whatever.

Mr. Hope-Jones, in replying, quoted German authors whose classification of clocks he had followed. The battery question was not so serious as had been made out, and the demand made upon the battery in his system was actually less than in many others. Insulating the clock movement, from anything which could act as a sound-board, by springs silenced the noise. A maintaining spring might be used in the master-clock, to get over any such difficulty as that suggested by Prof. Ayrton. He explained that the flooding of a conduit, blowing of a main fuse and earth on clock wiring accounted for the trouble alluded to by Mr. Worthington. This closed the discussion, and the meeting adjourned.

CORRESPONDENCE.

Signalling Without Contact.

I fear that both you and your readers must be getting tired of this subject, but still I do not like to leave "C. M. J.'s" last letter without reply.

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"C. M. J.'s" method of answering questions is peculiar. I asked how a driver discovers the presence of an invisible signal. He replies with a list of points about the road which *may* and, of course, in many cases *do* enable the driver to know when he is in the neighbourhood of a signal post, but which, it is well known, do not always suffice. I asked what was the use of detonators if the signal could always be located without them (as "C. M. J." maintains) and assumed to be at danger. In reply, we are told that detonators and lamps are used for signalling—which was pretty well known before. The answer to my third question—What can a driver, otherwise unable to locate a signal, do but "assume that the line is clear if he does not hear a detonator explosion"?—is simply the old tale about assuming the arm at danger. To question four, however, the answer is direct—praise of the old method is not criticism of the new. I am glad to find that we are agreed on this point, at all events. The reason why it is easier for the driver to read signals that he has to pick out from others in the air than those, without surrounding ones, given before his face on the engine is that he can do several things at once! To the question, Where are trains to be seen running through four block sections per minute? the answer is that "there are many large station yards where the signal boxes are often not more than one-eighth of a mile apart." I leave comment to readers.

It is, at all events, consoling to find that "C. M. J." does not condemn my system *in toto*; and I am much obliged to him for expressing the opinion that I have "got hold of the right principle." This is another point of agreement between us.

W. S. Boult.

The Wilson Enclosed Motor.

I notice in your issue of December 8th a description of the "Enclosed Wilson Motor." Permit me, through your valuable paper, to point out that an identical machine to this, embodying the same special features as claimed by Wilson, was designed by me in the early part of 1896. In my design, both round and rectangular field magnets were employed (both detachable and cast to the outer shell of the magnetic circuit). These motors were manufactured by John Elmondson, of Leeds, and are now made by Mr. Thomas Barton, the Electric Works, Weir Street, Blackburn.

There are several motors from 1 to 25-H.P., working in different parts of the country. Messrs. Slingsby, Limited, Bradford, are driven exclusively by them from the Corporation supply.

Thomas Preece.

Board of Trade Regulations.

A note in your issue of the 8th inst. relating to this subject raises an interesting question. You say, or rather you quote from a contemporary, that "many engineers have considered that a 2 × 220-volt *alternating* current three-wire system comes within the category of high pressure supply," and you say that this applies to the distribution system. Presumably your dictum is based on the B.O.T. Regulations for 1896, Sections 1 to 5.

If your interpretation of these regulations is correct, then, by the ruling of the same regulations, a three-wire *direct* current traction system, employing anything under 500 volts on either side of the neutral, is a high pressure system.

I have always assumed, perhaps wrongly, that if the B.O.T. officials were to be asked why they tolerate a 500-volt trolley system of the ordinary type, they would reply that, so long as the 500 volts was not exceeded, they were not departing from their own regulations in sanctioning the use of a bare trolley wire overhead.

The question whether the same regulation applies in the same sense to a three-wire direct current 2 × 500-volt system seems of interest in view of the possible introduction into this country of this system in particular cases. If it applies, then presumably no bare trolley wires are permissible.

What, then, is of importance is the following sentence in the B.O.T. Regulations for 1896:—"The expression 'pressure' means the difference of electric potential between any two conductors through which a supply of energy is given, *or between any part of either conductor and the earth.*"

Now, if the latter half of this definition is an alternative and may be taken by itself, a three-wire direct current 2 × 500-volt system having the "neutral" earthed is a *low* pressure system, provided the 500 volts be not exceeded.

But, according to your dictum, a three-wire 2 × 250-volt alternating system having the neutral earthed is a *high* pressure system.

Are the two conditions of the definition quoted above quite inseparable? And, if so, by what process does the London United Tramways Company hope to gain official sanction to the three-wire 2 × 500-volt system?

A. M. Taylor.

A Hydro-Electrical Phenomenon?

A few days ago I was asked to report on the curious action of a steam boiler installed at a works in Birmingham where the electric light was in use. It was noticed that a person walking over the boiler on a wooden staging was liable, on approaching his hand to one of the supporting pillars of the yoke, through which the stem of the main steam valve screwed, to receive a severe shock, and could obtain a spark from ¼ inch to ⅜ inch long between finger and pillar.

The owners were afraid this was due to leakage from their electric plant. I explained it in the following manner:—Finding that on placing my foot on the plates of the boiler the spark could not be obtained, yet when standing on the wood it could, and as there was a considerable leakage of steam from a bad joint at the base of the pillar and all round it, I must have formed a species of Leyden jar to receive electricity from the pillar, it being brought to a high potential by the friction of the steam escaping through somewhat intricate passages at the base of the pillar, much on the same principle as Armstrong's hydro-electrical machine. I should like the opinion of your readers on this point, also as to whether it has been noticed before, and if it could have any bearing on the subject of your paper by F. S. Spiers on "Corrosion in Boilers," or would the presence of high voltage electricity at a leaking joint affect the plates?

Hugo Gibson.

Birmingham, *December 16th*, 1899.

Single-rail Tramways.

My attention having just been drawn to an article that appeared in your issue of May 19th last upon Monsieur H. F. Caillet's single-rail tramway, and to your remarks thereon, I have the pleasure to send you herewith a reprint from the *Journal of the United Service Institution of India* of "Notes on *Ewing's* Patent Single-rail Tramway, with reference to its adaptability to military purposes," by Lieut.-Colonel F. F. R. Burgess, I.S.E. The single-rail tramway therein referred to was patented by me in the United States of America, India, England, all the Australian Colonies, the Cape, Natal, Brazil, the Argentine Republic, and other countries in 1895. I also send you a photograph of a single-rail tramway which was worked in 1881 on exactly the same principle as the *so-called* Monsieur Caillet's invention is now. The photograph shows the line and truck as invented and exhibited by me on the Parade Ground at Dibrugaak, Upper Assam, so far back as 1881, before Field-Marshal Sir Donald Stewart—then General Sir Donald Stewart, Commander-in-Chief in India, General Sir George Greaves, then Adjutant-General, and the late General Sir Charles Macgregor, then Quartermaster-General in India. Among others who were present on that occasion were Lieut.-General Chapman, C.B., now commanding H.M.'s forces in Scotland, and who was then Military Secretary to H.E. the C-in-C. in India; General Nation, C.B., commanding our Eastern Frontier District (Assam); Colonel Way, Assistant Adjutant-General, Eastern Frontier District; and Colonel H. M. Evans and officers of the 43rd Assam Light Infantry. On this occasion 175 yards of the line were laid ready for work by 40 *recruits* of the 43rd Assam Light Infantry in 6½ minutes, and from H.E. the C-in-C. and his staff I received warm congratulations on having invented a means of transport that all said would have been invaluable during the recent Cabul war.

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My reasons for abandoning that system were (1) the width occupied, owing to the animals being at the side, the yoke at the end of the cross-pole, shown in the photo, being used for bullock power; and (2) that no matter whether the truck was fully laden or quite empty, the animal at the side was still necessary to balance each truck, and a *train* of trucks could not be taken by one pair of bullocks, horses, mules, or any other animals, and electricity or steam could only be applied in the manner you suggest in your remarks.

On my present system a pair of Indian bullocks can draw a *net load* of 7 tons in one, two or more trucks, and steam, electricity, or any other motive power can be applied as may be desired.

The most economical method of working the tramway would be by means of a traction engine with its driving wheels on the *road*, and all the load behind it in trucks on my system on the single rail. As the use of the rail increases the load that a pair of bullocks can draw on a first-class metalled road (¾ of a ton) to 7 tons *net load*, a traction engine with its driving wheels on the road or ground that can haul a gross load of, say, 10 tons behind it in the usual way, should be able to draw 100 tons were the load on the rail, as on my system. The only drawback to this would, when the tramway was laid on a *road*, be the necessity for laying the rail some 4 feet in from the edge of the road, to allow the driving wheels to run one on either side of the rail, whereas, with animal power as I use it, the rail can be laid on the extreme edge of the road, except where it crosses bridges, when it must be carried further out towards the middle of, and the rail laid flush with the surface of, the road, as with ordinary railway level crossings. Were an engine specially designed to run with its drivers on the rail, the latter would have to be increased in weight to carry the weight on the driving wheels of the engine, and so the heavier the weight to be drawn by the more powerful, and necessarily much heavier engine, the greater would be the weight *and cost* of the tramway; *but* with a traction engine having its driving wheels on the ground, the light *and cheap* tramway would do equally well for a light or heavy load, the load in the latter case being carried in a greater number of light trucks with stronger couplings than would otherwise be necessary. For this combination of my single-rail tramway and a traction engine I claim that it would be the simplest and cheapest method of land transport that has ever been invented. I forgot to add that another illustrated account of my tramway, by Lieut.-Col. A. J. Kelly, R.E., was published in the *Royal Engineers' Journal* (published at Chatham) of October 2nd, 1899.

Chas. Ewing, C.E.

Adyar, Madras,
November 21st, 1899.

Berrenberg Lamps.

With reference to an Editorial paragraph relating to the Berrenberg incandescent lamp appearing on p. 974 in your issue of the 15th inst. (and to which my attention has just been drawn), I must ask you to allow me to make a few observations on the same.

You publish as the result of what you state to be "an absolutely impartial test of initial candle-power and efficiency" a table of figures relating to four 16-C.P. and six 32-C.P. 100-volt lamps of the 2½-watt 1,000-hour class, manufactured by the Berrenberg Syndicate, under my own supervision, and which were sent to you with the invitation that certain tests should be made. You go on to point out that the figures in question show a deficiency in the candle-power of one-third below the marked values, the aggregate watts per lamp, however, working out at even less than we claim for the marked candle-power.

Taking the last-mentioned point first, we are not surprised to find we are practically at one—it is so easy a matter for anybody and everybody to put a lamp on the ammeter and see at once the consumption in amperes of current.

The question of photometrically deciding on the candle-power given, is, however, a much more involved question, and figures to be of any value in this respect require, as every electrician knows, some explanation. What standard of candle-power are we to understand was adopted, and what instruments were used? The results obtained by different methods and by different instruments when measuring for candle-power are as wide as the hills. I am not disposed, therefore, to accept figures blindly, and in the absence of any such information, your figures tell us nothing.

The Berrenberg lamps are made to, and marked for, "English standard candles." In the absence of any other reliable means of measuring a candle, the "Hefner candle" is used. This instrument, designed and made to register the "German candle," is examined, passed, and stamped by the German Government, and is the only instrument in the world franked with Government authority. The ratio of the "English candle" to the "German" is as 114 to 100, and it is working on this ratio that the Berrenberg lamp candle-power is arrived at. If anybody can point us to a better method it will be willingly adopted.

Respecting the suggestion that perhaps on 106 volts these lamps would give their marked candle-power, I desire to say that all lamps made by us are made to give the life claimed, and the proper candle-power at the E.M.F. marked on the lamp.

What we asked you to do before, and what I now ask you to do again, is to purchase 12 of the best of similar English lamps (at my expense) as the 12 100-volt lamps I am willing to send you. Let these lamps be tested by the same "impartial authority" in my presence, or in that of a representative of the Berrenberg Syndicate, each lamp of each make to be tested alternately for initial candle-power and current on the same day, and measured by precisely the same photometer and instruments, and the record of each lamp published in the REVIEW.

It matters not thus whether your photometer reading gives us 16 C.P., 10 C.P., or even 5 C.P., the fact that we are giving more light than the others, and that the ratio of difference can be ascertained, and the claim made by us that we give more light with a lower consumption of energy be readily proved or refuted, gives something tangible in the way of a lamp test.

I, personally, am willing to make myself responsible to pay to the person who can produce any other lamps on the market, giving the candle-power, combined with high efficiency and long life of the Berrenberg lamps, the sum of £100.

With reference to your concluding paragraph about a test of 200-volt lamps, I will ask you to kindly allow me to refer to these in your next issue.

A. Berrenberg.

December 20th, 1899.

Tested Lamps.

It is an easy matter for your correspondent to say that my experience with lamps is "very limited," but he must remember that I could just as easily say the same about him. I have already acquired the information that he kindly gives me *re* the "flashing" of filaments.

Strange as it may seem, I know that at least one lamp maker puts gas into his bulbs. His lamp is a very good one, and the "whole thing" does not "explode." I do not, of course, say that an "explosive" gas is used, and I need hardly add that the gas is under reduced pressure, indeed, I think, considering the low pressure in the bulb, it would be a difficult matter to make even an inflammable gas explode.

Few lamps with which I have had to deal have had a vacuum by any means perfect. A good authority on electrical matters says that if a lamp has a perfect vacuum the carbon of the filament dissipates.

When I spoke of efficient lamps, I meant "efficient" over a life of 600 hours.

I have not missed the point of contention, which, as far as I am concerned, was the "consumption of current," not the "inexplicit report," which I see was only an abstract. I will ask your correspondent to refer to Sir W. H. Preece's "Electric Glow Lamp Tests" (ELECTRICAL REVIEW, Nos. 983 and 984), he will there find a few instances of the current rising as the lamp burns.

The 100-volt lamps which I have tested have generally been "flashed," so in this point, at least, we agree.

On reading a letter which appeared in the *Electrical Engineer* of December 8th, I find attention is there called to

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an error your correspondent appears to have made, the ·017 increase he speaks of being really only ·007 ampere increase.

F. P. S.
Electrical Engineer.

MIXED SYSTEMS.

One of the leading lessons learnt by the members of the Institution of Electrical Engineers, who recently investigated the Swiss electrical supply systems, was that in Switzerland a hard and fast system was not prescribed for every town or locality, every place being treated on its merits, and such treatment frequently leading to diverse systems in different parts of the same locality.

A well-known North-Country electrical engineer, who has just returned from an extensive tour in the United States, finds a like state of things there.

The central station engineers responsible for work in the United Kingdom have, hitherto, in the main, ignored the great advantages arising from so-called "mixed systems." We say "in the main," because there have been exceptions. Prof. Kennedy, at Edinburgh, and Mr. Arthur Wright, at Brighton, have both availed themselves of the advantages arising from *feeding* their central areas by means of low pressure currents, and their outside areas by means of high pressure.

The electricity works at Sunderland were designed from the first to carry out a similar principle, while the method has also been adopted at the Blackburn, Preston, St. Helens, and Southampton works. From a recent report drawn by Mr. Robert Hammond for the Corporation of Sheffield, we see that one of his former assistants, Mr. Arthur T. Cooper, at Reading, has very successfully substituted a low pressure supply for the high pressure supply, within a mile radius from the generating works. We gather from the same source that Sir William Preece and Major Cardew are about to adopt a similar plan at Yarmouth.

Considering, however, the number of central stations in the kingdom serving areas which include both congested districts in close proximity to the works, as well as scattered districts on the outskirts, it is surprising that in only some half-dozen places has the "mixed system" plan been adopted.

It is true that engineers in charge of low pressure works have had less need to adopt "mixed systems" than their high pressure brethren; they have been immensely assisted, first by the introduction of the three-wire system, and then by the raising of the voltage of the incandescent lamp, these two improvements combined making low pressure distribution possible at distances from the generating works which formerly could only be reached by high pressure.

Starting with systems designed to cope economically with the district immediately contiguous to the works, low pressure engineers have been able to cope with the outskirts by the gradual improvements grafted on to their original methods.

On the other hand, high pressure alternating engineers have had no such devices prepared for them, and alterations of their supply had necessarily to be radical ones, with the result that, dealing with systems admirably adapted for distant and scattered lighting, they have clung to the same, even when their high pressure feeding necessitated the use of transformers for the supply to consumers just round the corner.

To such, we venture to say, follow the example set by Reading, and take steps to avoid the magnetising watts expended, or, commercially speaking, "lost" unnecessarily.

A better illustration could scarcely be afforded than that of Sheffield, where the distribution of the load appears to be:—

Consumers within ½ mile radius of the generating station	756	KW.
" between ½ mile and 1 mile	114	"
" between 1 mile and 1½ miles	104	"
" beyond 1½ miles	133	"
	1,107	"

It will be seen that 68 per cent. of the load is located within ½ mile of the works, 78 per cent. within 1 mile, and 88 per cent. within 1½ miles.

Here, surely, is a case where the new money spent by the Corporation on the undertaking might have been spent wisely in providing low pressure plant for supplying the consumers near at hand, instead of piling it, as they apparently have been doing, into high pressure plant, a contract for an additional 1,000 KW. set having only recently been signed, with the result that by the time the expert arrives on the scene the purse strings are tied.

Central station engineers cannot be too strongly urged to cast off hard and fast trammels, and, when spending the money ungrudgingly placed at their disposal by town councils or by directors, to consider well the claims of "mixed systems."

This advice is tendered especially to the high pressure single-phase alternating men, some of whom seem to hold tenaciously to the opinion that "magnetising watts," like poets, are "born, not made." These gentlemen dwell under the delusion that an extra pinch of coal is all that "magnetising watts" need for their production, ignoring the fact that every pinch becomes a handful in the "wee sma'" hours of the night, and in the daytime when the works are kept in operation mainly for the purpose of churning the air and turning out "magnetising watts."

The cost of production of the latter, therefore, must be deemed to include a proportion of the wages bill, repairs, maintenance, depreciation, rent, &c. Some see the force of this argument in the case of those works where the "magnetising watts" are sufficient to fully load up a complete set of plant; but obviously the principle stands good whether half a set, one set, or two sets be used, or, indeed, whatever the call upon the plant may be.

If by a stroke of Providence the onerous necessity for producing "magnetising watts" were mercifully suspended for a few weeks at winter time, we fancy that the generating plant thereby set free in the stations of the Metropolitan Company, for instance, would prove sufficient to cope with the overload which, plus the magnetising watts, broke down their supply last week.

Even the ingenious gentleman who has recently been circularising us with offers of perpetual motion machines of all sorts, has not ventured to claim that he can, with our present knowledge, produce magnetising watts out of coal alone, and we do not think they will succeed in doing that even in Sheffield.

The worthy president of the Institution of Electrical Engineers will see with some surprise that his Presidential Address is being used in Sheffield to show that he is an opponent of mixed systems, and that, in consequence of the Swiss trip, he is an advocate of the use of high pressure alternating currents, even when the bulk of the consumers are situated within half a mile of the works.

We fancy that if Dr. Silvanus Thompson were to descend from the Professorial Chair in order to design a plant to suit the above conditions, he would hardly deem it necessary to waste one-third of the units generated in the form of magnetising watts.

What the President did say was, that the time had come when the distribution to consumers would be by low pressure multiphase instead of continuous currents.

Since the displaying in the Sheffield newspapers of the President's remarks, as a means of discrediting Mr. Hammond's advice, seems to have befogged the town councillors there, we venture to say to Sheffield and the other places where mixed systems appear to be desirable, don't let the minor problem of the ultimate distribution to consumers obscure the much more important problem of the best method of "feeding."

Mr. Hammond's main contention is that in Sheffield the magnetising losses in the supply to the central area should be abolished; and all those unshackled by prejudice will agree with him.

His minor contention, that the distribution to consumers in the central area should be by continuous currents, will also, we feel certain, have the almost unanimous support of those who have had extended experience of the many advantages accompanying their use.

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THE POSITION OF THE ELECTRICAL HEATING INDUSTRY IN THIS COUNTRY.

(*Concluded from page* 955.)

A good deal of the annoyance introduced by heating apparatus giving way suddenly and leaving the users in the lurch can be avoided and guarded against by having spare parts, and we are inclined to think that if this point had only been observed by the trade when supplying apparatus, the bad name which heating apparatus has to some extent gained for itself for being unreliable, would have been largely avoided.

It must not be inferred from this that all heating apparatus is continually giving way, as, whilst some articles, such as flat irons, goose irons, and other apparatus getting up to about 500° F. are liable to break down, others, such as radiators, hot plates, &c., working at a lower temperature, very seldom give way.

In a complete installation, however, one is obliged to have some of the troublesome articles, and delay and annoyance consequent upon these breaking down must be reduced to a minimum by having spare articles.

We do not wish to propose that every user of heating apparatus should have a complete spare plant, but rather that the local supply company or contractors who lay themselves out for selling or hiring out apparatus, should keep a supply to avoid the necessary delay incurred in sending apparatus back to the manufacturers.

Electric radiators are coming more and more into daily use for heating spare rooms, bed rooms, sitting rooms, offices, &c., not exceeding about 5,000 cubic feet in volume each.

When this size of room is exceeded, however, the points in favour of electrical heating begin to decrease, until the power required becomes so great that the scheme becomes impracticable from point of view of running cost, excepting in certain cases where there are reasons for preferring the electrical system.

For rooms under this size, however, electrical heating is quite practicable, and for intermittent heating the cost will compare favourably with other systems, even when used off the central station supply.

For continuous heating, however, say for six or seven days a week and all through the day, the cost of electrical heating will come out expensive when compared with other methods, unless there are certain conditions pointing in favour of the electrical system, such as one finds in all theatres, music halls, &c.

The chief advantage of electric radiators for heating purposes lies in the fact that they are always ready for use, can be switched on and off as required, can be moved about from room to room, and, finally, require nothing but two wires to connect them.

The points of cleanliness, safety from fire, and absence of any smell, will also testify in their favour.

The amount of power required for electrically heating any room, depends greatly upon the amount of glass surface in the room, as well as upon the draughts and admission of cold air, which again are governed by the frequency with which the doors are opened.

It can be taken, however, for a guide that 500 watts will be required per 1,000 cubic feet of volume, and that the full power will be required switched on for between two and three hours during the coldest winter days, for first heating the room up to about 65° F.; after this the power can be reduced to $\frac{1}{3}$ or $\frac{1}{4}$, depending upon circumstances.

It should be borne in mind when comparing the cost of one system with that of another, that, thanks to the absence of dirt and dust with electric radiators, the annual cost of whitewashing, repapering, &c., is considerably reduced.

Radiators for heating yachts and ships are coming more and more into general use, and when it is considered that two small wires take the place of the ordinary cumbersome steam-piping, this is scarcely to be wondered at. On board ship the steam radiators themselves are quite bulky enough, though space can often be found for them, but when in addition to this, space has also to be found for the pipes bringing the steam to the radiators, it is little wonder that a system necessitating very much less space is commanding considerable attention. Radiators are also being introduced for theatre heating, and here again they have several great advantages.

For heating the stalls, for instance, it has been found advantageous, in addition to fixing a number of radiators along the sides or under the skirtings, to have several portable electric radiators in the stalls themselves, which can be removed to the sides as soon as the performance commences. There they are still giving out heat, and not interfering with people passing in and out.

The best designs of electric radiators are made to have a free draught and circulation of air through them, as it is found that, by enabling cold air to come into contact with both the front and back of each radiator plate, better effects can be obtained than by closing the case up, and obtaining heat by radiation only. In the former case, the radiator acts both as an "air warmer" and radiator, whilst in the latter case it acts as a radiator only.

When acting as an "air warmer," the plates keep a good deal cooler than when acting as a radiator, which alone is some advantage.

As to the question of cost of the necessary electric heat radiators complete, it can be taken as a guide that the first cost works out as below, which includes the radiator, regulating switches, and necessary flexible for connecting to nearest wall plug :—

Rooms up to 1,000 cubic feet in volume at 6s. per 100 cubic feet.
Rooms up to 2,500 cubic feet in volume at 4s. 6d. per 100 cubic feet.
Rooms up to 5,000 cubic feet in volume at 3s. 6d. per 100 cubic feet.

III. The third case in which electric heating and cooking apparatus is used as a supplement to the existing system is, perhaps, the one in which more strides have been made than in any other. The applications are certainly small ones, but, at the same time, when it is remembered that every house with the current on has a use for these applications, it will be appreciated that the total load derived from this source is not an insignificant matter to the electric supply company.

Among these smaller applications may be mentioned :—

1. Kettles for keeping water boiling during teatime, and taking the place of small spirit lamps.
2. Different sizes of hot plates for keeping dishes and plates warm during a meal.
3. Egg boilers, and other small water boilers, such as shaving pots, &c.
4. Ladies' curling iron heaters, which consist in a round tubular heater, into which the curling iron to be heated is inserted.
5. Bronchitis kettles.
6. Flat irons for ladies' use, or for use in private laundry.
7. Cigars and cigarette lighters.
8. Radiators for use in bed rooms or sitting rooms not continually in use.

Lastly, as to whether a heating load is one which is likely to benefit the central station supply.

We are of opinion that if this heating business were taken up more energetically by the central station authorities, the load derived therefrom would be very much to their advantage.

It must not be overlooked, however, that a certain percentage of the heating load would, in all probability, overlap the lighting load, though the maximum heating load would come on during the daytime, and most probably to a greater extent during the summer months than during the winter months, as in the summer one tries as far as possible to dispense with an open fire, and electric cooking steps in here to great advantage.

The load derived from heating apparatus in use in factories and works is likely in some cases to be quite as large as the load derived from private houses, and the factory load is not so likely to overlap the lighting load to any appreciable extent. The nature of the heating load is, of course, bound to vary very considerably in each district.

In spite of this slight overlapping, however, of the two loads, it would seem as if the heating load were one worth attention and encouragement. To properly cater for this load would necessitate a showroom for the purpose, in which the apparatus could be shown at work, and, further,

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some system for hiring out the apparatus to customers, whereby they might try and see for themselves whether it suited their purpose before deciding to purchase.

In some cases it would pay to hire out the apparatus at a nominal rental.

Further, spare apparatus must be kept to minimise any inconvenience caused by apparatus giving way.

We are of opinion that if steps were taken to push and introduce heating apparatus somewhat on these lines, the load to the central station would be beneficial, without involving much trouble and expense.

Surely, with current as cheap as it can now be obtained in some of our larger towns, great advance can be expected in this branch of the electrical business.

LONDON COUNTY COUNCIL.

The Council at the meeting on Tuesday further considered the question of lending £16,500 to the Bermondsey Vestry for a site for an electric light and refuse destructor station, and decided to grant a loan to that extent. It was also resolved to lend £30,000 to the Hackney Vestry for electric lighting purposes, £13,605 to the Poplar District Board for the erection of a generating station, and £20,000 to the Whitechapel Board for electric lighting purposes.

London United Tramways.

Mr. J. W. Benn, chairman of the Highways Committee, obtained the consent of the Council to the substitution of a fresh report to that presented in October in reference to the detailed drawings submitted by the London United Tramways Company for the approval of the Council relating to the electrical equipment of certain tramways in Hammersmith, as sanctioned by the company's Act of 1899. It may be remembered that this Act requires that an underground system of electric traction shall be adopted for the tramways from Young's Corner to Hammersmith Broadway, and thence along Beadon Road, Glenthorne Road, and Studland Road, and that part of The Grove between Beadon Road and King's Street West; and the drawings submitted by the company showed those lines on that system.

The Committee now stated that both before and since the former report was submitted, strong representations had been made by the inhabitants of King Street, Hammersmith, and by the Vestry, of the inconvenience and probable loss which would be caused to the tradespeople in that thoroughfare if the carriageway were to be disturbed for the construction of an underground system; and that the company had given notice of intention to ask in the next session for such an amendment of the Act as would permit of the lines referred to being equipped for an overhead system.

Without expressing any opinion with regard to the proposed amendment of the Act, the Committee thought that, in the circumstances, the Council might approve of those of the drawings submitted which relate to the lines which, by the Act, are authorised to be equipped for an overhead system. The adoption of that course would not prejudice the Council in any action it might think well to take with regard to the proposal for the amendment of the Act, but, at the same time, it would facilitate the company's operations with regard to the other lines. The Highways Committee accordingly presented the following amended recommendation, which the Council unanimously adopted:—

That the sanction of the Council be given to the plans and particulars submitted by the London United Tramways Company, under the provisions of its Act of 1899, and the agreement with the Council scheduled thereto—(a) for the overhead, or trolley, system of electrical traction to be adopted for the company's tramways in the Uxbridge Road between the Askew Arms public-house and the Uxbridge Road railway station, and in Uxbridge Road and Goldhawke Road between the railway station and Young's Corner; such sanction being, however, given without prejudice to any action which the Council may decide to take with regard to the proposal of the company for the amendment of the provisions of its Act of 1899 with regard to the equipment for an underground system of electrical traction of its lines between Young's Corner and Hammersmith Broadway, and in Beadon Road, Glenthorne Road, and Studland Road and part of The Grove, and, moreover, subject to the following conditions—that the trolley wires be not attached to the electric lighting standards of the Vestry of Hammersmith; that the company do furnish to the Vestry detailed drawings of the inspection chambers and boxes proposed to be placed in the carriageways or footways; that the "Bristol" designs for the side and centre traction posts be used; but the cut-out circuits be of such length as shall be approved by the Council's chief engineer.

The Default of the M.E.T.

The Highways Committee, in a further report, referred at some length to complaints made that the Metropolitan Electric Supply Company had nightly, for some weeks, discontinued the supply of electric light for some hours at a time in the district of Marylebone. The letters from the original complainants, dated December 4th and 7th, stated that interruptions of the supply had occurred on various dates between November 20th and December 7th. The company's attention was called to the interruptions specified in the letter dated December 4th, and stated, in reply, that interruptions on November 29th and 30th were caused through a fatal accident to the driver of one of the engines, and that on the 28th through the bursting of a main steam joint; and further, that difficulties had arisen in the starting of the new machinery, and that these had been seriously increased, as the impossibility of obtaining proper supplies of Welsh coal affected the efficiency of the works.

It appeared clear, in the opinion of the Highways Committee, that the Board of Trade regulations as to the supply of energy under the company's order had not been complied with, inasmuch as the company had without the consent of the Council and of the local authority, failed to maintain a constant supply. Section 2 of the regulations above referred to required that the undertakers "shall maintain a supply of sufficient energy for the use of all consumers entitled to be supplied . . . and such supply shall, except so far as may be agreed upon from time to time between the County Council, the local authority, and the undertakers, be constantly maintained; provided that for the purposes of testing, or for any other purposes connected with the efficient working of the undertaking, the authority by whom the electric inspector is appointed may give permission to the undertakers to discontinue the supply at such intervals of time, and for such periods, as that authority may think expedient; when the supply is so discontinued notice of such discontinuance, and of the probable duration thereof, shall be forthwith served upon the County Council and the local authority."

The company's order and the Board of Trade regulations provided for the imposition of penalties not exceeding under the order 49s. a day, or under the regulations £5 a day, in case of default of supply; and, as the repeated interruptions of the company's supply had caused serious inconvenience to those consumers who had discarded other means of illumination, the Highways Committee thought that proceedings should be taken against the company to recover penalties in respect of default in not maintaining a constant supply, and they submitted a recommendation to that effect.

Miscellaneous Matters.

The Asylums Committee asked the Council to approve of an estimate of £850 for preparing schemes for the provision of a central station for the supply of electric light and water on the Horton estate.

It was decided to approve plans submitted on behalf of the City of London Electric Lighting Company for the erection of an extension of the company's generating station in Sumner Street, Southwark.

The Council resolved to approve plans submitted by the engineer of the City and South London Railway Company for the erection of a new station at the north-east corner of Old Street and City Road. At the same time it was decided to negotiate with the company with a view to the corner of the station buildings being rounded off so as to permit of the kerb being similarly dealt with, and so avoid a sharp turn to the footpath.

BUSINESS NOTICES, &c.

Electrical Wares Exported.

Week ending Dec 20th, 1898.		Week ending Dec. 19th, 1899.	
Adelaide	Value £33	Adelaide	Value £130
Amsterdam	55	Alexandria	120
Antwerp	65	Amsterdam	60
Auckland	228	Auckland	100
Bombay	240	Bahia. Teleg. instruments	57
Boulogne	60	Bombay	108
Brisbane	129	Bordeaux	33
Calcutta	846	Boston	25
Cape Town	144	Boulogne	34
Chinde	16	Bremen	23
Christiania	45	Buenos Ayres	1,214
Colombo	69	Calcutta	201
Copenhagen	23	Cape Town	85
Durban	29	Chinde. Teleg. mat.	86
East London	961	Christiania. Teleg. cable	458
Ghent	195	Colombo	951
Halifax	27	Durban	28
Hamburg	120	Gibraltar	81
Hobart	103	Halifax. Teleg. apparatus	2,500
Malta	223	Hamburg	30
New York	86	„ Teleg. mat.	200
Ostend	36	Hong Kong	15
Port Elizabeth	9	Launceston	37
Rangoon	92	Madeira	43
Shanghai	80	Madras	116
„ Teleg. mat.	147	Malta. Teleg. cable	13,680
Singapore. Teleg. mat.	117	Melbourne	163
Suez. Teleg. mat.	516	Ostend	85
Sydney	41	Port Chalmers. Teleg. mat.	200
„ Elec. cable	1,625	Port Elizabeth	19
Vigo. Teleg. mat.	45	Rangoon	100
Wellington	49	Santander	30
„ Teleg. mat.	579	St. Lucia	21
		Stockholm	28
		Sydney	1,198
		Tokio. Teleg. cable	73
		Yokohama	143
Total	£6,414	Total	£22,407

Foreign Goods Transhipped.

Bombay	Value £50	Barbados. Teleph. apparatus Value £1
Brisbane. Teleg. mat.	148	
Sydney	541	
Total	£739	

Asylum Lighting.—Messrs. Coates & Sons, Belfast, have secured the contract for the electric lighting of Cork Lunatic Asylum.

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Annual Gathering.—The annual social gathering of the employés of Mr. James White was held in the Queen's Rooms, Glasgow, on Friday night, the 15th inst., at which between 800 and 900 of the employés and their friends were present. Lord Kelvin presided, and among those on the platform were Prof. Barr, Dr. Bottomley, Mr. David Reid, and Mr. James Ferguson. The chairman, in a few remarks, said it would be interesting to the employés and their friends to know that this was the jubilee year of the factory of James White. Instituted in Renfield Street, Glasgow, in 1849, it was not such a large factory then as it is now, but good work was done then as good work was being done at the present time. Having referred to the business abilities of the founder, James White, and especially to his ingenuity and zeal in entering on new work, Lord Kelvin touched on the progress of marine telegraphy, and observed that the first messages ever sent under the Atlantic were transmitted and received by instruments made in James White's factory. In congratulating the employés on having started a fund in aid of the families of reserve men working in the factory who had been called out to the war in South Africa, his Lordship expressed the hope that the war would be speedily brought to a conclusion, but patience must be exercised. The whole British nation must persevere until this had been brought to a satisfactory conclusion. He predicted that 10 years hence, when the two Republics became part of the British Empire, the Boers, freed as they would be from the terrible servitude of commandeering, would be happier than they had ever been, and under a government of liberty, and good subjects of Queen Victoria. An enjoyable musical programme was afterwards submitted, and a dance followed.

Bankruptcy Proceedings.—At the London Bankruptcy Court last Tuesday a sitting was held for the public examination of E. A. Max Winter, electrical engineer, Amberley House, Norfolk Street, Strand, who applied to pass upon accounts showing total liabilities £1,550 3s. 3d. (unsecured £975 3s. 3d.), and assets "a bad debt for £157 10s." Under examination by the Official Receiver the witness stated that he had carried on business at the above address as the Imperial Electric Light and Power Company, having started in May, 1897, with a capital of £700 or £800. His idea was to obtain concessions from public bodies and others for the supply of electricity and after the business was successfully established to convert it into a limited company. His labours, which took him all over England, Scotland, Ireland, and Wales, resulted in the obtaining of one concession, on which he paid a deposit of £500 on the purchase price of £15,000. He subsequently sold that option for £2,500, including the deposit, and that was the only business he really carried through, the result being that the idea of transferring the business to a company had to be abandoned. Witness had entered into a contract with his father-in-law to construct an electric railway in the grounds of the Alexandra Palace. He sublet that contract on terms that he was to receive a half share of the net profits, but the undertaking resulted in a loss. Witness attributed his failure to heavy business expenses against small returns, and pressure by creditors. The examination was concluded.

The *London Gazette* contains notice of a first and final dividend of 6d. payable on January 1st, 1900, in the case of J. E. Stott, electrician, of Huddersfield. Payable at 8, Princess Street, Huddersfield.

A receiving order has been made against F. B. de Foe Paynter, electrical engineer, of Catford (late Chiswick), at the Greenwich Court on a creditor's petition.

The examination of S. F. Walker, electrician, Cardiff, was closed at the Cardiff Bankruptcy Court on 14th inst.

Liquidation Notice.—A meeting of F. H. Royce & Co., Limited, is to be held at the Chartered Accountants' Institute on January 18th, to hear an account of the winding up operations from the liquidators, Messrs. F. H. Royce and E. A. Claremont.

Bullock's Works.—Following our notice of Bullock generators last week, we receive the intimation that the Bullock Electric Manufacturing Company, of Cincinnati, is now advertising for bids to extend its main building 200 feet. This extension has to be speedily effected, to cope with the increasing business. The main machine shop will then be 500 feet long × 101 feet wide.

Calendars and Catalogues.—Messrs. G. M. Callender and Co., of Victoria Street, S.W., have issued an illustrated list of water-tight reservoirs in connection with the use of their bitumen sheeting. A reprint is given of a paper explaining the lining of a reservoir near Whitby, in which bitumen sheeting is used for the floor.

Messrs. D. Stewart & Co., Limited, of Glasgow, have issued a wall calendar with monthly slips. A view of the "Glasgow" patent water-tube boiler appears thereon.

Messrs. Buck & Hickman, of Whitechapel, have issued a new English catalogue of tools and machinery dated 1900. The volume is beautifully and strongly bound, and contains 500 pp. of excellently printed illustrations and press matter descriptive of the firm's manufactures and specialities. The book contains a thousand and one items ranging from large plate edge planing machines down to small hooks and staples, and its collection of lathes, drilling, screwing, milling, punching, shearing and shaping machinery, pulley blocks, lifting jacks, vices, smiths' hearths, rail-benders, overhead and wharf cranes, winches, pulleys, saw benches, grindstones, wood-working machines, and a whole host of sundry accessories and tools renders it, we suppose, about as complete as one could desire, and makes it useful as a stock book for purchasers and users of engineering tools of these many kinds.

Calvert's Mechanical Almanac and Workshop Companion (4d.) with the 1900 edition reaches its 27th year of publication. It, as usual, contains a great deal of general reading matter which may be of use to many of those for whom it is written.

Messrs. Merryweather & Sons, Limited, the well-known fire engine makers and water engineers, send us a 1900 calendar.

Messrs. Holden & Brooke, Limited, of West Gorton, send circulars describing the "Sirius" steam trap and its advantages; also a very useful glass paper weight for the desk. We understand that the sales of the "Sirius" trap during the present winter already exceed those of any past season.

From Mr. Emil Passburg, of Berlin, we have received an illustrated list of his patent vacuum drying apparatus for cables, dynamos, motors, &c.

Messrs. Bayleys, Limited, of Newington Causeway, send us an illustrated list of their steam motor vans, showing a steam trolley and a dust van. Some general notes, together with remarks as to fuel consumption, are given.

The Scottish Provident Institution has issued its pocket diary and prospectus for 1900.

From the British Thomson-Houston Company we have received illustrated pamphlets as follows:—No. 50, polyphase induction motors; No. 51, G.E.-58 traction motor.

Change of Name.—The sanction of the Board of Trade to the change of name of the Brasilian Submarine Telegraph Company has been obtained. The name of the company will in future be the Western Telegraph Company, Limited.

Co-operative Consumers, Limited, v. Symmons and Co.—Last week at the Brighton County Court, plaintiffs claimed £2 5s. 2d. for goods supplied and expenses incurred by reason of the supply of "red" electric lamps, which, three months after being installed, turned "white." The judge held that a red lamp was one which remained red. If he bought a red hunting coat and it turned yellow, he would not expect to pay for it. Judgment for plaintiffs for £2 2s. 3d.

Downie v. Adams.—In the Queen's Bench Division last week an action was brought by Mr. Charles Manners Downie, of Bedwardine, Upper Norwood, against Mr. F. G. W. J. Adams, of 70, Balcombe Street, Dorset Square, N.W., for damages for libel. The libel complained of was contained in a letter written by the defendant to Messrs. Francis & Spilsbury, of 20, Bucklersbury, electrical engineers, dated April 27th, 1899. The defendant did not appear. Mr. Downie, the plaintiff, proved the defendant's signature to the letter, and Mr. Spilsbury the receipt of the letter.—Mr. Justice Wright, in summing up to the jury, said it was a most outrageous libel. The defendant pleaded in his defence that the statement was made in good faith and on a privileged occasion, but no privilege could excuse a libel such as that. He thought, although no special damage was proved, that they would be justified in giving substantial damages. They were entitled to give such damages as would show their opinion of the character of the libel.—The jury found a verdict for the plaintiff for £250 damages.

Electrical Engineering in Caucasia.—A contract has lately been secured by the Vereinigte Electricitäts Gesellschaft, of Vienna, for a complete electric lighting and power transmission plant for the ironworks of the Terek Mining Company at Alaghir, Caucasia.

Electrical Engineering in Germany.—The proprietor of the Berghaupten Collieries at Gengenbach (Baden) is credited with the intention of establishing a central power station, using the coal on the spot in the generation of electric energy for lighting and power purposes in the district.

Electrical Engineering in Italy.—After much negotiation the Società per L'Illuminazione Elettrica di Chiavenna has, under certain conditions, agreed to dispose of its rights in the water power of the River Liro to the Società delle Ferrovie Nord-Milano. The latter company intends to establish an electric power plant of 3,000 H.P., and to transmit the electrical energy generated to Como, whence it will be distributed for traction purposes as desired. One of the first lines on which electric traction is to be adopted is that between Chiavenna and Lecco.

Felten & Guilleaume.—A correspondent says that a joint stock company with a capital of £1,500,000 has just been formed to acquire and carry on the wire and electric cable business of Messrs. Felten & Guilleaume, of Mulheim-am-Ruhr-Germany.

Humber Defence.—Notice is given in the local press for the general information of mariners, that the War Department propose to work the electric light established at Paull battery for the defence of the Humber in connection with the Submarine Mining Service on every Wednesday from sunset to midnight between January 1st and March 31st next.

King's College.—The Lent term in engineering, architecture, and applied science commences on Thursday, January 18th. Particulars may be obtained from an advertisement in this issue.

Middlesbrough.—The North-Eastern Railway Company has placed orders with Messrs. Cowans, Sheldon & Co., Limited, of the St. Nicholas Works, Carlisle, for an electric installation for the new docks at Middlesbrough, which, it is said, will be the largest and most complete of its kind in the country. The order comprises three 10-ton and 17 3-ton electric cranes, besides electric capstans, &c.

Pyke, Harris & Co. v. The Gwynne Electrical Close Tube Company.—In the Westminster County Court on Tuesday, before his Honour Judge Lumley-Smith, Q.C., Messrs. Pyke, Harris and Co., Limited, of New Tothill Street, S.W., sought to recover £31 for making an electrical alternator for the defendants, the Gwynne

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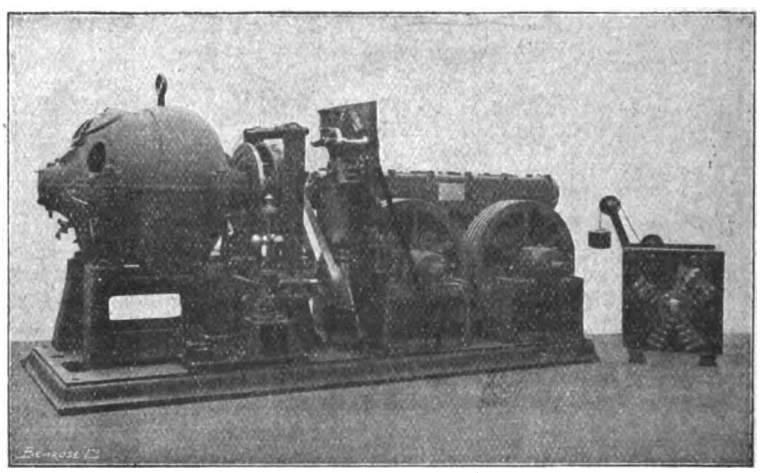
Electrical Close Tube Company, Limited. Mr. Andrews, who appeared for the plaintiffs, said the apparatus was made from a rough sketch by Messrs. Easton, Anderson & Co. and their charge was £28 4s. 6d. His clients charged a profit on that, but they would abandon that amount. Defendants had paid £15 into Court. He admitted that it was possible to make a machine like that for the amount, but then this had to be made from a rough sketch only. The cost book of Messrs. Easton showed that the labour amounted to £12 9s. 11d; the establishment charges £9 7s. 1d.; materials, £2 15s; establishment charges thereon 2s. 7d. The details of the claim were gone into at considerable length, and for the defence evidence was given that £15 was a fair price, that the work was rough, and some of the witnesses put the fair price of the thing at £4, as far as the labour was concerned. His Honour found for the plaintiffs for £25 3s. 6d., with costs.

E.C.C. Patent Lift Gear.—We illustrate a patent lift gear of novel design, recently introduced by the Electric Construction Company, Limited, for which it is claimed that failure of any part of the apparatus is unattended by danger, that nothing depends on the skill of the operator, and that a very high efficiency is attained. Two of these lifts have been erected as part of the electric installation at the new factory and warehouse of Messrs. Bovril, Limited, where they have been in successful operation for some time under very severe conditions, being in continual use all day under widely varying loads. The motor is of the E.C.C. enclosed ironclad type, and the weight of the empty lift is balanced by counterweights to the usual extent. If the load is such, in ascending or descending, that it overtakes and drives the motor above its proper speed, it acts as a brake by generating current and returning it to the supply mains. Should the supply mains at any time be incapable of absorbing power, provision is made to prevent over-running by applying a powerful friction brake through the action of a solenoid, the circuit of which is closed and opened by a centrifugal governor driven from the motor shaft. This brake consists of two arms which are held clear of the brake drum by means of an electro-magnet against the pull of a strong spiral spring. The coil of the magnet is in shunt across the mains, the circuit being made and broken along with the starting switch. The motor is connected by a claw coupling, having 90° play, to two right and left-hand worm gears, which take up the thrust, thus preventing loss of power by friction. Upon the axle of each worm wheel is mounted a pulley, round which the steel ropes run for supporting the cage and counterweights. The worm gear is completely enclosed in an oil bath, and will run for a considerable time without attention. An endless rope running through the cage actuates the starting and reversing switch shown on the right hand of the illustration. The motor is started up through a resistance, the cutting out of which is not under the control of the driver, but is performed automatically by the accelerating switch, which is mounted on the bed-plate. This switch is put into action by an oscillating lever driven by an eccentric from the motor shaft. The lever carries a pawl, which is actuated by a small magnet. When all the resistance is cut out the magnet is short-circuited and the switch bar ceases to move, although the lever still oscillates. The switch bar is retained by a brake band passing round a drum on the switch bar and operated by another small magnet, and on the circuit being broken the switch bar is automatically returned to the position in which all resistance is in, by the weight which can be seen in the illustration. The gear to enable the motor to generate a current with increase of speed when it is called on to act as a brake, either when the cage is ascending with a light load or descending with a heavy one, consists of a disc mounted upon a screwed portion of the motor shaft and driven by a pin fixed to the gear half of the coupling. As mentioned above, there is 90° of play between the halves of the coupling, and should there be a tendency on the part of the gearing to drive the motor it will be necessary for the half coupling on the gear side to travel through an angle of 90° before it comes into position for driving. In traversing this distance the disc will travel along the screwed shaft sufficiently to short-circuit a resistance in the motor field. The counter E.M.F. of the motor is correspondingly raised and a braking current generated which prevents undue rise of speed. On closing the starting switch, by means of the hand rope from the cage, the following action takes place:—The brake is held off and the motor starts slowly, gradually increasing the speed as it cuts out the resistance in circuit with the armature until full speed is attained. On switching off, the motor is short-circuited upon itself through a fixed resistance of such amount that the motor is adequately retarded, the friction brake is applied, and the switch bar returns to its position of "resistance in" in readiness for a fresh run. Trip switches are provided to the lift hatchway in case the cage should exceed the limits of its travel. These are arranged so that the switch bar is carried clear of the contacts by the cage and cannot be replaced in the contacts until the cage has been run back. When either of the trip switches is open the circuit is made by means of a switch placed in parallel with the trips. This switch is placed outside the hatchway and is in a locked box, so arranged that the cover cannot be shut down until the switch is open.



E.C.C. Patent Lift Gear.

Railway Station Lighting.—In reference to the paragraph under the above heading on page 974 of our last issue, we are informed that the arc lamps at Ludgate Hill and Holborn, London, Chatham & South-Eastern stations, are "Brockie-Pell's." Those at Snow Hill are of the Jandus make.

Rhodesia.—In the *British and South African Export Gazette* we read that the provision of an electric transmission plant, capable of driving a 20-stamp mill, with pumps, winding gear, and other accessories, at an estimated cost of £10,000, is under consideration by the directors of Rezende, Limited, for their properties in Eastern Rhodesia.

Smoke Nuisance.—The Guildford Council has decided to take action against the Electric Lighting Company for continued smoke nuisance. The engineer partly blames the fact that it is impossible to obtain Welsh coal at present because of the Government demand.

Sun Electrical Company.—At the showrooms of this company may be seen just now some pleasing novelties in electric fittings, which we understand are in process of being photographed for illustrating the catalogue which the company will have ready early in the new year. The Sun Electrical Company, who took over the business no longer ago than August last, have shown a determination to aim at a reputation for high class English-made goods, yet with a due consideration to the popular demand for a sterling article at a moderate price. Nor is the importance of prompt delivery lost sight of, ample stocks being kept. The company are wholesale agents for the Crystal Lamp Company, and are able to deliver immediately from stock on the premises. Mr. Collis, the courteous manager, is always pleased to show visitors round and answer inquiries.

To the Trade.—Mr. A. P. Lundberg's premises in Bradbury Street, Kingsland, were broken into on 17th inst. To all appearances the booty was very small, but as the letter box was tampered with Mr. Lundberg will be glad if those who have communicated with him, and have received no acknowledgment, will again write to him.

Trade Announcements.—Messrs. Christy Bros., of Chelmsford, announce that they have taken Mr. William Middleton, of Leeds, into partnership, and in future the name of the firm will be Christy Bros. & Middleton. This step has been taken owing to the continued growth of the business, more especially in connection with electrical transmission of power, and the desire of each partner to give fuller personal attention to each undertaking. Mr. Middleton is an Associate Member of the Institution of Civil Engineers, and was recently awarded a "Miller" Prize by that Institution for his paper on the "Electrical Driving of Workshops." The firm is also making several additions to its technical staff.

The address of Mr. Lewis Angell, C.E., late engineer and architect to the County Borough of West Ham, is now Westminster Chambers, 11, Victoria Street, S.W.

X-ray Apparatus in War.—There is no doubt that Röntgen ray apparatus will render most valuable aid in ameliorating the sufferings and hastening the recovery of our wounded soldiers in the South African Campaign. The only thing that occurs to us is whether the sets of apparatus which have been despatched will be sufficient to cope with the great amount of work that will be necessitated. Not only on the field of battle itself will humane operations by the aid of the Röntgen rays be carried on, but it is, of course, necessary that hospital ships should be equipped for the purpose. In the hospital ship, *Princess of Wales*, recently fitted out, this matter has been attended to, and a set of apparatus was specially designed and made for her by Messrs. Harry W. Cox & Co., Limited, of Cursitor Street.

ELECTRIC LIGHTING NOTES.

Aberavon.—At a meeting of the Town Council last week, Messrs. Lewis & Steinitz explained the objects of the Electrical Power Distribution Company, Limited, with regard to their proposed

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application to the Board of Trade for powers to supply Aberavon with electricity. It was decided to take joint action with other South Wales boroughs to oppose the scheme, as the company could give no guarantee to limit its supply to motive power only.

Auckland.—A special meeting of the Auckland Urban Council was held last week to consider the application of two companies which are applying to the Local Government Board for powers to light the town by electricity. It was unanimously decided to support the application of the Urban Electric Lighting Company, Limited.

Austria.—A large central station has just been completed at Soborten, near Teplitz, by Messrs. Kummer & Co., of Dresden, for the supply of electrical energy for lighting and power purposes to a large number of small towns in the district.

Battersea.—The vestry clerk is communicating with municipal electric supply works as to the powers of local authorities in regard to the wiring of private premises without requiring direct payment for the work, on the system adopted by the London gas companies in the case of the automatic slot meters and fittings.

Bournemouth.—Colonel C. H. Luard, R.E., one of the inspectors of the Local Government Board, held an inquiry on Thursday last week into the application of the Town Council to borrow £1,750 for purposes of electric lighting.

Broken Hill (N.S.W.).—The Corporation is about to undertake the supply of electricity for public and private lighting at an initial cost of £12,000.

Canterbury.—The Town Council has resolved to adopt the maximum demand system, at 7d. per unit for the first 100 hours' use per quarter of the maximum demand, and 3d. afterwards, to date from April 1st, 1900.

Cardiff.—A motion was to come before Monday's Council meeting thus:—

That this Council, viewing with alarm the proposals of the South Wales Electricity Power Distributing Company as contained in its Parliamentary Bill, considers the granting of such powers highly prejudicial to the development of the Cardiff electricity works in regard to the supply of electric current for lighting and power purposes. It is resolved (1) that negotiations with the district authorities contained within a radius of 20 miles of Cardiff be opened with a view to the erection of a joint electric power station on a convenient site in the Pontypridd coalfields. (2) That among other purposes, such power station shall supply all current necessary for the working of the electric tramways which have been proposed and sanctioned.

Hackney.—The Electric Lighting Committee is considering the tenders received for the erection of dust destructors in connection with the electricity works.

Hastings.—The Town Council has resolved to reduce the charge for electricity supply from 8d. to 6d. per unit, with special terms to long-period consumers.

Hoylake and West Kirby.—An inquiry was held last week, on behalf of the Local Government Board, into an application by the Hoylake and West Kirby District Council to borrow £27,000 for the purposes of electric lighting.

Ilford.—A Local Government Board inquiry is to be held to-day into the Council's application for leave to borrow £68,500 for tramways and electric lighting purposes.

Keighley.—The Gas and Electricity Committee of the Keighley Corporation recommends that application be made to the Local Government Board for sanction to borrow £45,000 for electric lighting purposes.

London.—Further letters have appeared in the *Times* with reference to the Metropolitan Electric Supply Company. We abstract them as follows:—

"Yesterday, the 12th inst., the shops on the north side of Oxford Street, from Vere Street to the Marble Arch, were plunged in darkness. If the shopkeepers will combine, the remedy is in their own hands. The excuse of the scarcity of Welsh coal is a fallacious one. Railway communication between London and other towns has not been interrupted, nor have the big steamships ceased to ply between England and other countries. The consumption of coal on the *Campania* must far exceed that of a dynamo. If the Metropolitan Electric Supply Company has not made due provision, that company, and not its customers, should suffer. There is but one real remedy, that of a competing supply.

"ALFRED L. COHEN.

"36, Gloucester Square, W., *December 13th.*"

"Permit me, as chairman of a committee of Marylebone tradesmen who are trying to obtain some redress in regard to the want of electric supply, to say that the trade consumers are not supplied with energy in preference to private customers. We have been sufferers in a much greater proportion, inasmuch as our light has been wanting for two months or more at the only time we require it for business purposes, that is between the hours of 4 and 8 p.m., and this has entailed a very serious loss.

"CHARLES R. WOOD.

"21, High Street, Manchester Square,
"December 14th"

"Your correspondents who urge that the local Vestry should be invited to undertake the supply of electric energy throughout the area at present supplied by the Metropolitan Electrical Company, in order that [a] better service should be afforded, seem to ignore the fact that local authorities are just as much liable as companies to the difficulties that are apt to occur in the early stages of all new and growing enterprises.

"To take two leading examples. The electrical supply both at Edinburgh and at Manchester is entirely in municipal hands, but those acquainted with the service given in these important cities not so very long ago are well aware that for a considerable period the supply was in both instances exceedingly defective, for causes which, as I understand, were much the same as are at present giving trouble in the case of the metropolitan service.

"Municipalisation is, in fact, no panacea.

"A. A. CAMPBELL SWINTON.

"66, Victoria Street, S.W.,
"December 12th."

"Mr. Wood's grievance is even greater than he indicates, since his side of High Street has been left without light while the shops on the opposite side of that street have been fully lighted! It is the misfortune of Mr. Wood, apparently, that he happens to be on the same circuit as Wimpole Street and Harley Street; but these facts illustrate the preferential treatment. Montagu Square, *e.g.*, which is west of High Street, is said to have been lighted continuously until quite recently.

"ZETETES.

"December 16th."

At the meeting of the Paddington Vestry on 13th inst. the matter was discussed. Consumers were said to be "suffering most intolerably," and to be subjected to "absolutely monstrous" treatment. Sir E. Galsworthy blamed the company for taking on new consumers before they had increased the machinery to keep up the supply.

Dr. Little said the Harley Street fraternity were much inconvenienced. Two medical men had informed him that they were in the midst of a dental operation when the light went out.

Mr. J. Lewis spoke of the inconvenience and loss of business at his shops in Oxford Street. Several hundred candles had to be used. It also meant a loss to the employés.

Mr. Stringer said the Parliamentary Committee had decided that they must have indicators fixed up at the Court house and connected with the various mains in the parish. This would be done under the agreement at the expense of the company. They must also have an electrical inspector to take the readings of the indicators as to the current supplied. The Committee had decided to appoint an inspector, and had called on the company to fix the indicators at once.

Mr. White, L.C.C., said it would only be a temporary appointment. The Vestry approved of the Committee's action.

The Chairman observed that it was little short of a scandal. If they had been able to make complaints to the Board of Trade and Parliament, there was not the least doubt that Parliament would have given the Vestry a competing order against the company.

Whilst the Chairman was making these remarks, the electric light failed in the board room, and remained out for half an hour.

On the motion of Mr. White, L.C.C., seconded by Mr. Stringer, the clerk was instructed to apply for a summons on behalf of the Vestry as consumers against the company for the 40s. penalty in default of non-supply. The letters received were referred to the Committee. It was also decided to have distributed a number of circulars giving abstracts from the Act showing the company's liability.

Manchester.—The Electricity Committee of the Manchester City Council has come to terms with the Midland Railway Company for the supply of the whole of the electricity required for power and light in the Midland Grand Hotel, in Peter Street, from the Corporation station. The installation in this colossal building will be exceptionally important, and it is estimated that the consumption of electrical energy will cost somewhere about £10,000 a year. Two years at least must elapse before the equipment is completed.

Newport (Mon.).—The Electricity Committee has decided, on the recommendation of the electrical engineer, to connect the condenser to the 3-inch water main, so that in case of emergency the Corporation water can be used for condensing. The total number of lamps connected and on order is equal to 31,540 8-c.p. Proper office accommodation for the electricity department is said to be seriously needed. There is available space alongside the existing station which might be used as a site for the tramways power station. This is under consideration. A deputation from the Lighting and Traffic Committee has been visiting electric tramways and power stations in other towns. The solicitors of the Zipernowski Patent Transformer Defence Fund have made another call for £9 odd towards the cost of defending the action brought by Mr. Martin Rucker against the London Electric Supply Corporation, and this sum has been paid.

Oban.—A scheme is on foot for supplying electricity in Oban from a municipal station.

Oswestry.—M. R. H. Bicknell, on behalf of the Local Government Board, last week concluded an inquiry respecting the application of the Oswestry Town Council for sanction to a loan of £18,000 for the purpose of completing the purchase of the Oswestry Electric Light and Power Company's undertaking, and carrying out the same. A number of ratepayers opposed the application.

Perth.—The Electric Lighting Committee has passed plans by the burgh surveyor of the electric light station which is to be erected at the Shore.

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Poplar.—The Council is applying to the London County Council for a loan of the additional money required for the electricity buildings. Since the surveyor's estimate in 1898, there has been an increase of 15 per cent. (£1,438) in the price of materials; then there are alterations and additions to the offices and buildings, which necessitate expenditure beyond the original estimate, bringing up the total of the present application to £4,370.

Portsmouth.—At a meeting of the Town Council on Tuesday a report from the Electric Lighting Committee was adopted, recommending that an offer of £750 be made for the purchase of property in Crown Street, Portsmouth, adjoining the electric lighting works, and that a formal offer of £700 be made to owners of other property adjoining the works, and that the necessary notices be given to the said owners of the intention of the Corporation to summon a jury to decide the price to be paid if an arrangement can be made. Electric light mains are to be extended along a number of roads.

Queenstown.—The Cork Electric Lighting Company have secured the contract for illuminating the town of Queenstown by electricity.

Rhyl.—The District Council has resolved that application be made to the Local Government Board for sanction to borrow £15,250 for the purposes of electric lighting, and £4,750 for a refuse destructor, and that Messrs. Trentham & Peers, electrical engineers, be engaged to prepare the necessary plans and documents. Applications have already been received for 1,100 lamps.

Ruislip.—The Northwood Electric Lighting Company and the Uxbridge Syndicate seem to be vieing with one another for permission to supply the electric light. Fifty persons petitioned the Parish Council in favour of the Northwood Company.

St. Helens.—The Town Council has resolved to apply to the Local Government Board for leave to borrow £20,000 for extensions of the lighting plant, and £25,000 for additional equipment for the tramways.

Salford.—An inquiry was held at the Salford Town Hall last week by Mr. W. A. Ducat, inspector of the Local Government Board, in regard to the application of the County Borough Council for sanction to borrow the sum of £398,683 for purposes of electric lighting and supply. The town clerk (Mr. L. C. Evans) stated that the population of Salford at the census of 1891 was 198,139, and in the present year it was estimated by the Registrar General at 218,244. By an order of 1890 the Corporation were authorised to supply electrical energy in the borough, and with the sanction of the Local Government Board they had already borrowed sums of money for carrying out their powers. The Corporation had established a generating station at Wallness Road, which was on the alternating system, but the demand for current had increased so rapidly during the last 12 months that the station was quite unable to cope with it, and after long consideration and the inspection of various sites the Corporation had purchased a plot of land which abutted on Strawberry Road, Pendleton, and plans and estimates had been prepared for the construction of buildings. The figure of £398,683 was divided into three parts—£50,000 for the erection of the requisite buildings; £335,783 for the whole of the machinery and plant and the underground and overhead distributing mains in connection with the station; £12,900 for the extension of the low and high tension cables connected with the existing station at Wallness Road. The lease of the tramways granted by the Corporation expires in 1901, and they had determined on its expiration to work the tramways themselves by the overhead system of electric traction. He urged the necessity of obtaining the sanction of the Local Government Board in order that they might proceed with the work in preparation for taking the tramways over. Mr. S. V. Clirehugh, consulting engineer, and Mr. C. L. Turner, resident electrical engineer, supplied the inspector with the necessary details, and Mr. A. Haworth, chairman of the Electric Lighting Committee, stated the reason for asking the Local Government Board's early sanction to the present application. There was no opposition.

Shildon.—At a meeting of the Urban Council it was unanimously decided not to proceed with the application for a provisional order for electric lighting this year. A committee was appointed to consider the whole question.

Shoreditch.—Plans for the construction of a new electric lighting sub-station at the junction of Great Cambridge Street and Hackney Road (cost £1,500) have been passed by the Vestry. Two additional motor transformers are to be purchased for the Worship Street and Great Eastern Street sub-stations.

South Shields.—Last week a Local Government Board inquiry was held with respect to the application of the Town Council to borrow £15,600 for electric lighting purposes, and the details of the scheme were explained by the town clerk and Mr. Jeckell, the electrical engineer. The money is required for additional electrical plant to meet the growing demand in the town for the electric light.

Smethwick.—At a meeting of the Town Council last week the Public Works Committee reported that, notice having been given by the Midland Electric Corporation for Power Distribution, Limited, of their intention to apply in the next Session of Parliament for an order empowering them to supply electricity for all public and private purposes in the borough of Smethwick, the Committee recommended that the town clerk be instructed to oppose the application and the granting of the proposed order. The directors of the Electric Corporation being desirous of interviewing the Committee upon the question, the Committee had expressed their willingness to receive them at their meeting on January 2nd. The report was adopted by the Council

Southend.—The Light Railways and Electric Lighting Committee recommended the Council to rescind the motion under which they agreed to hand over the powers of the Southend Electric Lighting Order to Mr. A. H. Gibbings, of Bradford, and also recommended that the Committee be instructed to carry out the powers of the order with respect to electric lighting concurrently with the light railways. It was explained that Mr. Gibbings wished the Corporation to enter into an agreement, the terms of which were in excess of those previously agreed to. Accepting the recommendation of the Committee, the Council has now changed its mind, we trust finally, regarding the question of electric lighting, and has resolved to carry out the order itself. The lighting scheme is combined with electric tramways, the total outlay being put down at £115,000 (electric lighting, £35,000; and tramways, including permanent way, £80,000). Mr. J. B. Mitchell, who has occupied the position of borough electrical engineer for some time past, will now, perhaps, be able to get forward with work which will show for itself. His position, we should imagine, has not been altogether a bed of roses recently. Presumably, the Council will shortly be in the market for tenders for the respective sections of the contracts.

Sowerby Bridge.—At a special meeting of the Council on Thursday last, the question of the electric lighting order was fully discussed, and it was decided to go forward with the same. Mr. W. Emmott, who is the consulting engineer retained by the Council, gave a report on the lighting of the district with the aid of a refuse destructor and electricity generating station combined, and gave full details of the scheme, and its probable cost. He also furnished particulars of a scheme to be worked without a refuse destructor, on the present gasworks site, and fed from what is practically gasworks refuse.

Stamford.—The Town Council has come to terms with Edmundson's Electricity Corporation, Limited, and will support their application for a provisional order.

Sudbury.—The Town Council have resolved to apply for a provisional order under the Electric Lighting Acts, 1882 and 1888.

Swansea.—The Electric Lighting Committee recommends that the scheme of the South Wales Electrical Power Company be opposed, as it might come into Swansea and supply electric light in competition with the Corporation.

Twickenham.—The District Council last week decided to oppose the application of the Teddington and Twickenham Electric Lighting Company (Richmond) for electricity supply powers, to drop its own application, and to support that of Edmundson's Electricity Corporation, Limited. When Edmundson's have done the work it will be taken over by a company to be called the Twickenham and Teddington Electric Supply Company, Limited.

Wellingboro'.—The Urban District Council has adopted the recommendation of the Lighting Committee to apply for leave to borrow £3,500 for carrying out the electricity works.

Wingate.—The contract for supplying electric light to the mining village of Wingate has been completed. A dynamo, capable of providing for 600 lamps, has been put down, and 43 lamps of 25 c.p. have been placed about the village. The underground workings of Wingate Grange Colliery have also been lighted by the same means, and arc and incandescent lamps are to be provided for the heapstead.

Yiewsley.—In reply to a communication from the Uxbridge District Council, the Yiewsley Parish Council has requested the former to oppose the application of the Uxbridge and District Electric Lighting Syndicate for powers to supply the parish with electricity.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—The overhead electric wire system on the Woodside tramway route was inspected on 15th inst. by Mr. Trotter, of the Board of Trade, and found satisfactory. The permanent way inspection was to follow a few days later. The public inauguration was to take place on Wednesday.

Barrow.—The British Electric Traction Company having taken over the Barrow steam trams, it is proposed to completely reorganise the system, electricity on the trolley system being substituted as the motive power. It is likely that the company will obtain power from the public supply works if satisfactory arrangements can be made.

Belfast.—The Corporation and the tramways company have again been unable to come to terms as to the proposed purchase of the company's undertaking, and negotiations are now stated to have been broken off.

Bradford.—The Tramways Committee proposes to set aside 5 per cent. of the gross receipts and the income from advertising on the electric tramcars for an insurance fund against accidents.

(*Continued on page* 1011.)

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AN ELECTRICAL QUARRY INSTALLATION.

In no case, perhaps, are the advantages and economies of electrical driving brought into evidence more clearly than in that of the electrical transmission of power in quarries; more especially is this so in the case of the quarry we are about to describe, which is in a mountainous district in the Lowlands of Scotland, where the nearest coal siding is two miles away from the quarry working. In this instance we have not only the economy of electric motors as compared with the highly inefficient steam crane, practically blowing off steam continuously, but also the facility of electric transmission of power from the railway siding to the centre of the workings.

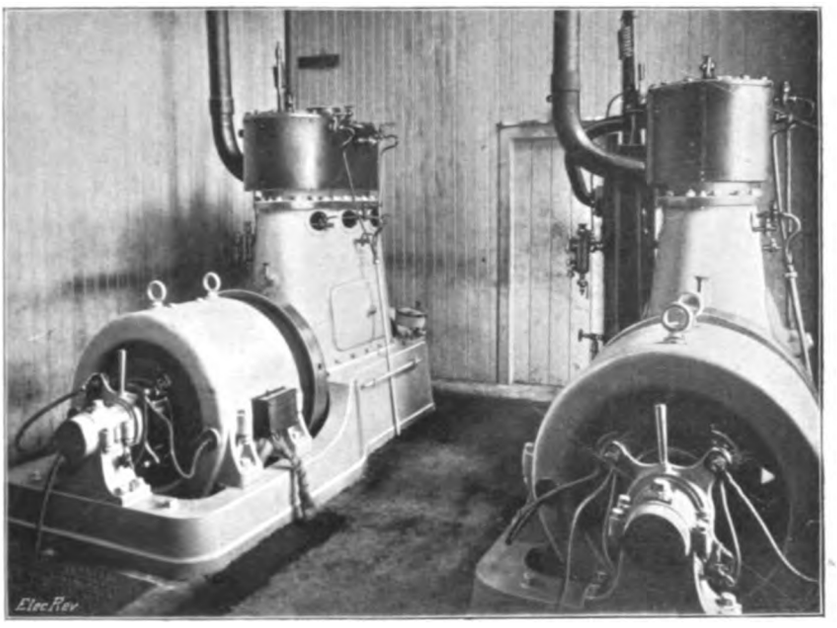

Fig. 1.

These quarries are situated about 6 miles from Dumfries; the generating station is at Closeburn, also about 6 miles from Dumfries, on the main line of the Glasgow and South-Western Railway. The generating plant consists of two 80-H P. direct-coupled sets. The dynamos were made by Messrs. D. Bruce Peebles & Co., Edinburgh, of their patent "P.P.P." traction type. The field magnet cores and poles are of annealed cast-steel, with patent cast-iron pole-tips; the function of the latter is to provide a constant magnetic fringe independent of the main field, in order to ensure sparkless commutation with fixed lead at all loads, a most important point for the very varying load which is such a feature of quarry work. The engines are by Messrs. Mirrlees, Watson and Yaryan Company, Glasgow, of their compound single-acting type, with piston valve between the high and low pressure cylinders. A view of the engine house is shown in fig. 1,

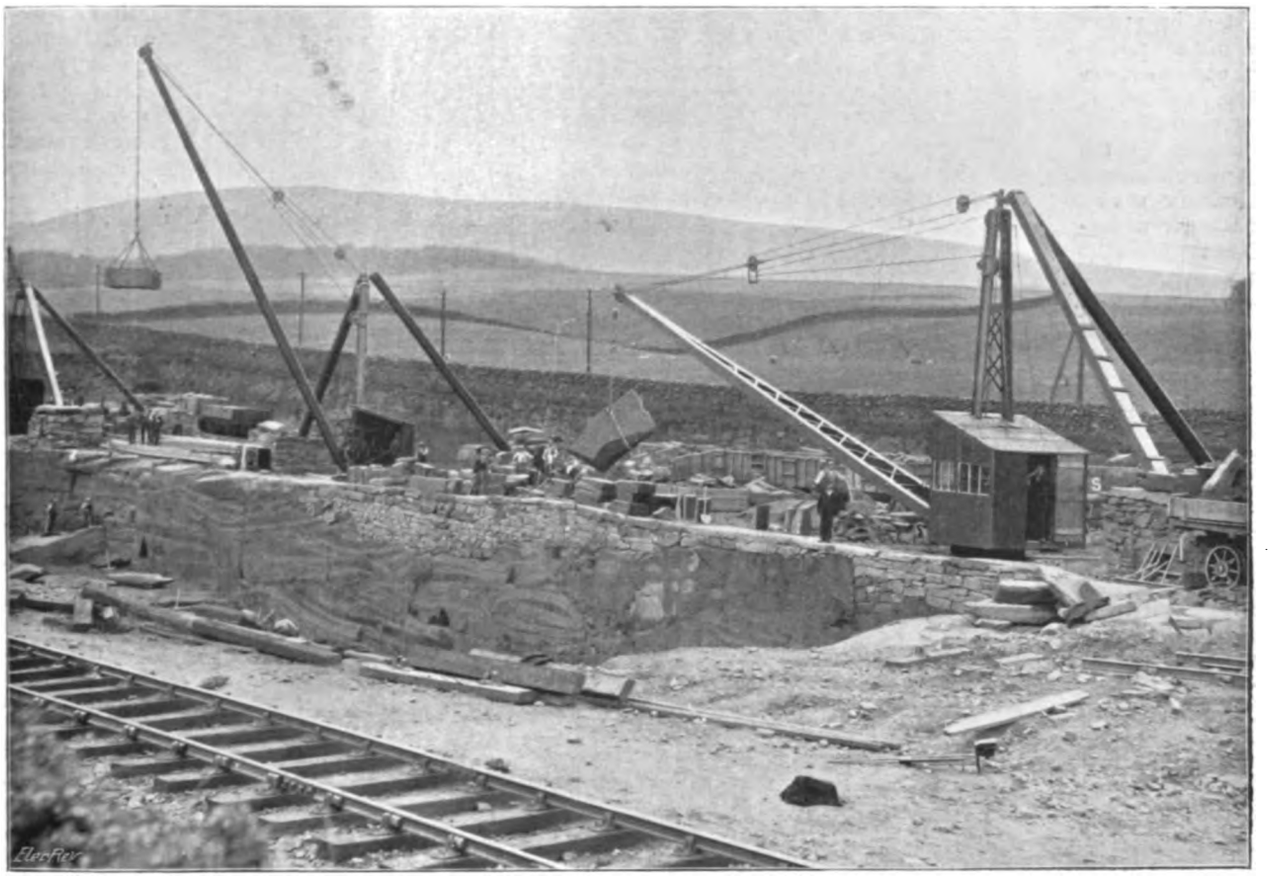

Fig. 4.

and of the switchboard in fig. 2. The generators are protected by automatic circuit breakers. The current, at a

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pressure of 500 volts, is carried for a distance of two miles along the railway track, as shown in fig. 3, where it will be seen that the line is overhead to the quarry workings, a view of which is given in fig. 4. The line was erected under the supervision of Mr. H. Agnew, resident engineer to the quarries, of which Mr. Thos. Lamb is manager.

At the quarry there are seven 10-ton derrick cranes at work, each driven by a 15-B H.P. Peebles patent "P.P.P." motor of the completely enclosed type. The motor is geared direct to the crab by means of a rawhide pinion, gearing into double reduction gear on the crane barrel, as shown in fig. 5; the ratio of the speed of the motor to that of the first shaft is 1 : 4·5.

The motions of the crane are operated by means of a patent reversing controller, as shown in fig. 6. This controller can be worked by the most inexperienced labourer or navvy, and is made as mechanically perfect and as strong as is possible. It is a most important point in crane work that the controller should be as strong and as rigid as it can be, and Messrs. Bruce Peebles & Co. have taken great pains in the design of their crane reversing and controlling switch to make simplicity and mechanical rigidity the main features of its construction.

As seen in the figure, the handle is in the middle position; a movement of the same through an arc of 45° sends the contact arm round by means of gearing through 180° in one direction, while moving the handle

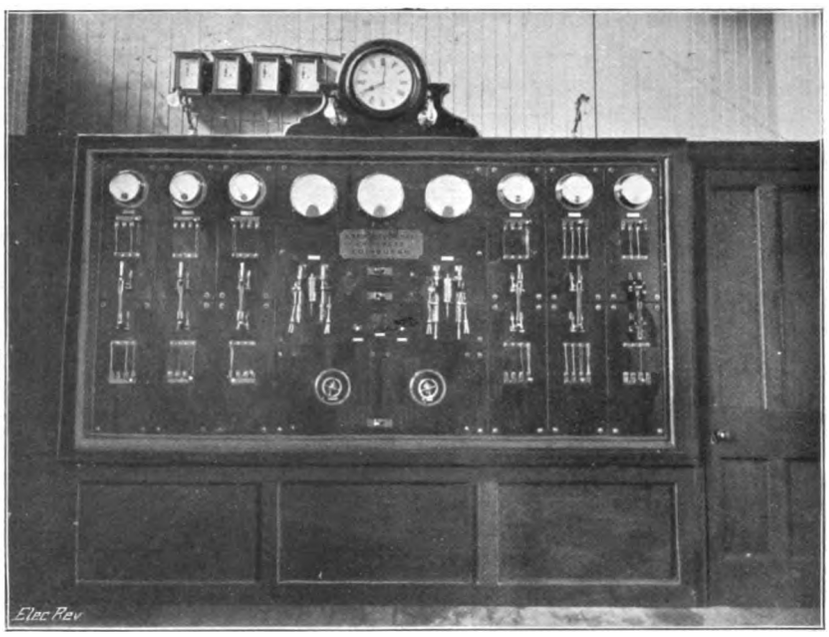

Fig. 2.

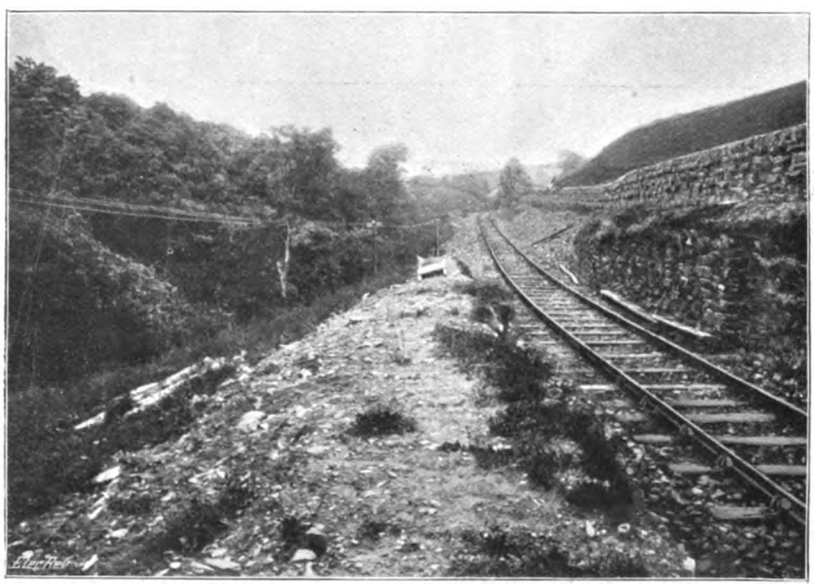

Fig. 3.

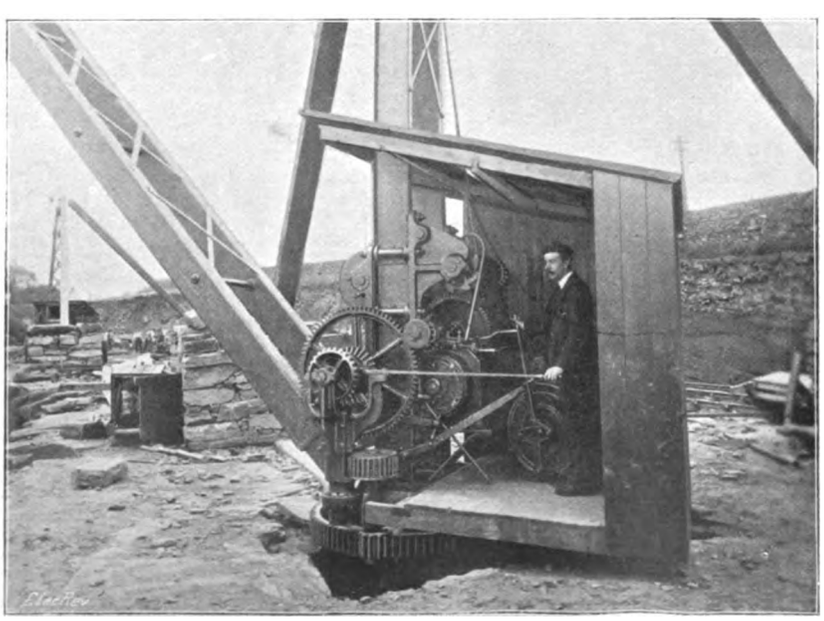

Fig. 7.

45° in the other direction sends the arm round 180° in the opposite sense, so that a very small movement of the radial arm implies a very large movement on the part of the switch. The contact blocks are removable, and have ample contact surface throughout. The makers state that this type of switch has given the utmost satisfaction wherever it has been used. A view is given in fig. 7 of the motor and controller in position on the derrick.

It is needless to point out how small and compact this arrangement is when compared with the ordinary donkey engine and its attendant coal bunker; and when it is remembered that these small engines are practically blowing off steam all day long, despite the fact that they are only worked for certainly not more than one-tenth of the working hours, the enormous superiority of an electric system of power transmission is very evident.

Fig. 5 shows the Peebles motor in detail, with its raw hide pinion, ready for erecting in position. The main points aimed at in the design of this machine for crane work are compactness and ability to start under excessive torque. The motor will readily take 25 H.P. without sparking. A point to be borne in mind when designing crane motors is that the electrical efficiency measured on the basis of the ordinary rating should be secondary to the ability of the motor to cope with varying loads and to be absolutely sparkless up to 50 per cent. overload.

A series wound crane motor should not be built on the same lines as an

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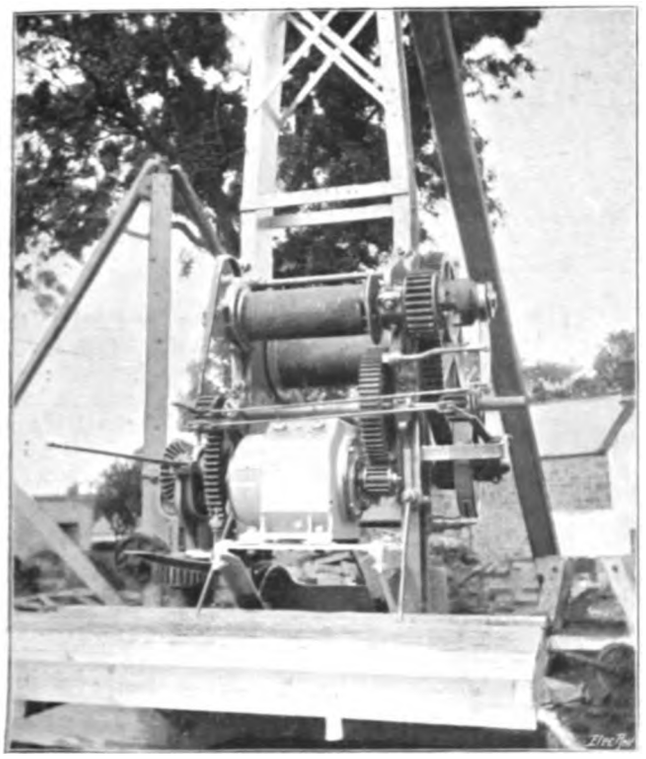

Fig. 5.

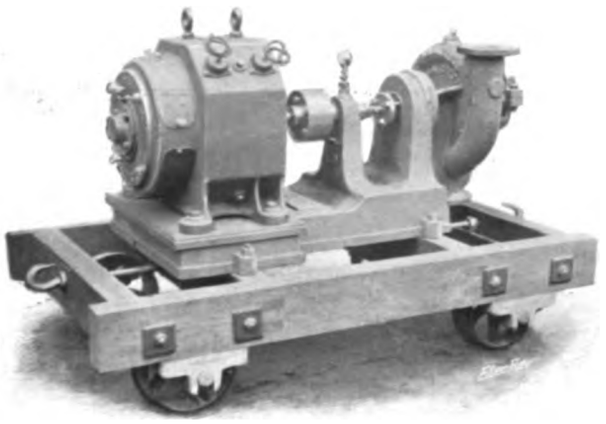

Fig. 10.

ordinary motor for continuous running, but should be designed in the same way as the standard traction motor, to withstand severe overloads and to be as mechanically sound as possible.

The Peebles motor has been specially designed with this end in view, and from its compact construction is admirably suited for work of this description.

Electric power is also utilised in the stone planing and cutting shops situated close by the generating station, where three 15 B.H.P. motors and three 10-B.H.P. motors drive respectively by means of gearing the reciprocating stone planers and sawing machines. Fig. 8 shows a Peebles "P.P.P." protected motor driving the gearing for a reciprocating saw; a similar motor driving a planing machine is seen in fig. 9. The rough stone from the quarry is here machined, before being placed in the railway trucks at the siding.

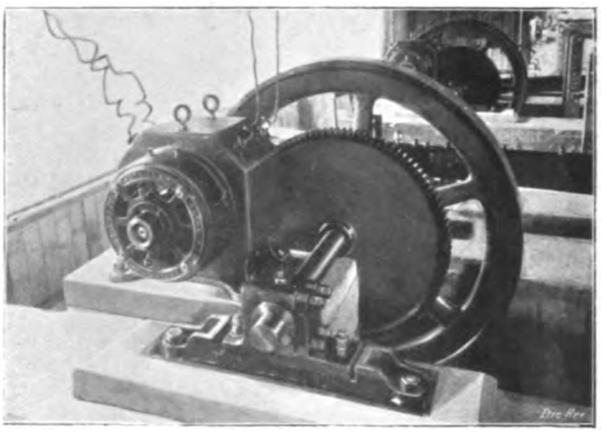

Fig. 8.

Fig. 9.

In fig. 10 is seen Messrs. Peebles & Co.'s standard combined centrifugal pump and motor, which is mounted on a movable trolley; several of these sets are employed in quarries for draining the workings, and are exceedingly convenient for this purpose, the power being transmitted by means of a flexible cable.

As regards the working of the plant, there are altogether seven cranes installed, each of which takes from 15 to 20 B.H.P. as a maximum, and the average load factor for the cranes alone may be set down at about 20 per cent. The same plant, however, which drives the cranes also drives

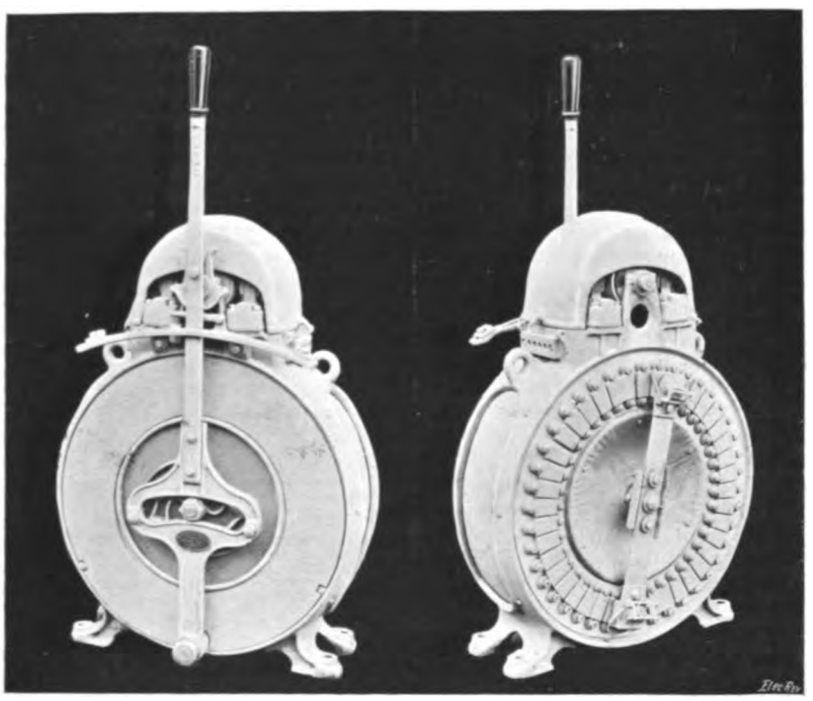

Fig. 6.

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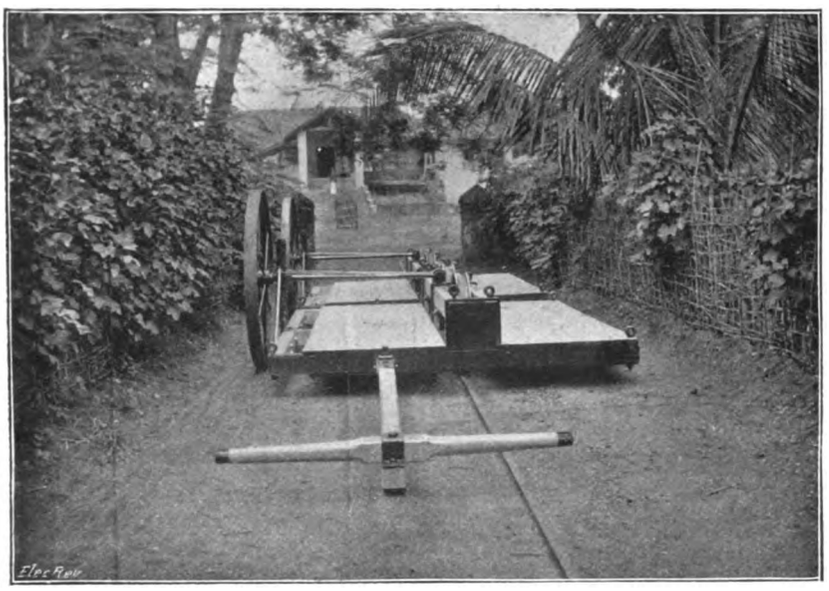

Fig. 1.

the stone cutting and planing machines, the average demand of which is 40 H P., with a load factor of about 50 per cent., so the whole plant could be normally run by working one 80-H.P. set at its full load, or the two running half load, so that if absolutely necessary either machine could act as a spare on the other.

As, however, the maximum load is *momentarily* as much as 140 H.P., it is advisable to run the two sets always. The average drop on the line is 5 per cent.; the line has to transmit the power to the crane motors only.

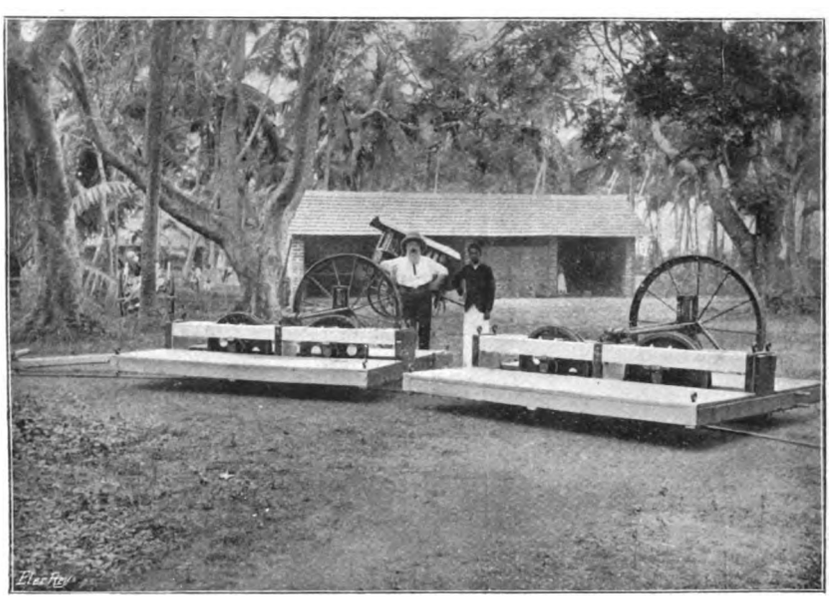

Fig. 2.

The monthly coal consumption for the whole installation, consisting of seven 15-H.P. crane motors, three 15-H.P. planing motors, three 10-H.P. saw motors, and a steam hammer and pulsometer, the latter two taking about 15 H.P. for an average of about four hours a day, works out at about 90 tons a month at 7s. 6d. per ton; this is working non-condensing and with cold boiler feed. Condensers are, however, being installed, and it is anticipated that when this alteration is made the consumption will not exceed 65 tons a month, which is about one-third of the coal consumption were the whole installation driven by steam. When the pulsometer and steam hammer are replaced by electrically-driven machinery, it is confidently expected that the comparison will be still more favourable to electrical working.

EWING'S SINGLE-RAIL TRAMWAY.

The accompanying figures illustrate the single-rail tramway invented by Mr. Charles Ewing, whose letter will be found in our "Correspondence" columns. The special advantages claimed for this system are simplicity, cheapness, speed of construction, and small tractional resistance.

Quoting from a paper read before the United Service Institution of India by Lieut.-Col. F. F. R. Burgess, I.S.C.:—

"On a level road one pair of bullocks can, on a single line, draw a train of trucks, carrying a net load of from 6 to 7 tons, a distance of 15 miles in a day with ease; it requires from 16 to 18 pairs of bullocks to draw this load in ordinary carts carrying the military regulation 800 lbs. load.

"The trucks run on a single line of rail laid on the ground or roadway, and are mounted on two or three double-flanged wheels placed under their centre. These wheels are of small diameter, varying from 15 to 30 inches, according to the size and weight of the trucks and rails, the flanges being twice as far apart as the width of the head of the rail on which the wheels run.

"The whole weight of the truck is thus borne on two or three double flanged wheels which run on the single rail, so that, unless it were supported in some way, it must fall over. The necessary

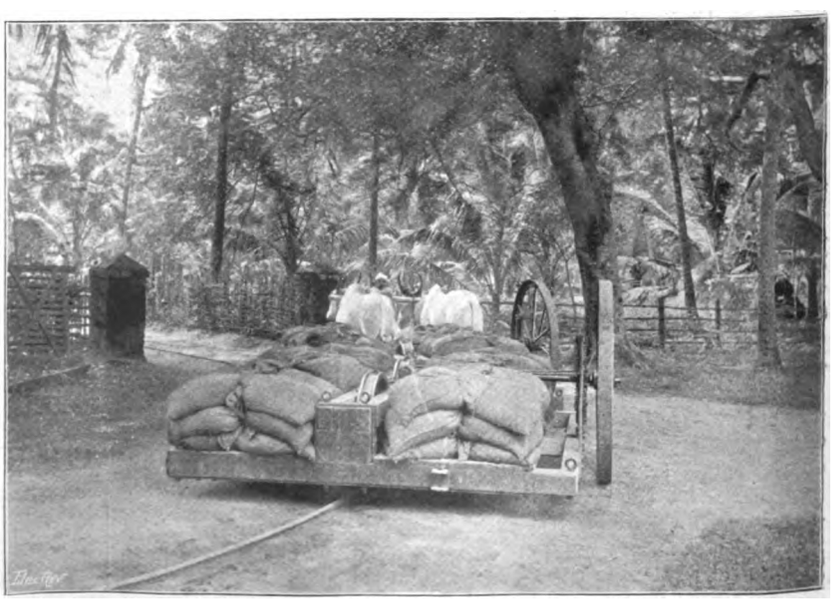

Fig. 3.

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support is afforded by a lightly constructed iron 'balance' wheel of comparatively large diameter, from 4 to 5 feet, with a 4-inch wide tyre, placed at the side of the truck.

"This balance wheel runs on the surface of the ground or roadway about 4½ or 5 feet away from the rail. It runs on an axle which is pivoted at right angles to the centre of the truck and is kept in position by a hornplate fixed to the frame of the truck. The axle is also furnished with a double helical spring which eases the jolting of the balance wheel when going over any inequalities. The platform of the truck, which carries the load, extends to an equal distance on each side of the central line of the truck over the rail and flanged wheels, and the load would usually be evenly distributed on it, but should it not be so, there would be no risk of the truck upsetting, as the balance wheel provides

Fig. 4.

against this, and an excess of several hundredweight may be placed on the far side, away from the balance wheel, without risk. This is due to the fact that the balance wheel is placed at a considerable distance away from the side of the truck, generally 5 feet from the centre of the light 1-ton truck, which has a 6-foot wide platform, and the leverage thus afforded enables a light balance wheel of only about 160 lbs. weight to balance more than three times its own weight of excess load on the far side and thus allow for careless loading, &c.

"The balance wheel does not bear any of the weight of the load on the truck, and but a very small proportion of the weight of the truck itself, and, therefore, causes very little loss of power through frictional resistance, especially on a smooth surface.

"The axle of the balance wheel may either be straight or cranked; in the latter case it goes under the platform of the truck, leaving it perfectly flush and clear for the load, which is an advantage; but for certain purposes it may be better to have the other pattern, which allows of the centre of gravity being considerably lowered, as the platform can be made very low, only 8 inches above the road surface, if required.

"The truck runs very smoothly, and requires very little force to start it on level ground. It is strongly but lightly constructed of teak or other suitable wood, and is fastened with iron nuts and bolts. It is very light in proportion to the load it is intended to carry, which itself is only limited by the weight of the rail and the description of rolling stock carrying it."

Fig. 1 is a front view and fig. 2 a side view of a pair of empty trucks to carry 3½ tons each; fig. 4 shows similar trucks loaded, and drawn by a pair of bullocks. In fig. 3 the train is seen going round a curve of very short radius.

"The rails used on this system are of the ordinary railway description, and their size and weight vary according to the work required; for instance, in the light planter's line on this system, such as that on Messrs. Finlay, Muir & Co.'s estates in the Travancore Hills, some 22 miles in length, the rail used weighs only 14 lbs. to the yard, the two-wheel trucks running on it carrying loads of 1 ton each, this light rail being only intended to bear the gross weight of three-quarters of a ton per wheel; but where heavier loads are required to be carried on larger and heavier trucks, a heavier rail would be necessary.

"Single line rails for ordinary use on existing roads are laid on small wooden sleepers to which they are spiked in the usual manner. These sleepers are 18 inches long, 8 inches wide and 3 or 4 inches thick."

There is no keeping the rails in gauge as in a double line, and it does not matter if the rails shift a little, a serious matter with a double line; the cars can be run with ease round curves of 25 feet radius, or even less.

To enable trains of cars to pass each other, each truck carries a ramp fitting the head of the rail, attached to a single rail; when two trains meet, these spare rails are used to make a temporary siding, on which one of the trains is run.

Bullocks are generally employed for haulage; but two men can easily propel a truck carrying a load of 1 ton at a walking pace. Various passenger cars, ambulances, &c., have been designed for use on this system.

The application of electric haulage to a line of this description appears to present no difficulties. A light trolley line carried on wooden brackets, and locomotives of similar design to the trucks, would afford a cheap equipment suitable for light traffic on either a temporary or a permanent line. Working on the principle of small loads at frequent intervals, electricity would be at its best, and would compete favourably with any other mode of haulage.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page* 1006.)

The Cinque Ports.—The Deal Council briefly considered the Cinque Ports light electric railway scheme last week, but could not make up its mind whether to approve it or not, and eventually the matter stood adjourned. There are a number of very narrow thoroughfares through which the lines would run.

The Sandwich Council has agreed to approve the scheme conditionally. The matter was also brought before the Rye Council. Mr. Mark Parker, engineer for the scheme, explained the system to be established between Ramsgate and Hastings. It is intended to have a generating station at Sandwich to supply the electric current for motive power from Ramsgate to Dover, the Corporation's supply and lines being utilised at the latter town, and a large station at Rye to supply the power from Dover to Hastings. He emphasised the company's desire to appoint local directors throughout the route. The Council referred the matter to their Railway Committee for consideration.

Darlington.—Mr. J. Clifton Robinson, the managing director of the Imperial Tramways Company, and Mr. Barnley, the local solicitor, appeared before the General Purposes Committee on 12th inst. regarding the proposal to drop for the time being 4½ miles of the scheme. It was explained that the company meant to carry out the work as soon as the public requirements demand that they should be laid down. They asked the Council to agree to only 4½ miles being laid down now, and that the remaining 4½ miles should be constructed in two portions at periods of five and seven years respectively. This matter was again fully discussed, as was also the question of the supply of current by the Corporation to the company. The question was again adjourned.

Durban.—The Town Council has recently been in the market for trolley poles, rails, crossings, &c., for electric tramways.

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Electric Railways.—It is quite possible, says the *Financial Times*, that the pending experiments with electric traction on a short section of the Metropolitan and District Railways may be successful from an operating standpoint, but only on the conclusion of the trials will it be feasible to form some idea of the financial prospects of the undertakings if steam locomotion were abandoned and electricity substituted as the motive power. In the meantime it is interesting to observe that the same problem, affecting two similar railways, has been raised in Berlin, although the experimental stage has not yet been reached in that city. The two lines concerned are the Berlin Metropolitan Railway and the Berlin Circle Railway, both of which are at present worked by steam locomotives and are hampered in dealing with the increasing traffic requirements. The Union Electricitäts Gesellschaft now suggests that by the substitution of electric for steam traction it will not only be possible to more easily handle the present traffic, but also that the alteration would increase the carrying capacity by no less than 260 per cent. It is claimed that this result would be accomplished by the adoption of trains each composed of eight motor cars (thus dispensing with an electric locomotive) and having a total passenger accommodation greater by 80 per cent. than that afforded by the existing type of steam train consisting of locomotive and nine coaches; and, further, by the running of the trains at intervals of two minutes instead of three minutes as prevails at present. According to the financial details worked out by the promoters of the scheme, the conversion of a large section of the two railways to the electric system would result in an economy in working expenses of 28 per cent as compared with the cost of steam-power. This result is arrived at after adding to the invested capital of £55,000,000, the sum of £9,150,000, which is the estimated cost of converting the particular section to the electric system. It is calculated that the receipts would readily allow of the payment of interest on the total capital outlay (£57,150,000) and also provide for redemption, and that with an extension of electric traction throughout the whole system the economy over steam locomotion would become greater than that already mentioned.

France.—The Paris, Lyons and Mediterranean Railway Company, of Paris, have just placed a contract for the establishment of a central power station to supply the electrical energy necessary for the electric railway between Chamounix and the Swiss frontier.

Glasgow.—The Tramways Committee received a deputation the other day, which brought forward the necessity that exists for electric trams in Alexandra Parade.

Gravesend.—The Drake & Gorham Electric Power and Traction Company have acquired the Gravesend tramway for the sum of £7,500.

Huddersfield.—A ratepayers' meeting last week approved of the Corporation Bill for reconstruction and extension of the tramways and electrical working.

Hyde and Stockport.—The Hyde Town Council held a special meeting on Monday night to consider proposals for a joint scheme of municipal electric tramways between Hyde and Stockport. The Electricity Committees of the two Corporations had previously met and decided upon terms, which, subject to a few alterations, have now been approved by the Hyde Council. It is proposed that in Session 1901 the Hyde Corporation shall apply for and obtain a provisional order for the construction of a tramway commencing at the borough boundary in Hyde Road, Bredbury, and terminating near the existing terminus of the Oldham, Ashton, and Hyde electric tramway at Gee Cross; such line to be constructed by and at the expense of the Hyde Corporation. Immediately upon the completion of the tramway the Hyde Corporation to grant, and the Stockport Corporation to take, a lease of it for 21 years, upon specified terms. By this scheme Stockport borough, the Urban District of Bredbury, and the Borough of Hyde will be served. Hyde is also in negotiation for another tramway from Hyde through Dukinfield, Stalybridge, and Mossley.

Johnstone.—Mr. Lea, representative of the British Electric Tramway Company, had an interview last week with Johnstone Town Council with a view to establishing electric tramways.

Kearsley.—Messrs. Lacey, Clirehugh & Sillar have been appointed consulting engineers for the tramway scheme.

Leeds.—At the Leeds County Court on 15th inst., Thomas Harmer (72), chemical manufacturer, recovered £25 from the Corporation for injuries received. He was stepping on to an electric car when it was started with a jerk, throwing him to the ground.

Manchester.—The Tramways Committee on Tuesday adopted a report by a special sub-committee which had been appointed to obtain information and to report as to the future administration of the tramways department. The report suggests the adoption of a general scheme of organisation prepared by the chairman of the Committee. This provides for the division of the organisation into two groups, one being the constructive and the other the administrative group. On the constructive side there are to be two sub-committees, one each for works and permanent way, and on the administrative side also two sub-committees, one for traffic and staff and the second an audit sub-committee. Under the two first of these sub-committees the chief officer will be the consulting engineer (Mr. C. H. Wordingham, the city electrical engineer), and under his direction will be a car works manager, a permanent way engineer, and electrical engineering assistants, who again will be in command of their respective staffs. The general manager will be answerable to the sub-committees on the administrative side, and will direct the duties of the outdoor superintendent, parcels superintendent, accountant, and chief clerk, under each of whom a special staff will operate. The works sub-committee is new, and it is proposed to delegate to it all the duties as to the provision of cars, car sheds, and works now in the hands of the Cars, &c., Sub-committee, whilst the latter sub-committee will become the Traffic and Staff Sub-committee. The Committee recommend the following arrangements and appointments of staff:—That Mr. J. M. McElroy (now secretary to the Committee) be appointed general manager at a salary of £400 per annum. That advertisements be at once issued for an accountant at a commencing salary of £200 per annum, a chief clerk at a commencing salary of £150 per annum, and a chief electrical assistant—applicants to state the salary they require. The special sub-committee have already visited London and obtained much useful information as to tramway administration from the London County Council, the North Metropolitan Tramways Company, the London General Omnibus Company, and they will, at a later stage, when they have had opportunities of inspecting other large tramway undertakings, submit a further report on the system of administration. Inquiries are being made as to premises suitable for the general offices of the department. The need for close organisation is indicated by the statement of a few facts. Tenders for no less than 450 electric tramcars have already been advertised for, and a contract has been placed for 5,000 tons of rails, the first delivery of rails to be made next April. As soon as the delivery is made the work will be begun of reconstructing the tramways in such a way as to suit the overhead trolley system. The first parts of the tramways to be dealt with will be the routes of Cheetham Hill, Bury New Road, and Rochdale Road. The relaying of the lines in other districts will gradually follow.

Musselburgh.—The Town Council last week had before it an agreement with the Drake & Gorham Electric Syndicate *re* electric tramways. It was decided to defer signing the agreement until a special meeting had been called.

Portsmouth.—The particulars of the claim of the Portsmouth Street Tramways Company and the Provincial Tramways Company against the Portsmouth Corporation for the compulsory acquisition of their undertakings have been deposited with the town clerk as a necessary preliminary to an inquiry before the arbitrator. The total claim amounts to £311,042 1s. 3d. Particulars of tenders received for electric cars appear under "Contracts Closed" this week.

South Staffordshire.—The Earl of Jersey and Colonel Boughey, light railway commissioners, heard evidence last week at the Town Hall, Willenhall, as to the proposed light railway from (1) Willenhall to Bilston; (2) Bilston to Ettingshall; and (3) Bilston to Bradley, promoted by the South Staffordshire Light Railway Traction Company. Mr. S. Morse, solicitor to the promoters, said the scheme was the outcome of suggestions made by the Willenhall and Bilston Urban District Councils. The only way of working the tramways in a satisfactory manner was to have them in the hands of one company. The length of the line from Willenhall to Bilston is under 1½ miles, from Bilston to Ettingshall about ½ mile, and from Bradley to Bilston just over ½ mile. The cost of the undertaking was estimated at £29,000 with equipment. There would be little difficulty as regards gradient; but at the corner of Bank Street and Highfield Road there was a narrow place which it was proposed to widen. Evidence in favour having been given by the two District Councils concerned, Earl Jersey signified his intention of recommending the sanction of the order to the Board of Trade.

Stirling.—Negotiations have been resumed between the Police Commissioners and the Stirling and Bridge of Allan Tramways Company with reference to the transfer of the company's undertaking to the British Electric Traction Company.

Swansea.—At the annual dinner of the Swansea tramways employés last week, Mr. D. Sugrue, J.P., the superintendent of the South Wales district for the British Electric Traction Company, responding to a toast, said the Swansea Improvements and Tramways Company and the British Electric Traction Company had come as a boon and a blessing to the people of Swansea. Work had been done by the allied companies which had never been properly appreciated by the town. At the present time, though the companies had relaid the line and spent a large amount of money with a view of improving the service between the outlying districts and the heart of the town—a service which could not fail to improve the trading connection between the town and the outlying districts—they were, unfortunately, meeting from the Corporation of Swansea successful opposition to projects which were conceived chiefly with a view of completing the system to Swansea. Actuated, he had no doubt, by the highest motives, but yet, he contended, by mistaken views, the Corporation had prevented them making extensions which every man in Swansea admitted were not only desirable, but necessary. What was the Corporation now going to do? It was clear that it could at present exercise no rights over the roads now in the possession of the companies; it was obvious that until it could do that it could not itself carry out the extensions it had prevented the companies he represented from making. If the extensions were to be carried out, the Corporation must approach the companies, for after the way the companies had been treated they certainly would not approach the Corporation.

Whitefield (Lancashire.)—The District Council last week resolved to apply to the Board of Trade for a provisional order to construct and work tramways. The application is stated to have reference to the proposed electrical tramways from Eccles to Whitefield.

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TELEGRAPH AND TELEPHONE NOTES.

The Cables to South Africa.—The *Daily News* says for the fourth time since the war began cable communication by one of the two lines connecting us with South Africa has been interrupted. This time it is the cable along the East Coast of Africa that is broken, and the damage is owing to a terrific cyclone that has raged at Mozambique. Houses have been blown down and the ships in the harbour wrecked. The telegraph station, we are informed by the Eastern Telegraph Company, has been unroofed, but the instruments have been saved. As soon as the storm subsides the line will be promptly repaired, and this will no doubt take less time than having to pick up the cable a long distance out at sea, as was the case on the two previous occasions when the East Coast wires were broken. The cable between San Thomé and Loanda, in West Africa, was, fortunately, repaired at the end of last week, or we should now be cut off altogether from communication with the seat of war.

The Continued Interruptions to the Cape Cables.—Last week, when detailing the interruptions to the cables which reach the Cape by the East and West Coasts of Africa, we expressed a hope that during the period of interruption then existing to the West Coast route the cables on the East Coast would hold out, thus saving us from being totally cut off from the Cape. This was fortunately the case, as the San Thomé to Loanda cable was repaired on Saturday last, but only just in time; the Delagoa Bay-Mozambique cable breaking down again last Monday. Altogether during the last two months one or other of these routes to the Cape has been useless, owing to interruption, for more than half the time.

Dewsbury Telephones.—At a meeting of the Dewsbury Chamber of Commerce last week complaint was made that Dewsbury had been left out in the cold in respect to the proposed reduction of charges in telephones, owing, it is stated, to some differences existing between the Town Council and the company.

French International and Colonial Cable Schemes.—The daily press of Paris announced on Saturday last that the Turkish Government is now examining a communication received from the French Government relating to a cable landing at Jaffa (Palestine). The project seems to be the laying of a cable from Marseilles to Jaffa, and a landline from the latter place across Arabia to the Persian Gulf, whence Madagascar, Mahé (in India), and other French colonies can be reached. In the Chinese seas the Eastern Extension Company will be expropriated, their Saigon-Hué-Tonquin cable being taken over by the French Government. Tonquin will then be connected direct to the system of the Great Northern Telegraph Company, whose lines reach Amoy through Russia, Siberia, and Japan. In other directions the French Government will acquire a line of communication from Oran (in Algeria) to Senegal, touching at Tangiers. From Senegal the other West African colonies of France will be reached by purchasing the West African Telegraph Company's system, or by subsidising a new French line. The Government does not consider the matter of prime importance, but, nevertheless, says *Le Temps*, contemplates the establishing of a cable between Senegal and Brazil.

Grantham Telephones.—Arrangements are in progress, on the part of the National Telephone Company, for opening a telephone exchange at Grantham. The erection of poles is being rapidly proceeded with.

Imperial Telegraphic Communication.—Following up Sir E. Sassoon's able speech on this subject, "A Parent" writes to the *Times* to mention an illustration of the present working of the prohibitive system. Although he has had three sons in India for some eight or ten years (one of them in the Civil Service, and two in the Army) up to the present time not a telegram has passed between them. Numerous cases, of course, have arisen when they would have been glad to have telegraphed, but the high prices deterred them. If the tariff had only been reasonable, many telegrams would have passed. "The companies, in insisting upon such high terms, are practically shutting the door to such communications, manifestly against the interest of the shareholders."

Leith.—The District Council has appointed a sub-committee of the General Purposes Committee to deal with the provision of better telephonic, telegraphic, and postal facilities for the borough.

Manchester Telephones.—The Special Telephones Committee of the Manchester Corporation last week received a reply from the Glasgow Corporation to a letter seeking an interview with them, and it was determined that a deputation consisting of Alderman Higginbottom, Councillors Brocklehurst, Phythian, and Plummer should wait upon the Glasgow Corporation at an early date. It was also decided that an interview shall be sought with the Salford Corporation, and the town clerk was instructed to make the necessary arrangements. The object of the interview is that of generally furthering municipal policy in regard to telephony. It was reported to the committee that at a recent meeting of the Association of Municipal Corporations, the following resolution was carried:—"That the secretary of the association be instructed to ascertain what boroughs in the United Kingdom are contemplating the establishment of a municipal telephone service under the provisions of the Telegraph Act, 1899, with a view to a conference of such municipalities being held."

A conference was held on Tuesday at the Manchester Town Hall between representatives of the special telephone committees of the Manchester and Salford Corporations in regard to the question of establishing common action between the city and borough. A very general desire was expressed at the conference in favour of common action in connection either with the municipalisation of the telephones or the granting of a license to a new company. A deputation from the Manchester committee left for Glasgow on Monday evening, and negotiations will be resumed when they have reported the result of their consultations with the Glasgow committee.

Pollokshaws Telephones.—The Council has agreed that no decision on the proposals of the National Telephone Company to introduce a new system of charging in the Glasgow area be arrived at until the result of the scheme of the Glasgow Corporation is ascertained.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies:—		
Jamaica-Colon	June 30, 1899 ...	...
Trinidad-Demerara (1871 original)	Oct. 20, 1899	Nov. 9, 1899.
Do. do. (1891 duplicate)	Oct. 6, 1899	one cable restored.
South African:—		
Zanzibar-Mombasa	Oct. 27, 1899 ...	...
Saint Thomé-Loanda	Dec. 11, 1899 ...	Dec. 16, 1899
Mozambique-Lourenço-Marques	Dec. 18, 1899 ...	...
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Latakia-Cyprus	June 20, 1899 ...	...
Landlines.		
West Indies:—		
Communication with Les Cayes (Haiti)	Nov. 22, 1899 ...	...
South African:—		
Communication with Mafeking...	Oct. 13, 1899 ...	...
Communication with all offices beyond Orange River	Oct. 18, 1899 ...	...
Communication with Burghersdorp, Cape of Good Hope, and Estcourt, Natal...	Nov. 7, 1899 ...	...
Communication with north of Mooi River (Natal)	Oct. 22, 1899 ...	...
San Domingo landlines	Dec. 15, 1899 ...	Dec. 16, 1899
Colombian Government lines to Bogota	Oct. 21, 1899 ...	...
Communication with interior of Colombia, excepting Amalfi, Ambalema, Baga, Cartago, Ibagua, Manizales, Medellin, Palmire, Pasto, Popoyans, Reimedos, Sonson, and Santo Domingo... ...	Nov. 6, 1899 ...	...
Communication with Valentia (Venezuela)	Nov. 18, 1899 ...	...
Indo-European lines between Odessa and Kertsch	Dec. 12, 1899 ...	Dec. 14, 1899
Indo-European lines between Odessa and Kertsch	Dec. 12, 1899 ...	Dec. 18, 1899
Indo-European lines between Odessa and Hertsch	Dec. 20, 1899 ...	...
Saigon-Bangkok	Dec. 16, 1899 ...	...

The Telephone Service.—At a meeting of the St. Giles's Board of Works on Tuesday, Mr. R. W. Dibdin, J.P., (chairman) in the chair, the Law and Parliamentary Committee reported that they had considered the letter of October 31st, from the secretary to the Post Office, as to the rights of the National Telephone Company of laying telephone wires and pipes under the streets. They recommended that having regard to all the circumstances of the case, no action be taken in the matter. Mr. E. Upton, in moving the adoption of the report, said that it would appear that some time ago the Post Office authorities entered into a covenant with the National Telephone Company to allow them to lay their wires in the trenches which they opened for telegraph purposes. The Post Office authorities had since changed their mind, and a rivalry now existed between them and the Telephone Company. He did not think that they (the board) should do anything to prevent the Telephone Company from laying their wires. Neither the Post Office nor the Telephone Company had authority to open the streets, and if they did the local authority could take action against them. The report was adopted.

A conference of representatives of boroughs in Kent and Sussex was held in the Town Hall, Hastings, on Wednesday last week. It was resolved to write to the Postmaster-General asking for definite information with regard to the several points discussed, and another meeting is to be held for the further consideration of the subject.

Telephone to Belgium.—The *Daily Chronicle* Brussels correspondent telegraphs that recent experiments with the view of connecting Brussels and London by telephone have been so successful that the negotiations have entered upon a practical stage, and a convention on the matter is about to be signed by the respective Governments. The wire will be carried through Lille, Calais and Dover.

Wireless Telegraphy.—Before the Indian Section of the Society of Arts on 14th inst. Colonel R. C. Temple, Chief Commissioner of the Andaman and Nicobar Islands, read a paper entitled "Round About the Andamans and Nicobars," in which considerable and interesting reference was made to the utility of wireless telegraphy for establishing convenient communication between the islands. In a report in the *Times* of 15th inst. we read that Colonel Temple

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suggested setting up a system of wireless telegraphic communication between the Andamans and India, in view of the great importance of the islands as meteorological stations, whence timely warning of cyclones could be given to shipping all over the Bay of Bengal. In dealing with this question, the lecturer stated that the idea of telegraphic communication between the Andamans and India was an old one, which had on more than one occasion reached the point of plans and estimates, but the overwhelming obstacles hitherto had been the physical difficulties and the great cost of laying a cable. The arrival of wireless telegraphy essentially changed the old conditions. The point to get at was Port Blair, which was such a long way by sea from anywhere—roughly, 1,000 miles from Madras, 750 miles from Calcutta, 350 miles from Rangoon—that at the first blush it seemed absurd to talk about reaching it by wireless telegraphy. But if one would carefully look at a general map the apparent impossibility at once disappeared. Roughly speaking, the Andamans on the one hand, and Narcondam, Barren Island, and the Invisible Bank on the other, were in reality the tops of submerged mountain ranges connected with the Asiatic Continent through Burma, while the Nicobars were the tops of a similar range connected with Sumatra. And, as a matter of fact, if the string of islands were viewed as a whole, the longest distances from the coast of Burma, from each other and from Sumatra were quite trifling. It would be perceived that telegraphic communication could be set up along the whole line of islands, either by the wireless system alone or by its combination with the ordinary overland wires, the portion of the route which it would be obligatory to bridge over by wireless telegraphy being the sea stretches. These were all that need be considered now, and the lengths of the stretches in question were in no case prohibitive. At Diamond Island, in the extreme north of the map, was an important telegraph station, used by ships awaiting orders from Rangoon, Calcutta, &c., and for similar purposes. From Diamond Island to the Alguada Reef, where there was an important lighthouse, was only 10 miles; thence to Preparis Island the distance was 55 miles; thence to the Cocos Islands, where was another important lighthouse, it was 45 miles; thence to Landfall Island it was 30 miles. On reaching Landfall Island one found himself in a long closely-connected string of islands, along which ordinary wires could be stretched to Port Blair, 150 miles. Communication southwards from this point could be extended to the south of Little Andaman with the help of wireless telegraph stations, in no case more than 25 miles apart. From the Little Andaman to Car Nicobar would be encountered the longest sea distance of 70 miles, but the distances onwards were not great; to Chowra, 40 miles; thence to Nancowry, 20 miles; thence to Little Nicobar another 20 miles, whence it was only 30 miles to Parsons Point, in the extreme south of the Great Nicobar. The meaning of all this was that the greatest sea distance to Port Blair was 55 miles, and onwards to the Nicobars it was 70 miles. Now, he was assured, and his own observations made with the kind assistance of Mr. Marconi and his friends, had confirmed him in the belief that anything under 100 miles was not an impossible practical distance for wireless telegraphy; at any rate, 55 miles was an easily feasible distance. To extend the line of telegraphic communication on to Sumatra they would find it 60 miles to Pulo Brasse, and then 15 miles to Acheen Head, whence communication could be run on by land and sea to Singapore or any other selected point in the general cable lines. In this way there could be set up an independent line of telegraph between India and the rest of the world. This, however, would involve co-operation with the Dutch East India Government and other political considerations. But, leaving this point out of the present purview, the fact remained that it was quite feasible to run a line of wireless telegraph stations down the whole length of the Andamans and Nicobars in direct communication with Diamond Island, every one of which could without difficulty be turned into a meteorological reporting station, thus creating that series of stations which it was so essential to have for practically useful meteorological reports. He asked them to consider on the one hand, the quantity and value of the shipping frequenting the Bay of Bengal, the extreme violence of the cyclones, the present difficulty in obtaining such accurate warning of them as would effectively prevent damage to shipping therefrom; and, on the other hand, that, though these islands in the bay were not themselves liable to frequent attack by cyclones, they were within the influence of every one that occurred, usually four days and more, before any part of the coast of India; and then the practical value of a series of meteorological stations down them became at once apparent. He would go further and say that, considering the magnitude of the interests concerned, both as to lives and property, the point was worthy of the very serious consideration of the commercial communities both of this country and India.

Major Flood Page stated that there would be no difficulty when the time came in establishing wireless telegraphy all along the Andaman Islands. He presumed, however, the Indian Government would deal with the problem of wireless telegraphy as a whole, and as to whether it should be applied to the islands first would in some measure depend on the influence which the shipping companies and others interested could bring to bear.

CONTRACTS OPEN AND CLOSED.

OPEN.

Accrington.—January 10th. The Town Hall Committee invites tenders for the switchboards, wiring and other works and appliances necessary for the electric light installation in the Town Hall. For specification and to view the various rooms, apply to the Borough Surveyor, Town Hall.

Barnes.—January 9th. The Urban District Council is inviting tenders for the supply and erection of:—(Section A) boilers; (B) steam dynamos and switchboard; (C) storage batteries; (D) cables, &c. Only those firms with plant of a similar size and type working satisfactorily in other electricity works will be allowed to tender. Specifications, &c., of the Surveyor, Council Offices, High Street, Mortlake, on deposit of £1 1s. for each section. Plans, specifications, &c., may be inspected at the offices of the engineer, Mr. William Fairley, 53, Victoria Street, S.W.

Bedford.—The Electric Light Committee wants tenders for one 420-B.H.P. inverted compound double-acting engine, and one 250-kw. alternator. See "Official Notices" December 15th.

Bermondsey.—January 13th. The Vestry wants tenders for the construction, &c., of a dust destructor, with furnaces, water-tube boilers, economiser, fans and forced draught appliances, in connection with the electricity supply undertaking. See "Official Notices" December 15th.

Birkenhead.—January 16th. The Corporation is inviting tenders for the construction of a new electricity generating station in connection with the electric tramways.

Blackburn.—December 23rd. The Corporation wants tenders for overhead trolley line equipment. See "Official Notices" November 24th.

Denmark.—December 28th. The Corporation of Aarhus is inviting tenders for water-tube boiler plant, steam dynamos, switchboard, and accumulators for electricity works. From our "Official Notices," November 3rd, further particulars may be obtained.

Dublin.—January 1st. The Dublin United Tramways Company is inviting tenders for the supply of general stores, including car fittings, iron, steel castings, oils, paints, glass, brushes, ironmongery, harness materials, electrical supplies, coal, &c., for the year ending December 31st, 1900. Particulars at the company's offices 9, Upper Sackville Street.

Gloucester.—December 28th. The Electricity Committee wants tenders for extension plant including Lancashire boiler, &c., one 300-kw. steam dynamo, switchboard work, condensing plant. See "Official Notices" November 24th.

Hackney.—January 2nd, 1900. The Vestry wants tenders for the supply of accumulators. See "Official Notices" December 1st.

Hull.—December 28th. The Electric Lighting Committee wants tenders for two 750-H.P. high speed three-crank vertical engines; and two 460-kw. continuous current dynamos (2,250 volts) for the Sculcoates Lane electric lighting station. See "Official Notices" December 8th.

Ilford.—January 20th. The District Council wants tenders for water-tube boilers, economiser, pumps, pipe work, two 200-kw. and one 100-kw. dynamos, motor boosters, battery, switchboard, 15-ton traveller, mains and road work, arc lamps and posts, and station lighting. See "Official Notices" December 15th.

Manchester.—December 30th. The Tramways Committee wants tenders for 450 electric tramcar bodies. See "Official Notices" December 15th.

Melbourne.—March 1st. The Corporation is wanting tenders for boilers, engines, dynamos, switchboard, feeders, mains, arc light leads, accumulators, &c., for electric lighting. See "Official Notices" this week.

Mistretta (Sicily).—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Palermo, stating that tenders are invited by the Municipality of Mistretta, not later than December 31st next, for the establishment of a service of electric lighting in that town. Such particulars as have been received may be examined on personal application at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 5 p.m.

Newcastle-on-Tyne.—January 24th. The Corporation wants tenders for laying down about 11 miles of double line tramway, the rails, fastenings, and the poles being supplied by the Corporation. See "Official Notices" this week.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

Salford.—January 8th. The School Board invites tenders for the electric lighting of the new schools in Grecian Street North, Lower Broughton. See "Official Notices" to-day.

Spain.—January 16th. Tenders are being invited until January 16th by the municipal authorities of Utrera for the concession for the electric lighting of the town by means of 300 10-C.P. lamps and 100 16-C.P. lamps. Tenders to be sent to El Secretario del Ayuntamiento de Utrera (Spain) whence particulars may be obtained.

Tunbridge Wells.—January 15th. The Corporation invites tenders for condensing plant to deal with 30,000 lbs. of steam per hour. See "Official Notices" to-day.

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West Bromwich.—December 22nd. The Corporation wants tenders for boilers, steam dynamos and condensers, switchboard, mains, and storage battery, for electricity supply. See "Official Notices" December 8th.

CLOSED.

Bradford.—The Corporation has ordered 25 electric car bodies from the Brush Company, and trucks and trolleys for same from Messrs. Blackwell.

Farnworth.—The contracts for the overhead equipment and the bonding of the rails to the specification of Messrs. Lacey, Olirehugh & Sillar, have been placed with Messrs. G. Hill & Co., of Manchester. The work will be commenced this week.

Hammersmith.—The Vestry on Wednesday evening decided to accept the tender of Messrs. Marshall, Fleming & Jack, £540, for a new 25-ton overhead traveller crane for the electricity works.

Liverpool.—The contract for overhead electrical equipment for 10 miles of tramway has been placed with Messrs. Blackwell. The Corporation has also ordered two economisers for the Lister Drive power station from Messrs. Green & Son at £513 each.

London.—The St. Pancras Vestry on Wednesday considered the following tenders for the supply of two dry back marine boilers for the Regent's Park station.—

Samuel Hodge & Sons	£8,825
John Fraser & Son	3,400
Fraser & Fraser, Limited	2,991
E. Danks & Co. (Oldbury), Limited (accepted)	2,645

The undernoted firms tendered for the supply of feed-water heaters:—

W. Boby (accepted)	£1,495
J. E. & B. Spencer..	1,017
Edwards & Barnes	869

The selection of the highest tender was due to the advice of the chief electrical engineer who expressed the opinion that the type of heater proposed would produce the most satisfactory results.

Portsmouth.—At a meeting of the Town Council last week the Tramways Committee submitted the following tenders for the supply of cars for electrical working, and on their recommendation the tender of Messrs. Dick, Kerr & Co., for the supply of 60 cars at the price of £34,382 11s. 6d. was accepted, with power for the Corporation at any time during the year 1900 to order 20 additional cars on the terms of the present tender and specification. The price named provides for the cars complete, and also for a sum of £500 for contingencies mentioned in the specification, which will be under the control of the committee. The tenders as worked out with the several extras required for the cars give the following prices:—

	40 cars.	60 cars.	80 cars.
	£ s. d.	£ s. d.	£ s. d.
Messrs. Blackwell & Co.	25,273 18 10	37,218 8 10	49,162 18 10
The Westinghouse Electric Co. ..	24,558 10 0	36,091 15 0	47,625 0 0
The Brush Elec. Engineering Co...	23,488 8 0	34,572 8 0	45,656 8 0
Messrs. Dick, Kerr & Co.	23,402 11 6	34,382 11 6	45,362 11 6
Messrs. McCartney, McElroy & Co.	21,931 0 0	....	....

Pontefract Union.—The contracts for electric lighting (400 lamps) have been placed with the Morley Electric Engineering Company, Limited, for plant, and the wiring of premises with Mr. E. C. Wallis, of Leeds. Consulting engineer, Mr. G. R. Peers, of Manchester.

St. Helens.—The Corporation has accepted the tender of Messrs. Yates & Thom for boilers; of the Chloride Electrical Storage Syndicate, Limited, for accumulators, and of the British Insulated Wire Company, Limited, for tramway feeders.

Swansea.—The Electric Lighting Committee has accepted the tender of Messrs. Yates & Thom for boilers, steam pipes, &c., at £10,800.

Wrexham.—Mr. George R. Peers, consulting electrical engineer of Manchester, writes us as follows:—"In your last week's issue I notice that you give the list of tenders received for the Wrexham town lighting scheme, and that you say the consulting engineer is Mr. Trentham. I should be glad if you would kindly correct this in your next by stating that Mr. Trentham and I are joint engineers for this scheme. We are working in a similar capacity for Rhyl Council."

NOTES.

Christmas Greeting.—The year has been a very prosperous one to the electrical fraternity, and no one, unless he be a veritable Scroodge, will grudge the brief spell of idleness that Christmastide brings with it. Abroad there is a beclouded horizon, but our healthy optimism will prevent this unduly interfering with the pleasures of the festive season. To every contributor, reader, advertiser, and our many other friends, we heartily wish a right merry Christmas.

Royal Institution.—The first of the Royal Institution Christmas lectures to young people, by Charles Vernon Boys, Esq., F.R.S., M.R.I., on "Fluids in Motion and at Rest," experimentally illustrated, will be delivered next Thursday, December 28th, at 3 o'clock. The other five lectures are arranged for December 30th, January 2nd, 4th, 6th and 9th, 1900.

Among the arrangements for Friday evening meetings before Easter, 1900, are the following:—January 19th, Lord Rayleigh on "Flight"; January 26th, Hon. C. A Parsons, on "Motive Power—High Speed Navigation—Steam Turbines"; February 2nd, Signor G. Marconi, M.I.E.E., "Wireless Telegraphy"; March 23rd, Sir Andrew Noble, "Some Modern Explosives"; April 6th, Prof. Dewar, "Solid Hydrogen." A series of six lectures on "Polarised Light" will be delivered by Lord Rayleigh on Saturdays, March 3rd, 10th, 17th, 24th, 31st and April 7th.

"Science Abstracts."—With the December number of this valuable periodical, it is announced that the date of issue will in future be the 25th of each month—except, we presume, December! Further, the scope of its operations is to be considerably extended; a section will be added dealing with steam plant, gas engines, oil engines and motor cars of *all* kinds. This is a step of which we heartily approve; it is given to no publication to be all things to *all* men, but it is well to cater for as many of them as possible. Among other interesting articles abstracted in the current issue are the following:—The Aron meter (new type); a 5-H P. steam engine for motor cars, consuming only 20½ lbs. water per H P.-hour; theory of induction motors; electric traction statistics; measurement of resistance by damping, &c.

Workhouse Work Wanted.—The *Councillor and Guardian* for December 9th contains the following advertisement:—

TO BOARDS OF GUARDIANS.

A CONSULTING ELECTRICAL ENGINEER, who has in hand several installations of electric lighting at Workhouses, will PREPARE REPORTS and SCHEMES for similar buildings upon moderate terms. Address—
ELECTRICAL ENGINEER,
c/o Councillor and Guardian,
29, Old Queen Street, Westminster.

Need we ask why this is anonymous?

Personal.—The Court of Common Council has appointed Mr. H. L. Dixon, assistant to the Corporation electrical engineer, to the post of inspector of overhead wires at a salary of £208 per annum. Previous to joining the Corporation, Mr. Dixon was erecting electrical engineer for Messrs. Manlove, Alliott & Co., Limited, Nottingham, and was for nearly two years mains foreman to the National Electric Supply Company, Limited, Preston.

Our New York namesake has the following interesting note:—"Among recent foreign arrivals in New York city are Managing Director Monks, Mr. H. F. Parshall, and Mr. W. E Baylor, of the British Thomson-Houston Company, London; Mr. A. K. Baylor, London; Mr. R. W. Blackwell and Mr. H. Lomas, of R. W. Blackwell & Co., Limited, London. These gentlemen are visiting the United States to look into the state of the American electrical trade, especially with reference to export orders.

Out of 33 applicants the Electricity Committee of the Ecc'es Town Council have selected Mr. James Moss, of Derby, for the post of electrical engineer for the borough.

Mr. Arthur Martin, the district manager at Liverpool of the National Telephone Company, has been promoted to be assistant superintendent of the northern province, which comprises Yorkshire, Northumberland, and Durham. Mr. Martin goes from Liverpool to Leeds at the beginning of the new year.

Mr. Arthur E. Cotterell, who has been for several years district manager in Birmingham for the National Telephone Company, Limited, has been promoted to the position of assistant provincial superintendent for the Midland province. The position which he vacates will be filled by Mr. J. W. F. Ashwin, who is at present district manager to the company at Edinburgh.

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An Electrical Fire.—In the *Times* of Tuesday last a letter, under the heading "A Remarkable Fire," appears over the signature of Mr. Montague Crackanthorpe, Q.C.

The writer graphically describes what must admittedly be termed a sufficiently alarming electrically-caused fire. From the description given it appears that the ceiling-rose connection for the room below was the incendiary, and according to the explanations of "the electrical engineer responsible for the wiring," and a "highly intelligent official" from the electrical department of the London County Council, by some "unexplained mischance" (the fire itself having destroyed all direct evidence of its origin), the insulating covering of the wires must have become injured, and, in spite of the "safety" fuse, the resultant arc of short circuit ignited the inflammable surroundings.

"Jerry wiring," or an imperfectly made or unsoldered joint could readily accomplish the result described.

We do not at this moment criticise the particular wiring in question, but wish to point out that the publication of the occurrence will accentuate the pressing necessity for the simplification, better standardisation and unification of the insurance company and supply station wiring rules. Some course of action should be decided upon under which all the insurance offices will find it desirable to effectively second the efforts of the Institution of Electrical Engineers.

More attention must be given to the suitability of the material installed.

Under the existing conditions methods of wiring which admittedly possess inherently a larger factor of safety than obtains with wood casing have no proper official recognition; nothing, in fact, beyond the arguments of their respective champions to encourage their adoption and extended use. "Wood casing," on the other hand, gets specific mention, but as all are equally accepted and passed, a premium is virtually placed on the "cheapest" in first cost.

This, again, means that low-priced material is fostered to the exclusion of the more expensive and probably more suitable, and the use of the cheapest material naturally calls forth the lowest cost and least reliable class of labour.

Undoubtedly the general public demand "low cost" wiring, and there is a tendency to supply it, but the true interests of the public and our electrical industry are best served by providing for and encouraging the growth of that class of wiring which provides inherently the greatest safety and freedom from incidental trouble.

The Copper Market During the First Half of December.—According to the last issue of Messrs. H. R. Merton & Co.'s statistical circular relating to copper, stocks have fallen 1,367 tons since December 1st, while prices have likewise fallen 25s. per ton. The detailed figures are as follows:—Total supplies, 14,617 tons; total deliveries, 15,434 tons; shipments to America, 550 tons. Stocks November 30th, 25,765 tons; stocks December 18th, 24,398 tons. Price G.M.B.'s November 30th, £73 15s.; ditto, December 15th, £72 10s. The supplies during the first half of December have been above the average, but deliveries have also increased in even greater ratio. In each case the increase is no doubt due to the approach of Christmas, and to the desire to obtain deliveries before the interruption of business by the holidays.

Smoke Prevention at Hammersmith.—At the meeting of the Hammersmith Vestry on Wednesday evening it was decided that, owing to the uncertainty of obtaining a continuous supply of Welsh coal for the electric lighting station, a set of Gregory's patent smoke consumers be fixed to one of the Babcock boilers, so that in the event of the North Country coal having to be used, the smoke might be kept down as much as possible. The estimated cost was £18, and in the event of the "consumers" not being satisfactory after a month's trial, they will be removed by the patentees, and no charge whatever be incurred by the Vestry.

Electric Shock Accident.—On 18th inst. a labourer employed at Messrs. Grandage & Co.'s dyeworks, Brownroyd, fell, and caught hold of an electric light wire, receiving a severe shock. He was conveyed to the Royal Infirmary, and detained there.

Lecture.—At the Glasgow and West of Scotland Technical College on 15th inst., Prof. Henderson, MA., D.Sc., lectured on "Electricity Applied to Chemical Manufactures."

Appointments Vacant.—A chief assistant engineer is wanted for the new electricity works at Gloucester, also a cable jointer. See "Official Notices" this week.

Stealing Electricity.—A Bill concerning the theft of electricity by tapping the wires has been laid before the German Federal Council.

NEW COMPANIES REGISTERED.

Reid, M'Farlane & Co., Limited (6,428).—This company was registered in Edinburgh on December 14th, with a capital of £7,500 in £5 shares, to acquire the business of Reid, M'Farlane and Co., of Glasgow, and to carry on the business of non-conducting composition manufacturers, &c. The first subscribers (each with one share) are:—J. M'Farlane, 25, St. Andrew's Drive, Pollokshields; Duncan M'Farlane, 58, Hyde Park Street, Glasgow, engineer; G. M'Farlane, 25, St. Andrew's Drive, Pollokshields, clerk; D. A. M'Farlane, 58, Hyde Park Street, Glasgow, engineer; James M'Intosh, 58, Hyde Park Street, Glasgow, manufacturer; T. M'Intosh, 58, Hyde Park Street, Glasgow, engineer; D. Smith, 58, Hyde Park Street, Glasgow, manufacturer; and Mary M'Intosh, 15, West Clarance Street, Glasgow. The number of directors is not to be less than three nor more than five; the first are J. M'Intosh, D. M'Farlane, T. M'Intosh, and D. M'Farlane; qualification, 50 shares; remuneration of chairman, £400 per annum; others, £150 each per annum. Registered office, 58, Hyde Park Street, Glasgow.

SUPPLY STATION ACCOUNTS.

Hanley Corporation Electricity Accounts.

The accounts of the electricity supply undertaking of the Hanley Corporation show a rather remarkable result in connection with the revenue and gross profit. The total cost of production per unit remains practically unaltered, but the revenue per unit has fallen by more than ¼d., and this, coupled with about £100 increase in interest and repayment charges, shows a greater loss last year than in 1897. The curious thing is the appearance of a minus quantity in the "increase" column of the "general statement" against the *gross profit* item.

The explanation is well known to those who have read the history of the fight between the local tradesmen's association and the Corporation on the question of rebate scale, and the method to be adopted in charging for electrical energy. An elaborate report was issued some months ago, defending the rebate scale principle, and with it we quite agree. Messrs. Lobley and Cowell, the borough engineer and borough electrical engineer respectively, have done all that is possible to show the logical position taken up in this matter, but the traders have failed apparently to appreciate the advantages offered, or more than 2,700 lamps would have been connected during the past year. It is perhaps a pity that the correct method of charging was not adopted at the initial stage of the business.

GENERAL STATEMENT.

	1897.	1898.	Increase.
Total capital expenditure ...	£51,634	£60,785	£9,151
Number of units sold	351,762	474,247	122,485
Number of lamps connected ...	23,314	26,040	2,726
Gross revenue	£6,520	£7,715	£1,195
Gross profit	£2,520	£2,420	−£100
Average price per unit sold ...	4·3d.	3·79d.	−·51d.

The reason for the augmented loss is shown by the revenue statement, for it will be noticed that the operation of the scale has been to reduce the return per unit from 4·45d. to 3·9d., a greater proportionate ratio than could be afforded with an increase of 122,000 units produced at the approximately same rate as in the previous year. No doubt the results of the current year's working will show a restoration to the old position, or even something better. It ought to be so, and one would only recommend the good people of Hanley to look around them and see how the rebate principle has assisted consumers in other towns.

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Revenue Statement.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase.
Sale of current ..	£6,292	4·30d.	£7,486	3·79d.	−·51d.
Meter rents	150	·10d.	215	·10d.	...
Supply of lamps, &c.	...	...	14	·01d.	+ ·01d.
Sundry	78	·05d.	...	...	−·05d.
Gross revenue	£6,520	4·45d.	£7,715	3·90d.	−·55d.

A total quantity of 551,259 units was generated. 118,494 units were used in 60 400-watt arc lamps; 4 500-watt arc lamps, and 69 incandescent lamps, all for public lighting; private consumers took the balance of 355,753 units. The maximum load during the year was 460 kw.

Cost of Production.

	1897. Gross.	1897. Per unit.	1898. Gross.	1898. Per unit.	Increase
Coal and other fuel	£1,003	·68d.	£1,398	·71d.	+ ·03d.
Oil, waste, water, and engine room stores.	226	·15d.	331	·17d.	+ ·02d.
Salaries and wages incurred in generation and distribution.	887	·60d.	1,208	·61d.	+ ·01d.
Repairs and maintenance of buildings, engines, boilers, dynamos, &c.	992	·67d.	1,176	·59d.	−·08d.
Works' cost	£3,108	2·10d.	£4,113	2·08d.	−·05d.
Rent, rates and taxes ..	357	·24d.	553	·28d.	+ ·04d.
Management and expenses, salaries of managing engineer, secretary, clerks, &c.	535	·36d.	536	·27d.	−·09d.
General establishment charges, stationery and printing, law charges and insurance	...	...	93	·05d.	+ ·05d.
Other expenses	...	...	...	...	...
Total costs ...	£4,000	2·70d.	£5,295	2·68d.	−·02d.

In our analysis of these accounts last year (March 25th, 1898), we referred to the short period for which the loans were granted, and also quoted the then report where it reviewed the results of changing the rate of charge for energy. The engineering costs are not unfavourable, as there has been a marked rise in cost of coal, &c., during the period under review, and when larger units of plant are started, unless consumers come on at a reasonable rate to fill them up the works' costs in individual items are sure to suffer. As a result, we find the rises in coal, oil, &c., and wages, nearly balance the reduction in the case of repairs. Rent, &c., is heavy, but "management" remains the same, with a new item of nearly £100 for general establishment charges.

Profit Statement.

	1897.	1898.
Interest on loans	£2,709	£1,156
Sinking fund for repayments		1,316
Net profit *	−189	−412
Gross profit	£2,520	£2,420

* Deficiency charged to rates.

CITY NOTES.

India-Rubber, Gutta-Percha, and Telegraph Works, Limited.

The thirty-sixth ordinary general meeting of the shareholders of the above company was held on Thursday, December 14th, at the Cannon Street Hotel, the Hon. Henry Marsham presiding.

The Chairman, in proposing the adoption of the report, said: Gentlemen, you will have noticed that in accordance with the resolutions passed at the extraordinary general meeting held in July last the report and accounts now submitted are for a period extending over nine months, and that in the future our financial year will terminate on September 30th in each year instead of on December 31st as heretofore. This change has entailed some extra trouble to our staff for the present year, but from our experience we believe that even in this case the balance of benefit has been on the side of the new date. There is little doubt that the full advantage of the change will be felt next year. In comparing the present balance-sheet with that presented at the yearly meeting held in February last, the only substantial differences to be noticed are due to the company at present holding a larger stock of raw material. From my remarks at the half-yearly meeting held in July last, you must have gathered that your board in view of probable work had been purchasing larger quantities of gutta-percha than the immediate requirements demanded. It is well that we took this precaution, because since we bought, owing to an extraordinary increase in the consumption of this gum, the available stocks have seriously diminished. In the profit and loss account debit side you will notice that in addition to the usual depreciations the figures include a depreciation of the ss. *International*. During this year we sold the vessel, and as we made a loss in the sale we have charged this loss against revenue. The general business of the company has been fairly profitable, and the turnover has exceeded that of the similar period of 1898. In trading we are encountering keener competition every day, and it is much to be hoped that the prices of raw materials will not remain at their present high standards. Since I last addressed you we have been obliged to advance our list prices of certain goods, and it is probable that we shall have to make a further advance in other lines. Our electrical machinery department has been very busy, and, in addition to work done for our own factory at Silvertown, has completed installations for several municipalities, amongst others, Leith, Canterbury and Greenock. As I am addressing you to-day the official reception of the work done by us at Hereford is taking place. At the half-yearly meeting I informed you that our ss. *Dacia* was about to start for the West Indies to lay a new cable for the International Ocean Telegraph Company of New York, and I have now to state that she successfully completed her task. We have in course of manufacture about 1,000 miles of cable for the Commercial Cable Company. This cable will be laid next year between Canso and New York.

Mr. S. W. Silver seconded the motion, which was carried unanimously.

The Chairman, in thanking the meeting for re-electing him as a director, said that recently he had had an opportunity of visiting the works at Persan, and, according to his judgment, they were in very good condition, and were doing very good business.

South Staffordshire Tramways Company.

An extraordinary meeting of the proprietors of the South Staffordshire Tramways Company was held at Cannon Street Hotel, on 15th inst., for the purpose of considering the provisions of a conditional contract dated November 23rd, 1899, and made between this company, the British Electric Traction Company of the second part, the South Staffordshire Tramways (Lessee) Company of the third part, and the Mayor, aldermen, and burgesses of the borough of Walsall of the fourth part, being a contract for the sale to the Corporation of Walsall of a portion of the undertakings of the South Staffordshire Tramways Company within the borough of Walsall, and for other purposes.

Mr. W. Somers Schuster, who presided, said that the periods at which the various local authorities through whose areas the tramways run might (under the provisions of the Tramways Act of 1870) purchase the parts of their undertaking which were within their respective boundaries were drawing near. The proximity of these dates had caused the directors great concern, and they had, therefore, assiduously devoted themselves to endeavours to find some means by which a future interest in all or part of the South Staffordshire tramways might be retained for the shareholders of the company. The directors would have been glad if all the local authorities were willing to postpone their right of purchase; but, unfortunately, there appeared to be a general desire on the part of the authorities to purchase the lines, and so obtain entire control of their roads. Some of the authorities appeared to contemplate subsequently working their own lines, but the South Staffordshire tramways depended absolutely upon giving a means of inter-communication between different towns, and the directors were able, from their experience, to state confidently that the company's tramway system required extension rather than cutting up, and that it could not be profitably worked except by a central authority. Walsall appeared to have had the right to purchase a piece of the line at what was popularly known as "old iron" price 12 years after the granting of the provisional order, and without paying any compensation for goodwill and disturbance. The whole situation was complicated and fraught with difficulties, and the directors thought that the agreement submitted to the shareholders offered an equitable solution of the question. The object of the agreement was to avoid litigation. They had obtained an independent valuation, and the result was that the plant, &c., was valued at £18,500. The resolution, seconded by Mr. Dawson, was carried unanimously.

Calcutta Tramways Company.

The ordinary general meeting of the shareholders of this company was held at Cannon Street Hotel, Mr. E. C. Morgan presiding. He said they had been endeavouring to come to an agreement with the Calcutta Corporation for the introduction of electricity. On June 14th last pourparlers took place with the municipal authorities, and negotiations were renewed. The settlement of certain details was referred to a sub-committee for report. Various alterations and amendments had been made, and the agreement has now been signed and sealed. The delay in carrying out the arrangement had not been due to the board's action, for they had done all in their power, even to the extent of yielding on points where they had a right to stand firm, so that they might carry out the beneficial change with all speed. Besides the agreement with the Corporation they had a second agreement with the Government of Bengal in reference to the lines upon the Maidaun. For years past they had been endeavouring to obtain permission to double the line which runs from the end of Dhurramtollah to the Kidderpore Bridge, and which is the direct route to the docks. Up to the present time this has been withheld, in spite of their representations as to the inconvenience and delay caused by a single line, but they had now obtained the necessary consent, and a new agreement with the Bengal Government on the same lines as that with the Corporation was in preparation. The double line and the electrical traction will afford the greatest convenience to the business community, and will also be of great advantage to the company by enabling them to meet the growing traffic to the docks. They deemed it desirable some months

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back to make preparations to avoid all possible delay in getting forward with the electrical equipment as soon as they were securely placed in a position to do so. They therefore entered into a provisional agreement with a first-class firm of contractors here, who have successfully carried out large works of a similar nature, by which they undertook to provide plans and specifications to the satisfaction of the Corporation, and thereafter to carry out the needful installation for the working of the lines by electricity at net cost of the materials and labour, plus 10 per cent., which was to include all expenses for engineering. The cost of the work is not to exceed a maximum sum—to be a sum named by the contractors and agreed to before the definite contract is signed, subject to abatement should it be found on completion that the cost of materials and labour, plus 10 per cent., falls short of their estimate. They also undertook to maintain the lines for six months. They proposed to put themselves into a position to take advantage of the first favourable opportunity, by creating a new series of 4½ per cent. debentures for £350,000. This included an amount needed for the redemption of the existing 5 per cent. debentures for £100,000, so as to make the new issue a first charge upon the undertaking. The cost of the electrical equipment is an unknown quantity at the present moment, but it will amount to a large sum of money, and besides this they deemed it needful to have a sum in reserve for extensions which will probably be called for soon. There was a large field for profitable extensions. He then proceeded to refer to the increased revenues and other advantages which would accrue from the adoption of electric traction.

The report was adopted.

Electrical Copper Company.

The third annual meeting of this company was held on Wednesday at Abchurch Chambers, E.C.

Mr. A. Fould (deputy chairman) presided. He passed a few remarks upon the report and balance-sheet, and said that the past financial year had not been up to expectations, but as they had to deal with the commercial application of a new process they must proceed with caution and acquire experience prior to erecting plant on a very large scale. Besides the difficulties associated with the novelty of the process, the engines required for driving the plant and other portions of the machinery were not erected according to their expectations, and this resulted in hindrances. They had had some difficulty in connection with their management, but the steps taken will prevent a recurrence of these difficulties. He hoped that the new plant would lead to satisfactory results.

The report was adopted.

The African Direct Telegraph Company, Limited.—This company notifies that the coupons of the 4 per cent. mortgage debentures to bearer, due January 1st will be paid at Parr's Bank, Limited, Bartholomew Lane, E.C. Interest warrants on the registered debentures will be sent out on the 30th inst.

Crompton & Co., Limited.—The directors have declared an interim dividend at the rate of 6 per cent. per annum for the half-year ended September 30th, payable on January 15th.

Eastern Extension Telegraph Company.—The directors announce an interim dividend of 2s. 6d. per share.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending December 16th, 1899, were £96 7s. 8d.; December 16th, 1898, £189 4s. 11d.; aggregate for half-year to date, £19,961 1s. 4d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending December 15th, 1899, were £2,341 11s. 9d.; corresponding period, 1898, £2,550 0s. 3d.; decrease, £208 8s. 6d.

The City and South London Railway Company.—The receipts for the week ending December 17th, 1899, were £1,151; December 18th, 1898, £1,080; increase £71. Total receipts for half-year, 1899, £24,801; total receipts corresponding period, 1898, £24,833; decrease, £32. Miles open, 3½.

The Dover Corporation Tramways.—The receipts for the week ending December 16th, 1899, were £126 17s. 9d.; December 16th, 1898, £139 11s. 5d.; decrease, £12 14s. 8d. Total receipts to date, 1899, £9,784 17s. 9d.; corresponding period, 1898, £8,209 3s. 0d.; increase, £1,525 14s. 9d. Miles of track open, 1899, 3; 1898, 3. Car miles run, 1899, 4,788; 1898, 4,810. Number of cars, 1899, 11; 1898, 11.

The Dublin United Tramways Company.—The receipts for the week ending Friday, December 15th, 1899, were as follows:—D. U. T. Co., horse cars, £102 18s. 9d.; ditto, electric cars, £2,739 10s. 4d.; D. S. D. Co., electric cars, £594 3s. 11d.; total, £3,436 8s. 0d.; corresponding week last year—D. U. T. Co., horse cars, £2,194 6s. 5d.; ditto, electric cars, £561 6s. 5d.; D. S. D. Co., electric cars, £614 6s. 8d.; total, £3,399 19s. 6d.; increase, £136 8s. 6d. Aggregate to date, £96,876 11s. 4d.; aggregate to date last year, £94,799 18s. 6d.; increase to date, £5,076 17s. 10d. Worked:—The mileage open is 40 miles electrically, 4 miles by horses, as against 16 miles electrically, and 28 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending December 17th, 1899, were £491; December 21st, 1898, £237; increase, £254. Number of cars, 1899, 28; 1898, 10. Total receipts to date, from April 1st, 1899, £22,218; 1898, from June 29th, 1898, £6,539. Miles of track open, 12; 1898, 8½.

The Liverpool Overhead Railway Company.—The receipts for the week ending December 17th, 1899, amounted to £1,432; corresponding week last year, £1,324; increase, £108; total increase for half-year to date, £1,991.

The South Staffordshire Tramways Company.—The receipts for week ending December 15th, 1899, were £527 0s. 8d.; December 16th, 1898, £608 4s. 1d.; aggregate receipts for 50 weeks £33,178 2s. 4d; 1898, £31,552 17s. 9d.

STOCKS AND SHARES.

Wednesday Evening.

It is a dismal duty that we have to face this week. There is but one way which stocks and shares have moved, and that is downwards. Not a single rise brightens the melancholy aspect of our lists, and the worst part of the situation cannot be seen by a reference to the prices. Most of the quotations have become altogether nominal, and a seller of any amount would find it impossible to get rid of his stock, even at the lowest price that is named. Within the last few days no small quantity of "pawned" securities have been thrown on the market—securities, that is to say, which have been taken up by bankers for their customers on a margin, and which the latter are forced to realise when they can no longer keep up the requisite amount of margin required by the bank. The serious news concerning General Buller's reverse at the Tugela River had a most depressing effect on all the markets of the Stock Exchange, and the semi-panic which broke out in the speculative departments rendered even the strongest sections sensitive. Then, too, Consols are under par, which they have not been since 1894, and the talk of a huge War Loan has naturally reacted unfavourably upon all the markets that are affected by the state of money.

Jobbers in the supply section have marked down prices 10s. at a time when never a share has changed hands. It is feared that Metropolitans in large numbers might be thrown on the market, and the price has been lowered as an intelligent anticipation. It is hoped that the company may "muddle out" of its difficulty at Willesden in course of time, but the trouble, evidently, is not over yet. Chelsea Debenture stock is quoted *ex* dividend, and if we add the distribution to the price, a rise of ¼ is the result. Which, after all, is something to be thankful for. Blackheath and Greenwich Ordinary are ⅜—1. Bournemouth and Poole are quoted at 12 to 13, *ex* the right of application for the new shares, and the Preferences are 10 to 11, also *ex* rights. Calcutta Electricity keep firm at 6¾, and Oxfords are nominally 7.

In the telegraph market the principal fall has occurred in Eastern Ordinary, and the drop was accelerated by the news of the fourth breakdown of the South African cable since the commencement of the war. "Chinas" are duller, but have not suffered to the same extent in proportion to Easterns. The American stocks are flat, owing to the financial crisis in New York. All the official bolstering up of credit was, after all, unable to stay a panic in which money has been lent, within the last few days, at the rate of nearly 200 per cent. per annum. Brasil Subs. are *ex* a dividend of 3s. per share, and allowing for this, the price has only relapsed 2s. The Trust Company's stocks have suffered, Globe Telegraph Preference the most heavily, owing to a persistent effort to sell shares in a flat market. Nothing is now said about the new cable; in fact, all new enterprise, for the time being, is completely at a standstill. National Telephones are weak, the Ordinary shares being now quoted at par (£5), and the Third Preference have also declined.

In the traction market the electric railway stocks have fallen all round. Central London Ordinary and Deferred half shares are each ½ down. City and South London Ordinary has lost 2, and Waterloo and City, 1 point. For these changes the crash in Consols is mainly responsible, it having caused a serious tumble in home rails generally, electrics proving no exception. British Electric Traction have been offered at 15½ without finding buyers. The dealers declare that they have more shares on their books than they want as it is. Anglo-Argentine trams are 3⅜; Blackwood and Fleetwood, 18; and the new Tramway's Union keep in the neighbourhood of 30s. Potteries Electric Traction are 12, the Preference, 10 to 11.

This is no time for selling. In many cases prices are at the lowest level of the year, and investors are growing frightened as they see their securities dwindle away in price day after day. They rush in to sell, and by their action only accentuate the weakness of the market and obtain a most unsatisfactory price themselves. It must be remembered that the Transvaal war does not affect the carrying power of an electric railway in this kingdom; it has a good effect upon telegraph companies; it influences only to a very small, very indirect degree, the profits of an electric supply company. The best thing that can be done now is to "see the thing through," if the investor's list is made up of sound stocks. Prices may go lower yet. We are inclined to think that they will before the New Year is with us, but there is no cause for alarm to genuine holders of solid securities, and they should not for a moment entertain the thought of sacrificing their stocks at such a critical time, when six months hence will probably see a very different complexion upon everything.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Dec. 13th.	Closing Quotation, Dec. 20th.	Business done during week ended Dec. 20th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	65 — 68	63 — 66	65	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	115½ —116½	113 —115	116	113½
3,047,220£	Do. do. Deferred...	Stock	...	...	18s. %	16¾ — 17¼	15½ — 16	16⅝	15¾
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	14¾ — 15¼	14¼ — 14¾xd	...	...
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	198 —202	198 —202	...	...
1,332,523£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	103 —105	103 —105	103⅝	102
224,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	⅛ — ¼	⅛ — ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	8½ — 9½	8½ — 9½	9 5/16	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	...	...
12,931	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
80,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½ %	3½ %	11⅜ — 12¼	11⅜ — 12¼	...	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101 —104	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½ %	7 %	7 %	150 —155	145 —150	154	145
1,795,000	Do. 8½ % Pref. Stock	100	...	...	...	98 —101	98 —101	100	99¾
89,900	Do. 5 % Debs., repayable August, 1899	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	115 —120	115 —120	116	115½
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	15 — 15½	14⅜ — 15¼	15	14½
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
330,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	116 —121	116 —121	121	116
85,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,500£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
300,000£	Do. 4 % Mort. Debs., Nos. 1 to 3,000, red. 1909	100	4 %	...	...	101 —104	101 —104	101	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—8,000	25	4 %	...	...	101 —104%	101—104%	...	...
180,227	Globe Telegraph and Trust	10	4½ %	4½ %	5½ %	11¼ — 11⅝	10¾ — 11¼	11⅜	10⅞
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	15½ — 15¾	14¾ — 15¼	15⅜	14⅜
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	10 %	...	31 — 33	31 — 33	31⅜	...
86,300	Halifax and Bermuda Cable, 4½ % 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000	1	...	...	...	½ — ⅝	½ — ⅝	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾ — 1	¾ — 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½ %	6 %	6 %	5 — 5¼	5 — 5¼	5	4¾
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5¼ — 5⅜	5¼ — 5⅜	5¼	...
1,329,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —102	100 —102	101	100¾
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	¾ — 1	¾ — 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	...	102 —105	102 —105	...	...
11,839	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,881	Submarine Cables Trust	Cert.	...	...	...	126 —131	125 —130	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¾ — 5¼	4¾ — 5¼	...	...
151,738£	Do. do. 5 % Debs.	Stock	...	...	...	105 —108	105 —108	105½	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	%	...	99 —102	99 —102	98	...
30,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	⅛ — 1	⅛ — 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	102 —105	102 —105	...	...
389,521	Western and Brazilian Telegraph 4 % Deb. Stock Red.	Stock	...	...	...	104 —107	104 —107	...	...
88,521	West India and Panama Telegraph	10	1 %	%	...	⅞ — 1⅛	⅞ — 1⅛	...	...
34,568	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	9¼ — 9⅝	9¼ — 9⅝	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	7⅞ — 8½	7⅞ — 8½	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	106 —109	106 —109	...	...
158,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7⅛ — 8½	7⅛ — 8⅛	...	...
12,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	...	9 — 10	9 — 10	...	...
80,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	10 — 11	9½ — 10½	10	9⅞
20,000	Do. do. do. do. Nos. 30,001—50,000	5	...	...	...	9½ — 10½	9½ — 10½	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5½ — 6½	5½ — 6½	...	...
84,000	*Chelsea Electricity Supply, Ord.,	5	5 %	6 %	6 %	7½ — 8½	7½ — 8½	...	...
100,000	Do. do. do. % Deb. Stock Red.	Stock	4½ %	4½ %	...	111 —113	109 —111 xd	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000	10	7 %	10 %	6 %	11 — 12	10 — 11	11¼	...
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	126¼	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10 — 11	10 — 11	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Rd.	...	...	...	...	111 — 114	110 —113	...	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	5 — 5½	4⅞ — 5½	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	2½ — 3	2½ — 2⅝	2⅝	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	5¾ — 6¼	5¾ — 6	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Rd.	Stock	...	...	...	104 —106	102 —104 xd	...	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	13½ — 14½	13 — 14	14⅛	13 13/16
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	13½ — 14½	13 — 14	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½ %	4½ %	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½ — 16½	15½ — 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	15½ — 16½	15 — 16	15½	...
20,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	4½ — 4⅝	4½ — 4⅝	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	9 %	12 %	12 %	14 — 15	13½ — 14½	13½	13¼

* Subject to Founder's Shares.
Unless otherwise stated all shares are fully paid.
† Quotations on Liverpool Stock Exchange.
‡ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Dec. 13th.	Closing Quotation Dec. 20th.	Business done during week ended Dec. 20th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2⅞— 3¼	2⅞— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	16½— 17	15 — 16	15⅝	15½
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	13 — 13⅛	12¼— 13¼	13 5/16	13
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	126 —129	125 —128	...	...
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11½— 12½	11½— 12½	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6½— 6⅝	6½— 6⅝	...	...
90,000	Brush Elecl. Engng., Ord., 1 to 90,000	3	nil	3 %	5 %	1⅞— 2⅛	1⅞— 2	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —115	110 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
30,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	13 — 14	12½— 13½	...	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	113 —116	113 —116	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	10¼— 10⅜	9⅜— 10½	10 7/16	10¼
178,308	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,083	Do. do. Pref. half-shares	5	...	...	...	4⅜— 5½	4½— 5	5	...
71,447	Do. do. Def. do.	5	...	...	...	5½— 5⅝	4⅝— 5	5⅛	...
680,000£	City and South London Railway	Stock	1 2/16 %	1⅞ %	2⅛ %	61 — 64	59 — 62	62	61
37,000	Do. do. Ord. shares, Nos. 22,501 to 60,000	4½	...	...	...	3½— 4½	3½— 4½	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £3 pd. 1 to 99,261	5	5⅛ %	6 %	6 %	2 — 2⅛	2 — 2⅛	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛ %	6 %	6 %	3½— 4⅛	3½— 4⅛	...	...
344,028	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2 — 2⅛	2 — 2⅛	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	2⅜— 3⅛	2⅜— 3⅛	...	...
140,800	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	104 —107	104 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000	2	...	...	...	⅜ — ⅝	⅜ — ⅝	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	10 — 12	10 — 12	...	...
20,000	Henley's (W. T.) Telegraph Works, Ord.	5	10 %	12 %	14 %	12 — 13	12 — 13	...	...
15,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	7 %	5 — 5⅛	5 — 5⅛	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	...	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3½ %	3½ %	8 1/16— 9 1/16	8 1/16— 8 15/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13¼— 13¾	13¼— 13¾	...	...
37,350	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	36 — 40	36 — 40	...	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9 — 10	9 — 10	9⅜	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	101 —104	100 —103	...	...

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½% Debentures of £100, 104—107.
National Electric Free Wiring, 10s. paid, 3/16—5/16.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 18—19.
Do. do. Pref. (£10 pd.), 10—11.
Smithfield Market Electric, 1—3.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
Kidderminster and District Electric, Pref. (£8 pd.), 6—6½ xd.
*T. Parker, £10 (fully paid), 18½.

* From Birmingham Share List.

Bank rate of discount 6 per cent. (November 30th, 1899).

MARKET QUOTATIONS, Wednesday, December 20th.

CHEMICALS, &c.	This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric .. .. per cwt.	5/-	5/-	..
a „ Nitric .. .. .. per cwt.	22/-	22/-	..
a „ Oxalic .. .. .. per cwt.	22/-	22/-	..
a „ Sulphuric .. .. .. per cwt.	5/6	5/6	..
a Ammoniac, Sal .. .. .. per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) .. per ton	£29	£29	..
a „ „ .. .. per ton	£27	£27	..
a Bleaching powder .. .. per ton	£6 1	£6 10	..
a Bisulphide of Carbon .. .. per ton	£15	£15	..
a Borax .. .. .. per ton	£16 10	£16 10	..
a Benzole (90 %) .. .. .. per gal.	7/-	7/-	..
a „ (50/90 %) .. .. per gal.	5/6	5/6	..
a Copper Sulphate .. .. .. per ton	£25 10	£25 10	..
a Lead, Nitrate .. .. .. per ton	£25	£25	..
a „ White Sugar .. .. per ton	£31	£31	..
a „ Peroxide .. .. .. per ton	£37 10	£37 10	..
a Methylated Spirit .. .. per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 159° C.) .. .. per gal.	5/6	5/6	..
a Potash, Bichromate, in casks .. per lb.	4½d.	4½d.	½d. inc.
a „ Caustic (75/80 %) .. per ton	£24	£24	..
a „ Bisulphate .. .. per ton	£25	£25	..
a Shellac .. .. per cwt.	68/-	68/-	..
a Sulphate of Magnesia .. .. per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers .. per ton	£6	£6	..
a „ Recovered .. .. per ton	£5 10	£5 10	..
a „ Lump .. .. .. per ton	£5	£5	..
a Soda, Caustic (white 70 %) .. per ton	£7 10	£7 10	..
Crystals .. .. .. per ton	£3	£3	..
a „ Bichromate, casks .. per lb.	3½d.	3½d.	..
METALS, &c.			
Aluminium Wire, in ton lots .. per ton	£224	£224	..
„ Sheet, in ton lots .. per ton	£191	£191	..
Babbitt's metal ingots .. .. per ton	£70 to £125	£90 to £160	dec.
Brass (rolled metal 7' to 13') basis per lb.	8d.	8d.	..
e „ Tube (brazed) .. .. per lb.	10d.	10d.	..
„ Wire, basis .. .. per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).	This week.	Last week.	Inc. or Dec.
f Ebonite Rod .. .. .. per lb.	2/-	2/-	..
f „ Sheet .. .. .. per lb.	5/-	5/-	..
g Copper Bars .. .. .. per ton	£85	£85	..
g „ Wire (basis price) .. per lb.	10½d.	10½d.	..
g „ Sheet .. .. .. per ton	£95	£95	..
g „ Rod .. .. .. per ton	£85	£85	..
m German Silver Wire .. .. per lb.	1/6	1/6	..
h Gutta-percha, fine .. .. per lb.	7/-	7/-	..
h India-rubber, Para fine .. .. per lb.	4/6½ to 4/7½	4/6½ to 4/7½	..
i Iron, Charcoal Sheets .. .. per ton	£18	£18	..
i „ Pig (Cleveland warrants) .. per ton	64/6	66/8	1/10 dec.
i „ Forgings, according to size per ton	From £11	From £11	..
i „ Scrap, heavy .. .. per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 .. per ton	£14 5	£14 5	..
g Lead, English Ingot .. .. per ton	£17 10	£17 10	..
g „ Sheet .. .. per ton	£19	£19	..
m Manganin Wire No. 26 .. .. per lb.	8/-	8/-	..
g Mercury .. .. per bottle	£9 12 6	£9 12 6	..
d Mica (in original cases), small per lb.	2d. to 8d.	2d. to 8d.	..
d „ „ „ medium per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large per lb.	8/6 to 7/6	8/6 to 7/6	..
p Phosphor Bronze, plain castings per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd str'p & sheet per lb.	From 1/2½	From 1/2½	..
o Platinum .. .. per oz.	£3 11	£3 11	..
p Silicium Bronze Wire .. .. per lb.	10½d. to 1/	10½d. to 1/1	..
f Steel, Magnet, acc'd'g to desc'p'n p. ton	From £15	to £40	..
f Steel, Magnet, in bars	£58	£58	..
g Tin, block .. .. per ton	£124 5 nom.	£124 5 nom.	..
g „ foil .. .. per lb.	1/7	1/7	..
n „ wire Nos. 1 to 16 .. .. per lb.	1/10	1/10	..
p White Anti-friction Metals—			
"White Ant" brand .. per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles pr lb.	7¾d.	7¾d.	..
j „ Best Flax, 6 lea. .. per lb.	5d.	5d.	..
j „ Hemp, 2 ply 10 lbs. .. per lb.	3½d.	3¾d.	..
j „ „ Russian, 10 lbs. per lb.	4½d.	4¾d.	..
j „ Jute, 180 lbs. rove .. per ton	£14	£14	..
k Zinc, Sheet (Vielle Montagne bnd.) p.t.	£24 3 nett.	£25	15s. dec.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Bolton & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakespeare.
h Messrs. Jackson & Till.
i Messrs. Belling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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NORTHERN SOCIETY OF ELECTRICAL ENGINEERS.

METHODS OF SUPPRESSING ARCS IN SWITCHES, FUSES, &c.

By Ernest Kilburn Scott, A.M.I.C.E.

(*Read at Manchester, Tuesday, December 5th.*)

(*Continued from page 982.*)

Choking Coil on Alternate-Current Switches.—Regulating switches for alternating current have not been required to any great extent hitherto, but the introduction of the regulating booster transformer, and of traction by multiphase motors, has shown the necessity for protecting alternating current switch contacts from excessive arcing. The method of reducing arcing by a double brush and small resistance on continuous current accumulator charge and discharge switches is well known. In much the same way alternating current regulating switches may be easily and cheaply fitted with a small choking coil, which automatically comes into circuit by means of a double brush at each jump from contact to contact, annihilating arcing as effectively

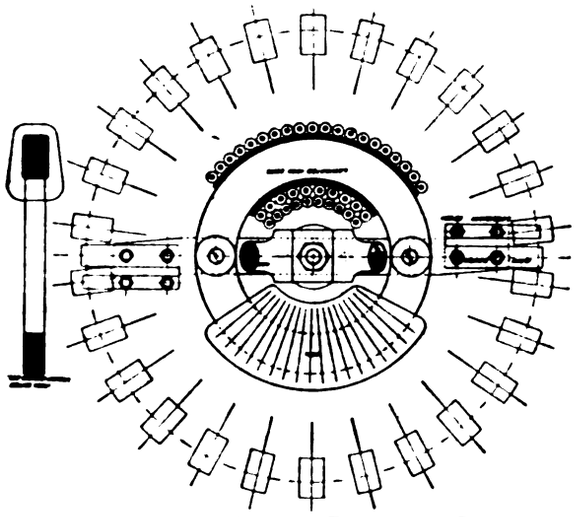

Fig 12.—Alternating Current Regulating Switch, with Choking Coil.

as does the magnetic blow-out. The small resistance used in continuous current regulating switches is not nearly so effective as the choking coil in the alternating current switch, because of the latter having a mass of soft iron entering into its construction. Fig. 12 shows the arrangement of such a switch for a booster transformer.

Use of Electrolytic Cells.—It is interesting to note that part of an alternating current wave may be suppressed by the employment of electrolytic cells. M. Adolph Müller, of Hagen, Germany, has been carrying out some work on these lines, and he advocates a method of preventing sparking on making and breaking circuits by the employment of electrolytic or polarisation cells.

As arranged for continuous current circuits, say for switching off arc lamps, a number of elements consisting of aluminium plates immersed in an alum solution are first switched into circuit, see fig. 12a, by moving the switch lever H in the direction of the arrow so as

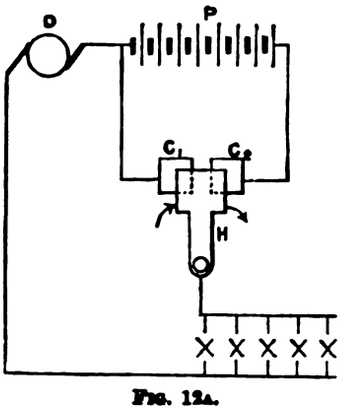

Fig. 12a.

to connect up the two contacts, C_1 and C_2. As soon as the lever touches contact C_2 the battery P is polarised to the terminal tension of the current source D. Current is thereby reduced to zero, thus permitting the circuit to be broken *without* sparking.*

The arrangement can be used for interrupting or breaking alternating currents, the polarisation batteries being made of small capacity, so that the condition of their charge can follow the change in the E.M.F. of the current source quickly enough to at any moment bring the sum of the latter and of the opposing E.M.F. of the consumption apparatus to zero, thereby stopping flow of current. The idea can be applied to stop sparking on a commutator operating synchronously with an alternating current, as in the Ferranti rectifier. In alternating current work the polarisation battery could be replaced by a condenser, but it would hardly be as mechanically reliable as the battery.

The cells may be made up of steel plates immersed in potash lye, or simply lead plates in sulphuric acid.

This, and, to some extent, the choking coil method just mentioned, are especially interesting, because the idea is to prevent an arc *forming*, whereas in all other cases we have so far considered the arc first formed and is then suppressed.

In this connection it may be of interest to briefly refer to several methods of preventing arcing in continuous current circuits which surround an iron core.

When a dynamo or alternator field winding is switched off, the magnetisation at once begins to weaken, and the change in the number of magnetic lines induces an E.M.F. tending to maintain the current in the same direction, and at the same strength as before. This induced E.M.F. may be many times greater than the working pressure, and so be liable to pierce the insulation; it is therefore the practice in shunt wound dynamos, particularly, to short circuit the field winding through a resistance (sometimes only the armature and a group of lamps) when shutting down. In this way current continues to flow through the coil in the same direction, and the demagnetisation being thus delayed, the induced E.M.F. is reduced within safe limits.

The flash on opening a field magnet circuit may be much reduced by building the coil on a sheet copper-former, the copper making electrical connection all round the pole. This method was used on some of the first arc lighting machines built in this country.

Another most effective method of preventing arcing under such circumstances has been recently introduced by Messrs. C. L. Buckingham and E. Germann. They merely wind on the various layers of the coil in one direction only, that is to say, each layer starts from the same end of the former. In telegraphy it has been known for some time that sparking at the key of a local telegraph circuit can be lessened by winding the electro-magnet with two wires connected in parallel. Buckingham and Germann's method is a development of this idea, and the beneficial result is most probably due to a condenser action between adjacent layers at different potentials, the electrostatic charges from which balance, to a certain extent, the self-induction. Destructive arcing being prevented by this means, it follows that there is much less liability of the insulation being pierced.

Part II.—Fuses.

Fuses, and especially switch fuses, which have recently come so much into use, form a distinct class of apparatus, and a few remarks thereon may be of interest.

Mordey Dust Fuse.—It is an axiom in the construction of high tension fuses, that both from the point of view of safety in handling, and also in order to ensure blowing at the right moment, the wire must be enclosed. It is obvious, however, that the mere enclosing of the wire in a straight tube with a terminal at either end is not going to destroy the arc unless made of unreasonable length, and principally with the idea of reducing this length, Mr. Mordey, in 1890, suggested his well-known *dust fuse*. In this fuse the wire is completely enclosed

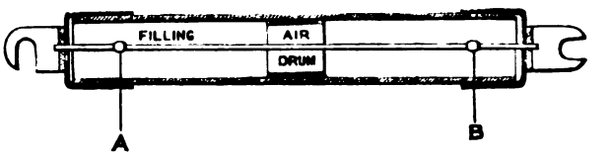

Fig. 13.

in a glass tube, and passes through a marble dust and sand, cement at each end, this refractory insulating filling preventing the arc travelling outwards to the contacts and absorbing the volatilised metal. For large currents it is used as a shunt to an ordinary fuse, the arrangement being such that the final break occurs between the two pellets of marble dust.

The Berend Switch Fuse consists of a long *papier-mâché* tube about 1½ inches in diameter, ⅛ inch thick, and 12 inches long for 4,000 volts. It is fitted at each end with gun-metal hatchet contact pieces to which the fuse wire is soldered. Before placing in position the tube is filled up with sand, the *papier-mâché* tube being perforated in several places, and the holes covered with tissue paper, so that when the fuse blows the paper is charred and serves to draw the attention of the attendant. To re-fuse, the metal ends are unscrewed and a new wire soldered to them. When the fuse blows, it is probable that as the vaporised

* Some few years ago Prof. Perry suggested the use of lead plates in dilute sulphuric acid in connection with two parts of a brush to prevent sparking on dynamo commutators. Something of the same sort was also suggested in connection with the experimental line at Wolverhampton on the Wynne surface contact system of traction.

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metal is many times greater than the volume of the fuse, there is a powerful tendency for the vapour to rush out from the space originally occupied by the fuse wire. The sand being porous, the vapour therefore easily penetrates it, and dividing up into numerous small streams of vaporised metal, the desired effect of breaking up the vapour is effected.

The reliability of the fuse would probably be increased if it had an air space round the wire at the centre, as in the Mordey fuse. Being closely surrounded along its whole length, its maximum carrying capacity is liable to change according to the length of time the fuse is in circuit, gradually becoming less as the surrounding material is heated. Obviously, a fuse which, when hot, would be a protection, is not so efficient a protection when cold. The use of an air chamber modifies this defect, because the confined air is so much less a conductor of heat than is the sand filling.

The D. and W. Fuse—a similar arrangement to Mordey's—is a good deal used in America, and has recently been adopted on the Central London Railway plant. It is shown in fig. 13. The wire is soldered to copper terminals at A and B, and an air space is formed in the centre by a little paper drum or capsule, which thus ensures the fuse wire first going at the centre, the confined air being a much poorer conductor of heat than the filling. The makers have accumulated a large amount of practical data, showing the connection which the rise in temperature bears to the current value, and thus, although the fuse can hardly be called novel, they undoubtedly turn out a properly rated and reliable piece of apparatus.

The Bates High Tension Switch Fuse has the fusible wire passing through an open-ended fireclay tube about ⅝ inch inside diameter, carried in a porcelain handle fitted with hatchet contacts as shown in fig. 14. When the wire melts the heated air escapes with considerable velocity at either end and so splits the arc in two. A Mr. G. F. Curtiss suggested using an open ended fuse in America as early as March, 1891, and those who visited Switzerland recently will have noticed that the same idea is very extensively employed there.

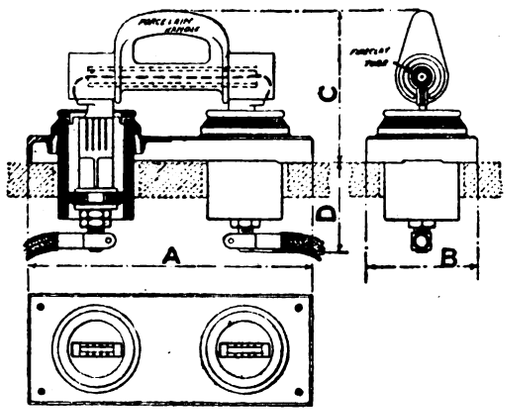

Fig. 14.—Bates Switch Fuse.

The Fowler (Hall and Fuller) Switch Fuse has a porcelain handle similar to the above, but each fuse wire is in this case closely surrounded by two lengths of asbestos sheathing, the whole being further protected by a glass tube. The fuse wire is placed in the asbestos by attaching it to the hemp core which is then withdrawn and the wire takes its place, see fig. 15. The asbestos is slightly porous, and this together with its incombustible nature helps to quench the arc.

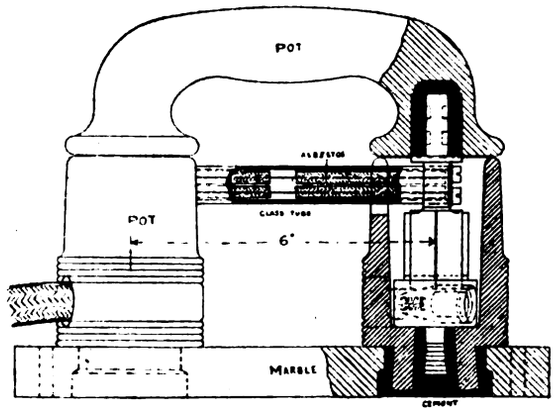

Fig. 15.—Fowler (Hall Fuller) Switch Fuse.

Thomson-Houston Fuse.—The British Thomson-Houston Company use a somewhat similar arrangement, the fuse wires being stretched tight between two fuse blocks, and each wire simply enclosed in a thin rubber tube. When the fuse wire melts, the intense heat causes a heavy sulphide gas to form from the sulphur in the rubber, and this reduces the arc. Although the wires are entirely out of sight the smell is sufficient to indicate where they have melted. This fuse has been used by the City of London Company for some time, and is well spoken of.

(To be continued.)

ALUMINIUM AND ITS USES AND TREATMENT IN ELECTRICAL ENGINEERING.*

By J. H. HENDERSON.

In the first place, I have to say that although the substances from which aluminium is extracted are widely diffused in nature and are in great abundance, it is only the last 10 years that have seen commercial and industrial success in the extraction of it from them.

The agent which has produced this success is electricity—the electrolytic extraction of it from its ores. This is how electrolysis produces it (by one successful method):—

In a metal carbon-lined crucible having two carbon electrodes, one of which acts as anode and the other as cathode, are put the following ingredients:—

Fluoride of calcium	234	parts by weight.
Double fluoride of cryolite ...	421	"
Fluoride of aluminium	845	"

To these add 3 to 4 per cent. of a suitable chloride; for example, calcium chloride. To this add alumina sufficient to form a very stiff mixture.

Before electrolysis can begin the above are fused by means of heat, which should not exceed 1,210° F. The heat is obtained from a furnace heated by gas, coke, or charcoal, care being taken that no gases from the furnace enter the crucible. The bath fused, the electrodes are dipped into it, the current switched on, and the metal is gradually deposited at the rate of 1 lb. of metal (in the best and largest of the crucibles) per 5 E.H.P.-hours.

The pressure required is 6 to 8 volts at a current density of 1½ amperes per square inch. The metal from time to time is removed from the crucible by means of a siphon or a ladle, care being taken to remove as little of the haloid salts as possible. There is another method of extraction, equally successful, but also more economical.

In this other method a set of similar ingredients are placed in a crucible having one or more vertically movable carbon electrodes, which are used as one or a collective anode respectively. The crucible, though lined principally with carbon, has some metal exposed to act as a cathode at the beginning of the process, this is to generate heat enough to fuse the bath, after which the anode is placed so that the extracted aluminium acts as a cathode. The molten metal is from time to time run out of a tap hole into a mould, and thence cast into ingots, or granulated by being poured into cold water. The same particulars as to results apply to this crucible furnace process also, except that not nearly so much of the bath is wasted in it, and the metal needs less purifying when molten. There is also no loss of time and money from the use of gas, coke, or charcoal, and of an extra furnace in this method.

Peculiarities of Aluminium as an Electrical Conductor.

There is first its lightness. It is, roughly speaking, about three times lighter than copper. By way of illustration: if a given diameter of copper wire weigh 1 cwt. and a certain length the same diameter of aluminium wire weigh 1 cwt., it will be found upon measurement being made that the aluminium wire is just over three times the length of the copper wire.

Aluminium is not so Good a Conductor as Copper.

Using the above illustration it would require nearly two-thirds of the aluminium wire to be melted up again and drawn into wire having the same length as the copper wire, but a very much greater diameter than the copper wire to give the same conductivity as the copper wire.

Its Incorrodibility.

Aluminium is incorrodible indoors. It is almost incorrodible in the outside atmosphere. When exposed to moist air a slight harmless oxide of alumina is formed, discolouring it a little, but protecting it from further corrosion. Steam and flue gases, ammoniacal vapours, any of the acids, strong or dilute (except hydrochloric acid slightly), do not affect it in any way; the alkalies alone affect it, hot caustic soda solution dissolving it very quickly.

Tensile Strength.

Its tensile strength is a little less than that of copper, diameter and length being equal; but weight for weight, aluminium has nearly three times the tensile strength of copper.

Its Use as an Insulated and Bare Conductor.

It is being largely used by American electrical engineers as a bare and insulated conductor for telephone and telegraph wires, and for power, &c. It is now being used as a trolley wire, and the British Aluminium Company are showing such a wire very neatly made and jointed with their soldering method. It is also being largely used by electrical firms for commutators on account of its

* Abstract of a paper read before the Manchester Junior Electrical Engineers, held at the Deansgate Hotel on Tuesday evening, November 28th, 1899.

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light weight and non-magnetic and non-sparking properties and for brushes and brush holders, switches and cut-outs for the same reason.

Aluminium in the Foundry.

Now about the peculiarities of aluminium in the workshop and the foundry. In the foundry very much larger runners and risers and gates must be used than for brass casting, and plenty of vents must be made in the moulds to let out the gases; as also in sand moulding, the mould must be rammed very loosely—the metal shrinks very much more than brass does—hence the need of the above. Also the nearer the metal is kept to 1,210° F. in melting, and the nearer it is allowed to cool down to a dull red heat before being poured, the whiter and more smooth will be the casting. Aluminium also makes certain good alloys, and is itself alloyed in very small percentages with steel and iron to ensure easy melting and sound, close-grained castings.

The Workshop.

In the workshop special precautions have likewise to be taken. In soldering, great cleanliness and absence of sootiness, a special solder and flux, and a nickel bit have to be used. The British Aluminium Company supply the solder and the flux. Good contact is also made by twist joints, screw joints, and riveted joints.

In turning the pure metal, the lathe has to be run at a high speed, and light cuts have to be taken with tools shaped pretty much as those for hard wood are shaped, the work being lubricated the while with a solution of stearic acid and turpentine. In filing the pure metal single-cut files have to be used to prevent choking. Stamping and pressing is done as in brass, annealing the metal from time to time. In engraving, coat the plate with stearic acid dissolved in turpentine to prevent slipping of the graver. In polishing, use a mixture of tallow and flour emery; for the finish gloss, use a mixture of rouge and turpentine and separate buffs, &c. In rolling and drawing, the only requirement is annealing at a very low red heat and plunging into cold water from time to time.

THE INSTITUTION OF CIVIL ENGINEERS.

At the ordinary meeting on Tuesday, December 12th, Sir Douglas Fox, president, in the chair, the paper read was on "Combined Refuse Destructors and Power Plants," by Mr. C. Newton Russell, Assoc.M.Inst.C.E.

The paper dealt with the subject of refuse destruction, particularly in reference to its employment for raising steam, and gave details of 10 combined plants, the data of which all tended to prove that a considerable amount of energy in the form of heat was to be obtained from the burning of ordinary domestic refuse. The results obtained from eight combined plants in England and two abroad were given, the Shoreditch plant being dealt with in considerable detail, as being the largest of its kind in operation.

The total amount of refuse destroyed during a period of 12 months was about 26,000 tons, of which 92 per cent. was ordinary house refuse, and 8 per cent. trade refuse, consisting of straw, paper, &c. The latter was practically useless for steam raising. The plant consisted of six Babcock-Wilcox water-tube boilers and 12 refuse furnaces of the Manlove-Alliott type, each boiler being placed between two refuse furnaces, the hot gases from which were led into the boiler tubes through short side flues, each boiler being provided with a special grate, on which coal might be burned if required. The refuse, on arrival at the works, was carefully weighed, and was afterwards shot, without sorting, into trucks which were raised by electric lifts (of which there were two) to the top platform. On arrival at this point the truck, which was on wheels, and fitted with an electric motor, was run off the lift on the overhead trolley system, to any position where it was desired to empty it; the refuse was then tipped into special charging trucks, one of which was provided for each furnace, and which was operated from the top platform by means of chain gearing. The average amount of refuse received per day was 84 tons, delivered between 9 a.m. and 5 p.m., although as much as 140 tons had been received in one day. It appeared to be impossible, in ordinary working, to guarantee a regular supply, and it was advisable to provide means of storage to cope with extra large deliveries. This difficulty was met at Shoreditch by means of a large rectangular iron storage bin fixed under the tipping platform, and holding about 60 tons of refuse. The lifts and trucks were operated entirely by electricity. Forced air draught was supplied to the fires by electrically-driven fans, the pressure in the ashpits being 1 inch of water. No coal or other fuel was mixed with the refuse, which burnt freely; the maximum temperature observed being 2,500° F., and the average, 1,500° F. Considerable inconvenience was experienced owing to cold air rushing into flues during clinkering operations, the trouble being, to a great extent, unavoidable, and called for a perfect system of dampers. The clinker residue amounted to 32 per cent., and was at present difficult to dispose of, owing to the cartage from works to the outskirts of the town being high. The clinker was suitable for making mortar concrete, and, when ground and mixed with Portland cement, made excellent paving slabs. The works were managed on the 8-hour shift system, 7 days per week. The feed water for the boilers was drawn cold from storage tanks by three-throw pumps, which forced it through economisers placed in the main flues, where it was raised to a temperature of about 200° F., depending upon the heat of the flue gases and condition of economiser. The water was then forced upwards into a large feed water storage cylinder, 30 feet by 8 feet, fixed about 20 feet above the boilers, and was connected direct to the main steam line, and which was, therefore, at the same temperature and pressure as the boilers, which were fed directly from this cylinder by gravity, the water flowing into the boilers freely without any strain or racking action on the check valves. The steam generated in the boilers, at an average pressure of 140 lbs. per square inch, was disposed of mainly by the engines attached to the electric generators, although a small portion of live steam was supplied for clothes-washing purposes to the public baths and wash-houses adjoining the electricity works; exhaust steam was also supplied to the baths and free library, which were entirely heated from the steam raised by the refuse destructor.

The average cost of burning the refuse during the second year of working, including four furnace men, two top men and one charge man, supervision clerks, &c., cleaners and yard men, repairs, stores and sundries, was 2s. 6·9d. per ton. The amount of electric energy absorbed in dealing with the refuse, including electric fans, lifts, trucks and lighting, was 4·98 Board of Trade units per ton per annum. A number of evaporative tests had been taken with the result that with one boiler and two refuse furnaces it was possible, by the burning of ordinary refuse, to evaporate 2,888 lbs. of water per hour, from and at 212° F.

The average calorific value of various tests was 0·99 lb. of water per lb. of refuse. The heating surface of each boiler was 1,300 square feet; the refuse grate area was 25 square feet, and the coal grate area was 27 square feet. The total amount of energy sold by meter to consumers was 1,031,348 Board of Trade units, including 131,140 units supplied to the refuse destructor. The total amount of refuse burnt was 26,201 tons, and of coal consumed 1,344 tons (value £1,308 14s. 8d.). The item of cost per ton for interest and redemption of land and plant—not usually considered in connection with refuse destructors—was a matter for serious consideration, and in the case of the Shoreditch destructor plant—where land is very expensive—the charge worked out at practically 1s. per ton.

A REVERSIBLE GAS ENGINE.

Some few months ago, when discussing the question of gas engines, we wrote that while we fully believed in the gas engine as a thermodynamic machine of considerably greater efficiency than steam plant yet it lacked certain features which made the steam engine *facile princeps* of prime movers in its convenience of handling. Our attention has since been drawn to a recently patented engine in which means have been adopted for securing the convenience and ease in handling that is now possessed by the steam engine. The patentees of this new engine, Messrs. Fraser and Macdonald, both practical engineers and fully alive to the shortcomings of the gas engine, have recognised that the feature which ensures the mobility of the steam engine is a stored surplus of energy behind it. The steam engine does not work from hand to mouth. The coal that is being consumed one minute in the furnace is furnishing the energy that will drive the engine in half an hour's time it may be. But in a gas engine fuel is put into the furnace and converted into power within a small fraction of a second. There is no store of energy, and there can be none of that mobility of the steam engine which enables it to stop, make a half revolution astern, stop again and go ahead a moment and generally obey its driver with certainty and promptitude.

Messrs. Fraser and Macdonald have met this difficulty by storing up a part of the energy of each stroke in the form of compressed air. The simple idea is to combine the engine with an air pump to force air into a receiver capable of holding sufficient air to supply several strokes of the engine, the compression of the air raising its temperature sufficiently to heat or vaporise oil where oil is the fuel used, or the temperature may be kept down in the usual way when desired.

The gas supply would be pumped at a pressure greater than the air pressure into a reservoir whence it would be admitted to the working cylinder by valves worked by the same ordinary valve gear which admits the air.

For large powers the air pump would obviously be best driven by an auxiliary engine of constant rotation in a uniform direction. In general the engine would be designed probably of the double acting type, being so arranged as to have an explosion as often as desirable and the limits of practical temperature will allow of the other strokes, if any, being performed by air pressure alone. In this way an economy may be secured. Working by compressed air is not usually an economy, but may be made so where the working air is heated by surplus heat that must otherwise be dissipated in the wasteful but necessary water jacket. These air charges are both cooling and scavenging in their action. The following is the cycle of this engine:—

1. Air admission at, say, 75 lbs. pressure for ·2 of the stroke together with gas, the mixture being exploded by electric spark or by ignition tube suitably uncovered by the piston.

2. The exhaust opens as the crank turns the centre. These operations are repeated. When using compressed air on alternate strokes the above two operations are followed by

3. Pure compressed air is admitted for ·2 of the stroke and

4. Is expanded and drives the piston and exhausts as in 2. In the oil engine the exhaust gases would be led through a regenerative heater into which the oil would be admitted with sufficient air to suitably dilute it, the air charge would thus be treated and the oil vaporised by simple spraying into the hot air.

For reversing purposes ordinary forms of valve gear are employed such as cam shafts with two sets of cams, one for forward and one for backward running. The cams are brought to bear upon the various valves for forward or backward movements. Thus to reverse the engine the following cycle of operations is all that is necessary:—

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(*a*) Gas supply shut off.
(*b*) Reversing lever brought over to back-gear position. This of course stops and reverses the engine under air pressure, and as soon as reversing is accomplished
(*c*) Put the reverse lever to its former position, when the cams which formerly drove it forward will of course equally send it backwards, gas being admitted again at the same time. In effect this accomplishes for large engines what is done for small engines by simply stopping them and giving them a turn by hand in the opposite direction, when they will run equally well. But one cannot thus stop and reverse a large engine. The store of air does this and keeps up the rotation until duty is again taken up by the admitted gas.

It is hoped to interest capital to perfect the engine and place it on the market.

ELECTRICAL TIME SERVICE.

This paper on this subject, which was read before the Institution of Electrical Engineers by Mr. F. Hope-Jones on Thursday last week, while in itself interesting, appears to us to be better fitted for the Society of Arts or the Horological Institute; although electricity stands alone in its applicability to the "distribution of time," but a very small percentage of the members of the Institution is likely to be concerned in its use for that purpose, or to possess sufficient experience therein to be able to discuss the details of the apparatus employed with advantage.

The paper commences with a summary of previous work in connection with electric clocks since their original inception by Alexander Bain in 1837. Electric clocks are divided into two classes:—(1) Independent, self-contained, self-wound clocks; (2) Systems of clocks connected together by a line and controlled by a master clock. Class (1) is very briefly dealt with, the author remarking that though hundreds of patents have been applied for in this connection, they are of little use, except when applied to electricity meters.

Turning to Class (2), methods of controlling pendulums by means of momentary currents transmitted at intervals of one second and acting directly on the bobs are touched upon, but are shown to fail

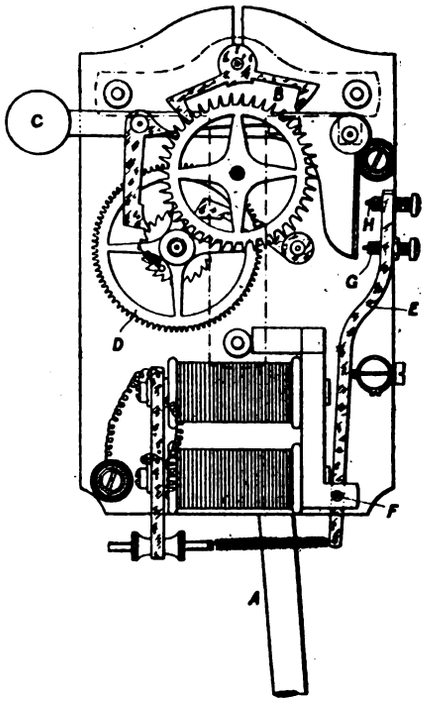

Fig. 1.

in practice. Sometimes, indeed, if the synchronising currents fail for a few beats, when re-established they may be so far out of phase as to oppose the swing of the pendulum and stop it altogether!

Devices which set the minute hand right once every hour are numerous, and one of these, due to Lund, is in operation at the present time in the hands of the Standard Time Company, Limited. In all these cases the complete key-wound clock is retained, and the author pertinently asks: Why use the line only once an hour, instead of using it every minute, or oftener, to directly propel the hands? By this means the clockworks and the necessity of winding up may be dispensed with.

Curiously enough, it is found that the most difficult problem to be solved is that of rotating pointers synchronously by means of periodic currents. A long list of names of inventors is given who have devised time "counters" on this principle, but none of these has attained commercial success. Further, the difficulty of ensuring reliable contacts has been a stumbling block; to avoid this Sir Charles Wheatstone, in 1840, employed a controlling clock, the pendulum bob of which generated alternating currents, which were conveyed to the line by flexible connections and actuated rotating magnets in the subsidiary clocks. Thus there are no variable contacts in the circuit, no battery is needed, and one would suppose the system perfect; unfortunately, however, the functions of time-keeper and magneto-electric generator were found to be incompatible. Similar methods have been put into practical use more recently, and models of these were exhibited at the meeting. Of electrical contact-making devices, the author considers those invented by Mr. T. J. Murday, and used in the Johnson and Phillips integrating meter, to be the best; a description of one form is given, with a figure.

For his own part, the author favours step-by-step dials operated by a central clock, and has directed his attention to ensuring certainty of contact and improving the dial movement. His master-clock, which is electrically driven, transmits a current every half minute to the dependent dials; the mechanism of the former is illustrated by fig. 1.

The pendulum, A, is driven by an escapement, B, in the usual way, the turning force being derived from a weighted lever, C, by means of a click and ratchet. E is an armature centred at F; as the lever falls driving the pendulum, its lower limb makes contact with the screw, G, in the tail of the armature, the circuit of the electro-magnet and of the dials in series with it is closed, and the armature is attracted. The weight is therefore thrown up, while the insulated screw, H, comes in contact with the lever, and the circuit through G is sharply broken.

The author claims for this apparatus the advantage that the whole of the energy required to drive the pendulum for half a minute is mechanically transmitted through the contact surfaces at each operation, and attributes to this feature the fact that he has never known one of these contacts to fail, out of hundreds that have been in use for years. Further, the driving power is absolutely constant.

Fig. 2 shows the movement of the dials controlled by the master-clock, and practically explains itself. The special features of this

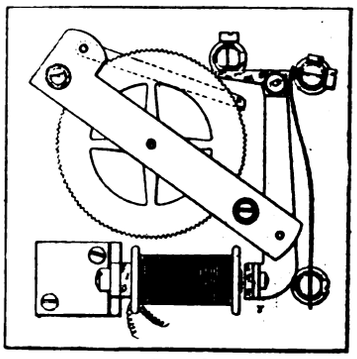

Fig. 2.

device are the use of rectangular teeth, an impulse click which is not tangential to the rim of the wheel, and a backstop click which works close behind the impulse click. Jamming and overthrowing are alike prevented, and extreme accuracy of workmanship is rendered unnecessary.

The use of relays for the driving of large turret clocks is described, and it is pointed out that even for independent clocks of this type it is better to use a small master-clock and electrical driving than to incur the much greater expense of the ordinary turret-clock movement.

An interesting experiment was exhibited, in which a number of dials were placed in series with a vibratory interrupter making 25 vibrations per second; even at this high frequency the dials kept perfectly in step!

The paper concludes with a discussion of the uses to which the system can be applied, and watchman's watchers in factories, speed recorders in engine rooms, school bells, automatic arc lamp switches, &c., are instanced, none of which, in our opinion, is at all likely to make use of it. The author's optimistic expectation that 50 per cent. of the offices in "a busy district of the city" will instal the dials, seems equally over-sanguine.

One drawback to the system, we think, is the *series* connection adopted by the author; true, he advocates very good work in the transmission lines, but with "from 50 to 100" instruments in series, the possibilities of interruption are far too numerous for a public service which, of all things, must be *absolutely reliable*. It is bad enough that now and then a public clock should go wrong, but the stoppage, even for 10 minutes, of all the public clocks in a district would be nothing short of disastrous.

Finally, we think that the author's summons to the electrical engineering profession, to bring about the establishment of a public time service, like his paper, should have been addressed to the Horological Institution.

Light Railways.—It is stated that the applications made to the Light Railway Commissioners in November for orders authorising light railways in England are for a total mileage of 433¼, nearly the whole of which it is intended to work by electricity.

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THE COMMITTEE ON COPPER CONDUCTORS.

We have received from Mr. A. H. Howard, the secretary of the above Committee, a copy of its report, which we reproduce below:—

The advantages of standardising are being largely advocated for almost all classes of engineering products, but copper conductors have hitherto not been included in the list, as everyone has assumed that they were already standardised, and that Matthiessen had settled the resistance and temperature coefficient of copper in his researches nearly 40 years ago.

This assumption is far from being true, and the catalogues of various electrical cable makers, as published before 1899, show considerable discrepancies in the resistance and weight of nominally the same cables, while the Post Office issued a specification differing from all the others.

In order to remedy this confusion, a committee was formed of those interested to determine a standard, and the Institution of Electrical Engineers, the General Post Office, and the principal manufacturers of rubber insulated cables, sent representatives. Meetings were held early in 1899, and the report given below was adopted by the following delegates:—

Sir W. H. Preece, K.C.B., F.R.S., *chairman*, Mr. J. Gavey, Mr. H. Hartnell (for the General Post Office); Prof. W. E. Ayrton, F.R.S., Mr. W. M. Mordey, Mr. Herbert A. Taylor (for the Institution of Electrical Engineers); Mr. J. W. Connolly (Connolly Bros., Limited); Mr. R. J. Hatton (Henley's Telegraph Works, Limited); Mr. W. E. Gray (India-Rubber, Gutta-Percha, and Telegraph Works, Limited); Mr. A. Paterson (Johnson & Phillips); Mr. F. Jacob, Mr. J. S. Huddlestone (Siemens Bros., Limited); Mr. A. H. Howard (W. T. Glover & Co., Limited.) The Telegraph Manufacturing Company, Limited, and the London Electric Wire Company, Limited, also co-operated in forming the Committee and have adopted its recommendation.

The report of the Committee is as follows:—

1. *Resolved.*—That Matthiessen's standard of 0·153858 standard ohms resistance for a wire 1 metre long weighing 1 gramme at 60° F. be taken as the standard for hard drawn high conductivity commercial copper.

2. Hard drawn copper to be defined as that which will not elongate more than 1 per cent. without fracture.

3. *Resolved.*—That Matthiessen's standard of 0·150822 standard ohms resistance for a wire 1 metre long, weighing 1 gramme at 60° F., be taken as the standard for annealed high conductivity commercial copper.

4. Copper to be taken as weighing 555 lbs. per cubic foot at 60° F., which will give a specific gravity of 8·912.

5. *Resolved.*—That Messrs. Clarke, Forde & Taylor's temperature coefficient as published in their pamphlet dated February 20th, 1899, be adopted, and that the average coefficient of 0·00238 per degree F. be adopted for commercial purposes.

6. *Resolved.*—That the resistance and weight of conductors be calculated from the actual length of the wires.

7. *Resolved.*—That a lay of 20 times the pitch diameter be taken as the standard for the calculation of tables.

8. *Resolved.*—That 2 per cent. variation of resistance or weight be allowed in all conductors.

9. *Resolved.*—That an allowance of 1 per cent. increased resistance as calculated from the diameter, be allowed on all tinned copper between Nos. 22 and 12 gauge inclusive.

Note to 1st and 3rd.

The figures inserted have been calculated for 60° F. from the figures 0·1469 per metre gramme for hard drawn and 0·1440 for annealed at 32° F. by Matthiessen's formula.

$$R_{t^\circ} = \frac{R_{32^\circ}}{1 - 0{\cdot}0021506\,(t - 32) + 0{\cdot}00000278\,(t - 32)^2}$$

A. H. Howard, *Honorary Secretary.*

From the above data the following formulæ are obtained:—

Solid Wires.

Copper weighs 555 lbs. per cubic foot at 60° F. Specific gravity = 8·912.

The resistance of annealed high-conductivity commercial copper is:—

Resistance per cubic inch, 0·00000066788 standard ohms.
Resistance per cubic cm., 0·00000169639 standard ohms.
Resistance of 100 inches weighing 100 grains, 0·150158 standard ohms.

$$\text{Resistance per mile} = \frac{0{\cdot}042317}{\text{Area in square inches}}$$

$$\text{Resistance per yard} = \frac{0{\cdot}000024044}{\text{Area in square inches}}$$

Resistance per mil-foot = 10·2044 standard ohms.

The resistance of hard-drawn high conductivity commercial copper is:—

Resistance per cubic inch = 0·000000681327 standard ohms.
Resistance per cubic cm. = 0·00000173054 "
Resistance of 100" weighing 100 grains ... = 0·153181 "

$$\text{Resistance per mile} = \frac{0{\cdot}0431689}{\text{Area in square inches}}$$

$$\text{Resistance per yard} = \frac{0{\cdot}0000245277}{\text{Area in square inches}}$$

Resistance per mil feet = 10·4099 standard ohms.
Weight per mile ... = 2035·1 × area in square inches.
Weight per yard ... = 11·5625 × area in square inches.

Cables.

A lay of 20 times the pitch diameter is adopted as a standard, and the resistance in parallel of the wires is taken as the resistance of the cable.

Resistance of	3	-strand cable =	0·33742	× resistance of each wire,
"	4	"	0·253055	"
"	7	"	0·1443557	"
"	12	"	0·084355	"
"	19	"	0·0532424	"
"	37	"	0·0273493	"
"	61	"	0·0165911	"
"	91	"	0·0111222	"
Weight of	3	-strand cable =	3·03678	× weight of each wire.
"	4	"	4·04904	"
"	7	"	7·07356	"
"	12	"	12·1471	"
"	19	"	19·2207	"
"	37	"	37·4414	"
"	61	"	61·7356	"
"	91	"	92·1034	"

The above formulæ give the standards, but a variation of 2 per cent. in resistance or weight is allowed for losses in manufacture.

These figures have been adopted by all of the parties represented, and it is hoped that they may become the universal standard for Great Britain.

The measurements made by Dr. Matthiessen were for the purpose of determining the best metal to use for a standard resistance, and the permanence of the resistance was of more importance than the actual numerical value.

The specific gravity of the copper was not taken, and as the results are given by length and weight, they afford no means of determining the resistance of a wire of any given diameter. In addition, B.A. units have been confounded with standard ohms, so that discrepancies have arisen from both causes.

The resistance of a stranded conductor varies according to the lay of the wires. Some makers use a lay of 12 times the pitch diameter, while others go so high as 30 times the pitch diameter; 20 was adopted as an average figure, and the resistances calculated from the actual length of the wires, viz., 1·01226 times the length of the cable for all except the centre wire.

As the Post Office specifications will be issued in accordance with the above report, and as all of the manufacturers mentioned will include the same figures in their catalogues, there seems little doubt that these standards will be adopted throughout Great Britain.

THE WORKMEN'S COMPENSATION ACT.

The case of Francis *v.* Turner Bros., which came before the Court of Appeal on Saturday, December 16th, involves the decision of a point which is of the greatest interest and importance to electrical engineers. The question was whether a workman who meets with an accident when employed upon a job away from his master's factory, can claim compensation under the Act. The facts, so far as they are material for our present purpose, were as follows: It seems that the injured man had been sent with other workmen to remove certain machinery from a factory situated at a distance of ½ mile from his employers' premises. While thus employed he met with a serious injury. He subsequently claimed compensation from his own employer on two grounds, (*a*) that he had met with the accident upon premises which were a "factory" within the meaning of the Act, (*b*) because his employer became occupier for the time being. The Court of Appeal declined to adopt either of these arguments, and gave judgment for the defendants who were the respondents in the Court of Appeal. Lord Justice Smith definitely stated the true interpretation of the law to be that the words "*on, in, or about a factory,*" within the meaning of the Act meant the factory of the workman's employer.

This important conclusion confirms the opinion of his Honour Judge Addison in the case of Belsey *v.* Sadler [which was commented on *sub. tit.* "What is a Factory?" in the Electrical Review for October 27th.] In that case the County Court judge decided that a workman injured while erecting an hydraulic crane on premises other than those of his own employer, was not entitled to relief.

To the electrical engineer whose business largely consists of the erection of installations, of lighting private houses, or of laying wires in premises other than his own, this decision cannot fail to have considerable value. Injuries sustained by workmen when thus employed can only be redressed by means of the older and more cumbrous means which are provided by the Employers' Liability Act, or, to go further back, by the common law.

Certain other decisions which have recently been arrived at in the Court of Appeal, also force themselves into a position of considerable prominence, inasmuch as they appear to relieve the employer from liability in a number of cases. Although, as a general rule, the state of the workmen's health must not be taken into consideration when the question of the employer's liability to pay compensation is mooted, yet, if the County Court judge finds as a fact that he was suffering from disease, and that his death, or the injury, was primarily caused by that disease, no compensation can be claimed. In a case which was heard last Saturday, for instance, the use of red lead and oil injured

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a workman's hand, the same having been rendered receptive by blisters which had been caused during the previous week. The County Court judge having decided that there was no accident, and that the workman had suffered nothing more than an injury which might easily arise as a consequence of his ordinary work, the Court of Appeal refused to disturb his decision. Similarly in the case of Hensey *v.* White (16 T.L.R, 64) the workman was suffering from chronic inflammation of the stomach, which caused the blood-vessels to become congested, and the man died through the bursting of the blood vessels while at his ordinary work, though at the time of his death the work was more arduous than usual. The County Court judge found, as a fact, that the man died of inherent weakness of the blood vessels, and not from an accident, and the Court of Appeal supported his judgment.

In fact, the true rule whereby the word accident is to be construed was stated by Lord Halsbury in the case of Pandorf *v.* Hamilton (12 A.C. 518), where he said "the word accident involves the idea of something fortuitous and unexpected."

SMOKELESS COMBUSTION OF AMERICAN SOFT COAL.

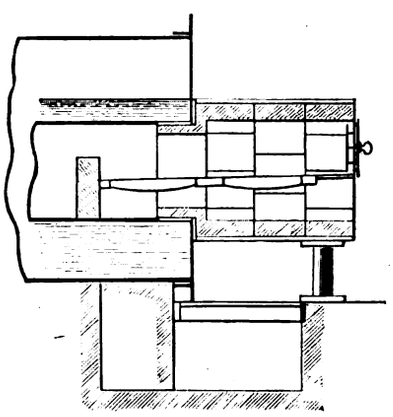
The bituminous coals of America, or soft coals as they are termed to distinguish them from the hard jet-like Pennsylvania anthracite are, we believe, more smoky than English bituminous coals. A recent paper by Mr. Kent, a well-known American engineer and a boiler expert, deals with the burning of soft coal. Mr. Kent calls attention to the work of Wye Williams and other authors 40 or 50 years ago to show that smoke prevention has been long a debatable subject. Williams was very clear on the question, but we do not at the moment remember if he laid any stress on the temperature side of the question. He recognised that smoke was caused by the attempt to burn large volumes of impure hydrocarbon gases without a sufficient admixture of air. Seeing that after all these years engineers are only now coming to accept correct views on the subject, we cannot blame Wye Williams even if he did not realise the importance of temperature. Mr. Kent puts forward his own experienced opinion as follows:—

(1) The gases should be evolved from the coal *slowly*, by which he means, we may suppose, as slowly as possible.

(2) They should be mixed with very hot air.

(3) They should be burned in a hot firebrick chamber, and

(4) While burning they should not come in contact with cool surfaces, such as the water-cooled parts of steam boilers, which means, they must have time and space in which to burn before touching the boiler. Mr. Kent says that the first condition is secured by mechanical stokers. It certainly is not secured by hand stoking, but in spite of this, we fully believe condition (1) need not be insisted upon too



strenuously where conditions (3) and (4) are provided for. The second condition he considers usually falls short in the amount of air provided and in the temperature. The third and fourth are violated in all furnaces where the coal bed is directly under the boiler, and the ordinary water-tube boiler which cools off the gases as soon as generated by means of a nest of cold water pipes is instanced. The same boiler is shown with an external furnace of firebrick extended in front of the boiler with ordinary grates and a roof and sides of brick, a bridge wall, and beyond this ordinary bridge wall a pair of walls projecting from the sides towards the middle of the furnace, so as to give a vertical central space at which the gases evolved from one side of the furnace meet with those evolved from the other side, alternate side hand firing being supposed. Beyond these walls is the combustion chamber with several projecting ribs of brick to afford a maximum of brick surface for collecting and distributing heat.

Apart from the absence from the drawing of any mechanical stoking appliance, Mr. Kent's arrangement of furnace differs little from those recently described. We should expect that with this furnace the water-tube boiler could be smokelessly hand fired. Indeed, as we have frequently pointed out, the conditions are so critical in ordinary practice that a step in the right direction, if only a short distance, will often avail to secure smokelessness. Too much stress, in the meantime, can hardly be laid on the wastefulness of excessive air. The minimum, consistent with perfect combustion, should be aimed at.

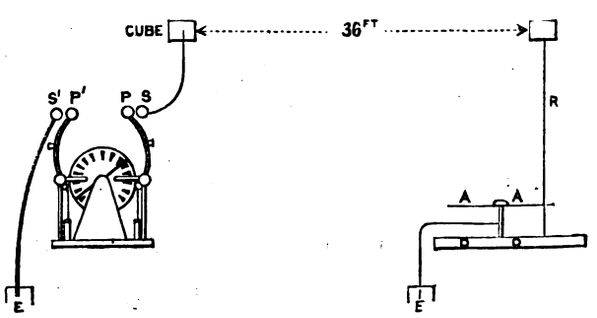
It will often be found extremely inconvenient to erect extensions of firebrick in front of a boiler. Too frequently there is absolutely no room, space being already restricted by parsimonious building construction below that required for convenient stoking. Where there is room, the application of the system to the Lancashire boiler will present some difficulty. We think, however, that a length of 2 or 3 feet of tube might be inserted in the present furnaces, the outer projecting end being supported by a stool or post from the floor. Such tube extensions might easily be made at least 6 inches wider than the furnaces, if not usually 8 inches, for they need not be absolutely concentric with the furnaces. They would thus bear the reduction of their diameter due to a lining of firebrick without being reduced as regards their grate width. We think it extremely probable that such short additions would prove quite sufficient to overcome all smoke, and to do it with actual economy. We would carry the lining forward into the boiler tubes themselves, if necessary, or even employ a number of distinct and separate narrow rings of firebrick in the tubes to diminish the exposed area of water-cooled plate.

WIRELESS TELEGRAPHY WITHOUT THE COHERER.

Mr. W. J. S. Barber Starkey has sent us an account of some interesting experiments he has been making in wireless telegraphy, in which the coherer is replaced by a delicately-suspended metallic needle.

The transmitting apparatus consists of an aerial wire surmounted by a metal cube, electric oscillations being excited in the aerial conductor by sparks from a Wimshurst machine, arranged as shown in fig. 1. The knobs, P P^1, of the machine are separated so far that a spark cannot pass between them, but the sparks can pass across two short spark gaps, P^1 S^1, leading to earth and P S leading to the aerial conductor. The earth connected knob, S^1, is held in the hand by an insulating handle, so that sparks can be evoked when required by bringing S^1 sufficiently near to P^1.

The receiving apparatus, fig, 2, consists of a delicately-suspended needle, A A, preferably made of silverfoil, and the pivot on which it is suspended is connected to earth. Near one end of the needle is mounted a second aerial conductor, R, with a cube on the top similar to the transmitting



conductor. This conductor is mounted on an insulating stand. The end of the needle is adjusted so that it is quite close to the conductor, R, but is not in contact with it.

When sparks pass at the transmitter the end of the needle, A A, is strongly attracted by the conductor, R. This movement of the needle can be utilised to ring an electric bell. A metal stop forming one terminal of the electric bell circuit is fixed on the baseboard, D, so that the needle strikes it as it approaches the conductor, R, the other terminal of the bell circuit being connected to the pivot of the needle.

Mr. Barber Starkey has succeeded with this apparatus in ringing an electric bell at a distance of 36 feet. At that distance the effect was strong, and promised to be available at much greater distances which, however, have not yet been tried.

The movement of the needle A A, is not due to an electrostatic field as in the well-known experiments of Henry, for no movement is observed till the sparks pass at the transmitter. The considerable distance at which the metallic needle is influenced also points to the action being due to

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electric waves. The interesting point about the experiment is that the electrostatic attraction on the needle caused by the electric surgings in the aerial conductor should be sufficient to close an electric bell circuit. This new electric wave detector is not likely ever to be so sensitive as the coherer, but its range might no doubt be considerably increased by improvements in details.

The height of the aerial conductors employed was about 8 feet. Two small Leyden jars were used with the Wimshurst machine.

In another form of his apparatus, Mr. Barber Starkey suspends the silver needle by a fine wire from an insulating stand, and connects the attracting conductor to earth.

THE USE OF A TRADE NAME.

The recent case of The Valentine Meat Juice Company *v.* The Valentine Extract Company, in which judgment was delivered by Mr. Justice Stirling on the 14th of November, raises an interesting and important question relating to the right to use a particular name in connection with a business. The plaintiffs, who are the proprietors of an extract of meat which is sold in the liquid form, and chiefly used as a medicine, sought an injunction to restrain the defendants from carrying on any business of a similar nature in such a manner and under such a title as would lead the public to believe that the defendants' goods were those of the plaintiffs'. It was proved that in 1895 an American, named C. T. Valentine, had commenced to manufacture a meat extract in this country, and that in 1895 he had taken out a patent for a method of enclosing the extract in globules, which subsequently became known as Valentine's Meat Globules. In 1898, he transferred all his rights and interests to the defendant company, who sold the goods under the name of "Valentine's Valtine Meat Globules." It was also shown that the plaintiffs' goods had become known and identified by the use of the word Valentine in connection therewith. Mr. Justice Stirling refused the injunction for several reasons—(1) because the defendants' predecessor, C. T. Valentine, had a right to use his own name in connection with the article sold and manufactured by him; (2) because he had a right to transfer his interest therein to the defendant company; and (3) because the substance manufactured by the defendants was a *solid*, and therefore easily distinguishable from that sold by the plaintiffs.

Such are the short facts of a case which involved the consideration of a great mass of evidence and a very lengthy discussion in Court. Generally speaking, it may be laid down that a man has a perfect right to use his own name in a business, provided he does not do so with a sinister motive. "If a man uses his own name to denote his own goods, it would be intolerable to confer on him the right to prevent other people of the same name from honestly using their own name to denote their own goods, even although they might be of the same kind as his and be undistinguishable from them" (Powell *v.* Birmingham Vinegar Brewery (1896) 2 Ch., 69). Such being the general principle, it is interesting to see how far it is applicable in practice. For this purpose reference may be made to the famous case of Turton *v.* Turton (42 Ch. D., 121), which arose in Sheffield. There the plaintiffs, Messrs. Thomas Turton & Sons, sought to restrain the defendants, Messrs. John Turton & Sons, from carrying on the business of ironfounders under any title closely resembling that of the plaintiffs' firm. Much evidence was forthcoming to show that great confusion was caused in Sheffield by the similarity in title, but it was proved that the defendants, who until 1888 had been known as Thomas Turton & Co., had added the words *& Sons* solely because two sons had, in fact, joined their father in the business. The Court refused to grant the injunction.

Where, however, there is an obvious intention on the part of a trader to adopt a title closely resembling that of his rivals, he may be restrained from using it. Thus in the case of Day *v.* Day, the defendants brought a partner named Day into their firm, for the express purpose of obtaining a surreptitious introduction to the "blacking" trade with which the well-known names of Day & Martin are so widely connected. Upon application made by the firm of Day & Martin an injunction was obtained restraining the defendants from using the name Day for any such purpose. A similar application was made by the proprietors of Holloway's Pills. Of course, there are a number of cases which run very near the line, but before the Court will declare that a man must not use his own name for the purposes of his business, a clear case of fraud must be made out. In illustration of this, we might refer to the case of Jameson *v.* Jameson [15 R.P.C., 169]. There the defendant had simply placed his own Christian name and surname on his goods, which were of the same kind, and got up in the same way as the plaintiff's, that particular get-up being common to the trade. This was held by the Court of Appeal (in the absence of *mala fides*) to be quite lawful.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester and Birmingham, to whom all inquiries should be addressed.

24,085. "Improvements in terminals and connections for electric cables and like conductors." R. F. Hall. Dated December 4th. (Complete.)

24,095. "An improved lamp chimney for either oil lamps, gas or electric lights." T. D. Curtis. Dated December 4th.

24,116. "Improvements in electric accumulators." A. Perrin. Dated December 4th.

24,148. "Improvements in electric furnaces for making glass or other analogous substances." J. Luhne. Dated December 4th. (Complete.)

24,155. "Improvements in regulating the light of electric incandescent lamps." R. Alexander. (A. B. Vanes, Cape Colony.) Dated December 5th.

24,172. "An improved form of mercury voltameter or electric meter." M. C. Clutterbuck. Dated December 5th.

24,175. "Improvements in or relating to electrically-propelled motor cars." F. W. Dickinson. Dated December 5th.

24,184. "Improvements in or relating to electrically-propelled vehicles." F. J. Newman and J. Ledwinka. Dated December 5th. (Complete.)

24,186. "Improvements in multiple blade starting switches." W. Fairweather. (Crocker-Wheeler Company, United States.) Dated December 5th. (Complete.)

24,196. "Improvements in and relating to thermostatic electric switches or pushes." G. Harrison, of the firm of D. Young & Co. (The Auto-Protective Appliance Company, of West Virginia, United States.) Dated December 5th. (Complete.)

24,208. "Improvements in electrically-controlled locking mechanism for collecting and other boxes." H. H. Lake. (F. Williams, United States.) Dated December 5th. (Complete.)

24,288. "Improvements in conductors for electrical railways." S. E. Gunyon. (H. Privat, Germany.) Dated December 5th. (Complete.)

24,230. "An improved anode or other electrode for use in electrolysis and process of making same." J. L. Roberts. Dated December 5th. (Complete.)

24,231. "A new or improved electrical massage, rubbing, or brushing apparatus." B. Kellerman and B. Kellerman. Dated December 5th.

24,244. "Improvements in electric arc lamps." E. H. Belden. Dated December 5th. (Complete.)

24,269. "Improvements in and relating to electric incandescent lampholders." A. Marr. Dated December 6th.

24,273. "Improvements in methods of quickly establishing connection, transmitting electrical energy and telephonic messages between ships, or ships and land, also on land." J. E. Farrow. Dated December 6th.

24,297. "Improvements in accumulators." J. B. Rolls and C. A. Rosier. Dated December 6th.

24,300. "Improved means for surfacing commutators of dynamos, electric motors, and the like." T. H. Nash. Dated December 6th.

24,308. "Incandescent electric cooking and warming apparatus." L. Meunier and I. Gousset. Dated December 6th.

24,325. "Improvements in electric arc lamps." J. A. Fleming. Dated December 6th.

24,352. "Improved system of electric wiring." G. H. Chard. Dated December 7th.

24,370. "Improvements in electric switches." D. G. F. White and J. Shaw Dated December 7th.

24,387. "Electric lamp." C. V. Devlenter. Dated December 7th.

24,412. "An improved tension device for coiling wire over the conductors of an armature or for operations of a similar character in which wire is paid out for coiling in a state of tension." J. W. Goudby. Dated December 8th.

24,431. "Electric rate indicators." J. Harris. Dated December 8th. (Complete.)

24,438. "Improvements in coin-controlled electric meters." The British Thomson-Houston Company, Limited. (C. E. Holmes, United States.) Dated December 8th. (Complete.)

24,439. "Improvements in systems of electric distribution, particularly applicable to electric railway systems." The British Thomson-Houston Company, Limited. (The General Electric Company, United States.) Dated December 8th.

24,440. "Improvements in or applicable to searchlight, heliograph and wireless telegraph apparatus." M. H. L. Clark. Dated December 8th.

24,450. "Improvements in electric telegraph apparatus." J. A. L. Dearlove and S. G. Brown. Dated December 8th.

24,451. "Improvements in storage batteries." H. H. Lake. (C. Bruno, Italy.) Dated December 8th.

24,458. "Improvements in supporting electrical contact rubbers or brushes below rail or tramway vehicles." R. B. Ransford. (La Compagnie Générale de Traction, France.) Dated December 8th. (Complete.)

24,473. "Improvements in accumulator plates." W. Majert. Dated December 8th. (Complete.)

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24,514. "Improvements in or relating to electricity meters." A. J. Boult. (F. Saldani, France.) Dated December 9th. (Complete.)

24,524. "Improvements in or connected with electric accumulators." G. Leve and The Monobloc Accumulator Syndicate, Limited. Dated December 9th.

24,536. "Improvements in thermo-electric piles." L. Gottscho. Dated December 9th. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

43. "Improvements in electric motors and apparatus for propelling cars, carriages, cycles and boats." H. F. Joel. Dated January 1st, 1897. Electric motors and apparatus connected therewith for propelling cars, carriages, cycles, ships and boats, or for like purposes. The motor is constructed with internal fields fixed to the axle and an external armature. The field magnet is built up of two halves, which, when put together, form a central core for receiving a single coil and four radial polar extensions, the ends of which are bent over at right angles. The armature is built up of laminated iron rings or segmental plates suitably wound with coils, and carries a pulley from which the motion is transmitted by a belt to a larger pulley supported by a fixed arm. By means of a lever, the belt covered pulley can be pressed against the inner face of a projecting rim on the carriage wheel, so as to drive the latter. Instead of the lever a screw or other means may be employed for throwing the parts into gear. A somewhat modified arrangement of the apparatus for driving a carriage is also described. The motor is mounted on the rear axle of the carriage, and, by means of spur gearing, drives a countershaft supported by two pivoted levers and carrying a pair of pulleys, which, by means of belts, drive a second pair of pulleys capable of being brought into contact with the projecting rims on the wheels. The apparatus is so arranged that the action of throwing the driving pulley into gear removes the brake from the wheel. 3 claims.

850. "Process for the extraction of metallic alloys and pure metals by electric heat." H. Aschermann. Dated January 12th, 1897. In obtaining metals or alloys from their oxides in electric furnaces an easily fusible sulphide is added as a flux to prevent the formation of carbides. Sulphide of antimony is usually preferred, the antimony being afterwards removed by heating. Ferro-chromium, ferro-cerium, and alloys of iron and copper may be obtained in this way. Pure chromium and pure aluminium may also be obtained. 1 claim.

1,159. "Improvements in dynamo-electric generators and motors." E. K. Scott and A. G. New. Dated January 15th, 1897. An electric generator, motor, or motor-converter is constructed with a vertical shaft carrying an armature whose centre is arranged a little below the centre of the magnetic field, so that the upward pull relieves the downward pressure on the roller bearings. The field magnet cores are laminated in planes at right angles to the laminations of the armature: they are bent into form and secured to the frame by a bent piece and bolts. 2 claims.

1,648. "Improvements in electric switches, and in apparatus for connecting electric circuits." J. D. F. Andrews. Dated January 21st, 1897. Switches are provided with spring catches, bolts, or the like, for locking or holding the sliding contacts in their extreme positions. Switches are also combined for regulating dynamos and accumulators. The block carrying contact slides on a tube. A handle has a tubular extension sliding in which is fitted with a cross head adapted to engage the block. A catch or pawl is pivoted within the tube, and when the tube is depressed forces one end of the catch through a slot in the tube so holding the block down. On pulling the handle upwards the cross head engages the inner end of the catch and releases the block. A spring gives a quick break. A stem carries levers fitted with a spring. When the handle is forced down the spring is extended, but on lifting the handle the spring gives a quick break. Instead of levers oscillating springs may be used. In a modification a handle is fitted with a cam-like extension. In a further modification, the handle is formed of a flat metal spring with one part bent at right angles and working in a slot in a fixed stem. In other arrangements, the handle screws on a threaded stem or worm fitted with suitable guide pins. A bar is connected to the dynamo. The contacts are in connection with the celle, and the brush connects them with the bar. A cut-out in which the fuse is bent and connected to bent conductors being a suitable ring or block is described. This arrangement tends to blow out any arc that may be formed. 6 claims.

2,105. "Improvements in electric meters." The British Thomson-Houston Company, Limited. (W. C. Fish.) Dated January 26th, 1897. Relates to energy meters for continuous or alternating currents, in which an armature in a high resistance shunt circuit rotates in a field produced chiefly by coils through which the main current passes, and partly by coils in the shunt circuit, the latter being provided to overcome the friction of the moving parts; the armature drives registering mechanism by a worm. In order to stop movement of the armature due to the shunt field coils when no main current is passing, the shunt coils are short-circuited periodically during the running of the meter, by contact pieces on the first registering wheel moving between brushes. Some resistance may be placed in this circuit. The invention is applicable to meters for alternating currents, in which the armature and shunt field coils are supplied by a step-down transformer connected across the mains. 6 claims.

2,106. "Improvements in closed conduit electric railways." The British Thomson-Houston Company, Limited. (E. W. Rice.) Dated January 26th, 1897. Relates to the road contact or rectional conductor system with electro-magnetic switches. To prevent the switches being energised when not covered by the vehicle, an independent shunt circuit to the ground is provided to prevent leakage currents passing to the contact connected to the switch magnet coils. 8 claims.

2,107. "Improvements in and connected with brake shoes for electric braking apparatus." The British Thomson-Houston Company, Limited. (F. E. Case.) Dated January 26th, 1897. Relates to disc electro-magnet brakes. The shoes are mounted on the axles and are prevented from rotating by the bar which slides between the lugs and is retained in place by the plates, play being absorbed by springs. 8 claims.

2,125. "New or improved means for economising electric energy in the heating of electrically-heated apparatus and facilitating the use of such apparatus." H. Edmunds. Dated January 26th, 1897. In order to save energy, electrically-heated apparatus is enclosed with a thermostat in an asbestos or other non-conducting covering, and the thermostat is connected with a switch to cut-off or supply current as the temperature increases or diminishes. Refers to specification No. 17,643, A.D. 1892. 2 claims.

4,212. "Improvements in or connected with alternating current meters." C. Raab. Dated February 16th, 1897. A motor disc meter is provided with two shunt field coils, arranged with opposite polarities, one in circuit with a choking coil, the other with a non-inductive resistance. These co-operate with series field coils to produce the same motive power for any particular load, whether it is inductive or non-inductive, the highly inductive shunt acting in the latter case, and the non-inductive shunt when the load in the main circuit is inductive. In a modification, the choking coil in one shunt circuit is the primary coil of a transformer, the secondary of which supplies the second coil. In another, the shunt coils are placed together and act on a single disc. In another, the shunt coils are placed apart, and symmetrically as regards the field coil, on a nearly closed magnetic circuit of iron. 6 claims.

4,242. "Improvements in means for connecting or continuing electric circuits through electrollers, brackets for electric lamps, and the like." J. B. Clarke. Dated February 17th, 1897. A back plate fixed on the ceiling, &c., is formed with a central screwed socket, and carries a porcelain or other insulating flanged ring on which are placed metal blocks, with binding screws. The conductors are passed through the ring and secured permanently to these blocks. The wires in the tube of the fitting are passed out through slots, and a screw coupling is then screwed on the end of the tube. An insulating flanged ring surrounding the lower end of the screw coupling carries blocks, to which the wires are permanently attached. The fitting thus wired is fixed by screwing the coupling into the fixed socket, a washer being interposed of such thickness that the blocks come together. Electric connection is made by fuses connecting the blocks. 2 claims.

4,894. "Improvements in or relating to portable electric lamps." A. J. Boult. (H. C. Hubbell and T. F. Boland.) Dated February 24th, 1897. A casing which may be partitioned into cells is moulded from a hot mixture of asphaltum, nine parts; asbestos, one-half part; sulphur and vulcanised rubber, one-fourth part of each, in a sub-divided state. A handle or clamp, a screw-socket and central contact for the lamp and wires connecting these with pins to support the electrodes, are all embedded in moulding the casing, which may be painted. A leather strap may be attached to its sides. The lamp is enclosed by a reflector, lens, and hood. The electrodes may be lead peroxide and lead or zinc; each is made with a tapered hole, closed at the top, to fit on one of the pins, which may be split at their ends. The casing being circular and the electrodes of different sizes, they cannot be placed wrongly on the pins. A solution of acid sulphate of soda is used. The casing is closed by a soft rubber sheet, a plate, and a cover which may be screwed in, or fixed by screws. Central openings are made in the parts and a rubber diaphragm is secured by a cap in an opening in the plate; pin holes or slits in the diaphragm permit gas to escape under pressure, but confine the liquid. The lamp may be used in mines, mills, and oil works, or on bicycles or other vehicles. 10 claims.

5,040. "A new or improved telegraph relay, suitable for long submarine cables." J. Rymer-Jones. Dated February 24th, 1897. Relays for submarine telegraphy are arranged with two coils suspended in strong magnetic fields, and provided with light cross bars. The cross bars are connected by fibres and by a glass or quartz fibre. Instead of the fibre being directly connected to the bars, magnifying arrangements may be inserted. The contact lever is supported at one end by a fibre, and at the other end is provided with a T-head which plays between removable amalgamated contact plates. The suspended end of the lever is bent down and dipped in acidulated water. The lever is moved by resting on the glass, &c., fibre, and is provided with an adjustable rider. The contact plates are mounted on hinged and adjustable supports. 7 claims.

5,171. "Improvements in conductors for electric railways and the like." W. Wood. Dated February 26th, 1897. At the junction and crossings of conductors grooves are made on the underside of the connecting pieces to receive and guide the flanges of the trolley wheels as they pass. 3 claims.

5,224. "Improvements in electric arc lamps." R. Raynor. Dated February 26th, 1897. The lower carbon is supported in the bend of a U-shaped tube or grooved bar, the vertical limbs of which slide in insulating rings in larger tubes fixed on the lamp frame. The U tube is supported by a flexible cord or chain passed through it and over a guide or guides to a pulley on a brake wheel. One end of the cord may be attached to the frame, or both ends may be attached to the pulley. When one end is fixed, the friction of the cord in the tube checks sudden movements of the carbon. The upper carbon may be supported by another U tube, or a weighted head connected by a rack and pinion, or by a cord with another pulley on the brake wheel. The brake wheel is carried by a screw threaded axle, or its rim is threaded, so that when rotating it moves laterally into contact with inclined brake surfaces on the regulating lever. The edge of the wheel is bevelled correspondingly, and the pulley surfaces are coned in order to increase their working diameter as the carbons are consumed and render their operations uniform. To strike the arc, the axle is carried by a tube vertically movable by connection with the core of a series solenoid, to lower the brake wheel and thus operate the cords to separate the carbons. The core is provided with rings so that the solenoid serves as a dash pot. In a modification, the spring and arm are dispensed with, the series coil core being attached to the regulating lever, so that this depresses the brake wheel to strike an arc. 9 claims.

5,237. "Improvements in the suspension of electrical accumulators or batteries on motor carriages." Hon. R. T. D. Broughem and W. C. Bersey. Dated February 26th, 1897. Consists of means for resiliently suspending accumulators or batteries on motor carriages in such a manner as to prevent undue oscillation and shocks. The box containing the batteries is suspended from the frame of the vehicle by links, supported by springs. Oscillation is checked by the bar pivoted at one end to the box and at the other end to the frame. The dies of continuous wire drawing machines are arranged in their supports out of line with one another, so that the wire passes round the drawing through rollers or cyclinders in spiral lines. The rollers which rotate in troughs may be mounted eccentrically on their shafts, or their boxes may be bored out larger than the shafts to give freedom to the motion of the wire and prevent it cutting into the rollers. The periphery of the cylinders or rollers may be concave. 2 claims.

5,258. "Improvements in electrically propelled motor road vehicles." L. Epstein. Dated February 26th, 1897. This is a vehicle of the kind described in Specification No. 15,564, A.D. 1895. On the fly-wheel shaft of the motor engine is secured a toothed wheel, which when the wheel is made to gear with it communicates motion from the engine to the dynamo-electric machine, the electricity produced being stored in accumulators at the back or back and front of the vehicle. Electricity is only produced when the vehicle is at rest, and issued to work as an electromotor, when the wheel is put out of gear with the wheel, and the wheel made to gear with the wheel; motion being then communicated from the electromotor to the countershaft and thence from the pinions by chains to the sprocket wheels on the axle of the driving wheels. The brake on the drum is controlled by a treadle. The front wheels have their axles pivoted on the ends of a cross bar, and by moving the handle both wheels are turned, thus steering the vehicle. 1 claim.

5,260. "A method of and apparatus for utilising electric energy." H. B. Gee. Dated February 27th, 1897. Contact is made and broken at the make and break switch, the lamps being alternately in and out of the battery circuit. It is stated that a much higher potential is obtained in the circuit and increased brightness of the lamps. Instead of the magnetic make and break a rotary one may be employed. 6 claims.

5,282. "Improvements in primary galvanic batteries." S. F. Walker. Dated March 1st, 1897. In portable, single fluid carbon zinc cells, the electrolyte consists of a solution of chromic acid with hydrochloric acid and sodium sulphate. To purify the acids, impurities may be precipitated by the use of suitable salts, such as barium chloride. The carbon is in the form of a hollow perforated cylinder, and the zinc is cast in the form of an inverted cone about a central supporting wire of iron or brass. The pores of the carbon are filled with sulphate in the manner described in Specification No. 12,028, A.D. 1897. 7 claims.

5,430. "Improvements in speed-regulating governors, specially suitable for electric light and other high speed engines." J. T. Marshall. Dated March 1st, 1897. Consists in a form of governor especially suitable for electric light or other high speed engines. A sleeve is mounted on a rotatory spindle so as to be capable of sliding thereon while revolving. The upper end of this sleeve carries a plate, on which are hung the centrifugal weights. The tails of these bear, through anti-friction rollers, on a plate rigidly attached to the end of the spindle. Outward movement of the weights raises this plate against the resistance of the springs, which are held between a collar on the sleeve and an adjustable abutment plate bearing, through studs, against the plate. The spring is preferably made in two parts oppositely coiled, so that the twist taking place on compression or extension shall be neutralised. 5 claims.

5,178. "An improved device for deadening the noise in telephone conductors and the like." H. Messing. Dated March 9th, 1897. A hollow sleeve of India-rubber or similar substance is enclosed in a split sleeve of lead. The ends of the sleeve are solid except for radial slits corresponding in position to the opening on the lead sleeve, so that the whole can be slipped on to a telephone, &c., line so as to deaden the buzzing in the wires, rods or posts. 1 claim.

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THE

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TRAMWAYS AND LIGHT RAILWAYS.

IN two years from now, unless continued by special grace, the Light Railways Act will come to an end, for it was only a provisional measure by intention. The whole business of tramways and light railways in this country seems ever to have been enveloped in ignorance, and crushed by ill-advised or ill-drafted measures. The Tramways Act of 1870 rendered impossible the raising of capital, and the Light Railways Act of 1896 has equally failed to secure the results aimed at by its framers. The intention of this Act was to facilitate the construction of light railways, and the gratuitous assumption seems to have been made that because such light railways were needed, because the public demanded their construction and was prepared to find capital to that end, therefore the servants or representatives of the public would necessarily afford all possible facilities to promoters.

But such hopes have been by no means fulfilled. It is a common saying that two are required to make a quarrel. It is equally true that two consents are required to an agreement, but it is lamentable to record that where agreement is called for between a promoter of a scheme and the authority concerned, the intention and meaning of the term agreement has been totally degraded. Where, for example, an electric tramway must of necessity erect poles for carrying the overhead system, the necessity of coming to an agreement as to the position of such poles is used as a means of levying blackmail on promoters. Now, it was not the intention of the Legislature that authorities to be agreed with should set themselves to be wilfully and perversely obstructive. Doubtless, it is annoying for a surveyor of roads who has, perhaps, taken a just pride in what he may call his roads, to see the same torn up by a tramway company. But after all, the roads are not the property of the road surveyors; they belong essentially to the public. If it is to the public interest that a portion of the road shall be occupied by the rails of a tramway or of a light railway, it is the duty of a road surveyor to acquiesce in all necessary works, and not to set up obstruction for the sole purpose of satisfying only personal grievances.

Nor is it only local authorities and their surveyors who have pursued a policy inimical to the public interest. The railway companies themselves, established by the good will of the public, and occupying the country by favour of the public, have largely contributed to hinder the good work of new comers in the field of transportation. These companies, whose special Parliamentary powers have enabled them to build ugly and light-obstructing bridges across public roads, on the plea of convenience to the public, have taken on themselves to use such structures as a means of obstruction to electric tramways.

Here, again, it never was the intention of the Legislature, when permitting such structures to be built, to grant to the then promoters the power to employ such structures as a means for obstructing future developments; developments

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as necessary to-day for the public good as were the steam railroads in their early days. Occasionally Parliament does act with some foresight, as, for example, when the Warrington bridge of the London and North-Western Railway was allowed at a low level, with the proviso that it should, when necessary, be raised to permit the passage of vessels. This provision became necessary when the Manchester Ship Canal was made—an undertaking violently opposed by the railway company on the grounds that it would be *impossible to construct it*, and that *when constructed* it would not pay, and no one would use it. Between now and two years hence some consolidation of existing Tramways Acts will surely be effected, this being done, it is to be hoped, with greater foresight than has so far been displayed. The experience gained in electric traction work in connection with the Act of 1896 and the earlier Act of 1870, should enable the public to be better represented before any committee of inquiry that may be constituted as a preliminary to a final Act, than has hitherto been the case. The abuses and blackmail, and the unparalleled delays and obstructions, forced upon promoters, should be rendered impossible.

In electric traction work it is perhaps unfortunate that there must be interference with the roads. Not merely must the permanent way be laid down, but the cables must be trenched in, and the overhead construction must be carried by its poles. As regards these, however, it cannot be claimed that they present so conspicuous an appearance as had been feared. Compared with the big black creosoted poles of the Post Office or of the telephone company, the neat iron poles of a tramway are hardly noticeable, especially as they can always be painted to suit a locality—green, for example, along a leafy road, and red brick colour or stone colour along building routes, according to the nature of the building material; so painted, they are invisible at a short distance. But, in any case, the crying necessity of the day is for better transportation facilities. The country is suffering from great loss of time every day through the lack of better facilities. The industries of the country suffer both directly and indirectly, and millions are being invested abroad for want of profitable investment at home, which would be available for the thousands of miles of necessary tramways, and the collateral industries that would flourish with them. It is, of course, of the greatest importance that proper provision should be made for the due protection of the public interest against future encroachment upon public rights, for these rights have been too much neglected in granting special powers to the railway companies in the past, but it is equally important that Parliament—whose intentions have been in the one case exceeded and in later cases obstructed—should correct such errors in the coming Act. Parliament is all-powerful, and can undo what it has done wherever the public interest demands it. It would be better for the country at large, both on the part of the general public, the inventors, and the commercial and working classes, if no change should be made and no new measures introduced unless it is definitely understood and provided that the electric traction industry is to have fair play; moreover, there must be no short-sighted obstruction on the part of local authorities, or of individual officials arrogating to themselves the ownership of public roads entirely apart from the opinions of the real owners. The country bids fair to be ruined by the restraining hands of men long since gone to dust, through the observance of the letter in matters which may in their time have been in touch with the spirit of the age. Altered conditions nowadays make such restrictions ridiculous.

For example, to take one matter which is for the purposes of to-day as extinct as the dodo—the necessity of paving a tramway track. The obligation to pave the track of a tramway, arose from the extreme wear inevitable where the horses of a tramcar were of necessity compelled always to run along the same narrow line. But to-day it is only through ultra-conservatism that there are any horse tramways at work. Clearly, the enormous expenditure of stone or wood paving ought not to be obligatory along an electric line which has no use for the paving, and causes no wear of it. It seems to us, also, that the obligation enforced upon the Dublin Street Tramways Company of sanding its track, is an unfair obligation. The sand is useless to the tramway company; the tramway track is used by any and every vehicle, and being part of the public road should be sanded by the public authority. True, the sanding of the rail surface might, perhaps, be demanded of the company, but beyond this we see neither sense nor reason in the decision. Future legislation should take into account the use of electricity as at present the chief motive power on tramways and light railways and though anything better than electricity has so far not even appeared in the dimmest distance, we would like not even the next coming motive power to be curbed and obstructed as electricity has been. We venture to say that but for the almost sole recognition of the horse, steam traction would have advanced far beyond what it has done. Steam traction on tramways has never had a chance of showing what it could do. Probably now it never will.

Electric Lighting Loans and the London County Council.

We are not enthusiastic admirers of the London County Council, or of all that it has done in the way of civic control, and in many electrical matters we confess that the attitude of this august body is quite beyond our comprehension. Its method of dealing with such a small matter as the lighting of the Thames Embankment suggested that it was quite beyond its power to deal in a business-like manner with technical matters; while on the subject of tramways it has developed an amazing amount of wrongheadedness. Having regard to these things therefore, it is not surprising that a pretty quarrel should have arisen with the Islington Vestry on the subject of electric lighting loans. One of the functions taken over from the Metropolitan Board of Works was the control of the raising of loans by the London vestries, and from the commencement of its career the County Council has had a good deal to do with loans for the development of electric light works. There have been, at different times, certain matters of difference between Vestries and the London County Council on the subject of lighting loans, but the one with the Islington Vestry, which was related in these columns some two or three weeks ago, is rather suggestive of an attempt to push the prerogative of the Council beyond what was ever intended by Parliament. Following the usual course in developing their electricity works, the Islington Vestry applied to the County Council for sanction to raise a loan for new plant. The Finance Committee, however, insisted upon a complete detailed scheme before they would grant the necessary permission. To our mind the Vestry very properly refused to give what they considered to be unnecessary details; because, as they stated, the estimates had been prepared by the Vestry's electrical engineer, and approved by the Lighting Committee, and the Vestry having confidence in the judgment of both, could not recognise the claim of the Council's officials to be supplied with the details. We may take it that the details were required by the Council in order to see if the Vestry were undertaking a sound scheme; but what member or official of the County Council would have been able to say whether the Vestry's estimate was right or wrong? A consideration of such details would necessitate a certain amount of technical knowledge; and surely the County Council would never dream of submitting an estimate to an outside engineer. Unless they did that, they would be unable to say whether the Islington Vestry's estimates were in order or not. The whole question of the County Council's authority in regard to lighting loans needs to be reconsidered, and the provision which has been made, giving a right of appeal to the Local Government Board in cases where the Council refuse to sanction loans, has not been made too soon.

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THE CONTACT v. THE CHEMICAL THEORY OF THE VOLTA EFFECT.

Several circumstances have recently brought into prominence this old and still unsettled controversy. The main question now at issue is the explanation of Volta's classical experiment and of a number of other experiments of a similar kind, though differing in detail, due to him and later physicists. At one time scientific men were divided into two parties by their views on this subject, which were held very strongly and expressed very warmly. Some 20 years ago the British Association made a determined effort to get agreement on the matter by obtaining a clear statement from some competent physicist of the experimental facts, and of the different modes of construing them. By these means it was hoped that the issues might be narrowed and clearly defined, and an end put to a long and irritating flood of loose reasoning and irrelevant experiment which had been poured out by both sides. Prof. Oliver Lodge's report to the British Association, made in 1884 at the Montreal meeting, is the principal document on the subject. To many people this report seemed to be decisive, at any rate against the contact theorists, and it would be difficult to make a clearer statement of the issues. Prof. Lodge's own opinions were given in a categorical series of propositions, expressly designed to challenge a direct negative from those who disagreed with any or all of them. Even this report has not brought the matter to a definite issue, and the Volta centenary has been the occasion of re-opening the whole controversy. The most important recent publication on the subject was Lord Kelvin's lecture, delivered May 21st, 1897, before the Royal Institution. A paper by Mr. Spiers, read before the Physical Society on November 10th last, described a series of difficult and ingenious experiments of the inconclusive character of much of the work on this subject. This paper elicited a short and unsatisfactory discussion, and a promise from Prof. Lodge that he would deal with the question in his next presidential address to the Society.

At one time the theory of the Voltaic cell was inextricably mixed up with that of the Volta effect, and it is clear that they cannot be wholly separated; but recent speculations on the action of the cell, based upon diffusion, are very different from the sort of considerations which have been employed to explain Volta's contact experiments, and have deprived the contact *v.* chemical controversy of much of its interest. We are publishing a translation of Prof. Augusto Righi's account of the theory of the cell, which was appended to his address on the scientific work of Volta, delivered to the Como Conference, and those who are interested will find there a clear general account of Nernst's theory, based on the action of diffusion. One can hardly formulate any statement on the action of Volta's contact effect that would be accepted by both sides, but it seems to be generally thought that the phenomenon is evidence of a statical straining of bodies towards combination, though there is disagreement as to the exact locality or nature of the action.

A peculiar feature of the whole controversy has been that there continually appears to be misunderstanding and confusion between the disputants as to the meaning and use of such terms as potential, and such relations as the one referred to at the Physical Society's meeting, viz., $J\pi = T\frac{dE}{dT}$ as well as to statements of what is actually observed in experiments. Confusion of thought is not to be suggested with Lord Kelvin and Prof. Perry on the one hand, or with Prof. Ayrton and Prof. Lodge on the other; but it is probably the case that words, and the word potential in particular, have been used in different senses at different times. This is especially liable to occur in colloquial discussion, and it is much to be hoped that that likely to ensue on Prof. Lodge's address may be carefully reported and revised by the speakers.

Before describing Volta's experiment the meaning of potential may be referred to. Potential is essentially a property of a position in space, and does not imply that matter exists or does not exist there. It is not a property of matter, and in this way differs in character from such quantities as temperature and velocity. It cannot be measured directly at all, but its value at a point may be deduced from measurements of the electrical force existing in the neighbourhood. These measurements can only be made in fluid media, and the potential of a point within a solid body can only be deduced from observations in the neighbouring fluid medium by means of some assumption. The potential of a point within a solid body has never been measured; and the accepted view that within a conducting body, not conveying a current, it has the same value at all points, has no experimental foundation. Lord Kelvin pointed out in his Royal Institution lecture that this is almost certainly not true of a crystalline metallic structure; and that of the many combatants who have used the term "potential of a conducting body," not one has ever told what he meant by the expression. In Prof. Lodge's Brit. Assoc. Report, 1884, it is stated that Sir William Thomson said that by the expression "potential of a conducting body," he meant "the potential of the medium close to the body." This is a perfectly intelligible and measurable quantity, but evidently it is not the sense which other writers have attributed to the words. The expression "potential at a point" has no ambiguity, but it must be remembered that when the point is within a solid body no value can be assigned to it except by means of some inference which may require careful examination.

The Volta effect may be stated as follows:—

1. If two bodies of different metals are connected metallically a field of electrostatic force is established in their neighbourhood.

2. The density of the field is proportional for any given gaseous medium to the condenser capacity of the system, the surfaces of the two bodies being equipotential surfaces.

3. The metallic connection between the two bodies may be made in any way, and through any series of metals, without affecting the observed field.

A particular case is shown in fig. 1, where a pair of zinc and copper plates, Z Z, C C, forming an ordinary condenser,

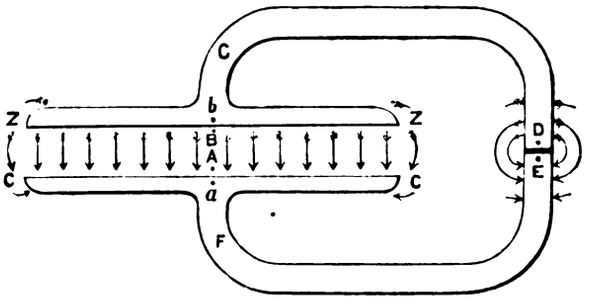

Fig. 1.

are connected by a wire shown partly of zinc, partly of copper, with a junction at D E. Experiment shows that—

1. A positively charged body between the plates experiences a force directed towards the copper plate, and the two plates experience a force tending to bring them together. This last result has recently been obtained directly and satisfactorily by Sig. Q. Majorana. *Phil. Mag.*, September, 1899.

2. The force is inversely proportional to the distance between the plates.

3. The connection C D E F may be made in any way, so long as it is metallic, without altering the field, so long as the surfaces Z Z, C C are unaltered.

If, with Lord Kelvin, the potential of a metallic body means the potential at a point close to and outside it, *e.g.*, A or B, then the above experiment proves that the potentials of the zinc and copper plates in the above experiment differ by a definite amount, which is independent of the form of the structure. (It is a quantity about ·7 volt.) But if the potentials of the bodies mean the potentials at points within them, *e.g.*, (*a*) or (*b*), the conclusion cannot be drawn.

The first step in the arguments drawn from this experiment has been stated in many ways, but all seem reducible to the following:—

(*a*) Experiment shows that a certain quantity of work, W, is done in conveying a positively charged body from a point,

D

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A near the copper, to a point B near the zinc by the path A M B.

(*b*) The work done in conveying a charge by the path A M B is the same as that which would be done in conveying it by the path A *a* F E D C *b* B, which is therefore W.

The question between the two sides is simply as to the part of the path A *a* F E D C *b* B at which the work W is done. According to the contact theory the potential at D is higher than that at E by the same amount as the potential at B is higher than that at A, and the work W is done in conveying the charge from E to D, *i.e.*, across the metallic junction. According to the chemical theory there is no difference of potential between points D and E, but there is between points A and *a*, and between points B and *b*; and the work W is done in conveying the charge across the gas to metal junctions at A *a*, B *b*.

Three observations may be made here :—

1. The character of the surfaces in contact at D E does not affect the field A M B. Suppose, for instance, that the surfaces were separated, the zinc thoroughly burnished, as in Erskine Murray's experiments, and the contact re-made. This is equivalent to inserting in the metallic connecting circuit a plate of burnished zinc, which, in accordance with the experimental results given in Section 3 of the statement of the Volta effect, makes no difference in the force at A M B. This will be generally admitted, though in some experiments the contact surfaces at D E were parts of the surfaces Z Z, C C, and were altered by burnishing, oxidation, polishing, &c.; and it is not clear whether the experimenters supposed that the alteration effected thereby in the force between A and B was due to the change in the surfaces Z Z, C C or in those at D E.

2. The character of the superficial layers of metal Z Z, C C affects the field A M B. Erskine Murray by burnishing, several experimenters by oxidation by heating, and recently Spiers by heating and exhausting the gas, have obtained large changes in the field. These operations introduce changes in the gas to metal junction, and, at the same time, introduce a new metal to metal junction, *e.g.*, between the burnished superficial layer and the unchanged metal beneath it; and it is not possible, *prima facie*, to attribute the effect on the field to one change rather than to the other.

3. The character of the gaseous medium, so far as we are able to test the point by changing it, does not affect the field A M B. Prof. Lodge holds that it would, but that we have no means of making changes sufficiently perfect to show any result.

There are two methods, both due to Lord Kelvin, of determining the contact force of metals which are not open to above objection :—

1. A known quantity of electricity is passed in a continuous current through a metal to metal junction, *e.g.*, from E to D, fig. 1. The heat developed consists of two parts, that due to the resistance of the conductors at a rate proportional to the square of the current, and that due to the difference between the potentials at D and E, at a rate proportional to the current, the latter action being known as the Peltier effect. If a measurement of the heat due to the latter cause showed that the difference between the potentials at D and E was the same as that between A and B, the contact theory would appear to be proved. The sort of quantities that would have to be observed may be shown by the example of fig. 2.

Heat is developed in virtue of the resistance of the conductors in the above arrangement at the rates ·00015 watt per cm. in the copper, and ·00053 watt per cm. in the zinc, sufficient, if there were no radiation, to raise the temperature of the copper at the rate 1° C. in 4·2 minutes, and of the zinc 1° C. in 1·3 minutes. If there were a difference of potential between points on each side of the junction of ·7 volt (suggested by the contact theory) heat would be developed there at the rate of ·7 watt, a quantity many times larger than those which produce the other easily observable effects. The observed results do not approach this, and are decisive, thus Maxwell and Lodge, against the seat of the main Volta effect being at the metallic junction.

2. If a current of electricity i flows along a homogeneous conductor which is not all at the same temperature heat, is developed at each point at a rate H which consists of two parts. One part ρi^2 is the product of the second power of the current by a quantity ρ, the resistance, which depends on the nature of the metal, and on its temperature at the point. The other part σi is the product of the first power of the current and a quantity σ, the specific heat of electricity, which depends on the nature of the metal, on the temperature gradient along the conductor at the point, and the temperature at the point, so that $H = \rho i^2 + \sigma i$.

For large currents the term σi is negligible compared with ρi^2; for small currents ρi^2 is negligible compared with σi. When the difference of temperature between the ends of a metal bar is small, say t, the heat developed by a very small current, i, is $\sigma i t$; and the difference between the potentials at the ends of the bar, due to the temperature gradient, is σt.

→ 1 ampere →

Copper.		Zinc.
·0113	sectional area sq. cm.	·0113
·1	weight grms. per cm.	·108
·00015	resistance, ohms per cm.	·00053
·091	sp.heat.	·091

FIG. 2.

Consider the closed circuit, fig. 2, of two metals whose junctions are at absolute temperatures $T + t$, $T - t$, differing by $2t$ a small quantity; so that T is the mean absolute temperature of each metal. H_{T+t}, H_{T-t} are the electromotive forces of contact at the two junctions; σ_1 σ_2 are the specific heats of electricity of the two metals at the temperature T, so that $2\sigma_1 t$, $2\sigma_2 t$ are the differences of potential between the ends of the conductors due to the temperature gradient along them. Then the electromotive force in the circuit is

$$e = H_{T+t} - H_{T-t} + 2(\sigma_1 - \sigma_2)t.$$

With an electromotive force very nearly equal to e impressed on the circuit (*e.g.*, by a changing magnetic field) so that the current is very small, the whole forms a reversible heat engine, absorbing heat at the hot junction and along one conductor, developing heat at the cool junction and along the other conductor, and doing work equivalent to the difference of the two heats on the magnetic field. The sum of the heats, each divided by the absolute temperature at the point where it is absorbed or developed, is zero (the second law of thermo-dynamics).

$$\text{Hence } \frac{H_{T+t}}{T+t} - \frac{H_{T-t}}{T-t} + 2(\sigma_1 - \sigma_2)\frac{t}{T} = 0$$

$$\text{Since } t \text{ is small, this reduces to } H_T = T\frac{e}{2t}.$$

H_T is electromotive force for the junction of the two metals at the absolute temperature T; e is the electromotive force for the whole circuit of the two given metals at the mean temperature T, with a small difference, $2t$, between the temperatures of the junctions.

This equation is commonly written

$$J\pi = T\frac{dE}{dT}$$

where J is the Joulian equivalent,
π is the measure of the Peltier effect,
E is the thermo-dynamic height of the couple,
T is the absolute temperature.

The value of E and e have been determined for various couples. Prof. Everett (C.G.S. units) gives the value of E for copper-lead $136 + ·95t$ units, and for zinc-lead $234 + 2·40t$ units at t° C. The electromotive force at a zinc-copper junction at 15° C. would be $288 \times 1·45$ units = 4·2 microvolts, a quantity much less than that indicated by the preceding argument, and still less comparable with the Volta effect of ·7 volt.

Though both these arguments are due to Lord Kelvin, he is satisfied with the deduction from neither of them of the electromotive force at a metallic junction. The passage in which Maxwell accepted the argument from the Peltier effect as conclusive against the contact theory, was quoted by Lord Kelvin, apparently in strong disapproval, in his printed lecture, and by Prof. Lodge, on the other hand, in his Brit. Assoc. Report in strong approval. The second thermo-dynamic argument is criticised by Lord Kelvin on the ground that the process "involves dissipation of energy by conduction of heat through metals at different temperatures in

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different parts," and cannot be treated as a case of a reversible engine. This objection seems to be fatal. It is apparently rejected also by Prof. Lodge (prop. xxi., Brit. Assoc. Report).

Prof. Lodge has been at great pains to make his own views on the matter very clear. He holds that there is a strain towards combination between the atoms on the surface of a metallic body and those of the surrounding medium. In the case of a metal in air, the strain to oxidation tends to draw positive charges towards the surface of the metal, and to repel negative charges. In the case of a body whose surface is uniform, the strain is equal all over, and no external electrostatic field is produced. If the surface is not homogeneous (*e.g.*, partly of zinc and partly of copper), or if different media are opposed to different parts of one surface, the strain is greater at one part than at another, and electrical displacement occurs. The part of the surface which is most readily oxidised, and experiences the greatest strain, becomes positively charged, the less readily oxidisable part negatively charged. In an oxidising medium, such as air, which cannot exchange charges with a metal immersed in it, the space about a non-homogeneous metallic surface is a field of electrostatic force. In the case of an electrolyte where charges can be exchanged with a metal, the medium is a field of electrical current. Prof. Lodge holds that there is no difference of potential between metallic bodies in contact other than the small quantities exhibited by the Peltier effects, but that there is a large difference of potential between points inside the metal and in the surrounding medium. The essential condition of the Volta effect, both in gaseous and liquid media, is a difference of tendency to combination between different parts of the surface of a metallic body and the media adjacent to them. This condition is met either by one medium and different kinds of surface on the metallic body, or by a uniform surface and different media.

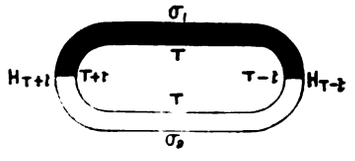

FIG. 3.

On Lodge's theory the Volta effect of any couple should be altered by a change of the gaseous medium, and should disappear in vacuo; and several Volta series calculated for different gases are given in the British Association Report. That the Volta effect is not altered by rarefaction of the air, by replacing it with hydrogen, by protecting the plates with varnish, or by scraping them under paraffin, presents to Lord Kelvin a serious difficulty in accepting the theory, but Prof. Lodge replies to this objection that any known mode of changing the medium near the plates leaves quite sufficient of the original medium to produce the old effect. A number of calculations of the Volta effect, based on the respective heats of combination with oxygen, while they do not in all cases closely correspond with the observed results, certainly do not disprove the theory. Lord Kelvin, on the other hand, looks for the cause of the Volta effect to a straining after combination between the metals of the two plates themselves, and while the effect by Lodge's explanation depends on the heats of combination of, say, zinc and copper with oxygen, Lord Kelvin makes it depend on the heat of formation of brass. He wrote: "This force" (that of attraction between two metals metallically connected) "is a result of chemical affinity between thin surface layers of the two metals; and the work done by it when they are allowed to approach through any distance towards contact between any parts of the surfaces is the dynamical equivalent of the portion of their heat of combination due to the approach towards complete chemical combination constituted by the diminution of distance between the two bodies."

The subject requires reference to one important experiment. In fig. 4 there is no electrostatic field at A, but there is at B.

The supporters of the contact theory supposed that all isolated metallic bodies immersed in an electrolyte are brought to the same potential, and that all uncharged isolated metallic bodies in air are at the same potential, and that a difference of potential is established when they are brought into contact. Prof. Lodge holds that different isolated metallic bodies immersed in an electrolyte or in air, uncharged, are at very different potentials, but are brought to the same potential (less the small Peltier quantity) when they are put in contact.

By the contact theory, in fig. 4 (*a*), the whole system is at one potential, and is uncharged. By Prof. Lodge's theory the three parts, two metals and one electrolyte, are at very different potentials, but remained uncharged, because each metal is strained equally all over, the tendency to oxidation being the same in both oxidising media, water and air.

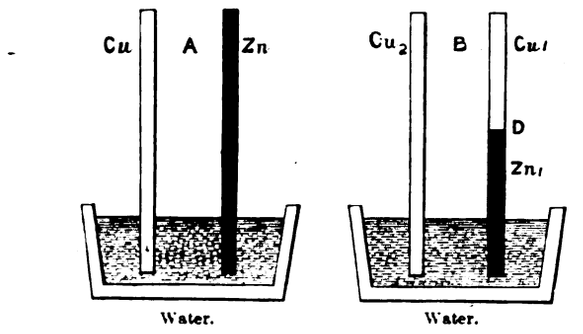

FIG. 4.

In fig. 4 (*b*), by the contact theory, the part Cu_1 is at one potential, being − vely charged, and the remainder of the system, Cu_2, the electrolyte, and Zn_1, are at another potential in consequence of the electromotive force of contact at D, and are + vely charged.

By Prof. Lodge's theory Cu_1 and Zn_1 are at one potential, which is intermediate between those of Cu and Zn in (*a*), Cu_2 is at another potential, and the electrolyte at a third. Cu_1 has a + ve charge, and an equal − ve charge is distributed over the surfaces of Zn_1 Cu_2 and the electrolyte.

The two theories give the same distribution of charges and the same field, so that no observations of the electrostatic forces discriminate between them.

The mode in which the experiment, fig. 4 (*a*) would be explained by Nernst's diffusion theory is not clear.

In conclusion, the following passages may be quoted from English writers on the subject to whom we have referred:—

The electromotive force at the junction of two metals as determined by this method (that of measuring the Peltier effect at a single junction) does not account for Volta's electromotive force. The latter is in general far greater and is sometimes of opposite sign. Hence the assumption that the potential of a metal is to be measured by that of the air in contact with it must be erroneous, and the greater part of Volta's electromotive force must be sought for, not at the junction of the two metals, but at one or both of the surfaces which separate the metals from the air or other medium which forms the third element of the circuit.—CLERK-MAXWELL, "Electricity and Magnetism," Vol. i., p. 340, second edition.

In all that precedes I have, by frequent repetition of the phrase "air or ether," carefully kept in view the truth that the dry Volta contact-electricity of metals is, in the main, independent of the character of the insulating medium occupying space around and between the metals concerned in each experiment, and depends essentially on the chemical and physical conditions of molecules of matter in the thin surface stratum between the interior homogeneous metal and the external space, occupied by ether and dry or moist atmospheric air or any gas or vapour which does not violently attack the metal; or by ether with vapours only of mercury and glass and platinum and steel and vaseline (caulking the glass stopcocks), as in Bottomley's experiments.—LORD KELVIN, Royal Institution Lecture, May 21st, 1897, Section 33.

XIX.—A metal is not at the potential of the air touching it, but is always slightly below that potential by an amount roughly proportional to its heat of combustion, and calculable, at any rate approximately, from it. For instance, clean zinc is about 1·8 volts below the air, copper about ·8 volt below, and so on. If an ordinary oxidising medium be substituted for air in the above statement, it makes but little difference.

XX.—Two metals put into contact reduce each other instantly to practically the same potential, and consequently the most oxidisable

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one receives from the other a positive charge, the effect of which can be observed electrostatically.

XXI.—There is a slight true contact force at the junction of two metals which prevents their reduction to *exactly* the same potential, but the outstanding difference is small, and varies with temperature. It can be measured thermo-electrically by the Peltier effect, but in no other known way. It is probably entirely independent of surrounding media, metallic or otherwise.

XXII.—If two metals are in contact, the potential of the medium surrounding them is no longer uniform; if a dielectric it is in a state of strain, if an electrolyte it conveys a current.

XXIII.—In the former case the major part of the total difference of potential is related closely to the difference of the potential energies of combination, and is approximately calculable therefrom. In the latter case the total E.M.F. is calculable accurately from the energy of the chemical processes going on, minus or plus the energies concerned in reversible heat effects.—Prof. Oliver Lodge on "The Seat of the Electromotive Forces in the Voltaic Cell," British Association Report, 1884, pp. 519-520.

W. A. P.

THE SCIENTIFIC PRINCIPLES OF PUBLIC LIGHTING BY ARC LAMPS.

By F. W. CARTER, M.A.

(*Concluded from page* 995.)

There is another expression for the horizontal illumination which we shall find useful in considering the effect of varying the height of the lamp, and that is in terms of the distance (B X = d feet, say) from the foot of the lamp. Since $r \sin\theta = \text{B X} = d$, we shall have $r = \frac{d}{\sin\theta}$, whence the horizontal illumination $\frac{\text{I} \cos\theta}{r^2}$ becomes $\frac{\text{I} \cos\theta \sin^2\theta}{d^2}$ candle-feet.

When we are given the curve between I and θ we can find the curves between (i) I $\cos^2\theta$ and θ, (ii) I $\cos^3\theta$ and θ, (iii) I $\cos^2\theta \sin\theta$ and θ, and (iv) I $\cos\theta \sin^2\theta$ and θ, obtaining the points on these curves either by calculation—by multiplying I by the various trigonometrical functions indicated—or, if we prefer it, graphically as follows:—

Let A (fig. 3) be the arc, its axis, A B, being vertical, let P be a point on its photometric curve, so that AP = I and P A B = θ; draw A N_1 vertical and N_1 P_1 perpendicular to A P. Then A N_1 = AP cos θ = I cos θ, A P_1 = A N_1 cos θ = I $\cos^2\theta$, so that P_1 is the point on our first curve (i),

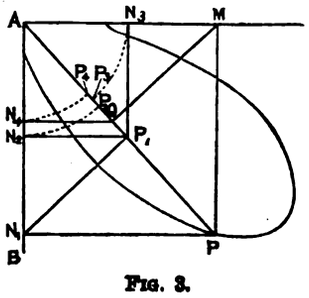

Fig. 3.

corresponding to P. Draw P_1N_2 horizontal, and make A P_2 = A N_2. Then A P_2 = A N_2 = A P_1 cos θ = I $\cos^3\theta$, and P_2 is the corresponding point on curve (ii). Draw P_1N_3 vertical and make A P_3 = A N_3. Then

$$\text{A P}_3 = \text{A N}_3 = \text{A P}_1 \sin\theta = \text{I} \cos^2\theta \sin\theta;$$

thus P_3 is the point required on curve (iii). Lastly, draw PM vertical, MQ perpendicular to A P, Q N_4 horizontal, and make A P_4 = A N_4. Then

$$\text{A P}_4 = \text{AN}_4 = \text{AQ} \cos\theta,$$

and AQ = AM sin θ, whilst A M = A P sin θ = I sin θ,

so that $$\text{A Q} = \text{I} \sin^2\theta,$$

and A P_4 = I $\sin^2\theta$ cos θ. Hence P_4 is the point on our fourth curve. In this way we can get a succession of points on any of the curves.

Let the large polar curve (fig. 4) be the photometric curve of the arc A, and the polar curves (i), (ii) and (iii) be the derived curves so designated in the preceding paragraph. We will, for shortness, call these the curves of total, horizontal and vertical illumination respectively. Draw BX horizontal. Take any point P on the photometric curve, let AP cut BX in N, and the polar curves i, ii, and iii, in P_1, P_2, P_3, respectively. Draw the ordinate at N, and make NQ_1 = AP_1, NQ_2 = AP_2, NQ_3 = AP_3. Repeating this for different positions of the point P, we shall trace out the Cartesian curves marked i, ii, and iii whose ordinates are proportional

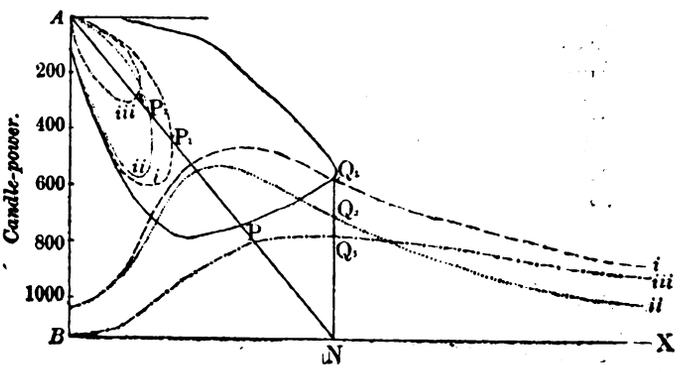

Fig. 4.— Photometric curve, and curves of total, horizontal, and vertical illumination, for a nine-ampere naked arc, burning 2 mm. long between an 11 mm. positive, and a 9 mm. negative, solid Apostle carbons.

to the total, horizontal, and vertical illuminations respectively at the level of the plane BX. The height, AB, of the arc above this plane we have called $h - h'$ above, and the distance, BN, from the lamp-post, should be to the same scale as AB, in which case the ordinate at N to any one of the curves divided by $(h - h')^2$ is the corresponding illumination at N. Thus we can get the particulars of the illumination at any point due to a single lamp. Since we are neglecting reflected light and the influence of other lamps, the illuminations given are, however, too small. The effects of other lamps on the illuminations in question could be found, though, in the cases of the total and vertical illuminations, only by introducing greater complications than the importance of the results justfies. As mentioned above, these illuminations are chiefly important in the neighbourhood of a lamp, where the effects of other lamps is proportionally small. The horizontal illumination at any point, due to a number of lamps, can, however, be easily found, for the separate illuminations of the several lamps have simply to be added. Thus in fig. 5 the outer polar curve at A is the photometric curve of a 12-ampere continuous current Oerlikon arc, with an opaline globe, whilst the inner curve is the derived I $\cos^3\theta$ curve—as is also the polar curve at A′. The height of a lamp is to the distance between them as 21 is to 120—thus they may be taken as 21 feet high and 40 yards apart. To find the illumination of the ground at any point N, join AN, A′N, cutting the I $\cos^3\theta$ curves at P and P′, set up an ordinate QN equal to the sum of AP and A′P′, then QN divided by AB^2 is the illumination at N; thus the illumination at N is proportional to QN. In this way is obtained the Cartesian curve, drawn in the figure, showing the illumination at every point on the line BB′. From the same polar curves we can, graphically, get the curves of equal illumination of the ground, and so study the distribution of light at points not on the line BB′. To do this, we must first describe about A a system of circles having radii in arithmetical progression (*e.g.*, the candle-power circles of the figure). Let any particular circle (*e.g.*, the 260 candle-power circle), cut the I $\cos^3\theta$ curve in P, and let AP cut the ground in N; then at N, and at every point at distance BN from B, the illumination, *due to the lamp at A*, is proportional to AP, *i.e.*, to 260 in our case. Hence, describing a circle about B, of radius BN, we get a curve of equal illumination for the single lamp A. Repeating this for each of the circles about A, we get the series of circles about B, corresponding to illuminations, 560, 540, 520, 500 . . . &c.—(the last six, viz., 60, 50, 40, 30, 20, 10, are separated by intervals of 10, however, in order the better to show the effect of superposing the illumination due to the second lamp). Now describe an exactly similar system of circles about B′, as shown numbered with dashed numbers (10′, 20′, &c.). Where circles of the two systems cut, the illumination due to both lamps is the sum of the numbers attached to the circles. Thus where

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30 cuts 10′ the illumination is 40, similarly where 20 cuts 20′, and where 10 cuts 30′. Thus the curve, due to both lamps, corresponding to illumination 40, passes through these points, as is shown in the figure. In this way the system of lines of equal illumination due to both lamps is drawn. We could now introduce a third lamp and obtain such curves for the three if required. These curves really tell us all about the illumination of the ground due to the system of lamps. Where they are close together, the illumination is varying rapidly as we cross them, so that a patch which is nearly uniformly lighted will have but few of these curves upon it.

It will be seen from fig. 5 how very small is the effect of distant lamps compared with the nearer ones. In fact, the illumination at B, due to A′, is about ½ per cent. of that due to A, although the ratio of AB to BB′ is somewhat greater than is usual in street lighting, where the height of the lamps is generally about 20 feet, and the distance between them 50 or 60 yards.

Thus we can find the distribution of light due to a number of lamps placed at given heights and in given positions. Let us now consider the question of the spacing and height of the lamps, when some particulars of the distribution are specified.

We will suppose the lamp to be of given type, *i.e.*, its photometric curve is given. First let the height, h, of the lamp from the ground be given, and the minimum illumination, m, on the line joining two lamps—a suitable specification for street lighting. Let the distance between lamps be x. For a single row of lamps the illumination is a minimum at the centre of BB′ (fig. 5) where it is $2\,\frac{\text{I}\cos^2\theta}{h^2} = m$.

Thus $\text{I}\cos^3\theta = h^2\,\frac{m}{2}$,—a known quantity. From the $\text{I}\cos^3\theta$ curve (fig. 5) we find the value of θ, where $\text{I}\cos^3\theta$ is equal to this known quantity, then $\tan\theta = \frac{x}{2h}$, or $x = 2h\tan\theta$. This gives x.

In practice the value of this minimum illumination lies, in general, between 0·01 and 0·1 candle-feet, according to the importance of the locality, and is usually, in England, about 0·04 candle-feet for principal streets. The minimum illumination of gas-lit side streets appears to be only of the order 0·001 candle-feet.

Taking the actual curve given in fig. 5, let $m = 0{\cdot}06$ candle feet, $h = 20$ feet.

$$\therefore \text{I}\cos^3\theta = 20^2\,\frac{0{\cdot}06}{2} = 400 \times 0{\cdot}03 = 12.$$

This gives $\theta = 74^\circ\ 10'$

$$\tan\theta = 3{\cdot}5 \therefore x = 40 \times 3{\cdot}5 = 140 \text{ feet.}$$

A place of minimum illumination may, with some lamps, occur at B, but it will be so small, and so liable to be lit up by scattered light from the bright zone close outside it, as to be unimportant.

If we are considering the illumination of an open space by an evenly distributed system of lights some small modifications will be necessary in the above.

Thus, if the lamps are staggered, as in fig. 6, we may take the illumination at the centre of any triangle ($A_1\,A_2\,A_3$) as due entirely to the lamps at its corners. Thus, we shall have θ given by

$$m = 3\,\frac{\text{I}\cos^3\theta}{h^2}, \text{ or, } \text{I}\cos^3\theta = h^2\,\frac{m}{3},$$

and $\tan\theta = \frac{OA_1}{h}$, or, if $A_1\,A_2 = x$,

$$x = \sqrt{3} \times OA_1 = \sqrt{3}\,h\tan\theta.$$

If the lamps are in rows, as in fig. 7, the point O is illuminated practically by the four lamps, $A_1\,A_2\,A_3\,A_4$; thus, θ is given by

$$m = 4\,\frac{\text{I}\cos^3\theta}{h^2}, \text{ I}\cos^3\theta = h^2\,\frac{m}{4},$$

and $A_1\,A_2 = x = OA_1\sqrt{2} = \sqrt{2}\,h\tan\theta$;

so any other case might be treated.

Let us now suppose that the height of the lamp is not specified, but the maximum, (M), as well as the minimum, (m), illuminations of the ground are given.

We may consider the maximum illumination as due entirely to the near lamp. Then, if $\text{I}_1\cos^3\theta$, is the maximum radius vector of the curve (fig. 5), we shall have the height of the lamp given by

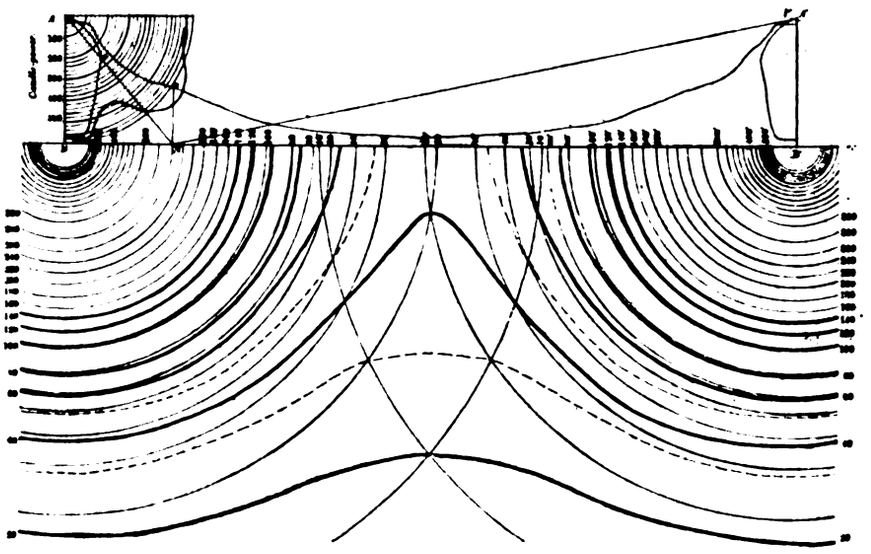

Fig. 5.

$$\frac{\text{I}_1\cos^3\theta_1}{h^2} = \text{M}, \text{ or, } h = \sqrt{\frac{\text{I}_1\cos^3\theta_1}{\text{M}}}.$$

Having found h, we proceed to find the distance between the lamps exactly as in the case just given. The maximum illumination of an arc-lit street is usually between 0·5 and 2 candle-feet.

Thus if $\text{M} = 1$ and $m = 0{\cdot}06$ candle-feet, with the lamp in fig. 5, where the maximum is under the lamp, we shall have

$$\text{I}_1\cos^3\theta_1 = 570$$

$$\therefore \text{H} = \sqrt{570} = 24 \text{ feet approximately.}$$

$$\therefore \text{I}\cos^3\theta = 24^2 \times 0{\cdot}03 = 17{\cdot}1$$

giving $\theta = 72^\circ\ 10'$, $x = 149$ feet or about 50 yards.

A more reasonable case, perhaps, is that in which the average illumination (M′) is given, as well as the minimum (m). To find the average illumination we must divide the total amount of light falling on the ground by the area which it falls on. There is no difficulty in doing this when we are considering the lighting of open spaces, as, in this case, we can divide the ground into as many square, rectangular, triangular, or other areas, as there are lamps. Thus if the lamps are at the corners of triangles of sides x (fig. 6), the area allotted to each is

$$\frac{\sqrt{3}}{4}\,x^2, \text{ thus } \frac{\text{L}}{\frac{\sqrt{3}}{4}\,x^2} = \text{M}',$$

or

$$x = \sqrt{\frac{4\,\text{L}}{\sqrt{3}\,\text{M}'}} = 1{\cdot}5\,\sqrt{\frac{\text{L}}{\text{M}'}},$$

where L is the total amount of light given out by each lamp.

If the lamps are at the corners of squares of sides x (fig. 7), each lamp has to illuminate an area x^2.

Thus, $\text{M}' = \frac{\text{L}}{x^2}$, or $x = \sqrt{\frac{\text{L}}{\text{M}'}}$.

If, however, the lamps are ranged along a street, some of their light will be wasted on the bordering buildings. This amount will not usually be great and will be partly reflected back on to the street. If we neglect that wasted, and call L still the total amount of light given out by the lamp, and z the width of the street, we have—since xz is the area lighted per lamp,

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$$\frac{L}{x\,z} = M', \text{ or } x = \frac{L}{z M'}.$$

This value is somewhat too large, since L should be only the light falling on the street instead of the total light emitted. The wider the street the more nearly correct will be the value of x given by the formula. The quantity L is 2π times the mean hemispherical candle-power of the lamp, taken over the lower hemisphere. We observe that, for a given type of lamp, to have specified the mean illumination, amounts to the same thing as being given the distance, x, between lamps.

The mean illumination of a street lit by arcs usually lies between 0·25 and 1 candle-feet, being generally, in our chief streets, about 0·45 candle-feet. This is, of course, only the part of the illumination due directly to the lamps. In some streets one could rely on its being considerably increased by the presence of shops.

Having found x, we must proceed to find h by making use of the curve between θ and $I \cos\theta \sin^2\theta$ (No. iv., fig. 3). For street lighting the horizontal illumination half way between two lamps $\left(\text{where } d = \frac{x}{2}\right)$ is

$$m = 2\,\frac{I \cos\theta \sin^2\theta}{\left(\frac{x}{2}\right)^2},$$

whence $I \cos\theta \sin^2\theta = \frac{m}{8}x^2$,— a known quantity. Our curve gives us the value of θ which satisfies this.

The height, h, is given by

$$\tan\theta = \frac{x}{2h}, \text{ or } h = \frac{x}{2}\cot\theta.$$

Thus for the curve in fig. 5 the mean hemispherical candle-power = 545 candles, or $L = 2\pi \times 545$.

Let $M' = 0{\cdot}4$ and $m = 0{\cdot}04$ candle-feet, which will correspond to very good lighting, let $z = 50$ feet, $x = \frac{L}{z\,M'} = \frac{2\pi \times 545}{50 \times 0{\cdot}4} = 171$ feet $= 57$ yards, whence $I \cos\theta \sin^2\theta = \frac{0{\cdot}04}{8} \times 171^2 = 146$.

$$\therefore \theta = 74^\circ\ 10',\ h = \frac{171}{2}\cot 74^\circ\ 10' = 24 \text{ feet}.$$

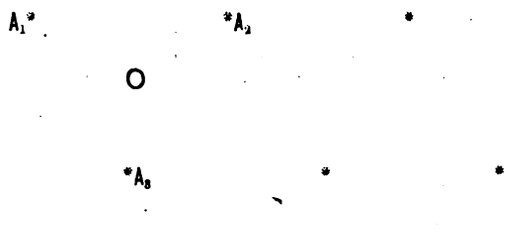

Fig. 6.

Similarly for the open space corresponding to fig. 6, $d = \frac{x}{\sqrt{3}}$, and θ is given by

$$m = 3\,\frac{I \cos\theta \sin^2\theta}{\frac{x^2}{3}} \text{ or } I \cos\theta \sin^2\theta = \frac{m}{9}x^2,$$

whence we get $h = \frac{x}{\sqrt{3}}\cot\theta$.

For the second open space considered (fig. 7), we have $d = \frac{x}{\sqrt{2}}$, whilst

$$m = 4\,\frac{I \cos\theta \sin^2\theta}{\frac{x^2}{2}} \text{ or } I \cos\theta \sin^2\theta = \frac{m}{8}x^2 \text{ gives } \theta,$$

and

$$h = \frac{x}{\sqrt{2}}\cot\theta \text{ gives } h.$$

Let us next consider the question of the fewest lamps that can be used in order that the illumination of the ground on the line joining the lamps may nowhere be less than m. This is the same as finding when x is greatest. For a single row of lamps we shall have, as in the last problem,

$$m = 2\,\frac{I \cos\theta \sin^2\theta}{\left(\frac{x}{z}\right)^2}, \text{ or } x^2 = 8\,\frac{I \cos\theta \sin^2\theta}{m}.$$

Since m is given, x is greatest when $I \cos\theta \sin^2\theta$ is greatest. Thus we have to find the value of θ, which makes the radius vector in the curve (iv.) fig. 3 greatest. Having found this value from the curve, and x from the formula above, we get the height of the lamp from the formula $h = \frac{x}{2}\cot\theta$. This height will, in general, be very great for street lamps, in the case of such arcs as are at present used. Thus for the lamps in fig. 5, $I \cos\theta \sin^2\theta$ is greatest when θ is about 54°; its value is then 258 approximately. Thus if $m = 0{\cdot}05$,

$$x^2 = \frac{8}{0{\cdot}05} \times 258 = 4{\cdot}14 \times 10^4,$$

$$\therefore x = 203 \text{ feet} = 68 \text{ yards},$$

$$h = \frac{203}{2}\cot 54^\circ = 74 \text{ feet},$$

which height is impracticable for street lighting with the lamps in question, and with minimum illumination 0·05. In fact the lamps must have their photometric curves with maxima very little below the horizontal for this method to lead to feasible results, unless the minimum illumination is to be very high. For the arrangement of lamps in fig. 6 we shall have

$$x^2 = 9\,\frac{I \cos\theta \sin^2\theta}{m}, \text{ and } h = \frac{x}{\sqrt{3}}\cot\theta;$$

whilst for the arrangement in fig. 7, $x^2 = 8\,\frac{I \cos\theta \sin^2\theta}{m}$, and $h = \frac{x}{\sqrt{2}}\cot\theta$, where, it must be remembered, θ is the angle at which $I \cos\theta \sin^2\theta$ is greatest.

Uniformity of illumination can hardly be hoped for when such large sources of light as arcs are used; nevertheless the conditions tending to uniformity may be elucidated. If the lamp-posts are given in position, and we suppose all the arcs raised gradually we shall find that, as the lamps mount higher, the maximum illumination of the ground diminishes,

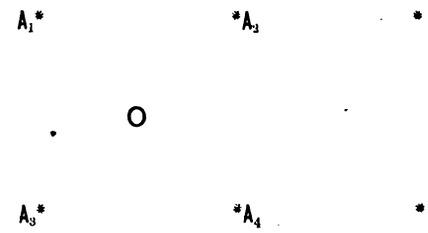

Fig. 7.

whilst the minimum for a time increases, and then begins to diminish. The turning point—when the minimum illumination is at its greatest—may be taken as giving the superior limit practicable to the height, which, in fact, will generally be found higher than is usual at present, unless very good lighting is required, so that the distance between lamps is small. For a single row of lamps,

$$m = 2\,\frac{I \cos\theta \sin^2\theta}{\frac{x^2}{4}};$$

where x is given, m is greatest when $I \cos\theta \sin^2\theta$ is greatest, and having found θ to make this as great as possible, we have $h = \frac{x}{2}\cot\theta$. In fact, this problem is the same as the preceding one, except that x is now given instead of m. To be given x is, as shown above, the same as being given the mean illumination, M'.

Perhaps a more practical discussion of uniformity which, however, only applies when we have a minimum illumination, not zero, under the lamps, as well as one between them, is based on the consideration that if we increase one mini-

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mum, we shall, for a time at any rate, diminish the other, and *vice versâ*. Under such circumstances we shall have an approach to uniformity if we make both kinds of minima equal. Thus for a single row of lamps,

$$m = \frac{I_0}{h^2} = 2\,\frac{I\cos^3\theta}{h^2},$$

where

$$\tan\theta = \frac{x}{2h},$$

and I_0 is the intensity vertically downwards. Hence we have to find the value of θ which makes $I\cos^3\theta = \frac{1}{2}I_0$ (fig. 3, curve ii). If the minimum illumination is given,

$$h \text{ is given by } m = \frac{I_0}{h^2}, \qquad \text{or } h = \sqrt{\frac{I_0}{m}},$$

whilst x is given by $x = 2h\tan\theta$

If the height, h, of the lamp is given, the minimum illumination is found from $m = \frac{I_0}{h^2}$, and x is given by $x = 2h\tan\theta$. If the distance, x, between the lamps is given, we shall have $h = \frac{x}{2}\cot\theta$, and the minimum illumination is given by

$$m = 2\,\frac{I\cos^3\theta}{h^2} = 8\,\frac{I\cos\theta\sin^2\theta}{x^2}.$$

In fig. 4, for instance, $2I\cos^3\theta = I_0$ when $\theta = 66{\cdot}5^\circ$ about, whence $x = 2h\tan\theta = 4{\cdot}6h$. If then the minimum illumination, m, is specified as, say, 0·06 candle-feet, we shall have

$$h^2 = \frac{I_0}{m} = \frac{120}{0{\cdot}06} = 2{,}000$$

$$\therefore h = 45 \text{ feet},$$

and $x = 207$ feet $= 69$ yards.

The maximum illumination is only 0·31 candle-feet, so that the contrast between brightness and darkness is much smaller than usual.

The foregoing methods, even when leading to impracticable results, may suggest improvements in arc lamp globes and reflectors. Usually, with such large sources, there is plenty of light in the neighbourhood of a lamp, and it is the dark space between lamps that requires attention. Here the illumination can be increased either by raising the lamps or by using such a lantern and reflector as will send out the greater part of the light but little below the horizontal. For the lighting of open spaces both are feasible; the second alternative being perhaps the better from a photometric point of view, since very high lamps give bad illumination of vertical objects near them. For streets, however, unless they be very wide, both are objectionable as wasting a lot of light on adjacent buildings which might have been more usefully employed, so that, unless very high illumination is required, we must be content with a less uniform distribution of light than is possible in an open space.

One would like to see manufacturers of arc lamps generally introducing the photometric curves of their lamps—running precisely under working conditions—into their catalogues. The derived system of circles of equal illumination would also be useful, together with a table giving the product of the minimum illumination due to two lamps and the square of their height (*i.e.*, $2I\cos^3\theta$), for different values of the ratio of the distance between the lamps to the height of a lamp.

Wigan.—On Wednesday last week the Mayor (Mr. Alderman Gee) switched on the electric current for the first time at the temporary central supply station. Mr. H. Collings Bishop, the electrical engineer, had to find a suitable temporary site, and hire plant. This he has done, the plant consisting of a Robey undertype steam engine of 100 H.P., and the dynamo a Byng-Hawkins of 240 amperes and 250 volts, and with this plant he is furnishing power for upwards of 1,800 lamps. He accomplished a creditable work in supplying the light before Christmas, as promised. We hear that Mr. E. H. Johnson, A.I.E.E., has installed the light at the Victoria Hotel, Victoria Vaults, Dog and Partridge Hotel, Shakespeare Hotel, &c.

NORTHERN SOCIETY OF ELECTRICAL ENGINEERS.

METHODS OF SUPPRESSING ARCS IN SWITCHES, FUSES, &c.

By Ernest Kilburn Scott, A.M.I.C.E.

(*Read at Manchester, Tuesday, December 5th.*)

(*Concluded from page* 1022.)

Ferranti Oil Fuse.—One of the most ingenious devices for suppressing high-tension arcs is the Ferranti oil fuse. This consists of a rectangular porcelain vessel containing resin oil to a depth of several inches. It is divided lengthways into two compartments, and in each there is a spring which, when at rest, has its free end resting on the bottom of the vessel. To set the fuse, the free ends of the two springs are raised up until they are clear of the oil, fuse wires are attached from terminal to terminal, their middle portion resting on the dividing porcelain partition, as shown in figs. 16 and 17. Naturally, when an excess current passes the wire melts, releasing the two springs, which plunge down through the oil on both sides, and thus put out the arc. This arrangement will satisfactorily break 500 amperes at 5,000 volts, and it forms one of the most important details in the successful Ferranti switch panel. It may be mentioned that on the Continent for extra high tension switches it is quite the usual arrangement to make the final break under oil.

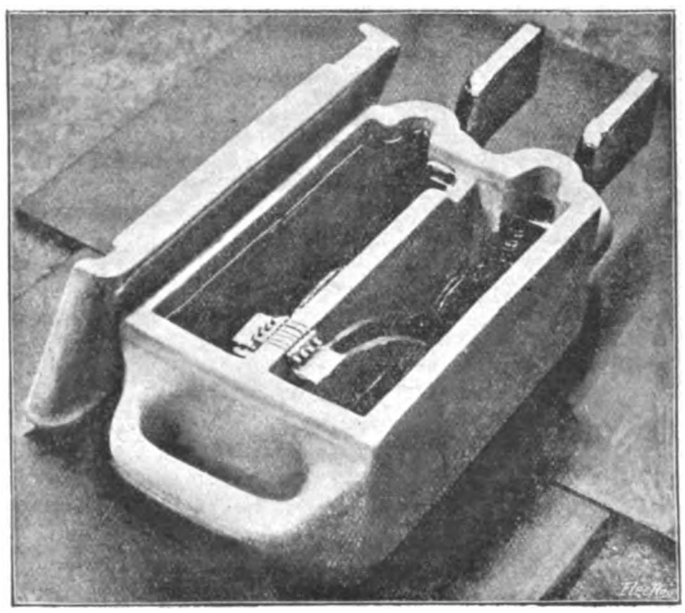

Fig. 16.—Ferranti Oil Break Fuse.

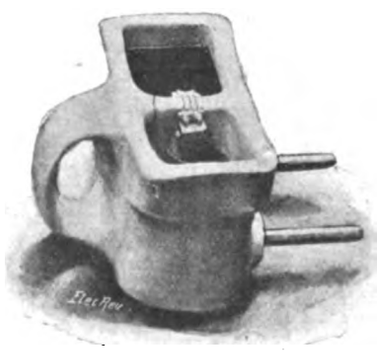

Fig. 17.—Ferranti Oil Fuse. (Small size for transformers.)

Verity & Steele's Oil Fuse.—A high tension fuse has been recently introduced by Veritys, Limited, which is more or less on the lines of Mr. Ferranti's device, in that the broken end of the fuse wire is submerged in oil, gravity taking the place of the springs used in the original type. The 50 amperes size is shown in fig. 18, from which it will be seen that the fuse wire is passed through a U-shaped glass tube. On excess of current the wire fuses in air at the point C (the opposite end, B, being thickened up by having an extra strand wrapped round it), and the tube with the oil in it immediately drops, the broken end of the fuse wire being drawn under the oil at double the rate of travel of the tube.

Spring Back Fuse.—A somewhat similar idea used in America is

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shown in fig. 19. The fuse, made of sheet metal, is in a state of tension between two hinged terminals, which are pulled apart by springs. Around the central portion of the fuse the porcelain blocks

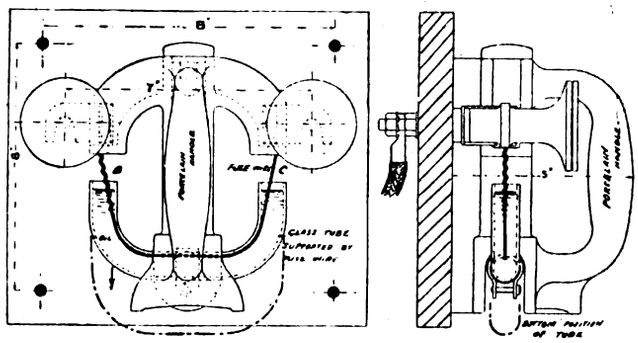

FIG. 18.—VERITY & STEELE'S OIL BREAK FUSE.

are recessed so as to provide an air chamber, which is vented through the hole in the upper block. As the fuse loses its tensile strength at a low red heat, it is pulled apart almost before the metal has had time to melt, with the result that very little of the metal is volatilised. With a fuse of this type occupying only 6 inches × 3 inches, Mr. W. L. R. Emmett says he has repeatedly broken 300 amperes at 13,000 volts without injury to the device.

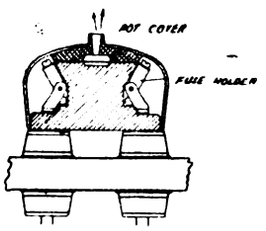

FIG. 19.—SPRING BACK FUSE.

The very ingenious "time fuse" made by Messrs. F. H. Royce and Co., in which a resistance coil heats up the fuse wire, is also provided with a spring, which draws the ends of the wire apart directly it is melted.

Shunted Fuse Working by Gravity.—The writer has suggested a combination of the shunted fuse with this springing back of the terminals. The arrangement is shown in fig. 20 applied to a high tension transmission of power line. The heavy fusible alloy which ordinarily carries the greater portion of the current is plugged in between the two lower terminals, whilst the shunt consisting of a fine copper wire connects the two upper terminals. These are hinged

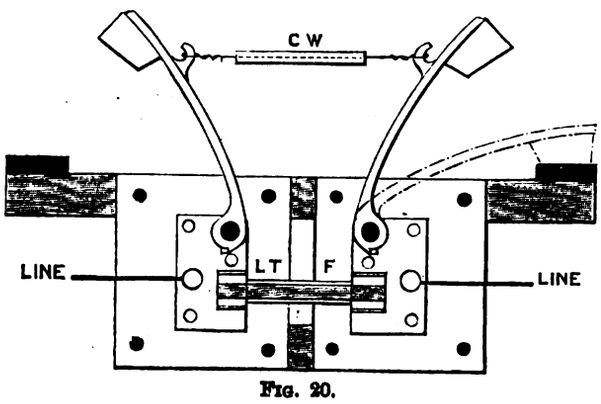

FIG. 20.

and weighted so that directly the copper wire melts by having the main current shunted through it, they fall back into the dotted position. Any arcing that may occur will soon go out, because the hot air tends to make it rise as in the exceedingly simple but effective Siemens & Halske lightning arrester, which works entirely by the arc creeping up two (or three for three-phase) curved arms and gradually lengthening until it flickers out.

PART III.—NON-ARCING METALS, &c.

The perfect non-arcing metal would be one having no resistance, for then there would be no heating of the final point of contact, and consequently the arc would not start. This is of course impossible, and therefore the term non-arcing metals is always taken to mean metal which on commencing to arc gives off a vapour which forms an exceedingly high resistance.

The Wurts Non-arcing Arrester.—As the result of most exhaustive researches Mr. Wurts found that certain particular metals and combinations of metals—the most important being zinc and antimony—gave a non-arcing effect when the distance between the metal was only $\frac{1}{32}$nd of an inch (see fig. 21). Various explanations are offered to account for this non-arcing property, but the one most generally

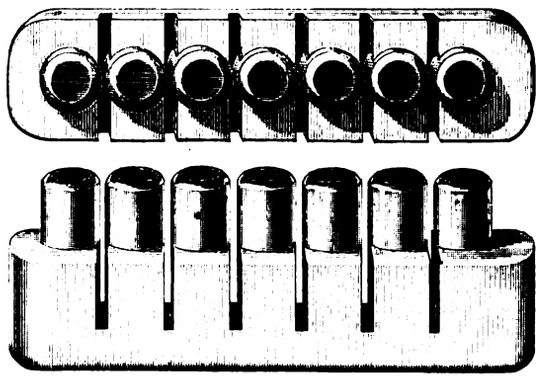

FIG. 21.

accepted is that the metals immediately produce a non-conducting oxide vapour over which the current cannot pass.

It has been thought that besides the non-arcing property of the alloy, the considerable mass of metal which is necessary for the rollers has a beneficial effect in cooling off the small arcs produced.

A peculiar feature in connection with the device is that if the spark gaps are long, say $\frac{1}{2}$ inch each, most vicious arcing will occur, probably because the oxide vapour has a much better chance of being dissipated.

Although originally introduced for the purpose of being applied to lightning arresters, it involves a principle of suppressing arcs, which the writer believes will some day have a much wider application. In the discussion on Mr. Byng's paper before the Institution of Electrical Engineers, the writer suggested the application of the idea to switches, and it is interesting to note that this has now been tried with satisfactory results.

Müller Non-Arcing Switch.—Mr. H. Müller, of the Electricitäts Actiengesellschaft, late Schuckert & Co., has designed a high tension switch for alternating current, in which the Wurts non-arcing device is introduced. It consists of 16 small rollers (see fig. 22) of non-

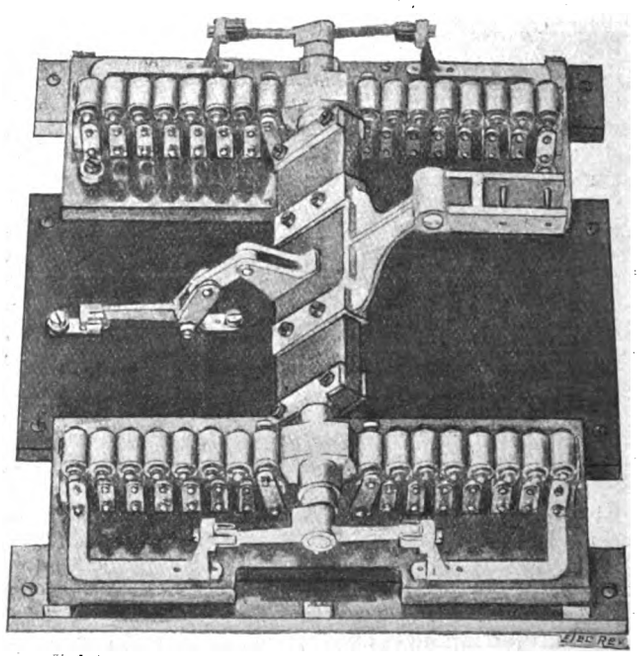

FIG. 22.

arcing metal, having spaces of 1 to 1½ mm. between them. When the switch is made, a cam comes between the two sets of rollers and forces them all into contact, at the same time rotating the rollers slightly, causing new faces to be brought into contact, and rubbing off any oxide which may have been produced. These switches will break 6,000 volts with very slight sparking, and they have been in use for some time in the municipal lighting station at Nurnberg, working with 2,000 volts 150 amperes. As the rollers are not very good conductors, for extra large current the rollers are used as a final break to an ordinary switch of the hatchet pattern, connected to the same cam which actuates the rollers. In switching on the rollers are first connected up, and then the main switch, and when the latter is home it takes all the current (see fig. 23).

Aluminium, Platinum, &c.—Experience with aluminium has been so favourable, that it is now used almost exclusively for high tension fuse wires in America, and it is possible that this preference may be due to its forming a non-arcing oxide. In a power transmission line in South California, working at 33,000 volts, the fuse wires are of

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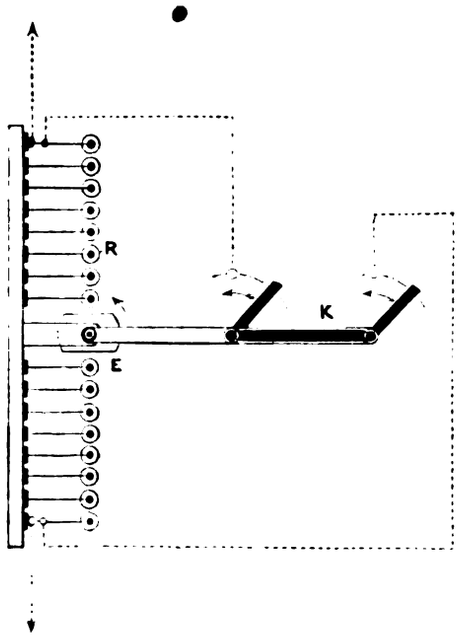
No. 20 gauge pure aluminium wire. They are 3 feet long, and run through wooden tubes, on the ends of which hatchet contacts are fixed, which can be quickly removed for re-fusing. On another plant working with 10,000 volts, an aluminium fuse wire about 1 foot long is



stretched horizontally, the wire being surrounded by a soft rubber tube. When the fuse goes, this tube drops by its own weight, carrying with it the molten metal and giving a clean break.

It is interesting to note that some metals do not readily oxidise with an arc. Platinum oxides, for example, can only be made by the wet process, and they are at once dissociated by the application of heat. Platinum is thus, in a sense, a non-arcing metal; its efficacy, when used as a final breaking point of switches, &c, is well known.

PART IV.—CONCLUSION.

Many suggestions have been made which have not been put into practice, thus one idea is that the fuse wire should have attached to it a small cap which will explode when the wire melts and thus dissipate the metallic vapours. Another suggestion is that the wire should be covered with some material which would combine with the metal to form a heavy insulating gas.

It has also been suggested that the fuse be surrounded by carbon dioxide gas, which ordinarily will not support combustion. This would not be much good with the electric arc, however, because we know from experience that an enclosed arc lamp or semi-enclosed arc lamp,* as it really is, burns well in an atmosphere consisting mainly of carbon dioxide gas.

In 1894 Mr. J. Sachs suggested burying the fuse wire in a chemical salt, which would combine with the metal of the fuse when heated. Something of the sort might be done, but there would always be the danger that its carrying capacity might be lessened, due to the salt attacking the metal when it was only warm.

A curious development of the difficulty in dealing with the large amounts of current at extra high voltages on transmission of power lines, is the suggestion to do away with safety devices altogether. It has long been known that certain types of alternators could be so designed that they would withstand considerable overloading without showing evil effects. It appears that American engineers are now going further in this direction, and actually designing multiphase alternators for transmission of power work, with the sole idea of their being able to withstand short-circuiting, so that when a fault occurs on the line a large current is passed sufficient to burn it out. The change is not so drastic as it appears at first sight, because the writer understands it has been the practice in this city for some time to burn out any faults which may occur on the underground continuous current cables.

Manchester and Liverpool.—The Irlam District Council has decided not to give its assent to the Bill promoted for the construction of the proposed electric railway between Manchester and Liverpool. As it is proposed to alter the gradients of some of the roads in the township, the Council desires to obtain a *locus standi* in the matter.

* As there appears to be some misconception on the point it may be mentioned that an *entirely* enclosed arc will not work satisfactorily. Directly every particle of free oxygen has been burnt up the carbons begin to pump violently and a steady arc is out of the question however much the mechanism may be adjusted.

COMBINED REFUSE DESTRUCTORS AND ELECTRIC LIGHTING PLANTS.

THE meetings held at the Institution of Civil Engineers on Tuesdays, December 12th and 19th, have again brought the question of combined refuse destructors and electric light installations to the front.

The occasion was the reading of a paper by Mr. C. Newton Russell, its subject being "Combined Refuse Destructor and Power Plant," and its object lesson "Shoreditch Works." A brief abstract was published in the ELECTRICAL REVIEW for December 22nd.

As a preliminary remark, we congratulate Mr. Russell upon the clear and explicit statements set forth, although our deductions may be somewhat different from his own.

Our readers will bear in mind that some two years since the question was discussed again and again in these columns, and we then expressed a doubt as to the advisability of thus combining two distinct undertakings, although the plea of economy is one which is undoubtedly a favourite topic with the faddists who are to be found on most of our vestries and district councils.

The perusal of this paper does not in the slightest degree alter the opinion we then formed, viz, that a well-constructed destructor and a well-designed electrical installation would work better if each were independent of the other, than any scheme of combination such as that in operation at Shoreditch.

In the paper itself there was nothing new, or beyond that which had already been put forth in detail, but it has the merit of being fairly concise, and of bringing into a readable form its various details.

The discussion which ensued was of an interesting character, and the gentlemen who took part were well alive to the importance of the subject, and were practically acquainted with it.

Mr. Laws, engineer of the Newcastle Corporation; Mr. Charles Jones, of Ealing; Mr. Blair, of St. Pancras; Mr. Terry, late Local Government Board inspector; a representative from Oldham; Messrs. Manville, Alliott and Beaman; Mr. Watson, of the Horsfall Company; and Mr. A. H. Preece, all added something to the general interest of the occasion, but we could not gather from anyone of them (other than they who were absolutely connected with Shoreditch) any very marked approval of the scheme, and although there was a decided approval of the character of the work as carried out, we could not help coming to the conclusion from the evidence of the great majority of these practical men, that the consensus of their opinions was that a large expenditure had been made on the capital account, and a very considerable expense was being incurred upon the current account. Therefore outlays were not justified by results, or, to put it in plain language, the game was not worth the candle.

The remarks of Mr. A. H. Preece were very interesting, he having been connected with the installation at Llandudno, and nothing could more thoroughly justify our opinion as to the desirability of the destructor and the electric light installation being absolutely distinct than the experience detailed by him of the Llandudno combination during the short period which has elapsed since its erection. The destructor in this case appears to have been designed for a town with a population certainly considerably larger than Llandudno, even when its influx of visitors is at its maximum. The admission that the destructor furnaces were let out at night in consequence of there not being sufficient material to burn (to say nothing of the admitted use of coal) shows an exceedingly weak point in the arrangement of the same, for anyone connected with the working of such undertakings knows full well that one of the essential points is that the combustion should go on night and day, year in and year out, excepting when it is absolutely necessary to shut down in order to repair.

Touching upon the several details of the work as set forth in the paper, we admit that time has to some extent proved the correctness of the statements made with respect to combustion of coals as an addition to the power derived from the combustion of house refuse, but the fact that some £1,308 was spent during the year ended March, 1899, is somewhat startling when we remember the language used in the early stages of this discussion, and when we suggested that it would

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be necessary to use a certain amount of coal, which would be better utilised in a boiler properly constructed, where advantage could be taken of its full calorific value.

The fact that a considerable amount of steam-raising property exists in house refuse has never been denied, but from the remarks made by Lord Kelvin at the opening ceremony, and repeated by him during his journey in the United States, it might be supposed Shoreditch was the first place that ever attempted to utilise house refuse. Probably, notwithstanding his extensive knowledge, Lord Kelvin was unaware, at the time, that destructors were a comparatively old institution in England, at any rate, some 30 years old, and that, from the very first, they had been used for steam-raising purposes.

We will not refer to the now historical banquet held at the opening of the destructor, to the "turning out of the old light and the turning on of the new," &c., nor to the dedicatory prayer of the esteemed Vicar of Shoreditch, but we regret the fact (referred to by Mr. Charles Jones in the discussion) that the remarks then made by such an authority tend largely to mislead many who are honestly desirous of utilising the waste material of their cities and towns. Many of these municipal men would be led into extravagance in the construction of an apparatus which, while suitable for a district such as Shoreditch, with its crowded population, would be in nowise suitable for a large majority of towns whose sanitary requirements are as great as those of Shoreditch, but whose means of meeting the same are far more limited.

Upon one question there can be no shadow of a doubt, that the installation in its entirety was a most expensive one, and that the cost of the destruction of refuse is immensely higher than in any other place in England. By referring to the tables in Mr. Charles Jones's book on "Refuse Destructors," published in 1894, we find that the expense incurred in destroying refuse is represented as varying from 3½d. to 1s. 7d. per ton, about 10d. being a fair average.

According to Mr. Russell's paper, at Shoreditch the cost may be taken at 2s. 7d. per ton, to which must be added 11½d. per ton for the repayment of principal and interest extending over 30 years, bringing it, in round figures, to 3s. 6½d. per ton.

Surely this is a serious item, more especially as it must of necessity extend over a long period of years. We note that the average term at Shoreditch is 30 years.

Now, if 10d. or 1s. may be taken as the average cost of the destruction of refuse per ton, and the remaining 2s. 6½d. had been devoted to coals, surely it goes a long way to prove our statement that these installations would be far better if independent one of the other, and so avoid the uncertainty which evidently appertains to the use of house refuse for steam-raising purposes.

We do not say that house refuse should not be utilised. There are many other purposes, not requiring so careful and scientific a treatment as electric lighting, where it might well be employed with advantage.

With reference to the "thermal storage," about which so much was said, and with which so little has been done, we have still less to say. Although un-utilised for a considerable period *after* the opening of the works, it appears now to be used to a certain degree, but notwithstanding that the term "thermal storage" is still used in connection with it, it appears to us to be very little more than a somewhat extravagantly sized hot water cistern, and we have very considerable doubt as to whether we shall find it in any further scheme which may be evolved from the brains of the designers of the Shoreditch installation.

The speakers had experience of both low temperature and high temperature. Mr. Laws had experience of low temperature only, and he spoke most highly of its usefulness in the town of Newcastle. Mr. Charles Jones has always been considered the champion of low temperature cells, but we find that he has a combination, and he spoke highly of the effect of his last-constructed cell which, by-the-bye, we had never heard of before, and which he evidently has kept very quiet until the time came for making it known.

The question of the character of the refuse was hardly touched upon. We regret this somewhat, for, as Mr. Russell states, the fact of Shoreditch being a large cabinet-making factory, or, in other words, that a very large proportion of its inhabitants are engaged in that trade, undoubtedly is supposed to give the key to the value of the refuse, but we note that in the appendix, he states that only 5 per cent. of the entire quantity can be taken as trade refuse. We do not doubt for a single moment Mr. Russell's statement, yet, at the same time, when we notice the large amount of motive power used, and that in cabinet-making works, we ask how it can be proved that only 5 per cent. is other than house refuse, and this detail is, we think, rather difficult to explain.

The question has, undoubtedly, a considerable bearing upon what Mr. Russell terms the "result of the experience gained at Shoreditch."

We doubt very much whether the domestic house refuse in London has, as alleged, a calorific value equal to 1 lb. water to 1 lb. refuse burnt, and certainly, if he includes greater London in the category, we say absolutely that such a thing cannot be. Taking seasons, such as the last three summer seasons, we believe that in greater London the refuse has been comparatively valueless, arising from the fact that the summer heat, to a great extent, minimised the combustion of coal. This statement we make on indisputable testimony.

No. 2 of his results goes to prove that in London domestic refuse can be destroyed for "2s. 5d. per ton." We know that it can be destroyed at less than one-half that price in properly and economically constructed cells.

We cannot see our way to agree with Mr. Russell in his third "experience," that if the whole of the refuse of London were burnt in suitably constructed furnaces there could be obtained from it 133,000,000 B.H.P.-hours!!!

"Experience" No. 4, with respect to one boiler and two furnaces in good condition, has too much the character of an advertisement for us to make any remark upon it.

Again congratulating Mr. Russell upon having at last produced a clear and explicit account of all the work done at Shoreditch, its successes and failures, we wish him every success, and hope that he may in the end produce results which will be more satisfactory to himself and to the pockets of the ratepayers of Shoreditch.

The lateness of the hour precluded Mr. Russell's reply; this, we believe, will appear in the *Proceedings* of the Institution.

MUNICIPAL EXTRAVAGANCE.

The publication of the Parliamentary aspirations of the West Ham Corporation ought to make that body immortal in the annals of municipal extravagance. The mere summary of the works contemplated occupies 17½ closely printed columns in the *London Gazette* of November 24th. The estimated cost is not, of course, at present disclosed. Equally the summary exhibits the presence of the pernicious socialistic ideas, the petty grasping after power, the resentment against checks upon excessive expenditure, and the general condition of "swelled head," which have so frequently rendered similar authorities the laughing-stock and, withal, the enemy of the business man.

One might have thought, however, that any corporation situated in such an essentially commercial district, would have been reasonably satisfied with their previous efforts, content to proceed at a moderate pace, and careful of the interests of the large ratepayers, lest perchance they should kill the goose which lays the golden eggs. But our unfortunate experience of local authorities leads us to expect nothing of the sort. On the contrary, that "Appetite grows by what it feeds on" was never more fatally illustrated than in the financial career of these bodies. They can digest any amount of public expenditure and always desire more.

The members constituting the local authority in a commercial district are not always, we had almost said not usually, people of much consequence by reason of any great activity displayed or success obtained by them in their own business. Nor are they usually conspicuous for the large sums which they contribute in the shape of rates towards the public expenditure upon which they so lightly embark. Where the bulk of the electors are working men, representatives of this kind, and with these ideas and characteristics,

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are usually elected. And then there is the fascination of spending money—other people's money—a fascination which comes with multiplied force to a man who has never had very much of his own. To see every road up, many buildings down, and a huge area covered with bricks and mortar, affords a sense of power and consequence to the class of mind with which the individuals who project these gigantic and extravagant public works are usually endowed. Of course hundreds of electors are thus provided with occupations at which they can work leisurely at comfortable wages. And so satisfaction—except in the breasts of the ratepayers—reigns supreme.

Turning to the summary, we find that the first 17 items of this preposterous programme relate to the widening of some 20 thoroughfares, and the construction of three new roads, one of which is to involve a bridge over the channelsea river. This is a pretty good mouthful to begin with, but it fades into insignificance by the side of the other morsels presented for the ratepayers' delectation.

The next item looks innocent enough at first sight. The Corporation desire to be empowered to erect, maintain, and work stations (in addition to the existing station) for generating and distributing electrical energy, with all necessary dynamos, batteries, accumulators, engines, plant, machinery, works, and conveniences for that purpose. This power, however, does not appear to be desired in order that the borough may be better lighted. Its true purpose is to be found in connection with the elaborate tramway system which the Corporation wish to create. This egregious body propose in the Bill to obtain power to lay down, work, use, and maintain *eleven* tramways, with "all necessary and proper rails, plates, sleepers, channels, junctions, turn-tables, turnouts, crossings, &c." The motive power to be used is declared to be, *inter alia*, electrical, and the Corporation are asking the Legislature "to alter and amend the provisions of the West Ham Electric Lighting Order, 1892, and to enable the Corporation to utilise electrical power generated under the powers of that order for the purposes of any of the tramways proposed to be authorised by the Bill." No wonder fresh generating stations will be required! And how much is all this to cost?

It will be seen that the enterprise of the Corporation is by no means confined to their own district, which is evidently much too cramped, in the opinion of these gentry, to afford a proper theatre for the display of their "improving mania." The urban district of Leyton is to be invaded for the purpose of widening streets and erecting artisans' dwellings. The urban district of East Ham is to be invaded by "Tramway No. 11." And the Corporation desire to be exempted in regard to any portion of the intended tramways which will be situate outside the county borough, from the provisions of the Tramways Act of 1870, with respect to the purchase of tramways by local authorities. That is, the Corporation wish to purchase and run, out of their own rates, a tramway situated out of their district! It is, indeed, fortunate that there are statutory safeguards which such municipal madness has to reckon with.

Is there *any* territorial limit to the ambition of the West Ham dignitaries? We, ourselves, can assign none, seeing that the Corporation already appear to regard the whole county of Essex as their lawful prey.

It must be remembered that the Corporation are seeking compulsory powers of acquiring lands for the purposes of their schemes. And they are asking Parliament for authority to purchase "so much only of any house, building, manufactory, or property as may be required for the purposes of the Bill." This affords a cheerful prospect to any unfortunate manufacturer whose premises are thus to be arbitrarily encroached upon. The inconvenience to him, and the difficulty of acquiring suitable premises in the neighbourhood to take the place of that portion of which he is deprived, are little likely to cause much heartburning amongst the members of the Corporation. The taking of a portion of a manufactory may easily render the remainder almost useless. Suitable re-arrangement may be impossible, and the manufacturer may be left with expensive premises which he cannot get rid of, and which no longer allow of the proper conduct of his business. It is true that he may get compensation for this, after much wrangling, but in any case it will hardly be adequate to reimburse him for the loss sustained by disorganisation of his trading arrangements.

The appetite of the Corporation for inaugurating and carrying on large undertakings is not even yet sated. In addition to the 11 tramways to be laid down, and the unlimited number of houses to be put up, the manufacture and sale of flagging and paving, or any material used in the paving of footpaths, is to be also conducted at the ratepayers' expense. There is certainly no half-heartedness about all these proposals. Considered as an instalment of the Corporation's fancies, they leave nothing to be desired, and everything to be feared. No doubt a complete works' department, which shall outvie that of the London County Council in wasteful inefficiency, is in speedy contemplation.

Another provision of the Bill calls for special notice. An attempt is made to get rid of Sub-section (4) of Section 174 (wrongly given as 175 in the Bill) of the Public Health Act, 1875. The obnoxious sub-section provides that, "before any contract of the value or amount of £100 or upwards is entered into by an urban authority, *10 days public notice at the least shall be given*, expressing the nature and purpose thereof, and inviting tenders for the execution of the same; and such authority shall require and take sufficient security for the due performance of the same." Why is this most salutary provision irksome to the Corporation?

We cannot dismiss the West Ham Corporation into the obscurity from which it has so unpleasantly emerged without a reference to the conditions upon which they do invite tenders. In the *South Essex Mail*, in the column next following the "summary" of the proposed Bill, there is a notice "to electrical engineers and others" inviting tenders for certain works. It is necessary under Sub-section (2) of Section 174 of the Act of 1875 that the due performance of a contract to execute works for an urban authority should be secured by a pecuniary penalty. The Corporation have interpreted this sub-section as allowing them to make compliance with any fanciful or sentimental whim which may possess them at the moment a term of the contract, and to secure its observance by the same penalty exacted for a serious breach of the contract. The contractor "will be required to pay *all workmen employed by him in or about the contract such rates of pay, and observe such hours of labour as are embodied in the schedule, which will be part of the contract.* In the event of any breach of such agreement the Council will enforce the penalty clause in its entirety." Impertinence would be a mild term to apply to the clause in italics, and the threat which follows it is an idle one. The sum fixed being a penalty, the Corporation could only recover so much of that sum as would be equal to the loss they had actually sustained by the failure to comply with the clause.

Apparently they are alive to the emptiness of this menace, for the notice inviting the unwary electrical engineer to tender proceeds to set out an even more insolent condition. "A tender will not be accepted unless it is stated by the contractor in the tender, and proved to the satisfaction of the Council, that the contractor *at the date of the tender* pays *to the whole* of his workmen such rates of wages and observes such hours of labour as are recognised by the workmen's trade unions *in the several localities* where his work is done. If after the contract is signed it shall be proved that the said statements of the contractor are contrary to fact the Council shall be entitled to rescind the contract, or at its option to recover from the contractor as *liquidated damages*, and not as a penalty, the sum of £50. Now, even a Corporation cannot alter the nature of things by juggling with names. It is more than likely that the £50, even though described as liquidated damages, will be held to be simply a penalty. If so, and the Corporation desires to recover more than merely nominal damages, it will have to prove that it has sustained actual injury.

If the desire to avoid public invitation of tenders is prompted by reluctance to bring these offensive stipulations to the notice of the ratepayers, some slight justification might be found for it. When all private contractors have been choked off, no doubt the Corporation will go rapidly downhill under the burden of its own works department. Meanwhile, considerable sums are to be spent in promoting this ridiculous Bill; and there is little or no chance of most of its provisions finding favour in the eyes of Parliament. It would be only justice if those responsible for the Bill could be compelled to pay the money thus wasted, out of their own pockets.

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LIGHT RAILWAYS.

The following is the complete official list of light railway applications which were lodged with the Light Railway Commissioners in November. Most of these have been already mentioned in the Review recently, but the list is of value as giving the gauge, length, engineer's name, &c.:—

Title.	Promoters.	Engineer.	Mileage.	Motive power.	Gauge.
England.					ft. in.
Aldershot and Farnborough (extension) ...	Power & Traction, Limited	G. Hopkins & Sons ...	½	Electric	3 6
Barnsley and District (extension)	British Electric Traction Company... ...	S. Sellon	½	„	3 6
Blackpool and Garstang	Blackpool and Garstang Electric Light Railway Company	J. J. Myres	16¼	„	4 8½
Blyth and District	British Electric Traction Company... ...	S. Sellon	1½	„	3 6
Brackenhill (extension)	Yorkshire District Light Railway Syndicate	Mammatt & White ...	2	Steam	4 8½
Bridgwater, Stowey, and Stogursey ...	H. P. Bouverie, A. Pearce, and R. A. Read	R. M. Parkinson ...	11	„	4 8½
Cheltenham and District (extension) ...	T. Nevins	T. Nevins	2½	Electric	3 6
Cinque Ports	D. Cook...	D. Cook and J. T. Rossiter	67¾	„	3 6
City of Bath	Bath Corporation	O. R. Fortune and G. F. Metzger	18	Mechanical	4 0
County of Hertford, No. 1	Hertford County Council and the Metropolitan Tramways and Omnibus Company	V. B. D. Cooper ...	5¾	Electric	4 8½
„ „ No. 2	Ditto Ditto	Ditto	2	„	4 8½
„ „ No. 3	Ditto Ditto	Ditto	9	„	4 8½
„ „ No. 4	Ditto Ditto	Ditto	3½	„	4 8½
County of Middlesex, No. 2	Middlesex County Council	H. T. Wakelam	12	„	4 8½
Devon South Hams	H. B. Sneridan and T. W. Barber	T. W. Barber	37½	Steam	4 8½
East and West Yorkshire Union, 1900 ...	East and West Yorkshire Union Railway Company	Mammatt & White ...	1¼	„	4 8½
East Sussex	J. Selmes and J. Neve	H. F. Stephens	7¼	„	4 8½
Gloucester and District	City of Gloucester Tramways Company ...	J. Clifton Robinson ...	8	Electric	3 6
Hayling Island	W. Paynter, H. R. Trigg, and E. Belfield ...	Knowles & Russell ...	4⅜	„	4 8½
Kingston, Surbiton, and District	Greenwood & Batley, Limited	A. H. Rowan	4¾	„	4 8½
London County (Archway Road, Highgate)	London County Council	Sir A. Binnie	¼	„	4 8½
London County (Clapham, Wandsworth and Kingston road)	Ditto Ditto	Ditto	5½	„	4 8½
London County (Deptford, Shooter's Hill, and Woolwich)	Ditto Ditto	Ditto	5½	„	4 8½
London County (New Cross, Lewisham, and Eltham)	Ditto Ditto	Ditto	4½	„	4 8½
Long Melford and Hadleigh	Rev. Sir Wm. Hyde Parker, Sir Wm. C. Quilter and others	H. F. Stephens... ...	15	Steam	4 8½
Loughborough and District	Loughborough and District Electric Traction Syndicate	C. H. Gadsby	8¼	Electric	3 6
Lulworth and Osmington	H. W. Blundell, F. Terrell, and W. B Pritchard	E. Cruttwell and R. St. George Moore	13½	Steam	4 8½
Mansfield and District	J. Fell, J. Lewis, and W. J. Kershaw ...	C. H. Gadsby	5¾	Electric	3 6
Mid-Anglian	C. T. Molineux-Montgomerie & B. M. Kilby	Jeyes and Godden ...	39¾	Steam or electric	4 8½
Morley and District	British Electric Traction Company... ...	S. Sellon...	10	Electric	4 8½
New Romney and Hythe	South-Eastern Railway Company & London, Chatham, and Dover Railway Company	A. T. Barry and P. C. Tempest	9¼	Steam	4 8½
Oldham, Ashton-under-Lyne, Hyde and District (extensions)	Oldham, Ashton, and Hyde Electric Tramway Company	S. Sellon	4¼	Electric	4 8½
Peterborough and District (extensions) ...	British Electric Traction Company ...	Ditto	1	„	3 6
Spen Valley (extensions)	Ditto Ditto ...	Ditto	12	„	4 8½
Tickhill...	Wm. McDonnell Mackay and G. H. Newborn	L. B. Wells	17½	Steam	4 8½
Wakefield and District	J. Fell, J. J. Gittings, E. Horton, and W. J. Kershaw	Pritchard & Co.... ...	10	Electric	3 6
Warrington and Northwich	A. Anderson, J. Hesketh, and A. Brown ...	R. H. Scotter	13½	„	4 8½
West Hartlepool (extensions)	Hartlepool Electric Tramways Company ...	S. Sellon	1⅝	„	3 6
Wigan...	Wigan and District Tramways Company ...	Ditto	7¾	„	3 6
Windermere and District	British Electric Traction Company ...	Ditto	6½	„	3 6
Witney, Burford, and Andoversford ...	Witney, Burford, &c., Light Railway Syndicate	Sir J. Szlumper and W. Szlumper	23¾	Steam	4 8½
Wotton-under-Edge	Railway Developments, Limited	A. P. J. Cotterill ...	3¼	„	4 8½
Wales.					
Llanelly and District...	Llanelly and District Electric Lighting Co.	R Wilson	7¼	Electric	3 6

LEGAL.

Jackson *v.* Clough.

The hearing of this case lasted nearly six days at the recent Leeds Assizes, where it came before Mr. Justice Grantham and a special jury. The plaintiff, Mr. Frederick Sagar Jackson, sued Mr. Walter Owen Clough, M.P., for damages for alleged false and fraudulent misrepresentations, and also in respect of certain alleged untrue statements contained in the prospectus of a company known as the India-Rubber Company (Mexico), Limited, of which the defendant became a director. It was alleged that, owing to certain false statements, the plaintiff had been induced to underwrite debentures in the company. Mr. Scott Fox, Q.C., and Mr. Manistry appeared for the plaintiff, while the defendant was represented by Mr. Tindal Atkinson, Q.C., Mr. A. J. David, and Mr. H. T. Waddy.

According to the pleadings the defendant was interested in two companies, called respectively the Mexican Finance Corporation, Limited, and the India-Rubber (Mexico), Limited. The first-named was a company to acquire a concession which had been obtained from Mexican land-owners of alleged India-rubber estates. It was also alleged that, in order to induce the plaintiff to underwrite debenture stock in the India-Rubber (Mexico), Limited, the defendant, in March, 1897, falsely and fraudulently represented, or caused it to be represented to the plaintiff (1) that the defendant had made no profit whatever on the sale to the Mexican Finance Corporation, Limited, and (2) that the vendors transferred their bargain to the said corporation without profit, and that the defendant had underwritten £5,000 in the India-Rubber (Mexico), Limited. It was further alleged that the plaintiff, on the faith of the said false and fraudulent representations, agreed to underwrite, and did underwrite, £2,000 in debenture stock in the India-Rubber (Mexico) Limited, and had been compelled to pay £1,600 in respect thereof. It was further alleged that a certain prospectus of the India-Rubber (Mexico), Limited, which was issued with the defendant's sanction, contained the following untrue statements:—(*a*) That the company had been formed to acquire and develop two estates in Mexico, known as La Esmeralda and Llano de Juarez, covering, together, about 287,000 English acres, upon which there were 350,000 India-rubber trees available for tapping. This statement was alleged to be untrue, it being alleged that the estates only covered about 56,000 acres, and that very few trees were growing thereon. (*b*) That La Esmeralda was the largest known matured India-rubber plantation. This statement was alleged to be untrue in every particular. The defence was a complete denial of the allegation in the statement of claim, and that the statements in the prospectus were honestly made after full and complete investigation.

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The following outline will serve to show the general nature of the case:—In the autumn of 1876 the defendant and other gentlemen subscribed to send out a Mr. Abrahams to inquire into certain estates in Mexico, said to be capable of producing India-rubber in large quantities. Mr. Abrahams reported favourably on the estate known as the Llano de Juarez; but in the course of the case it came to light that Mr. Abrahams was interested in the successful flotation of the company to the extent of £27,000. This was put forward by the plaintiff as showing that his report was unreliable.

Before forming a company to acquire the estates, inquiry was made of the British Consul at Mexico with regard to the Esmeralda. This gentleman replied by detailing the products that could be got from the estates. The syndicate then agreed to pay £34,000 for the Esmeralda and £116,000 for the Llano de Juarez. In order to carry out the undertaking, the defendant with other gentlemen proceeded to form a company known as the Mexican Finance Corporation. This was registered with a capital of £30,000 in 600 shares of £50 each, and the interest of the syndicate in the land was transferred to the corporation under two agreements. The vendors were to receive £10,000 in cash and shares, while the corporation were to take over the bargain of the vendors with all its privileges. The remainder of the shares in the corporation were to be allotted to the underwriters. The prospectus of the India-Rubber (Mexico) Limited, which was then issued showed a share capital of £406,000, comprising ordinary shares and £200,000 7 per cent. first mortgage debentures of £50. The purchase price of the two Mexican estates, which were alleged to be about 287,000 English acres, and to contain upwards of 350,000 India-rubber trees, was fixed at £556,000 by the Mexican Finance Corporation. This was to be paid as to £150,000 in cash, and as to the balance in cash and shares. [The income for 1897 from India-rubber was estimated to be £87,500.] At this stage the plaintiff was introduced by Mr. Lenty, M.P., to the defendant with a view to underwriting some of the debentures in the Rubber Company. Upon hearing that the defendant was himself underwriting to the amount of £5,000, and relying (as he said) upon the statements in the rubber prospectus, Mr. Jackson consented to underwrite £2,000 of shares. The subsequent failure of the public to take up shares, except to the extent of about £80,000, involved the plaintiff in a liability for £1,000, which he had paid.

In support of the allegations made in the statement of claim, a large number of witnesses were called on behalf of the plaintiff. With regard to the first allegation, namely, that the defendant had said he was making no profit, the plaintiff and Mr. Lenty both stated that the prospectus of the Finance Corporation which contained a statement to the effect that the directors were making a profit, had not been laid before them. Mr. Lenty also stated that he had twice been assured by Mr. Clough that he was making no profit. In answer to this, the defendant said that he had told Mr. Lenty in the first instance, that the vendors to the Finance Corporation were making a share profit but not a monetary profit. He also said that he had sent a copy of the prospectus of the Finance Corporation to the plaintiff in the first instance. He denied that he had ever told Mr. Lenty or the plaintiff that he was making no profit.

With regard to the second allegation, namely, that the plaintiff had been induced to underwrite because the defendant had himself underwritten £5,000 of debentures, it was proved that a list of underwriters had been prepared and shown to the plaintiff, upon which the defendant's name appeared. In answer to this the defendant gave evidence to the effect that he always had been ready and willing to underwrite to that extent, but that owing to the great competition among underwriters he had stood on one side.

With regard to the alleged false statements in the prospectus, a number of reports were referred to during the trial dealing with the area of the estate and the number of rubber trees which had been found thereon by the persons who have been sent out to survey it. Soon after the scheme to buy the estate had been mooted, Mr. Clough and his colleagues had sent out Mr. Abrahams to make a report. The defendant stated that he had been quite satisfied with Abrahams' report with regard to the Llano de Juarez, and that he had been corroborated by a pamphlet issued by the Foreign Office. He never had any reason to doubt that the area of both estates was correctly described, namely, Llano de Juarez, 215,000 acres, and La Esmeralda, 72,000 acres. When the estate was handed over there were annexes which would have made up the deficiency in La Esmeralda. As against this the plaintiff relied upon the report of Mr. Ford, according to whom the cultivated portion of La Esmeralda was only 8,500 acres, the remainder being quite uncultivated.

With regard to Abrahams, the defendant admitted that he had been sent out to make his report soon after he was made bankrupt, and that he was interested in the venture to the extent of £27,000. The company were charging nearly £2 per acre for 287,000 acres, although Sir H. Daring had stated in his report that the price of land was only from 3s. to 4s. per acre. The defendant explained the difference by saying that roads, &c., had to be erected on the property.

The learned Judge in the course of his summing up called attention to the Directors' Liability Act of 1890, and to the important issues under Section 3 of that Act which was raised in the case. He left the following questions to the jury:—(1) Were the statements in the prospectus set out in the statement of claim untrue? (2) Did the defendant believe or had he reasonable cause to believe that they were true? (3) Even if the defendant believed that the statements were true, had he reasonable ground to believe that the person who made the report on which the statements in the prospectus were founded was competent to make it? The jury found for the plaintiff on all counts, and assessed the damages at £1,100.

Mr. Tindal Atkinson applied for a stay of execution pending an appeal, which was granted subject to the payment of the full sum into Court within 14 days.

CORRESPONDENCE.

Berrenberg and Tested Lamps.

I have read the correspondence in your paper *re* the "Berrenberg Lamps" and also "Tested Lamps."

Now, I would suggest that the Tested Lamp Company should test the Berrenberg lamps, whether there is gas in their globes or not, whether their filaments are flashed or otherwise.

This would leave you free to attend to your editorial duties, which barely include the testing of lamps.

No doubt, if these lamps were connected to the Metropolitan Electric Supply Company's mains between 4 and 8 p.m., they would show as much light as any others, and have an extremely long life.

I am responsible for a small station in a town which is little better than a village, and I wish my customers were educated up to the London standard.

If the lights give so much as a flicker, I dare not walk through the streets for a week.

X.

The Scarcity of G.P.

In view of the present scarcity and high price of gutta-percha, and as now all attention is devoted to South Africa where, in consequence of the war, there are many unemployed, would it not be worth while for some of our specialists to examine and experiment with the juice of the Euphorbia? There are an immense number of these trees along the coast line and in the thorn valleys of Pondo-Land, Natal, and Zululand, and probably also further north.

There are several sorts of Euphorbia. They resemble cactus in appearance, and when the bark is cut a quantity of white juice like milk or cream exudes.

If this is thrown into boiling water it coagulates and becomes a more or less plastic substance, very much like gutta-percha. This may or may not be of value, but I do not think it has ever been brought to the notice of anyone capable of judging.

Possibly it may have some as yet undiscovered use, and in future form an export from the localities where the trees grow in abundance.

If this letter meets the eye of anyone in Natal who would take the trouble of collecting some and send it, say, to the office of your paper, you could hand it to some firm or expert who would be willing to publish his opinion of the substance in your columns. In fact, I would say of this letter, "Natal newspapers please copy."

J. E. R.

[The plant named has been thoroughly investigated times out of number, by manufacturers and experts.—Eds. Elec. Rev.]

BUSINESS NOTICES, &c.

Books Received.—"Annuaire pour l'an 1900," publie par le Bureau des Longitudes. Paris: Gauthier-Villars. 1fr. 50c.

"Electric Power Transmission" by Louis Bell. Second Edition, New York: *Electrical World and Engineer.*

No. 33. "Fire Tests with Glass." A casement glazed with ¼ inch plate glass. A casement glazed with 32 ounces sheet glass. A casement glazed with "Lead Lights." London: The British Fire Prevention Committee. 1s.

Charge of Fraud.—At Wonford Petty Sessions on 19th inst., Ernest John Thomas, an electrical engineer, of Exeter, was charged with obtaining, by false pretences, copper wire from Heaton and Degard, wire manufacturers, of Birmingham. Prosecutors received a letter with a heading describing the applicant as a consulting electrical engineer, of Plymouth, Tavistock and Exeter, asking for one mile and a quarter of copper wire. It was signed on behalf of J. J. Thomas, after which was placed "C.E." They sent the wire, valued at £3 17s. 6d.—William Edward Weston, goods porter, Tavistock, said defendant signed the book for the wire as "J. J. Thomas, C.E."—Detective Crocke deposed to apprehending the prisoner at Plymouth. He was occupying one room with his wife and children, and there were no appearances of any business having been carried on. Prisoner admitted he had no business books. Witness found that he had not carried on any business at Exeter, Plymouth, or Tavistock. The prisoner told him he had been in business in Exeter between 10 and 12 years as an electrical engineer, and established himself at Plymouth in 1897. Committed to take his trial at the Quarter Sessions.

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Electrical Wares Exported.

Week ending Dec 27th, 1898.		Week ending Dec. 26th, 1899.	
Adelaide	Value £500	Albany	Value £15
Alexandria	30	Alexandria	29
,, Teleph. mat. ..	56	Amsterdam	83
Algoa Bay	234	Bombay	66
Amsterdam	40	,, Teleg. wire	80
Bombay	13	Boulogne	30
Buenos Ayres	2,059	Bremen	68
Calcutta	239	Brisbane. Teleg. mat. ..	57
Colombo	60	Brussels	124
Delagoa Bay	44	Buenos Ayres	1,150
Durban	139	,, Teleg. wire ..	634
Hamburg	110	Calcutta	648
Las Palmas	31	Chinde. Teleg. mat.	64
Marseilles	18	Christiania. Teleg. wire ..	296
Melbourne	2,246	Colombo. Teleg. mat.	278
Penang	107	Copenhagen. Teleg. wire ..	95
Singapore	61	,, Telephones ..	88
St. Petersburg	30	Durban	1,156
Sydney	689	,, Teleg. mat.	79
		Havre	80
		Hong Kong	608
		Launceston. Elec. motor ..	120
		Madras	95
		Malta	27
		Marseilles. Teleg. cable ..	694
		Melbourne	264
		,, Teleg mat.	1,037
		Montreal	96
		Perth	44
		Port Elizabeth.	68
		,, Teleg. cable ..	371
		Shanghai	578
		Stockholm. Teleg. mat. ..	557
		Sydney	886
		,, Electric detonators ..	70
		,, Teleg. mat.	92
		Wellington	763
Total ..	£6,706	Total ..	£11,281

Foreign Goods Transhipped.

Bombay. Elec. goods ..	Value £87
Durban. Teleph. mat.	449
Hong Kong. Elec. light appts.	263
Total	£799

Bankruptcy Proceedings.—The first meeting of creditors and public examination in *re* W. Dalziell, electrical engineer, Newcastle-on-Tyne, are to be held on December 29th and January 11th respectively at Newcastle.

Mr. H. Crewdson Howard, 17, Coleman Street, E.C., has been appointed trustee in the failure of W. Rowbotham, electrical engineer, Teddington.

The first meeting of the creditors of Henry L. Howard, of "Wyvestow," Dragon Parade, Harrogate, and carrying on business at 16, Stonegate, York, and 17, Carlisle Street, Hull, electrical and mechanical engineer, and trading as Thomson, Howard & Co., was held at the Official Receiver's office, York, on 19th inst. The debtor's statement of affairs showed that the liabilities of 75 unsecured creditors amounted to £1,998 10s. 5d., and the preferential claims to £42 3s. The assets consisted of stock-in-trade £322 10s. and furniture £300, and with other property amounted to £733 2s. 11d. The deficiency was £1,307 11s. 4d. The debtor attributes his failure to losses on contracts and other business losses. The public examination was fixed for January 5th.

At the Bankruptcy Court on 20th inst. there was a sitting for the public examination of J. C. Howell, electrical engineer, before Mr. Registrar Hope. The accounts showed total liabilities £19,120, of which £10,348 was stated to be unsecured, and an estimated surplus in assets of £1,084. It appeared from the Official Receiver's observations that the debtor described himself as an electrical engineer, and that he commenced business on his own account in 1881, without capital, at Llanelly. In 1890 he took offices at 24, Queen Victoria Street, and traded at Llanelly and in London until 1892, when the business was formed into a company (J. C. Howell, Limited), with a nominal capital of £25,000. The debtor stated that he received as vendor £10,000 in fully paid shares, and remained with the company as managing director, at a salary of £800 per annum, until November, 1895, when the company went into voluntary liquidation. Since 1898 the debtor had acted as managing director of J. C. Howell, Limited (No. 2), a company which was formed in December, 1895. The debtor having been examined at some length, his examination was ordered to be concluded.

Liquidations, Dissolutions, &c.—Creditors of Rounds' Accumulator Company must send particulars of their debts, &c., to Mr. A. Pegram, 70 and 71, Bishopsgate Street, E.C., liquidator, by January 26th.

A general meeting of F. H. Royce & Co., Limited, will be held at Manchester on January 30th to hear an account of the winding up from the liquidators.

Bolling & Lowe's Trade Review for 1899.—In concluding their report last year, Messrs. Bolling & Lowe stated that the prospects of the iron and steel trades for 1899 were very encouraging, and this view has been fully justified. These industries have had quite a boom, and the workmen have fully shared in the benefits. The prosperity of 1899 is largely due to abnormal home requirements, and not specially to exports. This is confirmed by the amount of Government orders placed and the great extension of railways, tramways, electrical installations, shipbuilding, &c.; further, it is reported that Parliament has been applied to for powers to sanction the raising of about £95,744,257 for similar purposes. It is remarkable that in each succeeding boom of late the rise has generally been on a more limited scale and of shorter duration, *e.g.*, 1879, 1889. It remains to be seen whether the present advance will be an exception. In this connection it is noticeable that manufacturers often obtain smaller profits on the higher prices than in normal times when wages and raw materials are proportionately lower and the latter often less difficult to obtain. Germany takes the major portion of the orders from Russia and Eastern Europe, the former being at present one of the largest buyers of iron and steel, and likely to remain so for many years. Nevertheless, Germany's exports have decreased this year on account of the enormous home demand. Besides possessing a direct cable to the Bay of Biscay, she contemplates laying another, of home manufacture, to the United States, and this will probably be followed by others to various countries. The fact that the iron and steel mills in the United States are busy with home requirements (the accumulation of several bad years), and that they can spare little of real magnitude for the outer world, keeps prices rising here and on the Continent, but when the time comes for them to seek outlets for their surplus production, the position will probably be reversed. Their gigantic trade combinations have yet to prove their value to the shareholders and the country. To direct concerns working with vast capitals hitherto unheard of in the industrial world, and, in some cases, under totally new conditions, must require master minds. The Indian Government has granted powers for the construction of 550 miles of tramway and road railway, and three of the largest towns, viz., Calcutta, Bombay and Madras, intend converting their tram lines from horse to electric traction. The total mileage of railways in British India at the beginning of this year was 22,491 miles open, and 3,568 under construction. The many great Indian rivers, with falls suitable for electric power installation, will no doubt soon be utilised. The production of rails in Great Britain is likely to amount to 900,000 tons, of which about 600,000 to 700,000 tons are for export, the remainder being for home consumption. Our exports in iron and steel will exceed those of 1898 in quantity and value, in the latter especially, on account of the exceptional rise in prices; this includes a considerable quantity of pig iron, which goes abroad to be worked up, very often to compete in its manufactured state with material produced here. Since the Light Railways Act came into force there is evidence that the idea is very favourably received by the public. They will be the means of opening communication between towns and villages which were formerly too far apart for ordinary cart traffic, and will also be one of the inducements for the establishment of factories in the country, instead of in or close to towns, consequently shifting the working population further out. The metric system is gaining ground all over the world, but the British Empire has not yet adopted it. With this exception buyers mostly employ it for their inquiries and demands. When we are full of work in this country, as at the present time, manufacturers hesitate to take the trouble to transpose the English measures into metric and *vice versâ*. Business often leaves us for that reason in favour of our competitors, and once custom is placed in new channels it is difficult to regain. The practical success gained by Signor Marconi with his wireless telegraphy has undoubtedly been the scientific achievement of the year, and will prove a great commercial benefit. The prospective Pacific cable uniting British Columbia and Australasia is still in embryo, and the new Telephone Act has been too short a time in existence to demonstrate its expected benefits.

Change of Address.—The Western Electric Company notify that they have removed from their offices at 79, Coleman Street, E.C., to Bridge Chambers, 171, Queen Victoria Street, E.C.

The "Economic" Boiler.—For this type of boiler (Davey, Paxman & Co.) which, as will be seen from another column of this issue, is employed at the Waterloo and City Railway works, the attributes of efficiency, economy and durability are claimed. The "Economic" is of an internally fired type. The furnace terminates in a brick combustion chamber, which becomes greatly heated—in fact, to almost a white heat—and the combustion is stated to be perfect. There is an absence of smoke, which enables the surfaces to be kept clean and to absorb the heat, the gases being cut up in a similar way to those passing through the tubes of a locomotive boiler. In addition to this, the gases pass into a smoke box and are directed round the external surface of the boiler. This is a greater advantage, perhaps, than is commonly thought of by casual observers, inasmuch as the boiler is kept at a more uniform temperature, with the result that there is an absence of leakage set up by undue expansion and contraction in the flue, shell, or tubes. The heating surface is of such a character that the distribution of heat has the greatest effect. These boilers have a large capacity at the water level, thus providing a good steam reserve against sudden calls, and giving a good working margin for the feed supply. In proportion to its heating surface the boiler occupies but little space. The tubes are made ¼th of an inch larger at the fire box than at the smoke box end so that they can be easily removed. There is almost entire freedom from smoke in consequence of the excellent combustion. These boilers are capable of standing heavy firing, being worked at high pressures, they are very reliable, and the cost of repairs is said to be almost *nil*. The "Economic" boiler occupying small space (about half of the Lancashire boiler), there is only a small amount of brickwork required, and the boiler is, therefore, cheaply set. The cleaning of smoke tubes and flues, and also the removing of tubes, is entirely effected from the front of the boiler. The new arrangement of smoke tubes, which Davey, Paxman & Co., Limited, have recently patented, enables thorough inspection to be made internally of every part of the boiler. A very large number of "Economic" boilers are in constant work, and so far as their experience goes, the cost of repairs does not average 5s. per annum. They are being adopted very largely for general purposes as well as for electric light installations, and their excellent working is giving great satisfaction.

Factory Act Summons.—At the Sheffield Police Court last week Messrs. W. E. Burnard & Co., electrical engineers, of St. Mary's Road, were summoned under the Factory and Work-

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shop Acts. The assistant inspector stated that on Saturday, December 9th, the defendants employed two young persons, under the age of 16 years, until a quarter to five in the afternoon, whereas they should have left the premises at four o'clock. A representative of the defendant company said they had forgotten all about the Act. A fine of £2 in each case was imposed.

Electricity in Mining.—The chairman of the Pigg's Peak Development Company in the course of his speech to the shareholders last week, said:—

Working costs are now reduced to under 10s. per ton, and the extraction is considerably better than formerly. Having demonstrated that we have a payable proposition, I should like to tell you what we propose to do when we can resume work. In the first place, we would stop the continued running of the present mill and utilise the electrical power to push on developments in depth until we have a large tonnage of ore opened up for stoping. We should then duplicate the electrical power line from the Falls, where we have almost unlimited water power for all purposes, and erect a new mill and cyanide plant near the entrance to the low level tunnel, where our water supply for mill will be much more permanent and ample than at the old mill site, and facilities for handling the ore more economical. These proposals entail a large expenditure of capital.

The "Financial Times" and the Copper Combine.—The *Financial Times* has latterly been doing a good turn to the electrical engineering industry by devoting some of its surplus energy to an assault upon the American Copper Syndicate, and we hope these articles may be widely read and discussed. In our issue of December 8th we made some reference to these and other articles in our notice of the copper market in November: and below we give an extract from a still stronger article which appeared in the issue of the *Financial Times* for December 19th. This article endorses the opinion which has from time to time found expression in our notes during the past year, that sooner or later the increased supply of copper from outside sources will bring about the collapse of the syndicate's control.

The fall in the prices of American copper stocks during the year has already been extremely heavy, and one of the greatest sufferers is the Amalgamated Copper Company itself. Only a comparatively small amount of the shares was subscribed for by the public, either in Europe or America, and it is estimated that the Standard Oil clique themselves hold no less than ~60,000,000 of the ~75,000,000 of shares created. It is believed also that their other holdings in the copper mining field total about ~40,000,000, so that in all they are carrying some £20,000,000 of stock. This is no joke, even for such a powerful combination, and yet they are not only entirely unable to control the production, but even to maintain the price and to force consumers freely into the market. The American banks are beginning now to throw copper shares upon the market, and it is calculated that one bank alone holds some ~30,000,000 of Amalgamated shares. When the crisis which was threatened last week really comes about—and in our opinion it cannot be staved off much longer—one of the first collaterals to be thrown out will be Amalgamated. As the *Boston News Bureau* remarked the other day, the Amalgamated cannot go forward and make more shares of the same kind until the present shares are digested or floated, and when the black cloud of undigested Industrials hanging over Wall Street is spoken of Amalgamated heads the list. Complaints have been made of late on this side that the Amalgamated interests are not supporting the copper market as they should do, but the probabilities are that they are finding the immense task they have undertaken a trifle too big even for their capacity. They have endeavoured unsuccessfully to corner copper, and have sunk millions upon millions in the undertaking. They are now being cornered themselves, and can scarcely escape without heavy loss. They will get no sympathy here, even though, fortunately, very little of the loss will fall upon ourselves. If we have escaped lightly it is, however, not due to any lack of effort on the part of the Combine bosses. They have endeavoured to dump copper on the European consumer at famine prices, and they have sought persistently to unload their inflated shares on the European investor. But we have gained wisdom from past experience, and we can now afford to stand by and watch the downfall of the gigantic house of cards they have built with equanimity.

Railway Rates.—Notice is filed in the *London Gazette* under the Railway and Canal Traffic Act, 1888, stating that:—

Whereas applications have been made to the Board of Trade on behalf of all the railway companies in the United Kingdom to amend the classification of merchandise traffic, and schedules of maximum rates and charges, fixed in pursuance of the above-mentioned Act, by adding to the said classification the following articles, matters, or things, viz.:—

To be included in Class 5.

1. Incandescent mantles.
2. Electrical instruments (such as ammeters, voltmeters, &c.).
3. Electrical instruments for use in connection with telephone exchanges.
4. Automatic time registers.
5. Mutoscopes.

To be included in Class 4.

6. Copper cylinders.

And whereas the Board of Trade have heard the parties in support of and in opposition to the application so far as it related to the articles, matters, or things numbered 2 and 3 respectively, and there being no opposition to the said application so far as it related to the articles, matters, or things numbered 1, 4, 5, and 6, respectively. Now therefore the Board of Trade, in pursuance of the powers in them vested by the provisions of section 24, sub section (11), of the above-mentioned Act, do hereby determine and order that the classification of merchandise traffic and schedules of maximum rates and charges confirmed by the Acts of Parliament set out in the schedule to this order, be amended in manner following, that is to say, by adding to—

Class 4.

1. Electrical instruments for electric lighting and power.
2. Electrical instruments for telephone purposes.
3. Water heaters, copper.

Class 5.

1. Incandescent mantles.
2. Mutoscopes.

Dated this 14th day of December, 1899.

Courtenay Boyle, *Secretary Board of Trade.*

Raaschou v. Cassell and Another.—This was an action heard in the Queen's Bench Courts before Mr. Justice Kennedy to recover damages for an alleged breach of contract to supply two motor vans. The plaintiff, Mr. Theodor Raaschou, an electrical engineer, of Great Smith Street, Westminster, had intended to commence running express motor vans from Covent Garden, Billingsgate, and Smithfield Markets to the south-western parts of London for the purpose of carrying goods direct to the buyers' establishments. The *Times* report says that, with this view, he entered into a contract with the late Robert Rintoul Symon, who carried on business in Abchurch Lane as the Liquid Fuel Engineering Company. Under this contract Mr. Symon had agreed to supply two steam motor goods vans to be constructed according to certain specifications. It was for damages alleged to have resulted from a breach of this contract that the action was brought. The original defendant was Mr. Symon, but on his death the action was continued against his executors, Ernest Cassell and Martha Ann Symon. The price of the two vans was to be £650 each net, and one-third of the price of each van, or a total of £433, was to be paid on the signing of the contract. This sum was paid, and one of the vans was, after some delay, tried in London on December 14th, 1898. According to the plaintiff, the van failed to fulfil the terms of the specification in not being capable of running 50 miles a day with a load of three tons at the rate of six miles an hour, and by reason of its liability to skid. The plaintiff claimed to recover the sum already paid and also loss of profits by reason of the non-delivery of the two vans in accordance with the terms of contract. The plaintiff also claimed certain small items of expenditure. The defendants denied that the van had failed to fulfil the terms of the specification, and said that as to the skidding, it could only be discovered upon the trial and that it had since been easily remedied. Whilst denying all liability, they brought £500 into Court, and said that this sum was sufficient to satisfy the plaintiff's claim.—Mr. Pickford, Q.C., and Mr. Frank Dodd were for the plaintiff; Mr. English Harrison, Q.C., and Mr. J. Eldon Bankes for the defendants.—Mr. Justice Kennedy, in delivering his considered judgment, said that the result of the trial in London was such as to justify the plaintiff in refusing to accept the van, as he promptly did. The trial showed that the van could not be trusted to run as the maker undertook it should run, so as to be under perfect control, or as he impliedly undertook, with reasonable safety. The case therefore practically resolved itself into a question of damages. In the result his Lordship gave judgment for the plaintiff for £622 11s. 8d. and costs, the plaintiff to have leave to take in part satisfaction the £500 that had been paid into Court.

Trade Announcements.—The Clayton Engineering and Electrical Construction Company, Limited, have acquired the works of Messrs. Pollock & MacNab, Limited, and have removed their office from Clayton to Newton, Hyde, where all communications should now be addressed. The Clayton Company are now in a position to promptly execute orders for engines and dynamos up to 5,000 H.P. Special arrangements have been made for the equipment of generating stations for electric tramways and light railways, and a speciality is being made of electric crane building and installation. In connection with this announcement Messrs. Pollock & MacNab state that they have transferred their engine works and foundry at Newton together with the business of engine builders, pumps and accessories makers, and iron founders to the Clayton Company. Their business of machine tool makers, however, will be continued as usual at new premises acquired by Messrs. Pollock & MacNab, which will be known as Britannia Ironworks, Newton, Hyde, as before, and all communications should be addressed there.

ELECTRIC LIGHTING NOTES.

Audenshaw.—Notice appears in the *London Gazette* to the effect that the District Council proposes to transfer its provisional order to the Manchester Corporation.

Barking.—The Local Government Board has sanctioned a loan of £15,080 for the purpose of carrying out extensions of the electricity works.

Boston.—The Town Council has resolved to apply to the Board of Trade for a provisional order to light the town by electricity.

Bridlington.—The Town Council has decided, on the recommendation of the Electric Lighting Committee, to apply to the Board of Trade for a provisional order for the electric lighting of Bridlington.

Camberwell.—Failing to obtain from the County of London and Brush Provincial Electric Lighting Company, Limited, particulars of the price required to purchase the company's undertaking, the Vestry has resolved to appeal to the Board of Trade for assistance in obtaining the necessary information.

Chester.—The Corporation has decided on the purchase of an additional engine and dynamo, at a cost not exceeding £3,165, to cope with the increasing demand for electricity.

Crowland.—The Local Government Board has refused to grant urban powers to the Crowland District Council to light the town.

Croydon.—Colonel W. Langton-Coke, C.E., held an inquiry, for the Local Government Board, on Thursday, last week, into the application of the Council to borrow £25,000 for the extension of the electric lighting.

Cumbrae Lighthouse.—The electric light is being installed at Cumbrae and will shortly be in operation. The expenditure involved amounts to over £3,000.

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Dowlais.—It is stated that the Iron and Steel Company has under consideration the laying down of a large electrical installation to supply both the old and the Ivor works; but so far the scheme is only in embryo. At the old works there have been recent extensions in electric lighting, and they have proved satisfactory.

Egremont.—The District Council has resolved to apply to the Board of Trade for a provisional order for the supply of electricity. In a report by Mr. J. Enwright, the initial cost is estimated at £9,450, with a connection of 2,300 8-c.p. lamps. Although coal is cheap at Egremont, gas costs 4s. 7d. per 1,000 cubic feet; the prospects for electric lighting are, therefore, rosy.

Fladbury.—An ancient water-wheel at the Fladbury Mills has been removed, and in its place are fixed two 40-inch turbines, capable of giving 35 H.P. under the available head of water. The two turbines can be driven either singly or together for the mill work or the electricity alone, as necessity requires. The turbines are of the British Empire make, manufactured by Messrs. Armfield and Co., Ringwood, Hampshire, and the dynamos used are Messrs. B. Young & Co.'s. The bulkhead walls to which the turbines are fixed are 24 inches thick, consisting of blue bricks and cement, with a foundation of concrete 3 feet 6 inches in thickness. The cables are put in all the way up the village to Weston House, and in the course of a few more days light will be supplied from this installation. It is proposed by the small company who have taken this work in hand, which is called the Fladbury Electric Lighting Company, of which Mr. S. H. Deakin is chairman, that storage cells for the present shall be fixed at the respective houses where the light is supplied, in case of very high floods. Only a limited number of houses in the village are supplied at present, but as time goes on there is no reason why, with the extension of machinery, as there is still plenty of waste water-power that could be made available, adjoining villages should not also be supplied from the same source. This work has been contracted for by Messrs. B. Young & Co., electrical engineers, Birmingham, from plans by Mr. A. W. Keen, who has superintended the whole of the work.

Glamorgan.—The Glamorgan County Council last week considered a report by the Parliamentary Committee, which stated that a company had been projected to acquire Parliamentary powers to distribute electric energy in the county, and they sought very extensive powers of carrying electric mains along and across the roads. The Committee recommended the Council to authorise them, or some other committee specially appointed, to obtain expert advice as to the extent to which the powers sought will affect the public interest of the county and the property and rights of the County Council, and how such powers ought to be modified or guarded, and, if thought expedient, to present a petition against the Bill. The Council decided to strengthen the Parliamentary Committee to deal with this particular matter.

Gloucester.—At a meeting of the Gloucester City Council last week the consulting engineer, Mr. R. Hammond, M.I.C.E., and Mr. R. Read (city surveyor), who have visited various cities where destructors are in operation, presented a report as to the best system which could be adopted in connection with the electric light works. They recommended the twin-cell system as erected by Messrs. Heenan & Froude at Farnworth. It consists of two cells side by side, only separated from each other by a low bridge like that at the back of a boiler grate, so that an open communication exists between the two cells. Each cell has a charging door on one side of the furnace corresponding to the clinkering door on the opposite side, and the combustion chamber is placed above the two cells, extending the whole length of them; above the combustion chamber is fixed the boiler. The feeding is done through a hopper, which is provided in connection with each charging door, so that the refuse can be put straight on to the grate bars, and the men on the clinkering side can also pull it forward, if necessary, so that there is a direct course either by pushing from the charging door or pulling from the clinkering door to get the refuse into the grate. The blast is fed to the under side of the ashpit, the grate being supplied with air blast by a fan, or by a steam jet, the whole under entire control. The main feature of the destructor is, that by simply altering the direction of a damper, the gases from either grate can be alternately made to travel over the hot fire in the other grate, and so into the combustion chamber, and finally into the boiler. The whole apparatus is compact and close together, without any long flues for loss of heat before reaching the boiler. Charging and clinkering taking place alternately, first with one cell and then the other, there is always a hot fire in the one cell to cremate the smoke and fumes from the other. The guaranteed consumption is 12½ tons per cell per 24 hours. There are two boilers, with a large heating surface, and guaranteed to evaporate from 1¼–2 lbs. of water from and at 212° F. per lb. of refuse. The Council adopted the report, and accepted Messrs. Heenan and Froude's tender for the erection of the destructor, £4,150. This, it was explained, is not the lowest tender, but the Committee deemed it advisable, in order to have a destructor which would combine all the latest improvements, not to allow £500 to stand in their way.

Hebburn.—The District Council has resolved to apply to the Board of Trade for a provisional order for the supply of electricity in the district.

Kensington.—At last week's Vestry meeting some discussion arose over the negotiations which the surveyor was authorised to enter upon with the surveyor appointed by the Kensington and Notting Hill Electric Light Companies as to the price to be paid for the land at Wood Lane, which the companies have acquired from the Vestry. The Vestry's surveyor submitted a letter from the companies' surveyor, Mr. H. A. Hunt, stating that he was authorised to offer £1,600 per acre for the land, and intimating that in the event of the Vestry not seeing their way to accept this price, the matter must go to arbitration, or a jury, as the Vestry might prefer. It was considered by the Vestry that the price offered was inadequate, and it was thought advisable that the matter be submitted to arbitration.

Llandudno.—Notwithstanding the more general use of electricity, the chairman of the Gas Committee reports an increase of nearly 3,000,000 cubic feet in the manufacture of gas this year as compared with last; £11,539 is being spent upon gas extensions.

Marylebone.—In consequence of the repeated failure of the electric supply in the Marylebone district recently, a meeting of residents and tradesmen interested was held on Wednesday night last week at the Portland Hotel, at which it was decided to take common action with a view to obtaining a better supply in future, and compensation for the loss now being sustained.

Ogmore Valley.—The secretary of the Ogmore Valley (Glam.) Electric Light and Power Supply Company has applied to the local District Council for an extension of the company's license for a further year, pending its application for a provisional order. The Council has assented.

Pwllheli.—At a special meeting of the Town Council last week, a resolution to the effect that the Council apply to the Board of Trade for a provisional order for supplying the town with electric light was passed.

St. Helens (I.O.W.).—The District Council has accepted the terms of the electric lighting company, allowing purchase after 14 or 21 years.

St. Pancras.—The Vestry last week considered a letter from Mr. Dewey, clerk to the Islington Vestry, referring to the laying of mains in Brecknock Road and York Road. The letter stated that whilst Islington

> Is anxious to give your Vestry every possible assistance, it regrets that it is unable to accede to the request now made, seeing that it is not legally empowered to assent to your Vestry laying mains in the parish of Islington.
>
> I may add, that its action in connection with the matter coincides with that it has deemed it advisable to take in connection with applications by the National Telephone Company and others, who have applied from time to time for the Vestry's permission to lay mains, &c., under streets in this parish.

In commenting on the letter Dr. Walter Smith, chairman of the Electricity Committee, stated that it showed that their neighbours were not so ready to help them as they had professed a few months ago. With the new boundaries, however, those roads would be in St. Pancras a year hence, when the Vestry would be in a position to supply the consumers. Mr. Barnes suggested that the Committee should take the bull by the horns and at once proceed with the laying of the mains. In his opinion, no action would be taken in regard to the matter, but the suggestion did not seem to meet with approval. As to the condensing plant required for the Regent's Park station, Dr. Smith stated that of the five tenders received one was too high, whilst the other four did not comply with the specification. The Committee had, therefore, decided to advertise for fresh tenders, but the Vestry refused their application for permission to accept a tender, so as to avoid delay in the delivery of the condensing plant.

Sudbury.—The Town Council has decided to apply to the Board of Trade for a provisional order for the supply of electricity.

Whitechapel.—The electricity supply was formally turned on last week. As the generating station is not yet completed, a temporary building has been made use of, so that while the larger building is being erected the Board can be securing a good business. At an informal gathering at the depôt, the electrical engineer, Mr. Arthur Wright, said that the electric light was the light of the poor, and that by the system to be adopted in Whitechapel it would be cheaper than gas. A great mistake had been made in beginning at the West End, for the long hours in which artificial light was used in the East End, and the late hours at which shops closed, rendered the district the most profitable for electricity.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

Aberdeen.—Major Sir Francis Marindin, of the Board of Trade, last week inspected the new permanent track of the Corporation electric tramway from Union Street to Woodside, a distance of 2½ miles of double track. The line is now open for traffic.

Barking.—At a meeting of the Urban Council last week tenders to the amount of £4,810 were accepted for the electrical portion of the light railway to be constructed between Barking and Beckton. The consideration of tenders for other portions of the plant was deferred.

Liverpool.—The tramway receipts for the fortnight ending December 20th were:—Horse cars and omnibuses, £7,746, a decrease of £3,333 as compared with 1898; electric cars, £5,020, an increase of £3,917, the net increase thus being £583. The passengers carried were—By horse vehicles, 1,374,996, a decrease of 123,578; by electric cars, 1,054,911, an increase of 838,875, the net increase being 715,297. The mileage was—Horse vehicles, 217,711, a decrease of 16,458; electric cars, 97,861, an increase of 82,453, the net increased mileage being 65,995.

(*Continued on page* 1053.)

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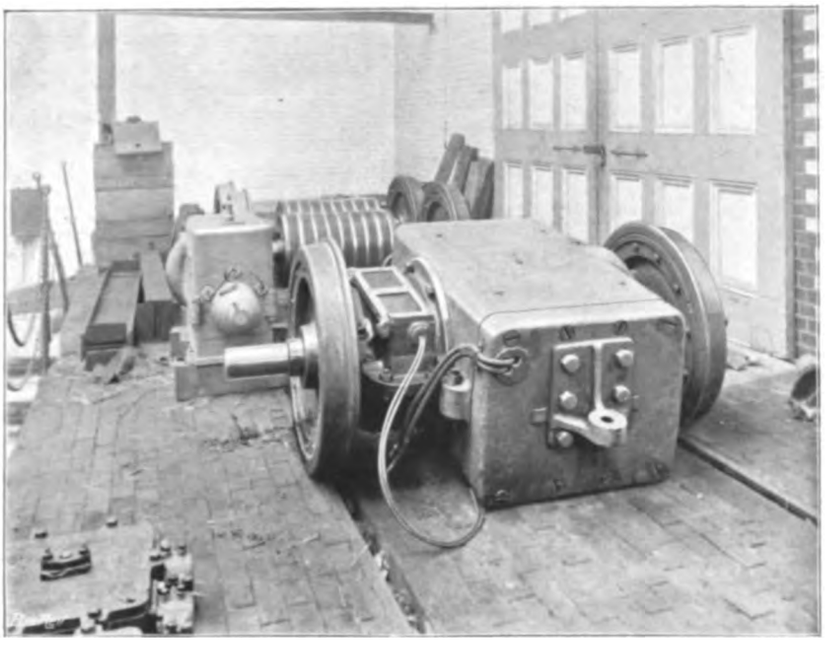
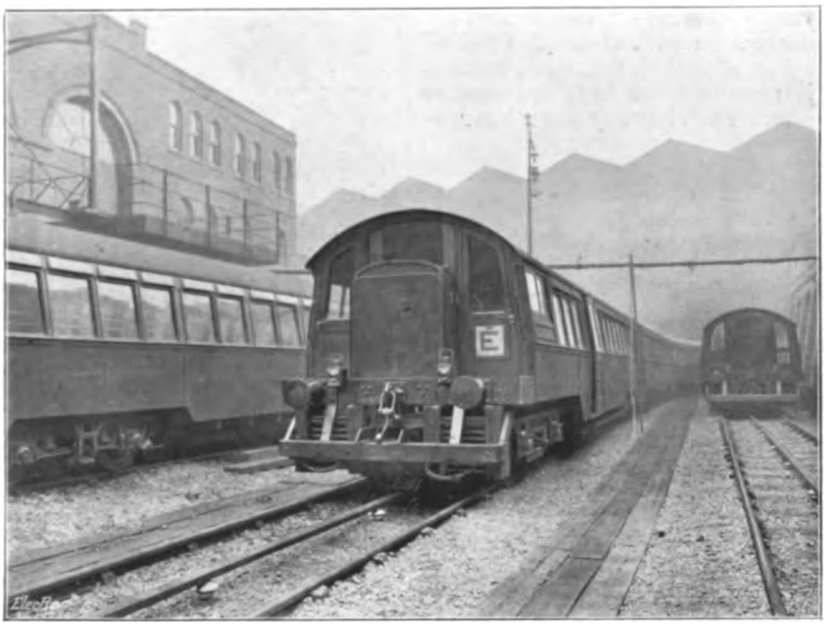
THE WATERLOO AND CITY ELECTRIC RAILWAY.

Since the Waterloo and City underground line commenced working in July, 1898, we have, at intervals, given certain details regarding the undertaking. For general notes of the system we may refer our readers to an article in the Electrical Review for July 15th, 1898, and to the authorised abstracts of papers read at the Institution of Civil Engineers a few weeks ago by Messrs. H. H. Dalrymple Hay and B. M. Jenkin.* The details and photographic views of the generators at the works at Waterloo were given in our issue of June 16th, 1899, p. 980.

By the kindness of the contractors and of Mr. Jenkin, who has favoured us with the loan of a number of the lantern slides used to illustrate his Civil Engineers' paper, we are enabled to supplement the information already given.



Motor and Axle Removed from Bogie.



Electric Trains in Sidings at Waterloo.

The steam-raising plant which is shown in one of the photographs consists of five Paxman "Economic" steam boilers, each fitted with a Vicars' patent mechanical stoker, with suitable engine, with shafting and pulleys for working the same.

The boilers are 14 feet long × 8 feet diameter, and each is fitted with two flues (2 feet 8 inches diameter), and provided with two circulating tubes. There are 92 smoke tubes of 3 inches external diameter. The heating surface is about 1,180 square feet, working pressure 160 lbs. per square inch; hydraulic test 260 lbs. per square inch. Each boiler will evaporate 7,500 lbs. of water per hour. Each flue is provided with Paxman's patent expansion boiler flue, the form of which gives it such strength, that thinner plates can be used in the construction than it would be safe to use in the plain flue. This is a great advantage, as it is a well-known fact that the heat passes more rapidly through thin plates, which are thus rendered more durable, because they do not become overheated. In this way the full excellence of the materials is retained for a great length of time. The strength and durability of a boiler depend greatly on there being proper provision for expansion and contraction. When this is not provided for, furrowing and ripped seams are the inevitable results. Paxman's patent expansion boiler flue provides completely for this, without injuring its efficiency as a stay. The flue is made up of a series of short lengths, which are made of fine, soft, and exceedingly tough steel. The plates are bent in such a way as to be when finished perfectly cylindrical, thus adding to the strength of the flue. They are then carefull welded, after which the ends are heated in a suitable furnace and enlarged in a powerful flanging machine in such a way that the end of one plate fits exactly within that of the next; the holes are then drilled through both and riveting completes the work. Both the laps, or doubling of the plates at the seams, as well as the rivet heads are removed from the line of draught and consequently escape the scouring action and intense heat of the gases as they pass along the flue. Flues made on this principle have withstood severe tests most successfully, and the collapsing strength is almost doubled.

The generators, of which particulars have already been given, consist of six Belliss T.E.C.4 high speed, vertical engines direct coupled to two-pole direct current generator

* Electrical Review, November 24th, 1899, p. 859.

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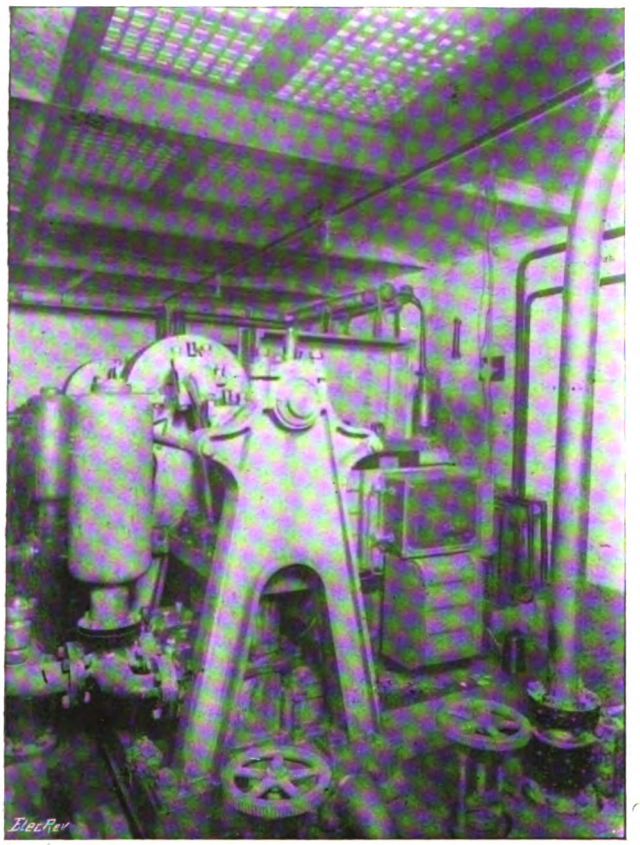
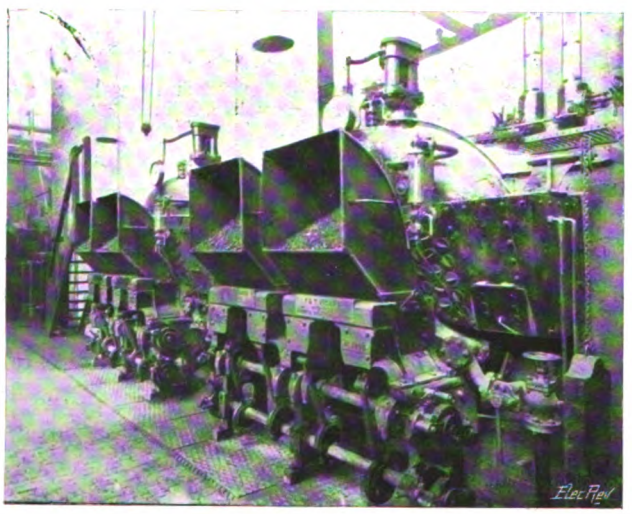
of Siemens's well-known type, each provided with a fly-wheel weighing about 6 tons.

The engines govern excellently, the momentary variation in speed being less than 4 per cent. when the full load is



Pump Room.

suddenly taken off, and under 2 per cent. when the full load of 380 amperes is switched on after the set has been running light; the permanent increase of speed from full load to no load is only 0·8 per cent. The efficiency E.H.P./I.H.P. of



"Economic" Boilers and Vicars' Stokers.

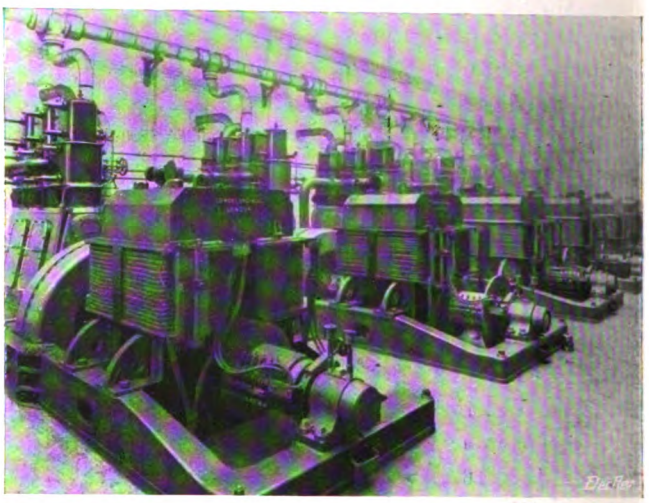
the combined sets at full load is 86 7 per cent., and at half load 81·7 per cent.

The train service is, as our readers are well aware, conducted almost entirely through twin tunnels, one for the "up" and one for the "down" service. The length from Waterloo Station to the City station, situated at the end of Cheapside and Queen Victoria Street, is 1½ miles.

In regard to the line construction, the steel conductor rail, which is of channel section, weighs 39 lbs. per yard, and has a specific electrical resistance equal to eight times that of copper. It is carried on porcelain insulators, which are mounted on iron stalks screwed to the sleepers.

Fig. 1 shows the special type of support used for anchoring the rail, the insulators in this case being surmounted by a malleable iron cap, to which the rail is secured by a bolt to prevent creeping.

The insulated conductor rail is placed between the two running rails of the permanent way. It is laid in 30 feet lengths, these being connected by copper bonds of 1·5 square inch section (see fig. 2), the bond serving



Six Belliss-Siemens Railway Generators.

the double purpose of fishplate and electrical connector. The copper rivets by which the bonds are attached to the channel steel are expanded into the rivet holes under hydraulic pressure, so that the electrical resistance between the surfaces in contact is negligible.

Interior of Trailer.

The running rails, which are used as the return path of the current, are bonded with copper bars of 1 square inch section, which lie outside the fishplates, and are connected

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with the rails by coned copper rivets in a manner similar to the bonding of the conductor steel (fig. 3).

The feeders and central conductor for the "up" and "down" lines are independent of each other, and accidents

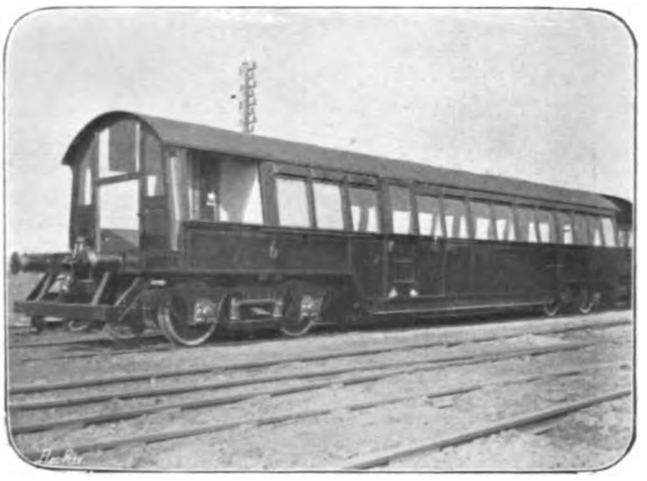
End View of Motor Car before being Electrically Equipped.

Shunting Locomotive.

Front View of Motor Car showing Cab, Controller and Resistances.

occurring on one line or tunnel do not affect the supply of current to the other. The tunnel lighting is effected by an independent system of feeders and mains while the train-lighting is managed from the circuit supplying power to the motors, the track rails being used for the return. A motor carriage is at each end of the train with two trailers between them. The former have collector shoes. There are two 4-wheeled bogies to each carriage, and on one bogie of each motor carriage there are two Siemens's series wound motors. The motor armatures were built directly on the driving wheel axles, the field magnets surrounding them being fixed in position, so that they move in a horizontal plane with the bogie, but cannot rotate. No reduction gearing is employed.

Each motor carriage has its driver's cab, of which we



Motor Car before being Electrically Equipped.

show the interior in fig. 4. Here there are fitted up a Siemens series-parallel controller, brake regulators, an automatic cut-out for 600 amperes, and gauges for indicating the current, voltage, air pressure, and speed of the train. The height of the interior of the cab is rather less than that of the passenger coaches, the floor being raised 16 inches to give room for the motor on the bogie below.

The controllers and motors at each end of the train are

Motor Car and Trailer on South-Western Main Line.

connected by rubber-insulated cables laid along the roofs of the cars. In fig. 5 we illustrate the coupling used for connecting these cables. It will be noticed that it has 18 distinct sets of contacts, separated from one another by "stabilit" insulators. The two halves of the coupling are bolted together, and pressure is put on the interlacing contact pieces by tightening the screws at the ends of the coupling.

One of our photographic views shows a motor bogie with two motors and collector shoe on the front end. When the photograph was taken the car was jacked up to allow

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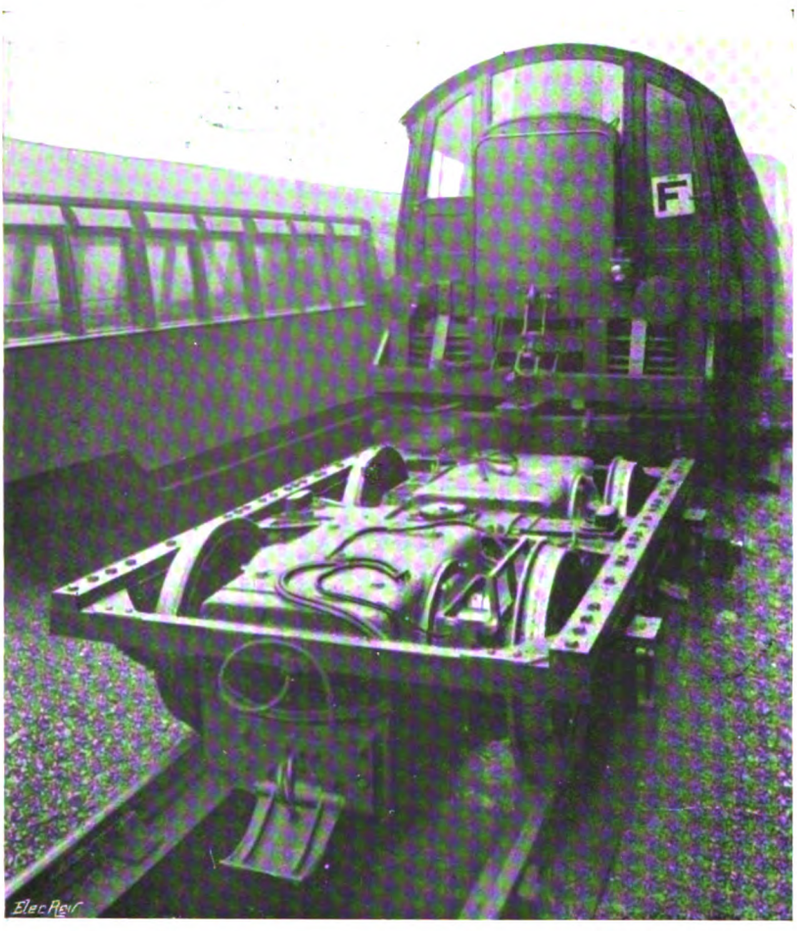
for the removal of the bogie. We also illustrate the motor and axle as seen removed from the bogie, spare armatures on axles being shown in the rear. Other views show the front of a



Motor Bogie showing Motors and Collector Shoe.

motor car with the cab, controller, and resistances; and a motor car without electrical equipment as it was brought up on the South-Western main line. In another illustration the motor armature may be seen on axle, but the magnets were not at the time in position. A motor car and part of a trailer on the main line of the South-Western Railway appear in another view, being drawn by a South-Western locomotive.

Messrs. Siemens Bros. & Co. were the contractors for the entire electrical equipment of the Waterloo and City line. Mr. D. Heap is the resident electrical engineer at the generating station.

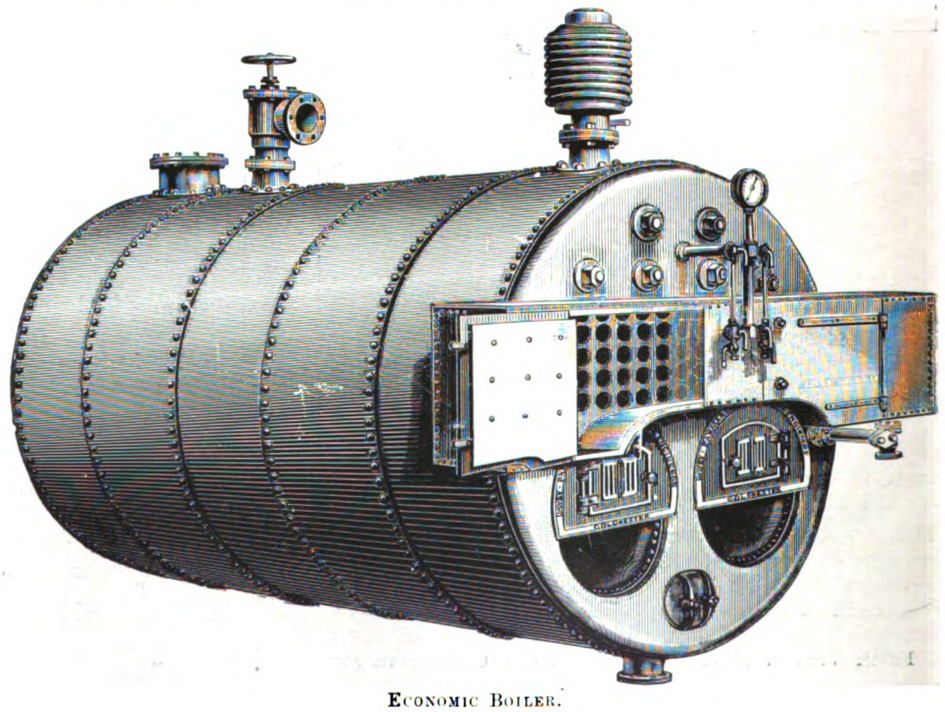
ON THE VALUE OF A HORSE-POWER.

By ED. C. DE SEGUNDO, Assoc.M.Inst.C.E.

The above is the title of a paper presented at one of the meetings of the American Society of Mechanical Engineers. The author, Mr. George J. Rockwood, was much struck by the entire absence of anything like a consensus of opinion on the value of a horse-power amongst the experts called to give evidence in a lawsuit brought by the owners of certain water-power concessions against the municipal authorities of the town of Worcester, Mass., who had diverted a portion of the river upon which these concessions were granted, for the purposes of the water supply to the town.

The quantity of water diverted amounted to an average, throughout the year, of about 5,500,000 gallons in 24 hours. There were 80 water privileges controlled by 67 owners, the total head of water being 827 feet. The hydraulic engineers on both sides seemed to be fairly unanimous as to the quantity of power lost, which was put at 1,000 H.P. for 11 months in the year, but the legal minds were not so readily prepared to accept this estimate, and the matter was further complicated by the fact that the loss of power to the various owners ranged from 66 H.P. to a fraction of 1 H.P. The case was tried before a commission consisting of a lawyer of experience in water cases, a manufacturer and user of water-power, and a hydraulic engineer, and after a trial extending over 50 days, in the course of which a very large number of witnesses on each side were examined, a verdict was given for the plaintiffs for $500,000 with interest at 6 per cent. per annum. Unfortunately, the wording of the verdict of the commission gives no useful reasons for their decision, and, what is even more disappointing, nothing is said as to how the $500,000 is to be divided between the 67 owners of these privileges.

The arguments advanced by the plaintiffs and the defendants are ingenious and interesting. It was held by the plaintiffs that "a horse-power is a piece of property—a commodity—which may be considered as on the market, and hence as having a definite market value known to those who deal in it." The financial injury done to the plaintiffs was therefore easily arrived at—according to *their* view—by ascertaining the market value of 1 H.P.* and multiplying it by the number of horse-power of which they had been deprived by the action



Economic Boiler.

of the city authorities. Counsel for the defendants argued in reply that, in point of fact, the owners had not been

* Although a horse-power is spoken of throughout the paper, what is clearly intended is a horse-power-year.

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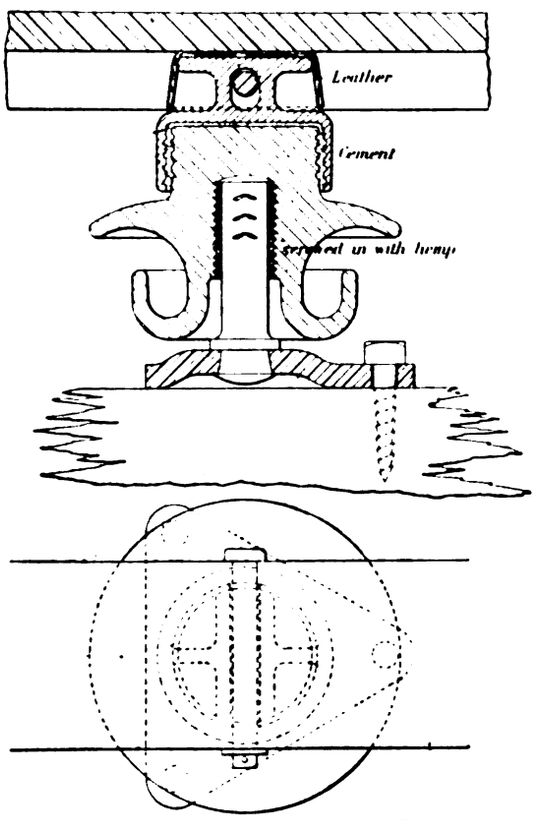
deprived of any "horse-powers," but that by the diversion of a certain quantity of water, the owners had lost an easement or privilege attaching to their estate, namely, the right to make use of such water as might flow through their premises without unduly affecting the flow to others below them — in other words, that the river did not produce "horse-power," which could be taken away and sold at the nearest market like vegetables. Hence, argued counsel for the defence, there can be no such thing as the market value of a "horse-power." Moreover, in this case the "horse-power" resulted from the utilisation

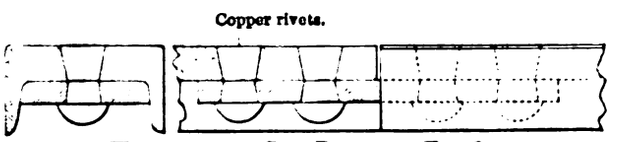


Waterloo and City Railway.—Fig. 1.

of falling water, which varied in volume to such an extent that every mill on the river possessed steam plant capable of supplying nearly the whole power required.

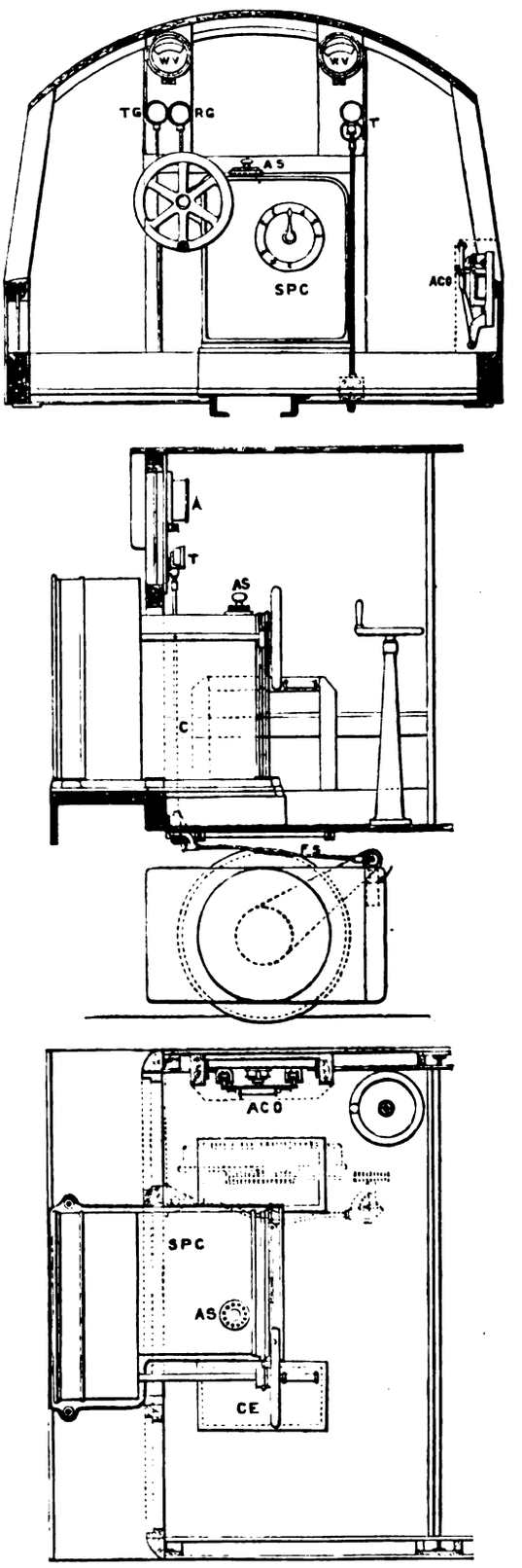
Another point upon which the opinions of the experts on both sides were diametrically opposed was whether the damage sustained by the diminution of 1 H.P. in a water-power was to be valued at the cost of production of 1 H.P. or at the price which could be obtained for it, say, by way of rental. In the absence of any precedent as to which view should be taken, it is obvious that neither side would ever convince the other on this point.

It is, of course, never possible to arrive at the an easement by a mathematical formula, and everyone who has



Waterloo and City Railway.—Fig. 2.

had experience of valuations of any kind will readily admit that, except in cases to which well known precedents apply, a valuation becomes a matter of opinion. The author of the paper under discussion deplores that this should be the case. After calling attention to the names of those called as expert witnesses, he says "undoubtedly at this very moment each side still considers the other to be most obviously in the wrong. This, of course, is highly unsatisfactory from an engineering point of view, though, perhaps, not unusual considered from the legal standpoint." With deference to the author, however, is this innuendo justifiable? Could any result other than a complete disagreement between the experts on each side have been anticipated in the circumstances? In the first place, the flow of water varied to such an extent that, admittedly, each mill was fitted with steam power capable of driving the whole plant, and it was further testified that at times there was no flow at all. It would thus be impossible to fix upon any proper proportion that the amount diverted should bear to the total flow, and at such



W V, Weston voltmeter and ammeter; T G, Train gauge; R G, Reservoir gauge; T, Tachometer; A S, Ammeter switch; S P C, Series parallel controller; A C O, automatic cut-out; A, Ammeter; F S, Flexible shaft; C E, Commutator end.

Waterloo and City Railway.—Fig. 4.

times as the river was practically dry, the diversion would also be *nil*. Further, the loss of power to individual owners was stated to vary from 66 H P. to a fraction of 1 H P., and the pecuniary damage sustained would be dependent upon the proportion that this loss bore to the total power obtained before the city authorities diverted a portion of the water.

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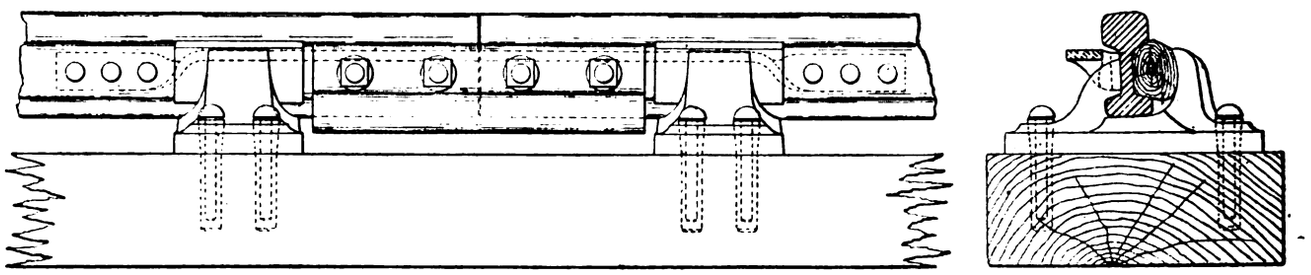
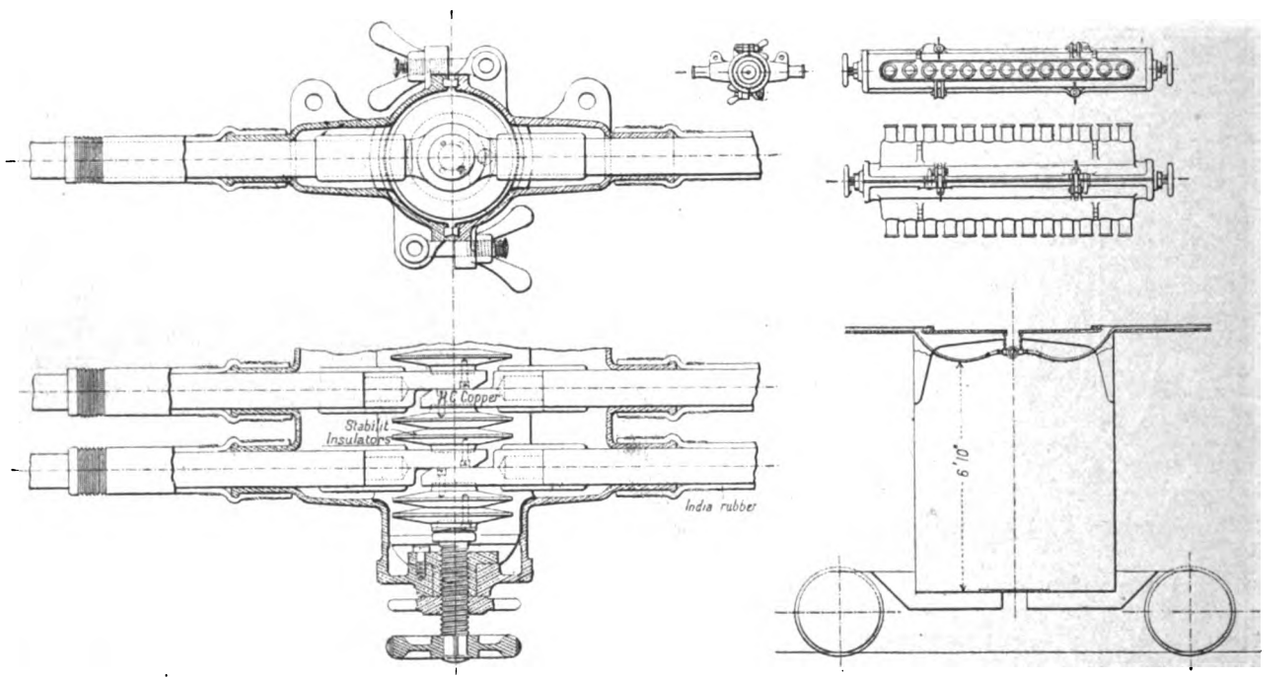
The same volume of water must flow through each privilege* at any one period, and the power which can be obtained from it will vary directly as the head. Thus the man who drives his turbine under a 50-foot head, will suffer five times (roughly) the loss in horse-power that would be sustained by a millowner at another privilege where only 10-feet head was available. This point does not appear to have been considered in the trial.

Without wishing in any way to cast aspersions upon the sincerity of the expert testimony given, it must not be overlooked that the millowners had suffered a loss, and were



WATERLOO AND CITY RAILWAY.—FIG. 3.



WATERLOO AND CITY RAILWAY.—FIG. 5.

anxious to get compensation on the highest possible scale, whereas the city authorities had taken the water, which occasioned the loss, not for purposes of manufacture, or for profit, but for the purposes of the town water supply, and thus had no direct incentive to unduly underestimate the loss sustained by the millowners. We must confess that we sympathise with the argument of counsel for the city, who stated that, in his opinion, the proper way to value the loss was by a computation of the cost of substituting other practical and economical means of generating power at each privilege to the extent to which the normal power at any time was diminished by the action of the city authorities, and as each mill possessed steam power capable of providing for the whole plant, the cost of substituting the power lost would be the cost of the extra coal burnt, plus an allowance for oil, waste and water, and wear and tear and depreciation. This, however, the millowners would not allow, their argument being that the *selling value* of the power lost, and *not* the cost of replacing it, should be the proper test of the damage sustained. This argument was sustained by counsel for the millowners by an illustration which certainly appears to have had the effect of confusing all the experts for the city. Thus:—

Counsel for plaintiffs to witness for defendants:—"If a man's property is taken away from him, don't he get what it is fairly worth and what he can sell it for in the market? A man has got 100 horses here in Worcester. Somebody comes along and takes away 50 of them. He is liable to him for doing it. Now the horses, we will assume, are worth $100 a piece in Worcester in the market. Ought he to have $100 a piece for those horses, or $50 a piece because he has got a ranch somewhere in the West where he can produce them and get them to Worcester for $50?"

To this no satisfactory answer was ever forthcoming. We admit that one seldom thinks of the right thing to say at the right time, but no doubt it has since occurred to the confused witnesses that they were made victims of a forensic trick, inasmuch as "horse-powers" cannot be produced on a ranch out West and taken in some convenient form to market. What the millowners really lost by the diversion of the water was the means of producing power in one particular way at one particular spot, and this is in no sense synonymous with the nature of the loss suggested in counsel's illustration.

Doubtless much could be said on both sides, but in our humble judgment the test of the damage sustained would be the cost of establishing the *status quo ante* or its equivalent. Clearly if the diversion of the water were stopped, the millowners would again enter into the enjoyment of their full rights. This end would, however, also be attained if the means of bringing up the diminished power to its former amount were supplied to the millowners. In this particular case, every mill was obliged to have ample steam-power owing to the varying flow of water, hence the value of the loss sustained could be measured by the cost of a suitable supply of coal, each individual case being considered on its own merits with due regard to the head of water.

In England the valuation of water-powers does not often engage the attention of engineers, but it is a subject of much importance, as the utilisation of water-power for manufacturing purposes of all kinds is rapidly growing, and as it usually happens that waterfalls only exist in the most out of

* The point of diversion being higher up the river than any of the mills in question.

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the way places, it almost follows as a corollary that a town will spring up in the neighbourhood, the authorities of which will one day begin to consider the water in the light of a Naboth's vineyard.

ELECTRIC TRACTION AND MOTIVE POWER NOTES.

(*Continued from page* 1046.)

Electric Railways in Germany.—A scheme has been prepared, says a financial daily, for the construction of a system of underground electric railways in Berlin. The project, which has already been approved by the Mayor and the Traffic Committee, will shortly be submitted to the municipal authorities, who will be asked to approve the carrying out of the works. It is proposed to construct two circle railways and two transverse lines from north to south and east to west respectively. The scheme provides for the building of the railways by private enterprise at the expense of the town, but whether they would be leased to a company or worked by the city authorities is a question for the future to determine. It is believed that the railways could be completed and opened to traffic in two years from the time of commencement, as was the case with the underground electric railway in Buda-Pesth.

Elland.—On 19th inst. a deputation from the Halifax Corporation waited upon the Electric Lighting Committee of the Elland District Council to discuss the terms on which they were prepared to extend their service of electric tramways to Elland. The question at issue between the two authorities is as to the supply of electric current for the tramways. The members of the Elland Council, who are seeking provisional orders for electric lighting, demand that they shall be allowed to supply the current, and thus provide a day load for their proposed electrical installation. To this Halifax raises the objection that it would entail divided control of their tramway system, to which they decidedly object, but they are prepared to erect a sub-station near Elland, and from this supply not only the current for the tramway, but electricity for lighting purposes as well. They threaten, if Elland refuses to accept their terms, to drop their scheme of going to Brighouse by Elland, and to content themselves with a line to Brighouse *vid* Hipperholme. After a prolonged discussion last week no definite decision was arrived at.

Hastings.—The Council will oppose the Cinque Ports light railway scheme but will dissent only to that part of the scheme inside the borough.

Hull.—A horse took fright at an electric car in Hessle Road one night last week. It was knocked down, and its rider fell beneath the car and was killed.

Italy.—The Government has approved of the scheme to adopt electric traction on the railway between Milan and Varese.

Liverpool.—A Walton electric car collided with a lorry on 19th inst., overturning the wagon and injuring the horses.

Manchester and Liverpool.—The Bill for incorporating and conferring powers upon the Manchester and Liverpool Electric Express Railway has been deposited for next session, in accordance with the Standing Orders of Parliament. By this Bill the incorporated company ask for powers to construct a railway 34 miles 4 furlongs 2 chains in length, commencing on the west side of Deansgate, Manchester, passing from thence *viâ* Salford, Pendleton, Eccles, Widnes, Halewood, Garston, and Toxteth Park to its termination in Liverpool, near the entrance gate of the Bluecoat Hospital in School Lane. The capital required for the construction of this railway is £2,000,000, which will be divided into 200,000 shares of £10 each, with the right to raise a further £660,000 for equipment purposes by the issue of debenture stock. The first directors of the proposed company will be the Hon. Robert John Strutt, Mr. John Simeon Bergheim, Mr. Edward Tootal Broadhurst, Mr. James Hyslop Macmillan, Mr. William Mather, "and two other persons to be nominated by them or the majority of them." The railway is proposed to be worked by electrical power from a generating station to be erected on a site in the parish of Great Sankey, and the line will be constructed on the monorail system. The time required within which to construct the railway is five years from the passing of the Act, and during this period it is proposed to expend £150,000 in the payment of interest out of capital. The maximum passenger fares proposed to be charged are 2*d.* per mile first-class and 1*d.* per mile second-class, with a minimum charge "as for three miles."

South Staffordshire.—With reference to the report of the South Staffordshire Tramways Company's meeting which appeared in our last issue, we are informed that Messrs. Burstall & Monkhouse did not value the Walsall plant, &c., at £18,500. They were not asked to value the line. They were asked to consider a large number of agreements, view the position generally, and advise the board. This they did, and advised the board that the price mentioned was in view of all the circumstances *reasonable*. No car or power house is included in the agreement, and the sale is more an act of policy than anything else, and but for the lease mentioned in the agreement, the board would not have asked the shareholders to accept it. Some of the remarks quoted were not made by the chairman, but were read by him to the meeting from Messrs. Burstall & Monkhouse's report. In our recent list of electric tramways we stated that the South Staffordshire tramway line is leased to the South Staffordshire Tramway Lessee Company. It should be mentioned, however, that the lease is not to begin till February 1st.

Withington.—The Urban District Council on 16th inst. passed a resolution approving of the promotion by the Council in the next session of Parliament of a Bill for constructing additional tramways in the district to be worked by either animal or mechanical (including electric) power.

TELEGRAPH AND TELEPHONE NOTES.

Foreign Press Telegrams.—It is announced that on and after January 1st next press telegrams will be accepted for transmission between the United Kingdom, on the one hand, and France (including Corsica), Algeria, and Tunis, on the other, between the hours of 6 p.m. and 9 a.m., at half the rates for ordinary telegrams, with a minimum charge of 10*d.* per telegram. The general condition, will be furnished on application to the Secretary, General Post Office London, E.C.

Huddersfield Telephones.—Last week the Electricity Committee of Huddersfield recommended the Town Council to establish a municipal telephone service, subject to the subscribers having the same facilities as subscribers of the National Telephone Company's system. The recommendation was adopted.

Party Line Telephone Rates.—Taking a hint from the penny-in-the-slot idea, the National Telephone Company are introducing in some towns experimentally what are known as party line rates—a system which has been tried in the States with most excellent results. This system enables each user to send messages for 1*d.* each, which is collected at the time by means of an ingenious automatic box, thus doing away with all monthly or quarterly accounts. This great cheapening of telephone rates is effected by the same wire being used by two or more subscribers, instead of one exclusively as heretofore, and it is then called a two-party, four-party, or eight-party line, as the case may be. The only additional cost to the subscriber is that 10*s.* per month is charged for a two-party line, 7*s.* 6*d.* for a four-party wire, and 5*s.* per month for an eight-party arrangement. For those who are likely to make but few calls on the telephone this new departure offers very obvious advantages, and this concession on the part of the National Telephone Company must greatly increase the use of the telephone all over the country.

Telegraphic Interruptions and Repairs:—

Cables.	Down.	Repaired.
West Indies:—		
Jamaica-Colon	June 30, 1899 ...	...
Trinidad-Demerara (1871 original)	Oct. 20, 1899 }	Nov. 9, 1899.
Do. do. (1891 duplicate)	Oct. 6, 1899 }	one cable restored.
South African:—		
Zanzibar-Mombasa	Oct. 27, 1899 ...	...
Mozambique-Lourenço-Marques	Dec. 18, 1899 ...	...
Cayenne-Pinheiro	Oct. 11, 1899 ...	...
Latakia-Cyprus	June 20, 1899 ...	...
Landlines.		
West Indies:—		
Communication with Les Cayes (Haiti)	Nov. 22, 1899 ...	...
South African:—		
Communication with Mafeking...	Oct. 13, 1899 ...	...
Communication with all offices beyond Orange River	Oct. 18, 1899 ...	...
Communication with Burghersdorp, Cape of Good Hope, and Estcourt, Natal...	Nov. 7, 1899 ...	...
Communication with north of Mooi River (Natal)	Oct. 22, 1899 ...	...
Colombian Government lines to Bogota	Oct. 21, 1899 ...	...
Communication with interior of Colombia, excepting Amalfi, Ambalema, Buga, Cartago, Ibagua, Manisales, Medellin, Palmire, Pasto, Popoyans, Reimedos, Sonson, and Santo Domingo... ...	Nov. 6, 1899 ...	...
Communication with Valentia (Venezuela)	Nov. 18, 1899 ...	...
Indo-European lines between Odessa and Kertsch	Dec. 20, 1899 ...	Dec. 21, 1899
Saigon-Bangkok	Dec. 16, 1699 ...	Dec. 23, 1899

Telephone Service.—At the meeting of the St. Luke (Middlesex) Vestry last week, a letter was read from the London County Council stating that their attention had been called to the fact that the National Telephone Company had lately carried out works in several parts of the metropolis without first having obtained their consent, as required by the Telegraph Acts, to open the roads. For a considerable time the Council had been endeavouring to come to an arrangement with the company, but the negotiations had hitherto proved abortive. They asked to be immediately informed when the company commenced any works in the district. Mr. W. Howes, chairman of the Vestry, said that the Telephone Company had the sanction of the Vestry under an agreement to open the roads. What

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the company had done in St. Luke up to the present, they had done openly and above board. In view, however, of the letters received from the Postmaster-General and the County Council, they should give them no further permission to lay pipes in that district. After some discussion, the officers of the Vestry were directed to inform the County Council when the company commenced works.

Wireless Telegraphy.—A Central News telegram from New York says:—"The United States Navy Department, after exhaustive experiments, has decided not to employ the Marconi system of wireless telegraphy in the American Navy. The Department officials believe they can themselves perfect a system equally good, if not better."

CONTRACTS OPEN AND CLOSED.

OPEN.

Accrington.—January 10th. The Town Hall Committee invites tenders for the switchboards, wiring and other works and appliances necessary for the electric light installation in the Town Hall. For specification and to view the various rooms, apply to the Borough Surveyor, Town Hall.

Barking.—January 23rd. The Urban District Council wants tenders for two continuous current transformers and switchgear, underground cables and roadworks for the Creeksmouth electric lighting extension. See "Official Notices" to-day.

Barnes.—January 9th. The Urban District Council is inviting tenders for the supply and erection of:—(Section A) boilers; (B) steam dynamos and switchboard; (C) storage batteries; (D) cables, &c. Only those firms with plant of a similar size and type working satisfactorily in other electricity works will be allowed to tender. Specifications, &c., of the Surveyor, Council Offices, High Street, Mortlake, on deposit of £1 1s. for each section. Plans, specifications, &c., may be inspected at the offices of the engineer, Mr. William Fairley, 53, Victoria Street, S.W.

Bermondsey.—January 13th. The Vestry wants tenders for the construction, &c., of a dust destructor, with furnaces, water-tube boilers, economiser, fans and forced draught appliances, in connection with the electricity supply undertaking. See "Official Notices" December 15th.

Birkenhead.—January 16th. The Corporation is inviting tenders for the construction of a new electricity generating station in connection with the electric tramways.

Dublin.—January 1st. The Dublin United Tramways Company is inviting tenders for the supply of general stores, including car fittings, iron, steel castings, oils, paints, glass, brushes, ironmongery, harness materials, electrical supplies, coal, &c., for the year ending December 31st, 1900. Particulars at the company's offices 9, Upper Sackville Street.

Hackney.—January 2nd, 1900. The Vestry wants tenders for the supply of accumulators. See "Official Notices" December 1st.

Ilford.—January 20th. The District Council wants tenders for water-tube boilers, economiser, pumps, pipe work, two 200-kw. and one 100-kw. dynamos, motor boosters, battery, switchboard, 15-ton traveller, mains and road work, arc lamps and posts, and station lighting. See "Official Notices" December 15th.

Manchester.—December 30th. The Tramways Committee wants tenders for 450 electric tramcar bodies. See "Official Notices" December 15th.

Melbourne.—March 1st. The Corporation is wanting tenders for boilers, engines, dynamos, switchboard, feeders, mains, arc light leads, accumulators, &c., for electric lighting. See "Official Notices" December 22nd.

Mistretta (Sicily).—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Consul at Palermo, stating that tenders are invited by the Municipality of Mistretta, not later than December 31st next, for the establishment of a service of electric lighting in that town. Such particulars as have been received may be examined on personal application at the Commercial Department of the Foreign Office any day between the hours of 11 a.m. and 5 p.m.

Newcastle-on-Tyne.—January 24th. The Corporation wants tenders for laying down about 11 miles of double line tramway, the rails, fastenings, and the poles being supplied by the Corporation. See "Official Notices" December 22nd.

Port Alegre.—December 31st. The Secretary of State for Foreign Affairs has received a despatch from Her Majesty's Minister at Rio, stating that tenders are invited by the municipality of Porto Alegre, not later than December 31st next, at 1 p.m., for the electric lighting of that town.

Salford.—January 8th. The School Board invites tenders for the electric lighting of the new schools in Grecian Street North, Lower Broughton. See "Official Notices" December 22nd.

Spain.—January 16th. Tenders are being invited until January 16th by the municipal authorities of Utrera for the concession for the electric lighting of the town by means of 300 10-C.P. lamps and 100 16-C.P. lamps. Tenders to be sent to El Secretario del Ayuntamiento de Utrera (Spain) whence particulars may be obtained.

Tunbridge Wells.—January 15th. The Corporation invites tenders for condensing plant to deal with 30,000 lbs. of steam per hour. See "Official Notices" December 22nd.

Tynemouth.—Tenders are wanted for free wiring of premises in connection with the Corporation electricity works. See "Official Notices" to-day.

CLOSED.

Cork.—The Committee of Management have placed the contract for the electric lighting of the Lunatic Asylum with Messrs. Handley & Shanks, of Cork.

Gloucester.—The City Council have accepted the tender of Messrs. Heenan & Froude for the erection of a refuse destructor at a cost of £4,150. For further particulars, see our "Lighting Notes."

Germany.—Contracts have been placed with Messrs. Brown, Boveri & Co., of Baden and Switzerland, and Messrs. Siemens and Halske, of Berlin, for the conversion of the horse tramways in the town of Mannheim into electrical lines.

Glasgow.—Yesterday's *Daily Telegraph* is responsible for the following:—"The Glasgow Corporation has accepted the offer of the National Conduit Cable Company, New York, for electric feeders for the city tramways. The American price was £151,000, or £10,000 under the lowest British offer."

Lambeth.—With reference to the tenders given below for the supply of 25 arc lamp-posts and lamps for public street lighting purposes, Mr. F. A. Nixon, in a report to the Vestry on the subject, states that the offers from the best known firms very closely correspond in price and vary roughly from £700 to £850. The tenders were numbered by the chairman of the Vestry in the order in which they were opened, and not in that which appears in the complete list given. In this connection Mr. Nixon says:—

Nos. 1 and 7 are not complete and need not be considered. Nos. 3, 11 and 8 are very high-priced, and are not from the most well-known firms. No. 9 is a tender for a type of lamp which is, so far as I know, quite new and cannot be recommended from any extended experience. The remainder, arranged according to the price of the tender and which will bear closer inspection, are as follows:—No. 4, Messrs. Gilbert & Co., £858; No. 6, Messrs. The Brockie-Pell Company, £854 7s. 6d.; No. 12, Messrs. Johnson & Phillips, £822 10s.; No. 10, Messrs. The General Electric Company, £788; No. 2, Messrs. Oliver and Co., £784 12s.; No. 5, Messrs. Crompton & Co., £697. The difference in the price of these six is chiefly attributable to the price of the arc lamp itself, and as this is the most important consideration, especially in view of the position in which these lamps are to be placed, I think the Committee will not be content with accepting other than the best. The arc lamps specified in the tenders Nos. 5 and 10 have not in my experience given satisfaction on the South London Company's circuit, and I could not recommend their adoption. I am not acquainted with Messrs. Oliver & Co.'s arc lamp, and so of the remaining three, I unhesitatingly advise the acceptance of Messrs. The Brockie-Pell Company's tender, in which is included the Brockie-Pell L type lamp, which is one of the best in the market, and which has been giving great satisfaction where it has been installed on the South London Company's mains.

	£	s.	d.
Crompton & Co.	697	0	0
Johnson & Phillips	711	0	0
Oliver & Co.	784	12	0
General Electric Company	788	0	0
Johnson & Phillips	822	10	0
Brockie-Pell Arc Lamp Company (accepted)	854	7	6
Gilbert Arc Lamp Company	858	0	0
S. Griffith (Davy Lamp)	862	0	0
S. Griffith (Johnson & Phillips Lamp)	937	10	0
British Blahnik Arc Light Corporation	1,020	0	0
Thomas Kershaw	1,850	0	0
W. J. Allen & Co. (incomplete)	—		
W. S. Vellinghausen "	—		

The explanation of two tenders being received from one firm is that separate departments submitted independent offers.

Maidstone.—The Corporation contract for storage batteries at £1,390 has been given to the Chloride Electrical Storage Syndicate.

FORTHCOMING EVENTS.

Thursday, January 4th—At 8 p.m. At 20, Hanover Square. Röntgen Society. Paper by Chisholm Williams, Esq., F.R.C.S., on "The Interpretation of Skiagrams." Future arrangements of this Society are:—February 1st. Dr. Hugh Walsham—"Röntgen Rays in Diseases of the Chest." March 1st. Mr. J. H. Gardner — Subject to be announced later. April 5th. Dr. Norris Wolfenden and Dr. Forbes Ross—"The Influence of the X Rays upon the Growth and Development of Micro-organisms.

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Tuesday, January 9th.—At 8 p.m. The Institution of Civil Engineers Papers:—"The Purification of Water after its use in Manufactories," by Reginald A. Tatton, M.Inst.C.E.; "Experiments on the Purification of Waste Water from Factories," by W. O. E. Meade-King, M.Inst.C.E.

Friday, January 12th.—At 8 p.m. Institution of Civil Engineers. Students' meeting. Address by Prof. T. Claxton Fidler, M.Inst.C.E., on "The Theory of Structures and Strength of Materials."

NOTES.

1900.—We shake hands with the Old Year with feelings of reluctance, for he has been a good friend to one and all in the electrical profession. But we welcome the New Year with its bright promises of still better things in store. May the year 1900 see a greater degree of electrical development at home and abroad than any of its predecessors. A happy and prosperous new year to all our readers and friends!

Properties of Steel.—We have received copies of two papers on the properties of steel, read at the December meeting of the American Society of Mechanical Engineers. One, by Messrs. Maunsel White and F. W. Taylor, proposes a scheme of nomenclature for the colours of steel during gradual heating from the cool state, with the corresponding temperatures. The scheme is as follows:—

Dark blood red, black red	990° F.
Dark red, blood red, low red	1,050° F.
Dark cherry red	1,175° F.
Medium cherry red...	1,250° F.
Cherry, full red	1,375° F.
Light cherry, bright cherry, scaling heat,* light red ...	1,550° F.
Salmon, orange, free scaling heat	1,650° F.
Light salmon, light orange	1,725° F.
Yellow	1,825° F.
Light yellow	1,975° F.
White	2,200° F.

* Heat at which scale forms and adheres, i.e., does not fall away from the piece when allowed to cool in air. An interesting point of this carefully-prepared scheme is its evidence of the capacity of the eye for judging temperature especially in the neighbourhood of the critical point. This temperature, which varies somewhat with different kinds of steel, is about 1,375° F., and near this temperature the eye seems to be sensitive to about 15° F. The colour at this point is always described by tool smiths by the name cherry red, used by the authors of the paper. No doubt 15° F. is near enough for most purposes, but trained tool smiths must have learned to work much closer than this, and it is certainly not good enough for magnets. Mme. Curie observed that a magnet should be heated but little above its critical temperature; probably more than 3° F. above the critical point is undesirable, and to judge this is evidently beyond the power of the eye. A pyrometer of some kind is a necessity in magnet work.

The second paper, by Mr. W. J. Keep, gives an account of deflections within the elastic limits produced by steady pressure and by blows on spring-tempered steel bars freely supported at their ends. We do not know what the practical application of the results may be, nor is there any indication in the paper, but the experiments were very numerous, very consistent, and very carefully made. In view of the large amount of attention the whole subject of iron and steel is now receiving, the experiments are of considerable interest.

Fatal Accident at Bolton.—On Friday afternoon last a serious accident occurred in connection with the Bolton electricity supply undertaking. We are officially informed that the accident, which terminated fatally, was quite the fault of the two unfortunate men who were killed. They had gone down into one of the sub-stations to remove a transformer which was working in parallel with another. They cut off the supply of current on the high-pressure sides of both transformers by means of high-pressure switches fixed in the sub-station. They then disconnected the low-pressure leads between the transformer to be removed and the switch-board, in order that they might run no risk by the current being transformed up from 200 volts to 2,000. This they did all right: it was in their next move that the accident occurred. After the one transformer was thoroughly isolated, they disconnected both the high and low-pressure cables of the transformer itself, and instead of sealing them up left them hanging loose with the bare ends of the cables touching the metal cover of the transformer, from which the earth wire had already been disconnected in order that the transformer could be lifted out of the sub-station. After they had done this, they proceeded to put on current again to the one which had not been removed, and in doing so, turned on the wrong switch, making the whole of the metal case of the disconnected transformer alive. As it happened, the two men had hold of it and received a shock which ended fatally. We understand that both were capable men, especially one, who was the foreman in charge of all transformers and cables and of outside work generally. Their loss will be very greatly felt by the Bolton Corporation. It seems that the men should not have been working in the sub-station at the time, and they did so altogether on their own responsibility. Furthermore, they never warned the station that they were there, or asked for the current to be cut off. The names of these men are F. Walker, foreman, who leaves a widow and five children, and W. Hazelton, cable jointer, who leaves a widow and two children.

At the inquest on Tuesday evidence was given by Mr. Ellis, the borough electrical engineer, Dr. Adams, and a jointer who was working with deceased at the time. Dr. Adams deposed that Walker was first got out of the chamber and animation was restored, but efforts failed in the case of Hazelton. Dr. Robinson and Dr. Panton arrived, and attempts were made in the Wheat Sheaf Hotel, to which the men had been carried, to restore consciousness, and Walker was afterwards removed to the Infirmary. He examined Hazelton after death, and found that he was burned about the feet and hands, the boots being very much charred. Death was due to electrical shock, and the smoke was caused by the burning. The jointer, named Symonds, said that, being anxious to get the current on as soon as possible, they were doing two jobs at once, hence the mistake. The jury returned a verdict of "Accidental death."

Personal.—Mr. C. P. Sparks, the chief engineer to the County of London and Brush Provincial Electric Lighting Company, Limited, has been appointed consulting engineer to the Bournemouth and Poole Electricity Supply Company, Limited.

Transport says that Mr. Granville C. Cuningham, M.I.C.E., managing director to the City of Birmingham Tramways Company, has been appointed general manager of the Central London Electric Railway, and has already entered upon his new duties.

Herapath's Railway Journal says that Mr. H. Wynne, signal superintendent of the Highland Railway, has been appointed chief signal and electrical engineer on the New Zealand Government Railways.

The German Emperor has conferred the Royal Order of the Prussian Crown of the second class upon Sir Henry C. Fischer, who recently retired from the Post Office Telegraph service.

Middlesex County Council and Electrical Schemes.—The Middlesex County Council has resolved to oppose the following applications for powers:—The application of the Enfield District Council for an electric lighting order, as the main roads and bridges are affected. The application of the Harrow District Council for an electric lighting order. The Heston Boleworth District Council's application for an electric lighting order. The application of certain promoters for an electric lighting order for Teddington. The Twickenham Electric Lighting Order. The application for an electric lighting order for Staines, Egham, and Chertsey, in the Counties of Middlesex and Surrey. The Uxbridge and District Electricity Supply Order. The application for a provisional order by the North Metropolitan Electric Power Company for powers to generate and supply electricity in the areas of the Edmonton and Hendon Unions.

Electric Locomotives.—A lecture has just been delivered at Berlin on "Modern Electric Locomotives," by Herr Tischbein, engineer on the staff of the General Electricity Company in Berlin. The lecturer closed by comparing the economies of steam with electrical locomotives, which were greatly in favour of the latter. Only one man was required to drive the electrical locomotive, and there was, besides, no need for the building of water stations, pumps, ashpits, and water tanks. Electrical locomotion was more economical, in that it worked more continuously than steam locomotion.

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Société des Electriciens, Paris.—At the last monthly sitting of the Société des Electriciens, M. Gosselin read a paper on arc lamps working three in series at 110 volts. He described successively the Hegner, Vigreux, and Brillié arc lamps. The first-mentioned works with a shunt resistance which intervenes at the moment that it is required; the others work without any resistance. M. Gosselin worked the systems of lamps, and asked whether there was any gain of light in working three lamps in series. He explained that the diminution in the difference of potential at the terminals of the arc enables the diameter of the carbon to be diminished, and consequently the light to be increased by a certain quantity. He then worked a small alternating current arc lamp, which burned at a difference of potential of 40 volts, with a choking coil in circuit. This lamp is branched on the secondary circuit of a small transformer, placed in the pedestal of the candelabrum that holds the lamp. M. Aliamet advanced certain objections to the working of arc lamps in series without resistance. The resistance is necessary for good working, and has an appreciable influence on the regularity of the light. The arc should have a constant length, and in order to obtain this effect, we must consent to a loss of energy in the line. Without a resistance, during the period of lighting up, the current is very great, and the carbons are brought to a very high temperature, and they often flame. Without resistance the stability of the arcs is not ensured. For three arcs in series the difference of potential is 35 volts at the terminals of each arc. The arc is then short, and the shadows are considerable. Lastly, M. Sartiaux remarked that lamps above 25 amperes could not be used three in series, whereas at the present day lamps of 50 amperes are greatly in request for lighting large spaces. M. Hegner then observed that a special carbon with a particular core is necessary for arc lamps three in series. Also differential arc lamps are required. The rest of the discussion was postponed until the next sitting. M. Lauriol then spoke of the production of electricity by the combustion of household refuse; but he made only vague statements, based on uncertain experimental results.

The Committee on Copper Conductors.—A correspondent writes:—"I notice an article in one of your contemporaries which criticises the report of the Copper Conductor Committee on the ground that three leading cable manufacturers, the N.T.C., and the cable companies were not consulted. As to the report itself, it seems to want a lot of explanation. Resolution 6 seems to be like saying that a man's income shall be calculated from the money he receives. There is no other conceivable way of determining the resistance of a cable than from the dimensions of its strands. The object appears to be to agree upon a set of terms for use in specifying the conductors of cables, so as to make tenders readily comparable, but to an outsider the result seems to be extraordinarily clumsy. Still, unless one has had experience in tendering for cables, one has no right to criticise the methods other people may find convenient. It looks very much as if this is an attempt to defeat fraudulent specifications. We have heard of the carrying capacity of a cable defined by its sectional area, so that the effect of the outer strands lying obliquely is to make the conductivity appear greater instead of less than if they all lay parallel to the axis. I daresay there may be other ways of making the worse cause appear the better."

Mixed Systems.—Mr. A. T. Cooper, engineer to the Reading Electric Supply Company, Limited, writes to us with reference to the article on "Mixed Systems" appearing in the last issue of the ELECTRICAL REVIEW, stating that this has led several of his friends and many of our readers to suppose that Mr. Robert Hammond is consulting engineer to the Reading Company, and as such is responsible for the successful introduction of direct current supply into their home area, which was previously fed on the single-phase alternating system. He points out, however, that this is not the case. We believe that the credit is really due to Mr. Cooper himself. Mr. Hammond was, of course, perfectly justified in mentioning in his report to Sheffield the success of the change advised and carried out by Mr. Cooper at Reading.

The Cast Weld Steel Joint.—The Milwaukee Railjoint and Welding Company has recently designed a new type of its cast weld steel rail joints for the work which it is now doing for the Rochester (New York) Railway Company. The Milwaukee Railjoint and Welding Company is the pioneer in this type of welding. Its success, says the *Street Railway Review*, in welding exposed rails has been such as to excite surprise on the part of railroad men, who had not supposed it was possible to accomplish the results obtained. In 1898 the company welded eight miles of exposed rails between the city of Milwaukee and South Milwaukee. This track has been in constant use ever since, and subjected to the heaviest kind of interurban traffic. The breakage during the winter of 1898 did not amount to 1 per cent. Since the joints were repaired in the spring there had not, up to October 5th, been any further breaks, nor is it expected there will be; neither is there any kinking of the rails. In certain portions of the road slip joints were installed, but in other sections equally long the welding was made continuous, regardless of slip joints. The officers of the company state: "We find by experience that after the track is once adjusted after welding, it does not move a great deal, and there is not much necessity for a slip joint." The track referred to is certainly in first class condition, and will bear the closest inspection. As a result of the manner in which this welding stood the test of extreme temperatures the company received a second contract, for welding 15 miles of suburban track between Milwaukee and Wauwatosa on exposed rails. Another notable contract is on a line of railway running through the main street of Milwaukee, which is believed to be the finest piece of street railway work and cast-welding in the country. This is laid with 72-lb. T-rails on a 6-inch concrete foundation, with concrete between the ties; over this is asphalt paving. It is impossible in riding over this track to discern where the joints occur. The company has recently arranged with the Calumet, of Chicago, for the latter company to do its own welding, using the steel jackets under license; similar agreements have been made with the Rochester Railway Company, and a road at Columbus, O. The contract now being carried out at Milwaukee with the Milwaukee Electric Railway and Light Company, is for 20,000 joints, which, with the work done last year, will make a total of 28,000 joints of the cast weld steel process on that road. The headquarters of the Milwaukee Railjoint and Welding Company are in the Pabst Building, Milwaukee.

Lectures.—Under the auspices of the Greenock Association of Practical Science last week, Mr. M. Blackwood delivered a demonstrative lecture on the practical uses of electrical apparatus and X rays.

Last week, before the Royal Dublin Society, Prof. Barrett, F.R.S., read a paper prepared by himself and Messrs. W. Brown, B.Sc., and R. A. Hadfield, M.I.C.E., on "Further Results of the Determination of the Magnetic Properties of a Series of New Alloys of Iron (Part III.); (*a*) Non-Magnetic Steels; (*b*) Steels of Higher Permeability and not less Hysteresis Loss than the Best Iron." Dr. Molloy followed with a paper on a new method of making Hertzian experiments by which the phenomena of the reflection, refraction, and polarisation of electric waves may be shown to a large audience.

Before the Scottish Section of the Society of Chemical Industry at Glasgow last week, papers were read on the cyanide process of gold extraction, the analysis of copper, the separation of bismuth from lead, and the oxidation of ammonia by iron ore.

Bournemouth Telephones.—The Council having received communications from the Association of Municipal Corporations and Mr. A. R. Bennett, as to whether the establishment of a municipal telephone exchange is contemplated, has resolved to make inquiries of Tunbridge Wells and Southport as to the action taken there in the matter.

Wireless Telegraphy and the War.—A Reuter dispatch from Modder River says that Captain Kennedy, in charge of the wireless telegraphy department, has arrived there, having made most successful experiments between Orange River and De Aar, a distance of over 70 miles.

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Crystal Palace Engineering School.—The award of certificates for the Winter Session, 1900, took place on Thursday, December 21st, when Mr. William Tregarthen Douglas, M.Inst.C.E., M.I.Mech.E., M.Inst.E.E., late consulting engineer to Trinity House, presided, and addressed the students. He expressed satisfaction and pleasure in inspecting the work of the students, and gave some excellent advice as to the way in which the school training should be used as a foundation for future progress in the profession.

London County Council Electric Tramways and Light Railways.—The following will give our readers a correct idea of the proposals for which powers are being sought by the London County Council, for which Prof. Kennedy is consulting engineer. All the lines will be 4 feet 8½ inches gauge:—

LIGHT RAILWAYS.		
Deptford, Shooter's Hill and Woolwich.	Double track.	These lines will be equipped on the central conduit system.
New Cross, Lewisham and Eltham.	" "	
Clapham, Wandsworth and Kingston Road.	Part double track, part single track, with loops.	Partly conduit and partly surface contact or overhead.
Archway Road, Highgate ..	Double track.	Overhead equipment.
TRAMWAYS.		
Vauxhall and Camberwell	Double track.	Equipped on central conduit system.
Westminster and Tooting	" "	Partly conduit and partly surface contact.
Blackfriars and Kennington Park.	" "	Equipped on central conduit system.

Presentation.—On the occasion of his marriage, the staff of the Taunton Corporation electricity works have presented Mr. E. B. Thornhill, borough electrical engineer, with a handsome French onyx and ormulu striking clock.

Appointments Vacant.—The Bolton Corporation wants a foreman cable jointer, and a cable jointer. See "Official Notices" this week.

Volunteering for Service Abroad.—The Bristol sanitary authority has resolved to reinstate on their return any of its electric lighting employés who volunteer for foreign service.

Cable Communication with South Africa.—Yesterday's *Standard* says that the Telegraph Construction and Maintenance Company will not be in a position to despatch the completing section of the third cable connecting Great Britain with South Africa until towards the end of January. The section is to be laid between St. Vincent and Ascension, and the task of paying out the cable will probably occupy twelve days. At the earliest this third alternative cable route to the Cape will not be in operation before the middle of February. Meantime the Government have considered the possibility of both the present cables breaking down, and they have stationed a fast cruiser at Ascension, so that in such an emergency messages can be taken from that island to Sierra Leone, and then despatched by the ordinary route to England; in the event of the West Coast cable being broken north of Sierra Leone, whilst the East Coast route was also down, messages would be taken direct from Ascension to St. Vincent. This would mean a delay of at least four days even to Government despatches.

NEW COMPANIES REGISTERED.

Harry South & Co., Limited (64,525).—This company was registered on December 15th, with a capital of £10,000 in £1 shares, to acquire the business carried on at 10—12, Garrick Street, W.C., as "Harry South," and to carry on the business of electricians, electrical engineers, suppliers of electricity for the purposes of light, heat, motive power, and otherwise, and manufacturers of electrical and other apparatus and machinery. The first subscribers (each with one share) are:—M. J. Tilney, 8, Astwood Road, South Kensington, electrical engineer; H. E. Winter, Bush Lane House, E.C., solicitor; J. J. Tustin, 17, Harvist Road, Holloway, N., clerk; T. W. Hale, 6, Fernchiff Road, N., clerk; H. South, 10—12, Garrick Street, W.C., engineer; M. Harley, 33, Southampton Street, Strand, W.C., clerk; and C. H. Bolton, 47, Scarsdale Villas, Kensington, W., clerk. The number of directors is not to be less than two nor more than five; the first are H. South and M. J. E. Tilney (managing directors with £5 each per week); qualification, £1,000.

Sahlstroms, Limited (64,474).—This company was registered on December 12th, with a capital of £25,000 in £1 shares, to manufacture, produce, prepare for market, and deal in ozone and all electrodes and apparatus (whether electrical or otherwise) in relation thereto, and to carry on the business of chemists, druggists, chemical manufacturers, engineers, founders, &c. The first subscribers (each with one share) are:—J. Westaway, 47, Clipstone Street, Portland Road, engineer; J. E. Harris, Monmouth House, Stoke Newington, N., engineer; E. E. Strong, 36, Nunhead Lane, S.E., writer; C. G. Embleton, 26, Carlton Grove, Peckham, S.E., book-keeper; W. L. Williams, 41, Crewdson Road, Brixton Road, S.W., book-keeper; R. S. Darlasson, 162, Grovenor Terrace, S.E., clerk; and W. H. Nex, 10, Fetter Lane, E.C., clerk. The number of directors is not to be less than three nor more than seven; the first are to be appointed by the subscribers; qualification, £100; remuneration not less than £50 nor more than £500 each per annum.

Cecil Wray & Co., Limited (64,480).—This company was registered on December 12th, with a capital of £5,000 in £1 shares, to acquire and take over as a going concern the business carried on by Cecil Wray, at 76, Manchester Road, at 1A, Hallfield Arcade, and Borough Mills, all in Bradford, Yorks, and to carry on the business of metal workers, engineers, camera, cinematograph, lantern, and automatic, mechanical, optical, electrical, and scientific machine and apparatus manufacturers, &c. The first subscribers (each with one share) are:—Cecil Wray, 1A, Hallfield Road, Bradford, Yorks, electrician and optician; Walter C. Atkinson, 18, Park Row, Leeds, chartered accountant; William A. Thornton, Belper House, Wetherby, gentleman; Charles Atkinson, 10, Park Row, Leeds, solicitor; Wilhelm K. Ferro, West Burn, Burnley-in-Wharfedale, manager; George Crowther, 18, Park Row, Leeds, chartered accountant; and Moses Atkinson, Fairmount, Headingley, Leeds, gentleman. The number of directors is not to be less than three nor more than five; the first are William A. Thornton, Charles Atkinson, and Cecil Wray; qualification, £250; remuneration as fixed by the company.

Metal Electro-Amalgamating Syndicate, Limited (64,487).—This company was registered on December 13th, with a capital of £20,000 in £1 shares, to acquire the invention of F. H. Snyder for coating metals by an electrical process, and to carry on the business of metallurgists, makers and workers of alloys, electroplaters, electricians, chemists, chemical manufacturers, &c. The first subscribers (each with one share) are:—H. Firmin, 31, Lombard Street, E.C., merchant; J. E. Bennett, 167, Kingsland Road, N.E., engineer; H. M. Johnson, 3, Westcombe Rise, Blackheath, Commander R.N.; J. H. Hall, 31, Lombard Street, E.C., merchant; J. I. Vivian, 24, Bonham Road, Brixton, S.W., Lieutenant R.N. (retired); J. H. Matthews, 19, Chelsham Road, Clapham, S.W., clerk; and J. Morley, "Loriner Lodge," Sydney Road, Friern Barnet, N., clerk. The number of directors is not to be less than three nor more than five; the first are the first four subscribers; qualification, 100 shares; remuneration, £200 per annum, and a share in the profits, divisible.

OFFICIAL RETURNS OF ELECTRICAL COMPANIES.

Winchester Electric Light and Power Company, Limited (50,868).—This company's annual return was filed on November 1st, 1899, when 2,207 shares were taken up out of a nominal capital of £25,000 in 4,000 shares of £5 each. The full amount has been called up, resulting in the receipt of £10,875. £160 is owing.

CITY NOTES.

Alderley and Wilmslow Electric Supply, Limited.

THE annual meeting of shareholders of this company was held last week at 78, King Street, Manchester, Mr. F. E. Gripper presiding. Among those present were Messrs. A. Crewdson, W. P. J. Fawcus, P. Whyman, S. V. Clirehugh (consulting engineer), and W. E. Rowcliffe (secretary). From the report of the resident engineer it appeared that the works were giving every satisfaction, and the number of residents appiying for the supply of electric light was increasing. Mention was also made that it was thought probable that application had been made for the supply to be extended to the district of Mobberley, but the directors had decided to obtain further particulars in regard thereto. The secretary reported that the company had entered into an agreement with the National Electric Wiring Company, Limited, for the free wiring of premises in the district, and this would enable intending customers to have the use of the fittings at a very small cost. It was also reported that the directors were in communication with the Wilmslow District Council with a view to make an arrangement for the supply of current to that district, in respect of which a provisional order had been obtained. The two retiring directors, Messrs. W. P. J. Fawcus and Philip Whyman were re-elected. Mr. A. A. Gillies was re-appointed auditor.

The Wireless Telegraph and Signal Company.

THE report of the directors for the year ending August 31st, 1899, states that the year that has passed must be considered as another year of experiment and development. But a foundation has now been laid on which a sound commercial business may be expected to be built at an early date. Since the last meeting communication has been established for the Trinity Board between the East Goodwin lightship and the South Foreland lighthouse, a distance of 12 miles;

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and between the South Foreland and Wimereux, in France, a distance of 32 miles. Her Majesty's ships *Alexandra*, *Europa*, and *Juno* were fitted with apparatus, and under the personal charge of Mr. Marconi the system was made great use of during the subsequent naval manœuvres, signals being transmitted a distance of 70 miles. The results were most satisfactory, and it is expected that the company's system of wireless telegraphy will henceforth take its place as part of the equipment of Her Majesty's ships. The chief features of the meeting of the British Association at Dover during the year 1899 were the interchange of visits between the Association and the corresponding French Society, which held its annual meeting at Boulogne, together with the immense interest excited by the company's stations at the South Foreland and Wimereux. On November 2nd six assistants with apparatus sailed under agreement with H.M. War Office for South Africa. Naturally the experience of the company's assistants, under Mr. Bullocke, with the Marconi system for the first time in the field during active warfare is of very great interest. The shareholders will see from the notice convening the meeting that it is not intended to transact any business on Friday, December 29th, except to propose the adjournment of the meeting to a day to be fixed by the directors in January or February, 1900. At the adjourned meeting the directors will still place before the shareholders fully the position of the company, which they have every reason to believe will be found satisfactory. Manufacturing premises having been obtained at Chelmsford, machinery and plant have been installed, and the works are now in running order. The directors recommend that the name of the company should be changed into "Marconi's Wireless Telegraph Company, Limited," and will propose a resolution giving effect to their recommendation at the extraordinary meeting, which it is proposed shall be held immediately after the adjourned general meeting. Mr. William Smith has resigned the directorship, and Major Samuel Flood Page and Mr. Henry Spearman Saunders have joined the board. The directors retiring by rotation are Mr. William Woodcock Goodbody, who is eligible and offers himself for re-election, and Mr. Henry Jameson Davis. The auditors, Messrs. Cooper Bros. and Co., also retire, and offer themselves for re-appointment.

TRAFFIC RECEIPTS.

Blackpool and Fleetwood Tramroad Company.—The receipts for the week ending December 23rd, 1899, were £122 16s. 10d.: December 23rd, 1898, £132 15s. 0d.; aggregate for half-year to date, £20,083 18s. 2d.

The Bristol Tramways and Carriage Company, Limited.—The receipts for the week ending December 22nd, 1899, were £2,763 12s. 8d.; corresponding period, 1898, £2,729 15s. 7d.; increase, £33 16s. 8d.

The City and South London Railway Company.—The receipts for the week ending December 24th, 1899, were £1,194; December 25th, 1898, £1,134; increase £60. Total receipts for half-year, 1899, £25,995; total receipts corresponding period, 1898, £25,966; increase, £29. Miles open, 3½.

The Dublin United Tramways Company.—The receipts for the week ending Friday, December 2nd, 1899, were as follows:—D. U. T. Co., horse cars, £190 15s. 11d.; ditto, electric cars, £3,107 11s. 10d.; D. S. D. Co., electric cars, £647 9s. 0d.; total, £3,875 16s. 9d.; corresponding week last year—D. U. T. Co., horse cars, £2,202 1s. 7d.; ditto, electric cars, £587 12s. 9d.; D. S. D. Co., electric cars, £653 7s. 11d.; total, £3,443 2s. 8d.; increase, £432 14s. 6d. Aggregate to date, £103,752 8s. 1d.; aggregate to date last year, £98,242 15s. 9d.; increase to date, £5,509 12s. 4d. Worked:—The mileage open is 40 miles electrically, 4 miles by horses, as against 16 miles electrically, and 28 miles by horses, for the corresponding period last year.

The Halifax Corporation Tramways.—The receipts for the week ending December 24th, 1899, were £576; December 28th, 1898, £314; increase, £262. Number of cars, 1899, 28; 1898, 10. Total receipts to date, from April 1st, 1899, £22,794; 1898, from June 29th, 1898, £6,858. Miles of track open, 12; 1898, 3¼.

The Liverpool Overhead Railway Company.—The receipts for the week ending December 24th, 1899, amounted to £1,442; corresponding week last year, £1,439; increase, £3.

The South Staffordshire Tramways Company.—The receipts for week ending December 22nd, 1899, were £623 12s. 5d.; December 23rd, 1898, £685 8s. 7d.; aggregate receipts for 51 weeks £33,801 14s. 9d.; 1898, £32,188 6s. 4d.

STOCKS AND SHARES.

Wednesday Evening.

In giving a very short *résumé* of the principal movements in the electrical markets during the present year, we must preface our list of tables with the general remark that 1899 has been an unfortunate twelvemonth for those who have money invested in this description of security. Politics, dear money, war—have played their parts in reducing values, and it is only natural, under the circumstances, that prices should have given way. To take the little electrical railway market first, we give the closing prices of last year side by side with the opening quotations of December 27th, 1899.

Railway.	Dec. 31st, 1898.	Dec. 27th, 1899.	Fall.
City of London	68	60½	7½
Central London	10	9⅞	⅛
Waterloo and City	112½	101½	11

The fall in price notwithstanding, there has been a great increase in the number of electrical and other light railways under construction; most of the enterprises met with poor receptions from the public, but the work has been taken in hand by other companies and financiers, and any revival of interest in this class of investment will quickly find itself confronted with plenty of new outlets for its capital.

Turning to the market for supply shares, there is another list of falls to be put upon record, thus:—

Company.	Dec. 31st, 1898.	Dec. 27th, 1899.	Rise or fall.
City of London	28	10½	−12½
Charing Cross	12	10	− 2
Chelsea	9½	8	− 1½
Metropolitan	18½	13½	− 4⅝
County Brush Ordinary	13	10⅛	− 2⅞
St. James's and Pall Mall	16½	15½	− 1
Westminster	16	14	− 2

The end of last year, it must be remembered, saw this section in what might almost be called a state of boom. The unhealthy activity then developed has softened down into a much more chastened frame of mind in the Stock Exchange, and the uninteresting dividends declared by the various companies showed that trade was not rushing up as quickly as prices. Among the principal features of the year has been the excitement produced by the Charing Cross Company obtaining permission from the Corporation to compete with the City of London Company on its own ground. In consequence of this the latter company passed its dividend in September, and the year's concatenation of misfortunes has caused a fall of £12 10s. in the price on the year.

Several of the companies have added to their capital during the year, the House-to-House, whose shares stood at 9½ on December 31st last, has changed its name to the Brompton and Kensington Electric Supply; the price of the shares has fallen to £8.

Telegraph stocks have indulged in all kinds of vagaries. The general tendency has been downward, and the fall started with apprehensions as to what might be the effect upon telegraph companies if wireless telegraphy should come to supersede the older method of communication. Another scare was begun at the proposal to lay a new all-British cable, and these two causes, added to dear money, are responsible for a good deal of the fall which we have to chronicle.

Company.	Dec. 31st, 1898.	Dec. 27th, 1899.	Rise or fall.
Anglo "A"	17	15¼	− 1¾
Anglo "B"	116½	112	− 4½
Eastern Ordinary	175¼	145½	− 30
Eastern Extension	17⅜	14¼	− 3⅛
Brazilian Submarine	15¼	14¼	− 1¼
Great Northern of Copenhagen	29	32	+ 3

The Western and Brazilian has been absorbed by the Brazilian Submarine Company. Anglo-American stocks were largely bought in anticipation of a better award for the "A" class, but latterly the slump in Yankee Rails, and the general frightened state of the Stock Exchange produced by British reverses in the Transvaal, have combined to lower these prices, together with nearly everything else, Great Northern of Copenhagen being a remarkable exception.

The miscellaneous section has passed a quiet and uneventful year. The country's trade has improved, which naturally brings increased prosperity to the more commercial companies, but this department has also suffered from the war and from the effects of the 6 per cent. Bank rate. Selecting six or seven of the most representative shares, we present another little list:—

Company.	Dec. 31st, 1898.	Dec. 27th, 1899.	Rise or fall.
British Electric Traction	16	15½	− ½
Brush	1⅞	1⅝	+ ⅛
New General Traction	5	3⅜	− 1⅝
Edison & Swan "A"	2½	2¼	− ¼
Babcock & Wilcox	27½	43	+ 15½
Electric Construction	2⅜	2⅛	− ¼
Henley's	22½	12½ (= 25)	+ 2½
Telegraph Construction	39	38	− 1

The wonderful rise in Babcock & Wilcox shares is due to the equally wonderful development of the company's business. A rise of 15½ points in such a quiet year is in itself sufficient congratulation to the shareholders without further comment. The Henley Telegraph Company has rearranged its capital, reducing the Ordinary shares from their £10 level to a denomination of £5. Elaborate proposals with regard to the Elmore companies have had no effect upon the price of the Patent Copper Depositing shares. National Telephones have fallen from 5⅝ to 4⅜, partly on account of the agitation in favour of the Government taking control of the telephone system.

Although prices at the end of the year are weak, the markets are in a perfectly sound condition, and if the Transvaal matter be quickly and satisfactorily settled, there is little doubt that 1900 will set a brighter complexion upon the general aspect of financial affairs.

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SHARE LIST OF ELECTRICAL COMPANIES.—TELEGRAPH AND TELEPHONE COMPANIES.

Present Issue.	NAME.	Stock or Share.	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation, Dec. 20th.	Closing Quotation, Dec. 27th.	Business done during week ended Dec. 27th, 1899. Highest.	Lowest.
124,400£	African Direct Telegraph, 4 % Debs.	100	...	...	...	100 —104	100 —104	...	...
25,000	Amazon Telegraph, shares	10	...	...	...	3 — 4	3 — 4	...	...
125,000	Do. do. 5 % Debs., Nos. 1 to 1,250 Red	100	...	...	...	85 — 90	85 — 90	...	...
905,560£	Anglo-American Telegraph	Stock	£2 13s	3 %	£3 9s	63 — 66	62 — 65	...	...
3,047,220£	Do. do. 6 % Pref.	Stock	£5 6s	6 %	6 %	113 —115	111 —113	113½	111½
3,047,220£	Do. do. Deferred	Stock	...	...	18s. %	15¼— 16	15¾— 16¼	16	15⅝
205,151	Brazilian Submarine Telegraph	10	7 %	7 %	...	14¼— 14¾xd	14 — 14½	14⅜	14¼
75,000£	Do. do. 5 % Debs. 2nd series, 1906	100	...	...	...	107 —111	107 —111	...	...
44,000	Chili Telephone, Nos. 1 to 44,000	5	4 %	4 %	...	2 — 3	2 — 3	...	...
10,000,000$	Commercial Cable	$100	8 %	8 %	8 %	198 —202	198 —202	...	...
1,333,533£	Do. do. Sterling 500 year 4 % Deb. Stock Red.	Stock	...	...	...	103 —105	100 —103	...	...
234,850	Consolidated Telephone Construction and Manufacturing	10/-	2 %	1½ %	1 %	¼— ¼	¼— ¼	...	...
16,000	Cuba Telegraph	10	8 %	7 %	8 %	8½— 9½	8½— 9½	...	...
6,000	Do. 10 % Pref.	10	10 %	10 %	10 %	19 — 20	19 — 20	...	...
12,981	Direct Spanish Telegraph	5	4 %	4 %	...	4 — 5	4 — 5	...	...
6,000	Do. do. 10 % Cum. Pref.	5	10 %	10 %	...	9 — 10	9 — 10	...	...
30,000	Do. do. 4½ % Debs.	50	...	...	...	103 —107%	103 —107%	...	...
60,710£	Direct United States Cable	20	3 %	3½%	3½%	11¾— 12¼	11½— 12	...	...
120,000	Direct West India Cable, 4½ % Reg. Deb.	100	...	...	...	101 —104	101 —104	...	...
4,000,000	Eastern Telegraph, Ord. Stock	Stock	6½%	7 %	7 %	145 —150	143 —148	146	145
1,795,000	Do. 8½% Pref. Stock	100	...	...	...	98 —101	97 —100	...	...
89,900	Do. 5 % Debs., repayable August, 1899	100	5 %	5 %	...	... ...	... ...	...	...
1,432,268£	Do. 4 % Mort. Deb. Stock Red.	Stock	4 %	4 %	...	115 —120	115 —120	116½	...
250,000	Eastern Extension, Australasia, and China Telegraph	10	7 %	7 %	7 %	14¾— 15¼	14¼— 14⅝	14 1/16	14¼
16,200£	Do. 5 % (Aus. Gov. Sub.) Deb., 1900, red. ann. drgs., reg. 1—1,049, 3,976—4,326	100	5 %	5 %	...	99 —103	99 —103	...	...
64,400£	Do. do. Bearer, 1,050—3,975, 4,327—6,400	100	5 %	5 %	...	100 —103	100 —103	...	...
220,000£	Do. 4 % Deb. Stock	Stock	4 %	4 %	...	116 —121	116 —121	...	...
95,100£	Eastern and South African Telegraph, 5 % Mort. Deb., 1900 red. ann. drgs., Reg. Nos. 1 to 2,343	100	5 %	...	...	99 —103	99 —103	...	...
46,800£	Do. do. do. to bearer, 2,344 to 5,500	100	5 %	...	...	100 —103	100 —103	...	...
200,000£	Do. 4 % Mort. Debs., Nos. 1 to 8,000, red. 1909	100	4 %	...	...	101 —104	101 —104	...	...
200,000£	Do. 4% Reg. Mt. Debs. (Mauritius Sub.) 1—6,000	25	4 %	...	...	101—104%	101 —104%	...	...
180,237	Globe Telegraph and Trust	10	4½%	4½%	5½%	10¾— 11¼	10¾— 11¼	11¼	...
180,042	Do. do. 6 % Pref.	10	6 %	6 %	6 %	14¼— 15½	14¾— 15½	15	...
150,000	Great Northern Telegraph, of Copenhagen	10	10 %	10 %	...	31 — 33	31 — 33	...	...
86,300	Halifax and Bermuda Cable, 4½% 1st Mort. Debs., within Nos. 1 to 1,200, Red.	100	...	...	...	100 —103	100 —103	...	...
17,000	Indo-European Telegraph	25	10 %	10 %	10 %	48 — 52	48 — 52	...	...
100,000£	London Platino-Brazilian Telegraph, 6 % Debs.	100	6 %	6 %	...	106 —109	106 —109	...	...
71,000	Montevideo Telephone, Limited, Ord., Nos. 1 to 71,000	1	...	...	...	¼— ⅜	¼— ⅜	...	...
84,000	Do. do. 5% Pref., Nos. 1 to 84,000	1	...	...	...	¾— 1	¾— 1	...	...
490,000	National Telephone, 1 to 490,000	5	5½%	6 %	6 %	5 — 5¼	4⅞— 4⅞	4⅞	4⅞
15,000	Do. 6 % Cum. 1st Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	14	...
15,000	Do. 6 % Cum. 2nd Pref.	10	6 %	6 %	6 %	14 — 15	14 — 15	...	...
250,000	Do. 5 % Non-cum. 3rd Pref., 1 to 250,000	5	5 %	5 %	5 %	5⅛— 5⅜	5⅛— 5⅜	5 3/16	...
1,229,471£	Do. 3½ % Deb. Stock Red.	Stock	3½ %	3½ %	3½ %	100 —102	100 —102	99⅞	...
171,504	Oriental Telephone and Elec., Nos. 1 to 171,504, fully paid	1	5 %	5 %	5 %	¾— 1	¾— 1	...	...
100,000£	Pacific and European Tel., 4 % Guar. Debs., 1 to 1,000	100	4 %	4 %	...	102 —105	102 —105	...	...
11,339	Reuter's	8	5 %	5 %	...	7 — 8	7 — 8	...	...
3,361	Submarine Cables Trust	Cert.	...	...	...	125 —130	125 —130	...	...
58,000	United River Plate Telephone	5	5 %	6 %	...	4¾— 5¼	4¾— 5¼	...	...
151,738£	Do. do. 5 % Debs.	Stock	...	..	...	105 —108	105 —108	...	...
200,000£	West African Telegraph, 5 % Debs.	100	5 %	%	...	99 —102	99 —102	...	...
20,008	West Coast of America, Nos. 1—30,000 and 53,001—53,008	2½	...	...	...	½— 1	½— 1	...	...
150,000	Do. do. 4% Debs., 1—1,500 gua. by Bras. Sub. Tel.	100	...	...	...	102 —105	102 —105	...	...
339,531	Western and Brazilian Telegraph 4 % Deb. Stock Red.	Stock	...	...	...	104 —107	104 —107	...	...
38,321	West India and Panama Telegraph	10	1 %	2%	...	⅞— 1¼	⅞— 1¼	...	...
34,568	Do. do. do. 6 % Cum. 1st Pref.	10	6 %	6 %	...	9¼— 9¾	9¼— 9¾	...	...
4,669	Do. do. do. 6 % Cum. 2nd Pref.	10	6 %	6 %	...	7⅞— 8⅛	7⅞— 8⅛	...	...
80,000£	Do. do. do. 5 % Debs., Nos. 1 to 1,800	100	5 %	5 %	...	106 —109	106 —109	...	...
168,100£	Western Union of U.S. Telegraph, 6 % Ster. Bonds	100	6 %	6 %	...	98 —103	98 —103	...	...

ELECTRICITY SUPPLY COMPANIES.

19,661	Brompton & Kensington Elec. Lt. Sup., Ord., 101 to 19,761	5	...	4 %	6 %	7⅛— 8⅛	7⅛— 8⅛	...	...
12,000	Do. do. 7 % Cum. Pref.	5	7 %	7 %	...	9 — 10	9 — 10	...	...
30,000	Charing Cross and Strand Electricity Supply	5	6 %	7 %	8 %	9½— 10½	9½— 10⅝	9⅝	...
20,000	Do. do. do. do. Nos. 30,001—50,000	5	...	...	...	9½— 10½	9½— 10⅝	...	...
20,000	Do. do. do. do. 4½ % Cum. Pref.	5	...	...	...	5¾— 6¼	5¼— 6	5⅝	...
34,000	*Chelsea Electricity Supply, Ord.,	5	5 %	6 %	6 %	7⅛— 8½	7⅛— 8½	...	...
100,000	Do. do. do. % Deb. Stock Red.	Stock	4½%	4½%	...	109 —111 xd	109 —111 xd	...	...
60,000	City of London Electric Lighting, Ord. 40,001—100,000	10	7 %	10 %	6 %	10 — 11	10 — 11	10 9/16	10½
40,000	Do. 6 % Cum. Pref., 1 to 40,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
400,000	Do. 5 % Deb. Stock, Scrip. (iss. at £115) all paid	...	5 %	5 %	...	125 —130	125 —130	...	...
40,000	County of Lond. & Brush Prov. Elec. Ltg., Ord. 1—40,000	10	nil	nil	nil	10 — 11	10 — 11	...	...
20,000	Do. do. do. 6 % Pref., 40,001—60,000	10	6 %	6 %	6 %	13 — 14	13 — 14	...	...
200,000	Do. 4½ % Deb. Stock, Prov. Certs (all paid) Red.	...	...	...	...	110 —113	110 — 113	...	...
26,100	Edmundsons Elec. Corp., Ord. Shares	5	...	5 %	7 %	4¾— 5¼	4¾— 5¼	...	...
110,000	London Electric Supply Corporation, Limited, Ord.	3	...	...	...	2¼— 2⅝	2¼— 2⅝	...	...
48,050	Do. do. do. 6 % Pref.	5	...	...	6 %	5½ — 6	5½ — 6	...	...
100,000	Do. do. do. 4% 1st Mt. Db. Stock Red.	Stock	...	...	...	102 —104 xd	102 —104 xd	103	...
62,500	Metropolitan Electric Supply, 101 to 62,500	10	5 %	6 %	5 %	13 — 14	13 — 14	13⅜	...
22,500	Do. Nos. 62,501 to 85,000	10	...	...	...	13 — 14	13 — 14	...	...
220,000£	Do. 4½ % First Mortgage Debenture Stock	...	4½%	4½%	...	117 —119	117 —119	...	...
6,452	Notting Hill Electric Lighting	10	4 %	6 %	6 %	15½— 16½	15½— 16½	...	...
31,980	St. James's and Pall Mall Electric Light, Ord.	5	10½ %	14½ %	14½ %	15 — 16	15 — 16	...	...
30,000	Do. do. 7 % Pref., 20,081 to 40,080	5	7 %	7 %	7 %	9 — 9½	9 — 9½	...	...
65,000	South London Electricity Supply, Ord.	5	...	...	...	4¼— 4⅜	4¼— 4⅜	...	...
79,900	Westminster Electric Supply, Ord., 101 to 80,000	5	9 %	12 %	12 %	13½— 14½	13½— 14½	...	...

* Subject to Founder's Shares.
† Quotations on Liverpool Stock Exchange.
Unless otherwise stated all shares are fully paid.
‖ Dividends paid in deferred share warrants, profits being used as capital
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

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SHARE LIST OF ELECTRICAL COMPANIES—*Continued.*

ELECTRICAL RAILWAY, MANUFACTURING, AND INDUSTRIAL COMPANIES.

Present Issue.	NAME.	Stock or Share. ‡	Dividends for the last three years. 1896.	1897.	1898.	Closing Quotation Dec. 20th.	Closing Quotation Dec. 27th.	Business done during week ended Dec. 27th, 1899. Highest.	Lowest.
60,000	Aluminium "A" shares, Nos. 1—60,000	1	10 %	10 %	...	2¾— 3¼	2¾— 3¼	...	...
90,000	Do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	95 —100	95 —100	...	...
30,000	British Electric Traction	10	...	...	6 %	15 — 16	15 — 16	15½	15⅜
30,000	Do. do. 6 % Cum. Pref. 30,001—60,000	10	...	...	...	12⅞— 13¼	12⅞— 13¼	...	...
200,000	Do. do. 5 % Perpetual Debenture Stock ...	Stock	...	...	...	125 —128	125 —128	127	126½
40,000	British Insulated Wire Ord., Nos. 1 to 40,000	5	...	...	...	11½— 12½	11½— 12½	...	...
27,500	Do. do. 6 % Cum. Pref. Nos. 1 to 27,500 ...	5	...	...	...	6¼— 6⅝	6¼— 6⅝	...	...
90,000	Brush Elecl. Enging., Ord., 1 to 90,000	3	*nil*	3 %	5 %	1⅝— 2	1⅝— 2	...	...
90,000	Do. do. Non-cum. 6 % Pref., 1 to 90,000	2	4 %	6 %	6 %	2⅛— 2⅜	2⅛— 2⅜	...	...
125,000£	Do. do. 4½ % Perp. Deb. Stock ...	Stock	...	...	...	110 —115	110 —115	...	...
50,000	Do. do. 4½ % 2nd Deb. Stock Red. ...	Stock	...	...	...	104 —107	104 —107	...	...
20,000	Callender's Cable Construction shares, Nos. 1—20,000 ...	5	10 %	12½ %	15 %	12½— 13½	12½— 13½	...	...
20,000	Do. do. 5 % Cum. Pref.	5	...	...	...	5½— 6	5½— 6	...	...
90,000	Do. do. 4½ % 1st Mort. Deb. Stock Red.	Stock	...	...	...	113 —116	113 —116	...	...
35,250	Central London Railway, Ord. Shares	10	...	...	...	9⅜— 10¼	9½— 10	10	9¹¹⁄₁₆
178,303	Do. do. do. £8 paid	10	...	...	...	...	...	...	...
61,083	Do. do. Pref. half-shares	5	...	...	...	4½— 5	4½— 5	...	...
71,447	Do. do. Def. do.	5	...	...	...	4⅜— 5	4½— 5	...	...
630,000£	City and South London Railway	Stock	1 2/16 %	1⅞ %	2⅛ %	59 — 62	59 — 62	...	...
37,000	Do. do. Ord. shares, Nos. 22,501 to 60,000	4½	...	...	...	3½— 4½	3½— 4½	...	...
32,098	Crompton & Co., Nos. 1 to 32,098	3	...	...	...	3½— 4	3½— 4	...	...
100,000	Do. 5% 1st Mort. Reg. Debs., 1 to 900 of £100, and 901 to 11,000 of £50 Red.	...	...	...	...	100 —103	100 —103	...	...
99,261	Edison & Swan Utd. El. Lgt., "A" shares, £8 pd. 1 to 99,261	5	5⅛ %	6 %	6 %	2 — 2⅛	2 — 2⅛	...	...
17,139	Do. do. do. "A" Shares, 01—017,139	5	5⅛ %	6 %	6 %	3⅛— 4⅛	3⅛— 4⅛	...	...
344,023	Do. do. do. 4 % Deb. Stock Red. ...	100	...	...	...	95 — 97	95 — 97	...	...
112,100	Electric Construction, 1 to 112,100	2	5 %	6 %	6 %	2 — 2¼	2 — 2¼	...	...
25,000	Do. do. 7 % Cum. Pref., 1 to 25,000 ...	2	7 %	7 %	7 %	2⅜— 3¼	2⅜— 3¼	...	...
140,300	Do. do. 4% Perp. 1st Mort. Deb. Stock ...	Stock	...	...	...	104 —107	104 —107	...	...
91,196	Elmore's Patent Copper Depositing, 1 to 70,000 ...	2	...	...	...	⅜— ⅝	⅜— ⅝	...	...
9,600£	Greenwood & Batley, 7 % Cum. Pref., 1 to 9,600 ...	10	7 %	7 %	7 %	10 — 12	10 — 12	...	...
30,000	Henley's (W. T.) Telegraph Works, Ord.	5	10 %	12 %	14 %	12 — 13	12 — 13	...	...
15,000	Do. do. do. 4½ % Pref.	5	7 %	7 %	7 %	5 — 5½	5 — 5½	...	...
50,000	Do. do. do. 4½ Mort. Deb. Stock...	Stock	4½ %	4½ %	...	111 —114	111 —114	...	...
50,000	India-Rubber, Gutta-Percha and Telegraph Works ...	10	10 %	10 %	10 %	21 — 22	21 — 22	...	...
300,000	Do. do. do. 4 % 1st Mort. Debs.	100	...	...	...	100 —104	100 —104	...	...
37,500	†Liverpool Overhead Railway, Ord.	10	2½ %	3¼ %	3½ %	8⅛— 8 15/16	8⅛— 9 1/16	...	...
10,000	† Do. do. Pref., £10 paid	10	5 %	5 %	5 %	13¼— 13⅝	13¼— 13⅝	...	...
37,850	Telegraph Construction and Maintenance	12	15 %	15 %	15 %	36 — 40	33 — 37	36	...
150,000	Do. 4 % Deb. Bds. Nos. 1 to 1,500 Red. 1909 ...	100	...	...	...	103 —106	103 —106	...	...
13,400	Telegraph Manufacturing, Ord. Nos. 6,601 to 20,000 ...	5	...	...	...	9 — 10	9 — 10	...	...
13,400	Do. do. 5% Cm. Prf. Nos. 6,601 to 20,000	5	...	...	...	5½— 6	5½— 6	...	...
540,000£	Waterloo and City Railway, Ord. Stock	100	...	...	3 %	100 —103	100 —103	...	...

† Quotations on Liverpool Stock Exchange.
‡ Unless otherwise stated all shares are fully paid.
Dividends marked ‖ are for a year consisting of the latter part of one year and the first part of the next.

LATEST PROCURABLE QUOTATIONS OF SECURITIES NOT OFFICIALLY QUOTED.

*Birmingham Electric Supply, Ordinary £5 (fully paid) 8—10.
Brompton and Kensington, 4½% Debentures of £100, 104—107.
National Electric Free Wiring, 10s. paid, ⅛—⅜.
Oldham, Ashton, and Hyde Electric (£10 pd.), Ord., 18—19.
Do. do. Pref. (£10 pd.), 10½—11.
Smithfield Market Electric, 1—3.
Kensington and Knightsbridge Electric Lighting, Ordinary Shares £5 (fully paid) 12—13; 1st Preference Cumulative 6%, £5 (fully paid), 7½—8. Debentures, 104—107. Dividend, 1898, on Ordinary Shares 10%.
Kidderminster and District Electric, Pref. (£8 pd.), 6—6½.
*T. Parker, £10 (fully paid), 18⅜.

* From Birmingham Share List.

Bank rate of discount 6 per cent. (November 30th, 1899).

MARKET QUOTATIONS, Wednesday, December 27th.

CHEMICALS, &c.		This week.	Last week.	Increase or Decrease.
a Acid, Hydrochloric	per cwt.	5/-	5/-	..
a „ Nitric	per cwt.	22/-	22/-	..
a „ Oxalic	per cwt.	32/-	32/-	..
a „ Sulphuric	per cwt.	5/6	5/6	..
a Ammoniac, Sal	per cwt.	40/-	40/-	..
a Ammonia, Muriate (crystal) ..	per ton	£29	£29	..
a „ „	per ton	£27	£27	..
a Bleaching powder	per ton	£6 10	£6 1	..
a Bisulphide of Carbon	per ton	£15	£15	..
a Borax	per ton	£16 10	£16 10	..
a Benzole (90 %)	per gal.	7/-	7/-	..
a „ (50/90 %)	per gal.	5/6	5/6	..
a Copper Sulphate	per ton	£25 10	£25 10	..
a Lead, Nitrate	per ton	£26	£25	..
a „ White Sugar	per ton	£31	£31	..
a „ Peroxide	per ton	£27 10	£27 10	..
a Methylated Spirit	per gal.	2/9	2/9	..
a Naphtha, Solvent (90 % at 160° C.)	per gal.	5/6	5/6	..
a Potash, Bichromate, in casks..	per lb.	4½d.	4½d.	..
a „ Caustic (75/80 %) ..	per ton	£24	£24	..
a „ Bisulphate	per ton	£35	£35	..
a Shellac	per cwt.	68/-	68/-	..
a Sulphate of Magnesia	per ton	£4 10	£4 10	..
a Sulphur, Sublimed Flowers ..	per ton	£6	£6	..
a „ Recovered	per ton	£5 10	£5 10	..
a „ Lump	per ton	£5	£5	..
a Soda, Caustic (white 70 %) ..	per ton	£7 10	£7 10	..
Crystals	per ton	£3	£3	..
a „ Bichromate, casks ..	per lb.	3½d.	3½d.	..
METALS, &c.				
Aluminium Wire, in ton lots ..	per ton	£294	£294	..
b „ Sheet, in ton lots..	per ton	£191	£191	..
p Babbitt's metal ingots	per ton	£70 to £125	£70 to £125	..
c Brass (rolled metal 9" to 12") basis	per lb.	8d.	8d.	..
c „ Tube (brazed)	per lb.	10d.	10d.	..
c „ Wire, basis	per lb.	8½d.	8½d.	..

METALS, &c. (*continued*).		This week.	Last week.	Inc. or Dec.
f Ebonite Rod	per lb.	8/-	8/-	..
f „ Sheet	per lb.	6/-	6/-	..
g Copper Bars	per ton	£85	£85	..
g „ Wire (basis price) ..	per lb.	10½d.	10½d.	..
g „ Sheet	per ton	£85	£85	..
g „ Rod	per ton	£85	£85	..
m German Silver Wire	per lb.	1/6	1/6	..
h Gutta-percha, fine	per lb.	7/-	7/-	..
h India-rubber, Para fine ..	per lb.	4/6½ to 4/7½	4/6½ to 4/7½	..
i Iron, Charcoal Sheets	per ton	£18	£18	..
i „ Pig (Cleveland warrants)	per ton	64/6	64/6	..
i „ Forgings, according to size	per ton	From £11	From £11	..
i „ Scrap, heavy	per ton	50/- to 55/-	50/- to 55/-	..
i „ Wire galvanised No. 8 ..	per ton	£14 5	£14 5	..
g Lead, English Ingot	per ton	£16 10	£17 10	£1 dec.
g „ „ Sheet	per ton	£18	£19	£1 dec.
m Manganin Wire No. 28.. ..	per lb.	8/-	8/-	..
g Mercury	per bottle	£9 12 6	£9 12 6	..
d Mica (in original cases), small	per lb.	2d. to 8d.	2d. to 8d.	..
d „ „ „ medium	per lb.	1/9 to 2/9	1/9 to 2/9	..
d „ „ „ large	per lb.	8/6 to 7/6	8/6 to 7/6	..
p Phosphor Bronze, plain castings	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ rolled bars & rods	per lb.	1/1 to 1/4	1/1 to 1/4	..
p „ r'l'd str'p & sheet	per lb.	From 1/2½	From 1/2½	..
o Platinum	per oz.	£3 11	£3 11	..
p Silicium Bronze Wire	per lb.	10½d. to 1/1	10½d. to 1/	..
i Steel, Magnet, acc'd'g to desc'p'n	p. ton	From £15	to £40	..
i Steel, Magnet, in bars		£58	£58	..
g Tin, block	per ton	£108 to £110 nom.	£124 5 nom.	dec.
g „ foil	per lb.	1/7	1/7	..
n „ wire Nos. 1 to 16	per lb.	1/8	1/10	2d. dec.
p White Anti-friction Metals— "White Ant" brand ..	per ton	£40 to £70	£40 to £70	..
j Yarns, Cotton, Single 10lb. bundles	pr lb.	7¾d.	7¾d.	..
j „ Best Flax, 6 lea. ..	per lb.	5d.	5d.	..
j „ Hemp, 8 ply 10 lbs. ..	per lb.	8½d.	8½d.	..
j „ „ Russian, 10 lbs.	per lb.	4½d.	4½d.	..
j „ Jute, 180 lbs. rove ..	per ton	£14	£14	..
k Zinc, Sheet (Vielle Montagne bnd.)	p.t.	£24 5s.	£24 8 nett.	2s. inc.

Quotations supplied by
a Messrs. G. Boor & Co.
b The British Aluminium Company, Ltd.
c Messrs. Thos. Rolston & Sons.
d Messrs. F. Wiggins & Sons
e

Quotations supplied by
f The India-Rubber, Gutta-Percha, and Telegraph Works Company, Ltd.
g Messrs. James & Shakspeare.
h Messrs. Jackson & Till.
i Messrs. Bolling & Lowe.
j Messrs. Henry C. Yee & Co.

Quotations supplied by
k Messrs. Morris Ashby, Limited.
m Messrs. W. T. Glover & Co., Ltd.
n Messrs. P. Ormiston & Sons.
o Messrs. Johnson, Matthey & Co., Ltd.
p The Phosphor Bronze Company, Ltd.

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SUPPLEMENTS TO RAILWAY SIGNALLING (BRIERLEY'S APPARATUS).

The whole of the elaborate system of railway signalling, consisting of simple block, automatic or semi-automatic block, where in use, interlocking, has as its object the exhibition of appropriate outdoor signals for the guidance of the drivers of trains. Such signals, as is well known, are visual signals, and when fogs or snowstorms are prevalent they are, as is also well known, supplemented by others which depend upon the train passing over detonators placed on the rail by hand, and thus giving an explosive danger signal. Much—so very much—might be written in criticism of the existing method of signalling during fogs, &c., but probably enough has been said. It

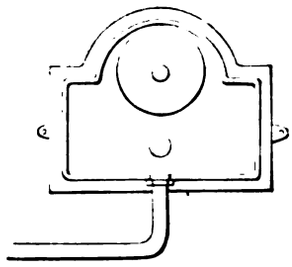


Fig. 1.

need, therefore, for the purpose of this article, only be remarked that since men have to be drawn from other occupations during the day, and from their homes at night, there is always a chance that it may not be immediately available; that the "all right" signal being conveyed by the absence of an indication is of a negative character, liable to misinterpretation, and is of no avail for localisation; and that the signalman who directs the operations has no actual control over the indications given, and therefore transmits his signals through a medium which is liable to err.

Something, of course, has been done in various places to put the operation of depositing explosive signals in position into the hands of the signalman, and instances are not wanting in which such mechanical arrangements have done excellent service. They, however, largely depend upon the efficient working of mechanisms, or the medium of operation, which cannot always be depended upon, especially for long distances; the receptacles can only hold a certain number of detonators and have to be refilled at intervals; and the signalman has no certainty that the operations he has gone through will have the effect intended, as he is unable to see the result of these operations. Besides all this, such arrangements, when made, make no change in the character of the signalling to the driver, and it is in this respect that those who have given attention to the subject consider the existing system most inadequate.

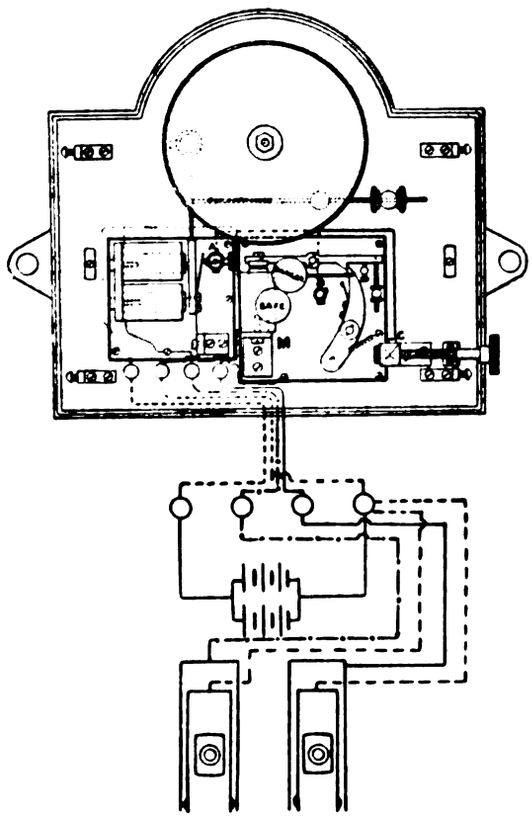
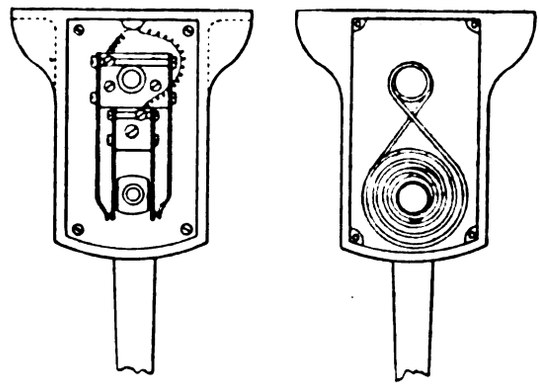


Fig. 2.—"All Right": Danger, Line Contacts.

There is no lack of substitutes, nowadays, for the ordinary form of fog signalling. Mr. Boult's system has been tried, and described in these columns. Raven and Baister's system has been tried on the North-Eastern; the Great Eastern, was reported some time ago to be contemplating the use of electric warning bells placed somewhere in the neighbourhood of the signals to be indicated; the system about to be described has been under trial on the Great Northern for 12 months, and there are other suggestions more or less varied. Somehow, however, no real progress seems to be made, and the old system retains its hold, probably on account of an innate dislike of change, and the trouble involved in making experiments which, after all, may prove abortive. There is, of course, something to be said for such an attitude. The percentage of accidents to the number of trains run under the existing system is undoubtedly low; railway companies do not indulge in the luxury of an experimental staff, and the departmental officers have usually as much on hand as is good for them; and the inventor, wherever found, is usually an optimist in so far as his own apparatus is concerned. It would, of course, be easy to meet these objections in detail, but there is no necessity to do so in the present case.

Suggestions for substitutes for the ordinary signals, may be divided, primarily, into two classes: those which give the desired indication on the engine of the train signalled, and those which give the indication external to the engine. Of the first class, Boult's, and



Contact Springs. Lever Springs.

Fig. 3.

Raven and Baister's, are types (neglecting the system to be described for the present). Of the second class the ordinary detonator, and the warning bells, are examples. The first class may be further divided into those which give the signal, primarily, through the impact of some part of the moving train against an obstruction purposely placed on the side of the line, and those which do not require such an impact. Raven and Baister's is an example of the first subdivision, and Boult's of the second. Several other distinctions might be drawn between the different classes of apparatus, but enough has been said for the present purpose.

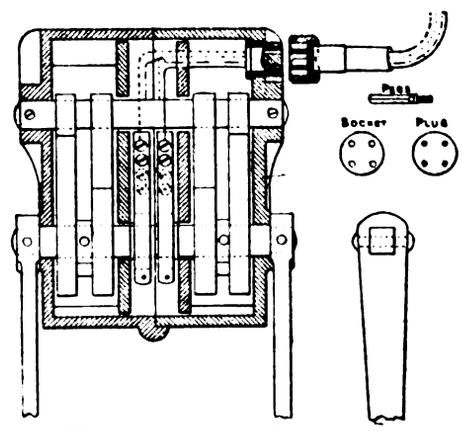


Fig. 4.—Section of Lever Box.

Brierley's system, which is being introduced by Messrs. Saxby and Farmer, has been under trial on the Great Northern for about 12 months, and is said to have given great satisfaction, and to have been inspected and approved by an inspector of the Board of Trade. The system is one which depends upon the movement of normally balanced levers, fixed on the engine, by impact with obstructions placed on the line side, and gives appropriate indications, on the engine itself, of the positions of the ordinary signals. The movement of the levers is made to close electrical circuits on the engine, and the indications are given by the ringing of an electric bell and the appearance of discs, which, by convention, convey the information desired. The apparatus is capable of giving two indications to the driver, corresponding to the "all right" and "danger" positions of the ordinary signal arms. The former indication is given by the bell ringing a short time only, and no change in the disc exhibited.

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The latter indication is given by continuous ringing of the bell until stopped by the driver, and the substitution of a red disc for the white one exhibited at all other times. The normal indication exhibited by the white disc is "all right," and the ringing of the bell when a signal in that position is being approached may be considered as confirmatory only. When the "danger" indication is being exhibited, and the bell is ringing, the apparatus may be replaced into its normal position at any time.

Such, briefly, are the objects sought and attained. The means by which they are obtained are of a very simple character.

Fig. 1 shows the outer form of the indicating apparatus; the lower circle on the front representing the window at which the discs (white and red) appear. Fig. 2 shows the indicating apparatus, and a diagram of the electrical circuits to which reference will be made later. Fig. 6 shows the balanced levers (2), the box containing

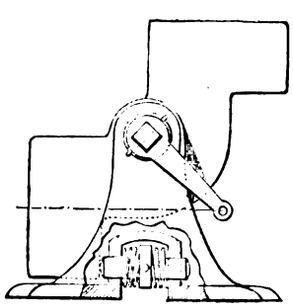


Fig. 5.

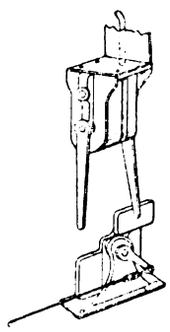
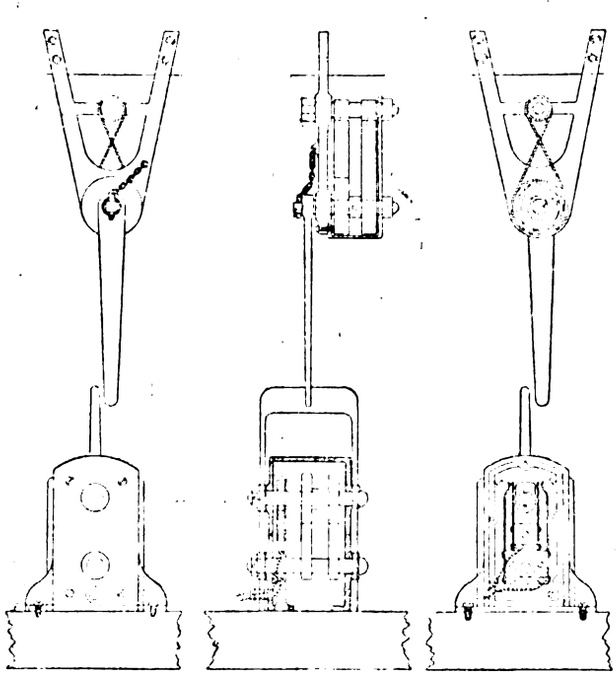


Fig. 6.

the circuit closing apparatus, and the means by which the levers are balanced, and the force of the impact, over and above that required to give the necessary movement, taken up. Further details of this part of the apparatus are shown by figs. 3 and 4, which are sections of the box. Reference to these shows that there are in each box four points at which contact is made, but only two circuits, and that in whatever direction a lever is moved the electrical results are the same. Figs. 3 and 4 show that the control of the levers consists of two volute springs in reversed order. One end of each spring is fastened to the shaft carrying the two levers, and the other ends are fastened to a bar above. Hence movement of either bar in either direction is checked by a spring. Save for the control exercised by the springs the levers are free.

The lever box is carried on the engine in an appropriate position to allow the lever bars to engage the arms of the contact rocker shown by fig. 6. The latter is fixed to the sleepers at the side of the line, at an appropriate distance from the signal to be indicated, and is worked by a prolongation of the signal wire; it therefore repeats, so to speak, the position of the arm. The position shown by fig. 6 is that occupied when giving the "danger" indication; when the "all right" indication is to be given, the movement of the crank by the



Figs. 7, 8 and 9.

wire from the signal reverses the position of the rocker, and the front lever, as seen in the figure, is engaged. The position shown by fig. 6 may be said to be the normal position, since that is the position the rocker takes up naturally, owing to a difference in the weights of the arms. In this respect the normal position of the rocker corresponds to the normal position of the signal, and failure of the wire operating either or both, results in a "danger" indication being given.

Turning next to fig. 2, it will be seen that the apparatus consists of an ordinary make and break bell (which, however, in giving one of the indications, acts as a single stroke bell only), a second electro-magnet, M, the armature of which controls the position of a curved lever, which itself is a circuit closer, and the means by which the discs are mechanically actuated. A plunger is also shown at the side by which the curved lever may be mechanically replaced in the position shown in fig. 2 at any time after having been released by M. This plunger is also a circuit closer.

A little consideration of fig. 2 shows that the closing of the "all right" circuit causes a current to pass through the *coils* of the bell. Under these conditions the bell acts as a single stroke bell only, but inasmuch as the lever arm will necessarily oscillate for some time, the circuit will be closed each time the lever passes its normal position, and the bell will ring under the impulses of the discontinuous currents set up. The time is about two seconds, and this is also a measure of the time required by the lever to take up its normal position after being struck. It will be noticed that this is the only electrical action for this indication.

If the "danger" position is being indicated a circuit through M is first closed, and the armature releases the curved lever. The fall of the latter causes the red disc to replace the white, and also closes a second circuit through B, A, the make and break, and the bell coils, thus causing the bell to sound. This local circuit is dependent upon

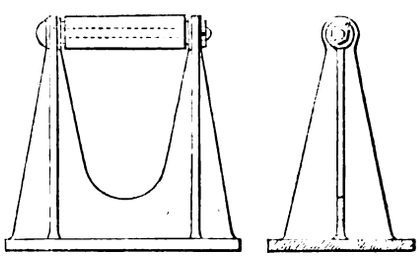


Fig. 10.

the position of the curved lever, and independent of the contact made in the lever box. Hence the bell will continue to ring until the curved lever is replaced. This, as already mentioned, is effected by the use of the plunger, acting mechanically on the lower end of the curved lever. The latter operation restores the white disc to the window. The use of the plunger to replace the apparatus completes the cycle of operations, but it should also be mentioned that as the plunger completes the same local circuit as is completed by the falling of the curved lever, the use of the plunger affords a means of testing, at any time, of, at least, a portion of the apparatus.

A very large number of points arise for consideration in connection with apparatus for such a purpose, but there is no intention of discussing them fully here at present. Mr. Brierley's system, it is understood, has been under trial on 25 miles of the Great Northern Railway, and is said to have given satisfaction, and to have been approved by an inspector of the Board of Trade. It is also said that those who are entitled to an opinion on the adequacy of such apparatus, speak highly of it after seeing it. To have obtained such commendation is in itself an achievement of no mean order.

It would, however, be interesting to know what number of engines were fitted with the apparatus and the number of times they ran over the fitted portion of the line, the speeds, and the character of the trains. It will be noticed that either the lever boxes or the

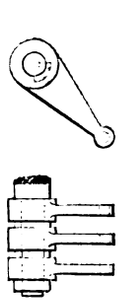


Fig. 11.

contact rockers would require to be in duplicate, for universe application, since engines sometimes run tender first. In other systems requiring impact breakages of the levers has not been infrequent. It is difficult to see how the volute springs used for balancing the levers can minimise the *blow* sustained, since this is practically instantaneous. Only by lengthening the time occupied in completing the contact between the lever and the rocker can the effect of the *blow* be lessened. The springs can only take up the energy imparted to the lever.

The apparatus, whilst it provides "all right" and "danger" indications, takes no notice of the fact that some signals are not *stop* signals, even when they occupy the "danger" position. Some such discrimination would seem to be necessary in cases where localisation of position is difficult.

Again, fig. 11, which is called a signal selector, illustrates another

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difficulty. The apparatus is not a signal selector in the same sense as Sykes's apparatus bearing that name, but is simply a device for reducing the number of rockers on a line leading to a diverging junction, to one, no matter how many lines may diverge, and, consequently, how many signals there may be. This apparatus illustrates the point that a driver approaching a diverging point not only requires to know that *a* signal is off, but that *the* signal he requires is in that position. Under ordinary conditions he obtains this information from the positions of the signals relatively to each other, but no number of contact rockers will give him this information, with only one set of indicating apparatus on the engine.

Again, the provision of a means of replacement by hand, for the indicating apparatus after a "danger" indication has been received, seems to be a matter that would require grave consideration.

Many other points than those merely touched upon arise, but it is impossible to discuss them at length. Mr. Brierley's apparatus is not confined to fog signalling alone. Adaptations of it are claimed as useful for other purposes, such as "last vehicle" indicators (figs. 7, 8 and 9), and alarms for use when platelayers are at work on the line—which is always. With reference to the former it need only be said that, as with previous suggestions, duplication of the carrying parts is necessary; and with reference to the latter it may be pointed out that where an alarm is desirable—and it should be compulsory in some cases—it is the platelayer who should be warned, and not the engine driver. Where renewals of the line are in progress, and cautionary signals are to be given, it is desirable that they should be of a character entirely distinct from the ordinary signals in order to prevent confusion.

CALCULATION OF THE ELECTROMOTIVE FORCE OF BATTERIES BY THE THERMIC CONSTANT METHOD.

By Dr. D. TOMMASI.

In order to calculate the electromotive force of batteries by the thermic constant method, it is necessary to know, in the first place, the numerical relations that exist between certain thermic data.

These various numerical relations may be expressed by the following law, which I discovered in 1882.*

"*When one metal is substituted for another in a saline solution, the heat given off is for each metal the same, whatever may be the nature of the acid base that forms a part of the salt.*" †

Zinc, for instance, on being substituted for copper in sulphate of copper, gives off 50·6 calories; now, the substitution of zinc for copper in any other soluble compound of copper will always give off this same quantity of heat.

If we take cadmium instead of zinc, we find 33·8 calories, and this thermic value will be the same for all the salts of copper. It would be the same for all metals capable of substitution, not only in a solution of copper, but in any saline solution whatever.

Moreover, we know from the laws of thermo-chemistry that the heat given off by the substitution of zinc in sulphate of copper is equal to the difference between the heat of formation of sulphate of zinc and that of sulphate of copper.

From the principles that I have just explained, it must follow that if the difference between the heats of formation of sulphate of zinc and sulphate of copper is equal to 50·6 cals., this quantity will also represent the difference between the heats of formation of chloride of zinc and chloride of copper, bromide of zinc and bromide of copper, acetate of zinc and acetate of copper.

Speaking generally, if we call B, B′, B″ the acid bases and M, M′, M″ the metals, we shall get

$$c\,BM - c\,BM' = c\,B'M - c\,B'M'.$$ ‡

Working on these principles I drew up the following table, by the aid of which the heat of formation of all soluble mineral and organic compounds can be determined *a priori*.

I obtained this table by subtracting from the heat of formation of chloride of potassium in solution the heat of formation of other chlorides in solution. Thus the value 88·8 cals. placed in the table opposite the zinc expresses the difference between

$$2\,c\,Cl\,K - c\,Cl_2\,Zn = \theta\,Zn.$$

The figures 4·6 cals., placed opposite the sodium, express the difference between

$$c\,Cl\,K - c\,Cl\,Na = \theta\,Na.$$

TABLE OF THERMIC CONSTANTS.

General formula: $c\,\Delta = \delta - \theta$. Δ = a salt, of which we wish to find the heat of formation, δ the heat of formation of the salt of potassium, having the same acid base as the salt Δ, θ the thermic constant corresponding to the base of the salt Δ.

Value of θ as compared with the molecular weight of the salts in solution.

Salts of sodium	4·6 cals.
„ „ silver	87·4 „
„ „ thallium	62·3 „
„ „ magnesium	14·6 „
„ „ strontium	6·0 „
„ „ calcium	14·0 „
„ „ zinc	88·8 „
„ „ cadmium	105·4 „
„ „ iron	101·6 „
„ „ manganese	73·6 „
„ „ nickel	108·0 „
„ „ cobalt	106·8 „
„ „ copper	139·0 „
„ „ lead	143·2 „
„ „ tin	120·4 „
„ „ hydrogen, or acids	61·5 „

I will now show by a few examples taken at random the accuracy of this law, and at the same time indicate how the table of thermic constants should be used. We will suppose that we have to determine the heat of formation of sulphate of copper in solution. According to the general formula, we should get

$$c\,SO_4\,Cu = c\,SO_4\,K_2 - \theta\,Cu.$$

$$c\,SO_4\,Cu = 196\text{ cal.} - 139\text{ cal.} = 57\text{ cal.}$$

Result obtained by experiment 56·8 cal.

For the heat of formation of nitrate of cadmium we should get

$$c\,(NO_3)_2\,C\,\delta = 2 \times c\,NO_3\,K - \theta\,C\,\delta.$$

$$c\,(NO_3)_2\,Cd = 2 \times 96{\cdot}1\text{ cal.} - 105{\cdot}4 = 86{\cdot}8\text{ cal.}$$

Result obtained by experiment 86·6 cal.

For the heat of formation of iodide of calcium, we should get

$$c\,I_2\,Ca = 2 \times c\,I\,K - \theta\,Ca.$$

$$c\,I_2\,Ca = 2 \times 74{\cdot}7\text{ cal.} - 14\text{ cal.} = 135{\cdot}4\text{ cal.}$$

Result obtained by experiment 135·4 cal.

I could certainly add to these examples, but it would be quite superfluous. By using the general formula and following the indications that I have given, it will be easy to *check*, to *determine* or to *foretell* the heat of formation of *all* the soluble salts.

I will now show how the law of thermic constants can be applied to the calculation of the electromotive force of all batteries in which *the whole of the chemical energy is convertible into electrical energy.*

ELECTROMOTIVE FORCE OF BATTERIES WITH TWO LIQUIDS.

When a battery is formed of two metals each dipping separately into the solution of one of its own salts, and when these salts have the same acid or the same halogenous body, the electromotive force of this couple is equal to the difference of the thermic constants of these metals divided by the volt expressed in calories or v.

If we call E the electromotive force of a battery constituted under the conditions that I have just described, and θ, θ' the thermic constants of the two metals, we shall get the following very simple expression:—

$$E = \frac{\theta - \theta'}{v}.$$

The volt v corresponds to 46·3 calories.

It must be observed that the three first metals mentioned in the table are mon-atomic, and all the others are di-atomic. The constants, θ and θ', belong, therefore, to metals of either category; the two metals of a battery may be mon-atomic or di-atomic. It follows that whenever the thermic constant of one of the latter enters into the above formula, the thermic constant of the mon-atomic metal must be doubled. It is the same when the two metals composing the couple are mon-atomic.

We will suppose that it is required to find the electromotive force of the couples sodium-silver, magnesium-silver, zinc-magnesium, each metal dipping into the solution of its own salt; we shall get:—

$$\text{Sodium-silver: } E = \frac{2 \times 87{\cdot}4 - 2 \times 4{\cdot}6}{46{\cdot}3} = 3{\cdot}57\text{ volts.}$$

$$\text{Magnesium-sodium: } E = \frac{14{\cdot}6 - 2 \times 4{\cdot}6}{46{\cdot}3} = {\cdot}12\text{ volt.}$$

$$\text{Zinc-magnesium: } E = \frac{88{\cdot}8 - 14{\cdot}6}{46{\cdot}3} = 1{\cdot}6\text{ volt.}$$

Of the two metals, the one with the lower thermic constant constitutes the negative pole of the couple, and is also the one which is dissolved, while the other constitutes the positive pole and is augmented by the deposit resulting from the decomposition of its salt. From the law given above it follows that: *the electromotive force of any couple formed of two metals, each metal dipping into the solution of its own salt, is always the same whatever the acid or the halogenous body of their two salts may be.*

Thus, for instance, for a cadmium-zinc couple, the electromotive force will always be

$$E = \frac{105{\cdot}4 - 88{\cdot}8}{46{\cdot}3} = {\cdot}31\text{ volt,}$$

whether the salts employed be sulphates, chlorides, acetates, &c.

The general formula of the electromotive force of any couple formed of two metals, A and B, is therefore:—

$$E = \frac{\theta - \theta'}{v} = x\text{ volts.}$$

I will now apply this formula to the calculation of a couple, the

* See *Comptes Rendus de l'Academie des Sciences de Paris*, for July, 1882.

† For further details see Traité de l'Electrochimie, by Dr. D. Tommasi, p. 557.

‡ The letter *c* placed before a salt indicates the heat of formation of that salt.

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electromotive force of which has been accurately determined by experiment, *i.e.*, the Daniell couple.

As we know, this couple is formed of copper and zinc, each metal dipping into the solution of its own sulphate.

According to the above reasoning, the electromotive force will be:—

$$E = \frac{\theta\ Cu - \theta\ Zn}{v}$$

or, $$E = \frac{139 - 88{\cdot}8}{46{\cdot}3} = 1{\cdot}084 \text{ volt.}$$

The values of the electromotive force of the Daniell element obtained by various writers are as follows:—*

Electromotive forces.	Writers.
1·058 volts	Fleeming-Jenkin.
1·059 „	Favre.
1·059 „	Kittler.
1·079 „	Clark & Sabine.
1·101 „	Ledeboer.
1·155 „	Everett.
1·160 „	(†)

Electromotive Force of Batteries with a Single Liquid—*When a battery is formed of a single liquid, its electromotive force is equal to the difference of the thermic constants of the metal attacked, and of the hydrogen given off, divided by the volt expressed in calories.*

We must, however, except acids that can be reduced by hydrogen, or, more correctly, by H + eal., as would be the case with chromic acid, nitric acid, &c.‡

I will now suppose that it is required to determine the electromotive force of the zinc-copper couple with dilute sulphuric acid.

According to the general formula, we should get

$$E = \frac{2\theta H - \theta Zn}{v},$$

or $$E = \frac{2 \times 61{\cdot}5 - 88{\cdot}8}{46{\cdot}3} = 0{\cdot}738 \text{ volt.}$$

The electromotive force of this same couple, found directly by experiment, varies between ·69 and ·80 of a volt.

If the values found experimentally differ from that indicated by theory, it is owing to the fact that the electromotive force, or more correctly, the energy transmissible to the circuit of couples with a single liquid, varies not only with the nature of the positive electrode (inactive metal or carbon), but also according to its physical condition, and this explains why different values of the electromotive force of these couples have been found by the various experimentalists who have endeavoured to determine it, as is shown in the following table:—

Electromotive Force of Couples with a Single Liquid ($SO_4 H_2$ Ag).

	Electromotive force. Maximum.	Minimum.
Zinc-platinum (? platinised zinc) ...	1·56 volts	·71 volt
Zinc-platinum...	1·41 „	·60 „
Zinc-carbon	1·38 „	·83 „
Zinc-copper	·96 „	·88 „

I found for the zinc-carbon couple with dilute sulphuric acid the following electromotive forces:— §

At the beginning...	1·37 volts
After some minutes	1·00 „
After some hours...	·83 „

It follows, then, from the principle already stated, that if the chemical energy produced in couples with a single liquid is always the same whatever may be the acid used, and that it only depends on the metal attacked, the energy transmissible to the circuit, under the form of electric current, varies, on the contrary, with the nature and condition of the substance constituting the positive electrode of the battery. I will remind my readers, with regard to this, that I showed some time ago, that the electromotive force of the same couple varies according to the nature of its positive electrode. In fact, a magnesium-platinum couple with dilute sulphuric acid, should, according to thermic data, decompose water, since the heat given off by the action of the magnesium on the dilute sulphuric acid (112·8 cal.) is greater than the heat of decomposition of water (69 cal.)

However, the decomposition of water does not take place.

It is the same if we substitute for the platinum of the magnesium battery, copper or silver, but if we use a cylinder of graphite or retort carbon, electrolysis takes place.

According to Gore the electromotive force of the magnesium-platinum couple with dilute sulphuric acid is 1·92 volts corresponding to 88·8 cal., and consequently far above the heat of formation of water (69 cal.), and yet, as we have just seen, the water is not decomposed. Now, it has always been assumed that there is equivalence between the calories transmissible to the circuit and the electromotive force of the voltaic couple. How is it then that there is an exception in the case of the magnesium couple? It is very difficult to explain this anomaly, unless we assume that in this couple there are not only the calories confined in the battery (as Favre has stated) and not transmissible to the circuit, but also among the calories transmissible to the circuit, there are some that would act, if I may so express it, electrically, and some chemically. I cannot now develop this idea further, but I hope soon to return to this important question.

* Traité des Piles Electriques, by Dr. D. Tommasi.

† E.M.F. calculated by the electro-chemical equivalent.

‡ It was formerly thought that reductions of this kind could be explained by assuming a special, I might almost say a mysterious, condition of hydrogen, *the nascent state*. Since 1877 I have shown that hydrogen, at the moment when it leaves any combination, owes its reducing properties not to its nascent state, but to the quantity of heat given off when it is set at liberty. (For further details see Traité de l'Electrochimie, by Dr. D. Tommasi, p. 105.

§ For further details see "Traité des Piles Electriques," by Dr. D. Tommasi, p. 94.

THE UTILISATION OF HIGH FURNACE GASES FOR POWER IN GAS ENGINES.

It would appear that our contemporary, the *Engineer*, has been waiting for some expert of repute to bring before its readers the very high efficiency of the blast furnace as a producer of gas suitable for use in gas engines, rather than take the responsibility of so doing upon its editorial shoulders.

We notice that Mr. Bryan Donkin has adopted the title of "high furnace" to indicate the so well-known blast furnace. We quite agree with the writer of the article in saying that the utilisation of blast furnace—or should we say high furnace—gases to produce power "is one of the most striking developments of modern engineering skill."

In introducing the subject, the assertion that "a third step in the development of these engines, and one which bids fair to rival the others in importance, has been made within the last few years," would lead one to suppose that the credit for this development was due to some individual, but at this point the credit is withheld. Who found out that "furnaces for the production of pig iron form, in fact, ideal gas generators?" A little further on it is asserted that a saving of 50 per cent. can be effected by using this gas in gas engines instead of burning it under boilers in the usual manner. This appears to us a very guarded assertion when taken in connection with statements which have frequently been published of late, viz, that under boilers about 600 to 700 cubic feet of the gas is required to produce the power which 100 to 130 cubic feet will give when employed in internal combustion engines. If the gain to be obtained were only 50 per cent., then the conservatism of British ironmasters would be very reasonable.

In referring to the available gas for power purposes, Mr. Donkin would appear to consider that the amount of leakage in the pipes is considerable, for he says, "With full deductions for leakage in the pipes and for the necessary purposes of the furnace, viz., for heating the air blast and working the blowing engines, it has been calculated that at least 60 per cent. in volume of the gases would thus remain over to be utilised as power."

In this connection it may be mentioned that the leakage in the pipes is not at all considerable, and is so objectionable and poisonous that it is prevented by all possible means, whatever the loss from the top of the furnace may be, and we think that blast furnace managers will be surprised to learn that, including waste, only 40 per cent. of the gases are necessary to provide the heat of the blast and raise steam for the blowing engines, &c.; but if the figures are reversed there still remains an enormous amount of power available for any purposes to which it can be applied by means of suitable gas engines.

Large gas holders are not generally advocated, as other means can be preferably employed, such as a combined blower and exhauster for propelling the gas to the engine.

There is little doubt that the chief difficulty in the application of blast furnace gas to gas engines is the amount of fine dust carried along in suspension. Though a small engine may be run for a considerable period with the gases as they leave the ordinary dust catchers in common use with furnace plants, when larger engines are considered this arrangement cannot be satisfactory. It is practically admitted, by those who have made the experiment, that the gases must be freed almost entirely from suspended matter.

That British ironmasters have not made much progress in the matter of utilising their spare gases is probably due to the fact that gas-engine makers have not been in a position to meet the sudden demand for large gas engines, owing to the activity of the trade at the time when it was realised that it was possible to harness this large source of power.

Whether the idea of utilising these gases originated almost simultaneously in several countries, may be open to question, as nothing was done in this direction in any foreign country before 1895, whereas Mr. B. H. Thwaite's patent bears the date of 1894, and was published in 1895. That people on the Continent can claim ignorance of British enterprise seems strange when the *Iron and Coal Trades Review*, and *Le Rappel*, in France, had leading articles on the subject in 1895, and under the circumstances, we are surprised that more credit is not given to Mr. Thwaite, seeing that he filed the first patent of importance in 1894, or about a year in advance of any experiments on the Continent.

Where success has been attained on the Continent, the result has been achieved by a firm making the experiment and doing the work at its own expense; when it has overcome the difficulties and made the installation a success, the firm is quite ready to place orders for still larger engines, owing to the fact that the economy is so promising.

In the Oeckelhaeuser engine, illustrated in the article in the *Engineer*, there are many points which hardly commend its adoption in preference to the twin cylinder engine. To render it a two-cycle engine

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has necessitated a considerable amount of complication; there are three cranks as against two in the twin cylinder type, while in each case the frequency of the explosions is the same. The elongated cylinder and the air pump cause the engine to cover a considerable length of floor space, not to speak of the "disadvantages of the crosshead slides connecting rods, &c."

In Mr. Bryan Donkin's remarks about this engine he says:—"It is *said* to yield four times as much work as a four-cycle for same piston diameter, and the same speed."

"In the near future this engine *may* possibly have a considerable development."

"The governor is *supposed* to act simultaneously."

"The cooling jacket *appears* to work well."

"In the Oeckelhaeuser, these evils of overheating are *said* to be avoided." From which we gather that he has hardly confidence in the statements himself, and would prefer that they should be confirmed.

The tests made by Prof. Witz are very interesting and instructive, but the results have been before the public ever since they were made, in more or less complete form, and cannot now be considered up to date, the following papers being amongst those which have referred to the above test at Serang:—*The American Manufacturer*, November 4th, 1898; *Science and Art of Mining*, September 21st, 1898; *English Mechanic*, December 2nd, 1898; *Journal of Gas Lighting*, November 15th, 1898; *Electrical World*, October 29th, 1898; *Mechanical World*, December 8th, 1898.

THE ELECTRIC LIGHTING OF AN HOTEL.

There are numerous isolated electrical plants running in English hotels, which possess features of interest. We suppose that first in importance there stands out the extensive installation in service at the Hotel Cecil. It would seem that hotels generally afford a very satisfactory field for realising the advantages and economies which are considered to result from generating one's own current, as against its purchase from a supply company or a municipality.

In our issue of December 15th we referred to some excellent results which had been secured from the use of private plants in a hundred buildings of various descriptions in America. These results showed up well for separate plants, and we have no doubt that some of the larger hotels, stores, &c., in this country would, as in the case of the Blackpool Theatre Gardens installation, be equally satisfactory. The hotel proprietor may inexpensively safeguard himself against likelihood of breakdown, for in accordance with the present interpretation of electric lighting legislation he is permitted to be connected with the mains of the municipality or the company, as the case may be, whether he takes a continuous or only a "fits and starts" supply, according to the condition of his own plant. Of course the supply authority feels the injustice of such a state of things being possible, as were it to be perpetually prepared to have its supply abnormally increased without a moment's notice, there must be a perpetual expense above and beyond what is necessary under normal conditions. On the other hand, if the supply works have not stand-by plant sufficient for the purpose, the sudden demand is likely to cause some inconvenience to the general supply.

We do not propose at the moment to go generally into the details of hotel installations, but simply to describe an interesting plant which was placed in position in June last at the Atlantic Hotel, Newquay, Cornwall. The hotel is situated in a unique position on the Headland, overlooking the sea from every window.

The engine house, which contains the electrical installation, is about 200 yards away from the hotel; an exterior view is given in fig. 1. From the plant there installed current is obtained for supplying about 300 lamps ranging from 5 to 32 C.P., a five-passenger lift, and a pump. The work was carried out by Mr. F. H. Headley (late Headley and Wilson), of St. Austell, to his own specification.

There are two Campbell 15-H.P. oil engines (fig. 2). The oil is stored in a 1,500 gallon tank, and feeds the engines by gravitation. They drive by Hendry's laminated leather belting, two Wilson shunt wound dynamos, shown in fig. 3 (70 amperes 110 volts, or 50 amperes at 145 volts).

The switchboard has a panel for each dynamo, arranged for coupling either singly or in parallel, either for charging battery or working direct, independently or in parallel. Each dynamo is fitted with a sensitive minimum automatic switch, as well as a 75 per cent. shunt regulating switch, and a three-

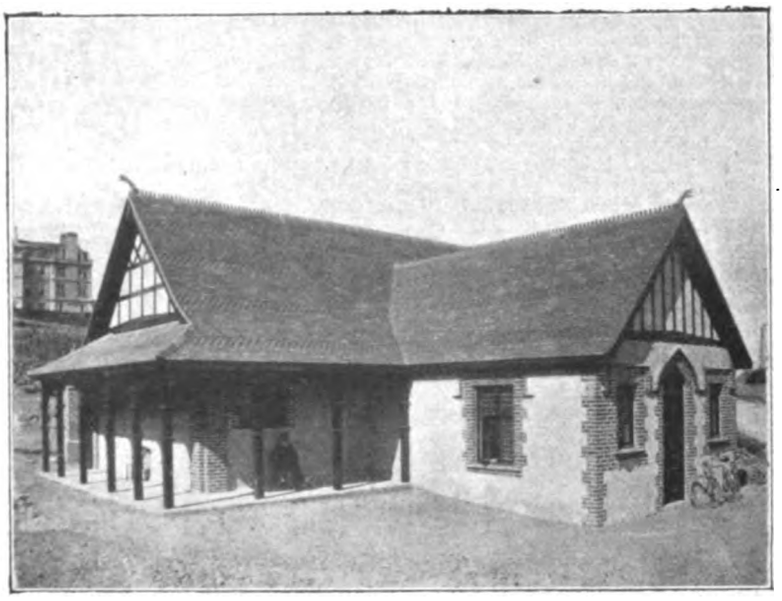

FIG 1.

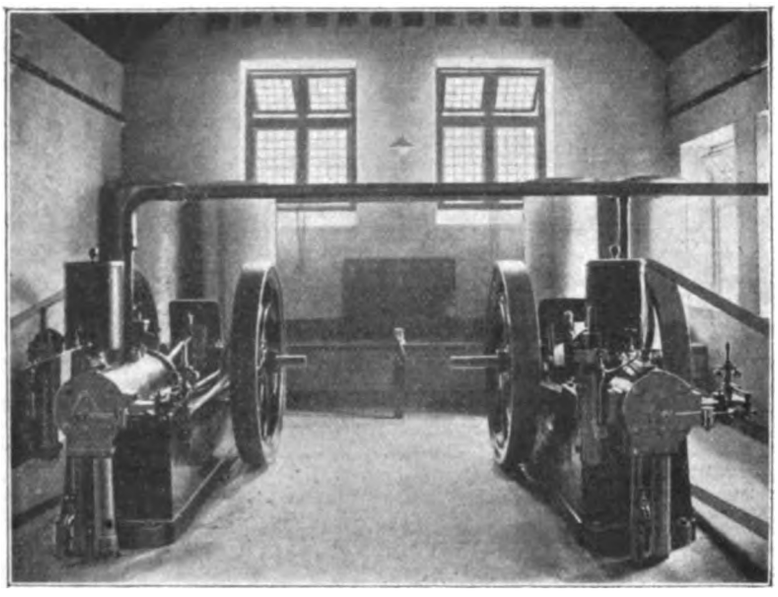

FIG. 2.

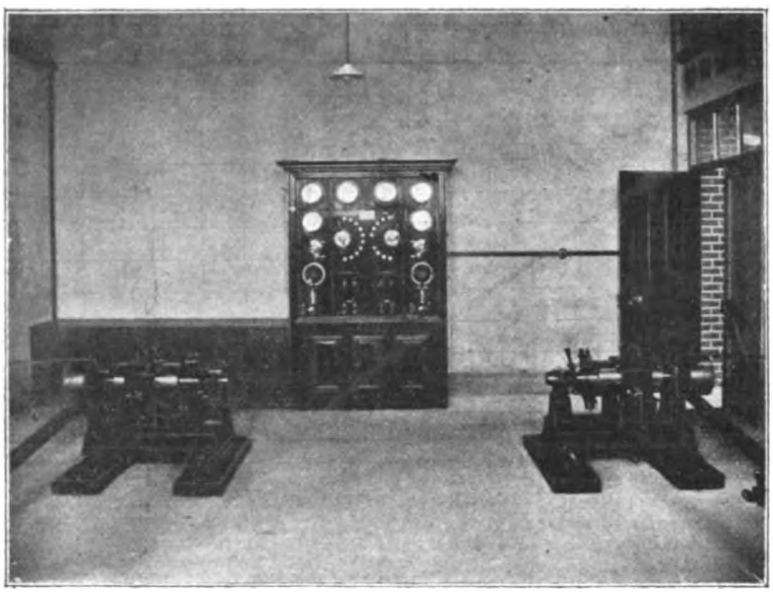

FIG. 3.

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way starting switch; by means of the latter the dynamos are made to start their respective engines, the first explosion of which immediately releases the automatic. The dynamo is then again connected up in the usual way. The governor and feed of engine is never altered, the starting, regulating and stopping being entirely controlled at the board, except the final act of turning off oil. The switchboard was designed by Mr. Headley, and manufactured, together with the dynamos and motors, under his late partner, Mr. W. H. Wilson.

The exhaust from the engines is carried in stoneware pipes about 250 yards to the top of the hotel where it causes no nuisance.

The battery consists of 55 D.P. 16-plate cells.

There are two mains from the engine house to the hotel, B.I.W. 19/12 and 19/16 concentric armoured and laid direct. The supply is controlled by D.P. switches and cut-outs on the board. The mains are

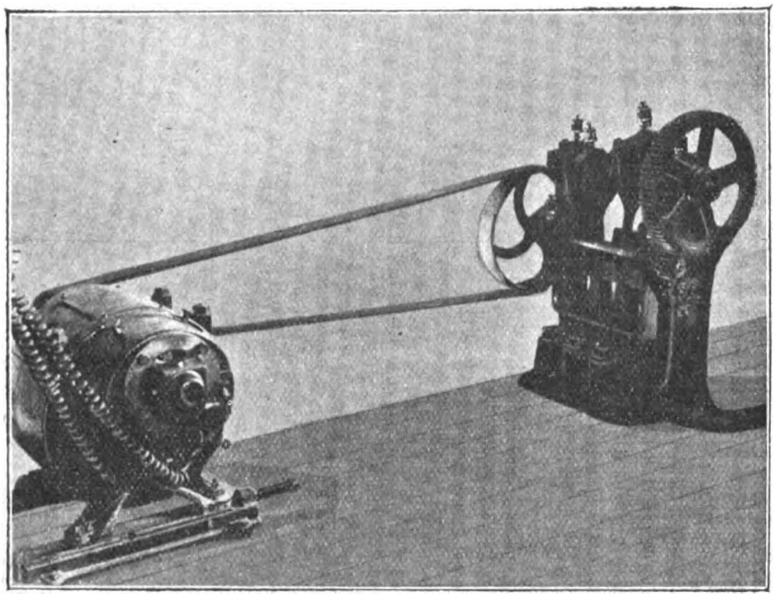

Fig. 4.

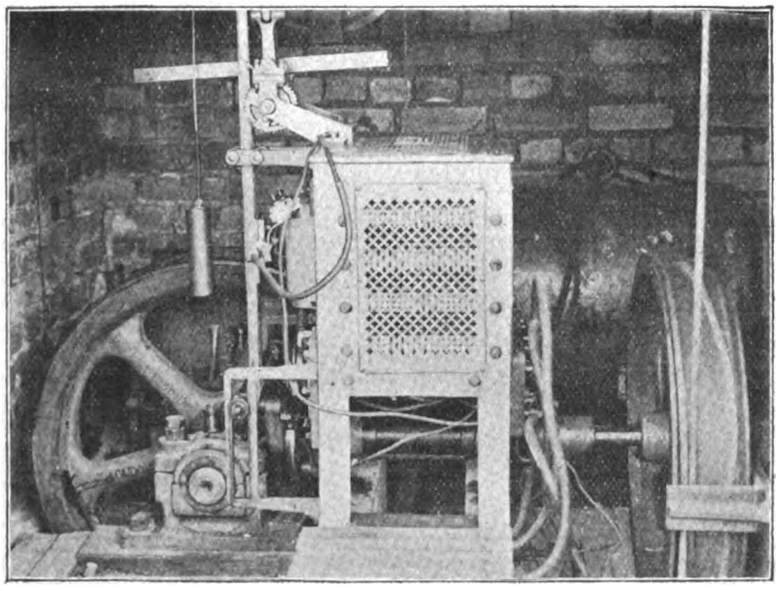

Fig. 5.

connected to another board in the hotel, containing switch gear for connecting the first for lighting only, the latter for power, or *vice versâ*, or in parallel. Each floor's supply is also controlled at this point, whilst the servants' floor is controlled from the manager's room.

The passenger lift machinery (fig. 5) is situated at the top of the well; it was sub-contracted for by Messrs. Waygood & Co.

The three-throw Blake & Knowles plunger pump (fig. 4) forces about 1,000 gallons of water per hour to the top of the roof, the tank being also situated on the top of the lift well. This pump is driven by a 1 H.P. Wilson enclosed motor (made by Messrs. Headley & Wilson, together with the switch gear). This motor is started and stopped by an automatic switch, according to the quantity of water in the tank.

Naturally the time of heaviest load is in August and September, when either the two dynamos, or one dynamo and the accumulators are equal to requirements. Thus the plant is duplicated.

REVIEWS.

The Drawing Office. By C. E. Hodgkin. Reprinted from the *Practical Engineer*.

This unpretentious little pamphlet, which embodies a paper read before the Engineering Society formed by the employés of the Brush Company, is primarily intended for the benefit of pupils and junior draughtsmen, but contains a great deal of instruction of value to more experienced designers. The treatment of the subject is thoroughly practical, and many valuable wrinkles are given in simple wording. The author rightly condemns those draughtsmen "who live for the drawing alone," and would rather pass a poor design than spoil their pretty picture by making alterations; while he applauds the *rara avis* who has learnt that bitter lesson, that the excellence of the design is the only consideration, and that the mere drawing is of no consequence whatever. "Note-book" men, who are lost when they are called upon to take in hand anything original, are referred to, and the learner is advised to depend on first principles instead of voluminous notes. Of especial importance, however, is the author's recommendation to record examples of *failure*, the causes thereof, and the cure. His contemptuous reference to "the crawlers who do as little as possible, and think more of exhibiting their chronometric properties at the end of the day than of the firm's welfare," ought to be posted up in every drawing office. The author deals with the questions of profit, pattern-making, founding, machining, proportions and strength, suitability, provision for wear, expansion, form, nomenclature, dimensioning, standardising, &c., with illustrations, and has something useful to say on each. We note especially the following:—"The Americans do very little fitting, and by their good design and good machinery, have been enabled to modify the operation to 'assembling.'"—There was an epidemic of hot bearings which baffled everyone, till at last it occurred to someone to try reducing the diameter of the shafts—with entire success.

The only fault that we can find is that the author says he wrote the paper for embryos. We trust he meant tyros.

Electric Wiring, Fittings, Switches, and Lamps. By W. Perren Maycock, M.I.E.E. London: Whittaker & Co. 1899.

While this book is suitable for candidates for the preliminary and ordinary examinations of the City and Guilds of London Institute, the author hopes that it will be useful also to engineers, contractors, wiremen, and others engaged in practical work. We have read it with pleasure and profit. We have rarely met with a book which more fully bore out its title and preface, while the treatment of the subject is simple, clear and thorough. We have often thought that some of the wonderfully comprehensive catalogues issued by our large supply firms were really valuable as text-books, and have recommended learners to study them; the present work, while of necessity embodying some of the features of a catalogue, goes much further, providing impartial criticism, explanations, and diagrams of connections. Curiously enough, the subjects occur in exactly the opposite order to that of the title; glow lamps of all kinds are first dealt with in detail, then arc lamps are treated very fully, and with capital figures. Innumerable types of switches and fuses, large and small, are illustrated and described, but we miss the "Nevile" automatic switch, one of the best. The better known systems of wiring buildings are next clearly explained, with numerous figures, and are followed by a capital treatise on *effective*

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electric lighting, or the art of disposing and shading the lamps to the best advantage. The book concludes with a section dealing with the calculations involved in ordinary wiring, &c., and a table showing the "lamp-density per head of population" in British cities and towns.

Misprints are remarkably scarce, especially for a first edition; blocks on pp. 90 and 328 are inverted, and on p. 48 the sign ∞ is substituted for $\propto$. We object to calling a 1,000-watt arc lamp a 1-unit lamp; why is the word "kilowatt" ignored? On p. 157 we read:—"The use of a switch at the end of a flexible cord means that both of the conductors are always 'alive' (unless the circuit is cut out), and there is some slight risk of a fire breaking out at an inopportune moment." As the lamp is in series with the hypothetical fault referred to, the risk is, in our opinion, *very* slight—and we wonder what the author would consider an *opportune* moment for a fire!

The expression "different degrees of positive action," p. 181, strikes us as objectionable: either an action is positive, or it is not. For example, a sunk or a flat key gives positive action, a saddle key does not, and there is no intermediate stage. On p. 365 the practice of stranding fuse wires is mentioned, but it is not pointed out that if this is done the strand will melt with less current than the sum of the currents required to fuse the wires separately. We regret that in the index references are given to paragraphs only, instead of to pages; this is a defect which we hope to see rectified in a later edition.

The faults that we have pointed out are trifling compared with the value of the book as a whole, which we cordially recommend both to students and to those engaged in electric lighting work.

NEW PATENTS AND ABSTRACTS OF PUBLISHED SPECIFICATIONS.

NEW PATENTS.—1899.

Compiled expressly for this journal by W. P. Thompson & Co., Electrical Patent Agents, 322, High Holborn, London, W.C., and at Liverpool, Manchester, and Birmingham, to whom all inquiries should be addressed.

24,667. "Improvements in controlling apparatus for electric lifts and other electric machines." J. S. Stevens, C. G. Mador, E. C. Stevens, and P. H. Stevens. Dated December 11th.

24,794. "Improvements in or connected with automatic electrical cut-outs." F. E. Guttenstedt and E. J. Selby. Dated December 11th.

24,614. "Improvements in telephone system and apparatus." E. E. Ries. Dated December 11th. (Complete.)

24,624. "Improvements in and relating to perforators for use in connection with automatic telegraph transmitters." A. Fraser, W. Judd, and G. Dreier. Dated December 11th.

24,634. "Improvements in apparatus for electrically lighting railway carriages, and other vehicles." C. A. Vicarino. Dated December 11th.

24,639. "Improved electric top for gyroscopes and the like." W. P. Thomson. Berliner Maschinenbau Action Gesellschaft vormals L. Schwartzkopff, Germany.) Dated December 11th. (Complete.)

24,641. "Improvements in the manufacture of accumulator batteries and in porous cells, plates or diaphragms for the same or other batteries and for other purposes of conical or mechanical where an extremely porous or hard material is required." W. W. Pilkington and W. R. Ormandy. Dated December 11th.

24,643. "Improvements in magnet frames for dynamo-electric machines and motors." J. Burke. Dated December 11th. (Complete.)

24,645. "Automatic load starting apparatus applicable to synchronous alternating current motors." C. L. Rosenqvist, A. Bedotheil, and H. W. Young. Dated December 11th.

24,646. "Improved apparatus for effecting locked step-by-step rotary motion from a reciprocating motion especially applicable to counting trains." Elgar-shed & Visocles, Limited, and S. Eversheb. Dated December 11th. (Complete.)

24,666. "A method of, and apparatus for the regulation of electric potential in alternating current transformers applicable also to 'boosters.'" F. Hamer. Dated December 12th.

24,668. "Improvements in or relating to means to be employed in connection with the electro-deposition of metals upon iron and steel." H. M. Punnett, and H. M. Punnett. Dated December 12th.

24,669. "Improvements in roller gearing and transmission dynamometers." T. Foster. Dated December 12th.

24,673. "Improvements in electric clocks." J. Butcher. Dated December 12th. (Complete.)

24,701. "An improvement in the manufacture of submarine electric conductors." Siemens Bros. & Co. and W. Dieselhorst. Dated December 12th.

24,717. "Improvements in fire alarm telegraph apparatus." B. J. B. Mills. (The Gamewell Fire Alarm Telegraph Company, United States.) Dated December 12th. (Complete.)

24,718. "Improvements in telephone systems and apparatus." J. E. Kingsbury. (The Western Electric Company, United States.) Dated December 12th.

24,728. "Improvements in the process of smelting ore and in electric furnaces therefor." F. E. Hatch. Dated December 12th. (Complete.)

24,739. "Improvements in or relating to electric switches." W. Ely. Dated December 12th. (Complete.)

24,740. "Improvements in or relating to electric switches." W. Ely. Dated December 12th. (Complete.)

24,760. "Improvements in electrolytic meters." E. Cross. Dated December 13th.

24,780. "Safety trolley head guard for electric tramcars, &c." G. T. Moore. Dated December 13th.

24,791. "Improvements in or connected with electrical traction." W. Kingsland. Dated December 13th.

24,792. "A new and improved method of, and means for carrying and connecting strikers to motor vehicles for mechanically operating electric switches." W. Kingsland. Dated December 13th.

24,799. "A new or improved method of measuring the difference of electric pressure between points of a circuit which may be distant from the observer, and apparatus therefor." M. B. Field. Dated December 13th.

24,805. "Improvements in appliances for reversing the current in continuous current dynamos." Siemens Bros. & Co., Limited. (Siemens & Halske, Aktien Gesellschaft, Germany.) Dated December 13th.

24,824. "Improvements in electric incandescent lamps." C. Howard. Dated December 13th. (Complete.)

24,832. "An improved method of making commutators for electrical machines." F. Kayeleff. Dated December 13th. (Complete.)

24,876. "Improvements in and in apparatus for the manufacture of mangano calcium carbide without the use of electric current." W. P. Thompson. (P. P. H. Mace, France.) Dated December 14th.

24,887. "Improvement relating to electric arc lamps." T. J. Digby. Dated December 14th.

24,888. "Improvements in electric time switches." A. J. Howard. Dated December 15th.

24,914. "Improvements in trolley electric tramways." J. W. Taylor. Dated December 15th.

24,916. "An improved mouthpiece for use with telephonic transmitters." A. Epstein and A. Brooker. Dated December 15th.

24,940. "Improvements in auto motor trolleys for electrically-driven vehicles." L. L. Gerin. Dated December 15th. (Complete.)

24,942. "Improvements in electric brakes." E. M. Tingley. Dated December 15th. (Date applied for under Patents, &c., Act, 1883, Section 103, May 18th, 1899, being date of application in United States.)

24,956. "Rotary field-measuring apparatus for uniformly loaded rotary phase current systems." (Siemens & Halske, Aktien Gesellschaft, Germany.) Siemens Bros. & Co., Limited. Dated December 15th. (Complete.)

24,960. "A method of producing electrodes for electrical accumulators." C. Leckow. Dated December 15th.

24,965. "Improvements in electric locomotives." B. Hopkinson. Dated December 16th.

24,968. "Process for the production of thermo-electric batteries." B. Jonas. Dated December 16th.

24,970. "Improvements in electric hair brushes." C. R. Schmutz. Dated December 16th. (Complete.)

24,978. "An improvement in or applicable to the filaments of incandescent electric lamps." W. Morton. Dated December 16th.

25,011. "An improved primary electric battery." W. P. Thompson. (J. P. Fontaine, France.) Dated 16th. (Complete.)

25,012. "Improvements in electric accumulators." W. P. Thompson. (G. Dasking and A. Brandes, Germany.) Dated December 16th.

25,019. "An improvement in safety fuses for electrical circuits." Siemens Bros. & Co., Limited. (Siemens & Halske Aktien Gesellschaft, Germany. Dated December 16th. (Complete.)

ABSTRACTS OF PUBLISHED SPECIFICATIONS.

Copies of any of these Specifications may be obtained of Messrs. W. P. Thompson and Co., 322, High Holborn, W.C., and at Liverpool, Manchester, and Birmingham, price, post free, 9d. (in stamps).

1897.

5,479. "Improvements in and connected with dynamo-electric machines." C. H. Wade and H. O. Farrell. Dated March 2nd, 1897. For the purpose of obtaining a practically constant voltage from dynamos driven at variable speeds, the field magnet is wound with a main or energising coil and a subsidiary coil acting in opposition thereto. The subsidiary coil is divided into sections, which are connected to the terminals of a switch, operated either by hand or automatically, such as by a centrifugal or other governor. When the machine is run at constant speed, the apparatus may be used to control the output. 2 claims.

6,187. "Improvements in or relating to electric apparatus for governing engines." J. Snow and A. G. Cooper. Dated March 9th, 1897. Relates to the governing of an engine driving a dynamo, and consists in an arrangement of electro-magnetic devices, operating in conjunction with a centrifugal governor to control the expansion gear of the engine so as to adjust the steam supply to the requirements of the external circuit. The solenoid acting on the core attached to the lever through which the adjustment of the expansion gear is effected, is arranged either in the main circuit of the dynamo or in a shunt circuit. The latter is in practice adopted by preference. The current in the circuit is varied in accordance with variations in the potential difference of the dynamo by the automatic regulation of resistances in a shunt containing a solenoid, acting against an adjustable spring. The application of the invention to a shaft governor is also shown in the specification. In this form of the invention the solenoid is mounted on the governor disc, the circuit being completed by means of brushes. 3 claims.

6,212. "Improved means for supplying electric current to electrically-operated time keeping mechanism." A. W. Staveley, J. H. Parsons and T. J. Mardlay. Dated March 9th, 1897. A roller on a pendulum lifts a bevelled horizontal lever, so making a pawl which hangs from the lever drive a ratchet wheel, the arbor of which bears the minute hand. The energy of the pendulum is maintained by an electro-magnet, the resilient arm of which bears a hook engaging the pendulum rod. Normally the circuit is broken by a gap between two strip terminals, and a loose finger upon the pendulum is drawn to and fro over a block on the upper terminal. When the oscillation becomes so reduced that the finger does not leave the block, the terminal is thrust against its fellow and the current passes. In a modification, instead of the pendulum, there is a balance driving the hands by means of an anchor propelment. 8 claims.

8,308. "Improvements in calling-off apparatus for telephone exchanges." Siemens Bros. & Co., Limited. (Siemens & Halske.) Dated March 10th, 1897. Calling-off signals for telephone exchanges are sent by reverse currents from the subscriber's magneto-generator, which produce a visible signal in a polarised indicator. The signal is either sent by hand or automatically by means of a coiled spring, which is set by sending the ringing-up signal. In one arrangement is the generator crank, the axle of which carries a wheel gearing with a wheel on the same axle as a ratchet wheel. A spring pawl on a spring-controlled lever engages with the ratchet wheel, and so turns the lever when the ringing-up signal is sent that the heel engages above a spur on a spring lever. The telephone lever is provided with an extension which releases the levers, thus sending the calling-off signal when the telephone is placed on the hook. In a modified form, a drum spring is used, a tripping pawl being released by the telephone lever. 4 claims.

8,774. "Method and appliances for brazing or soldering by electricity." W. C. Johnston. Dated March 15th, 1897. Tubes, cycle and motor car frames, tubes, and tube plates for boilers or condensers, and tubular articles are joined by interposing a layer of soldering or brazing metal between the surfaces to be united, and then passing an electric current either longitudinally or transversely through the two articles to be joined. The soldering or brazing metal is in the form of a sleeve or a gauze or spiral of wire. The wires may be of different degrees of fusibility, and some of the wires may remain unmelted and form

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distance pieces between the objects to be united. The built up frame with the brazing metal interposed in the joints is held in clamps or supports on a slate, &c., bed. The conductors for the current are connected to the frame by terminals. 5 claims.

6,929. "Improvements in apparatus for electrolysing sodium chloride or other salts." F. Taylor, A. Cooke and B. W. D. Montgomery. Dated March 17th, 1897. Relates to apparatus for electrolysing sodium chloride or other solution and for absorbing the evolved chlorine. The vat contains a number of iron sheets or cathodes alternating with vertical rows of carbon rods or anodes. Each anode and cathode is supported in a frame which also supports on each side of the electrode glass or other strips arranged louvre fashion. The upper part of each anode has an inverted trough to collect the evolved chlorine and direct it through tubes. The caustic soda or like body formed at the cathode falls to a bottom trough, and is led away therefrom. To prevent polarisation air may be injected below each anode, or the electrolyte can be kept agitated by injecting it in an intermittent or pulsating manner. The evolved chlorine is absorbed in a vessel charged with water and lime or magnesia, the gas entering from the tube to a rotating tube provided with hollow distributing arms. 8 claims.

6,962. "Certain improvements in electro-plating apparatus." J. Guise. Dated March 17th 1897. Relates to apparatus for electro-plating with nickel or other metal small articles such as knitting-pins, crotchet-hooks, and small parts of bicycles. Consists of a watertight wood barrel having one removable end which is secured by bolts and fly nuts, a rubber or like band making a watertight joi. The articles and electrolyte having been placed in the barrel, the latter is m. nted by its divided axle upon standards. A spirally-wound wire joined by cross wires is secured around the inside of the barrel and is connected to an external metal ring connected by a brush to the cathode wire from the dynamo, &c., while insulated nickel or other discs are connected either directly by the axle or indirectly by the insulated wires to a brush connected to the other pole. A canvas or like screen may be inserted near each end of the barrel to prevent the articles from touching the anodes. The barrel is rotated by any suitable means, such as by a pulley, whereby the articles are polished during position. 2 claims.

7,012. "Improvements in supplying electrical energy to electrically-propelled aerial machines and balloons." R. Diesel. Dated March 17th, 1897. To enable the cable supplying electricity from the ground to the electrically-propelled aerial machines to become longer or shorter as the machine is swayed by the wind, it is coiled on a drum at one end, which is constantly tending to wind it up. The drum may be turned by an electromotor which is reversed by the pull of the cable when it becomes excessive, or the drum may be driven through a clutch which is thrown out of gear by an excessive pull on the cable, and into gear by a spring when the pull is diminished. 1 claim.

7,027. "Improvements in and relating to secondary batteries or accumulators and the manufacture thereof." A. J. Marquand. Dated March 17th, 1897. Electrodes or plates are made by heating lead grids, frames or foundations, in a closed box with sulphur to the melting point of lead, so as to cause the formation of lead sulphide on the surface of the plate. The conducting strips and supports of the lead frame are protected from the sulphur preferably by coating them with an enamel composed of calcium fluoride, felspar, sodium silicate, silicon dioxide, and barium sulphate. The plate thus formed is converted into a negative plate by electrolysis in a solution of dilute sulphuric acid, and fr the negative plates positive plates are formed by electrolytically peroxidisin. on. The liquid in which the lead sulphide plates are reduced is used as a electrolyte in secondary batteries, or a similar liquid for the same purpose may be formed by adding thionic acids or their salts to dilute sulphuric acid. In a modification, the lead grid is packed with a paste consisting of lead sulphide or a mixture of lead or lead oxides with sulphur, and this is heated and then electrolytically formed in the usual way. 5 claims.

7,212. "An improved rheostatic apparatus particularly applicable to the starting of electro-motors." G. E. Dixon. Dated March 19th, 1897. Resistance coils, wires, or strips, which may be of iron or German silver, are embedded in enamel on the underside of an iron or other metal base as illustrated in section, so that they may be allowed to become hot. Ribs are formed on the base to dissipate heat. The base has hollow feet and carries a row of contact studs connected with different parts of the resistance, and a movable switch arm. The studs and switch pivot are insulated with bushes of heat-resisting material, such as vulcanised fibre. The switch is turned against a buffer by a spring to include all the resistance in circuit, but may be held by a clip at the other end of the line of contacts. The rheostat is particularly applicable for starting electric motors. 3 claims.

7,223. "Improvements in electric sound producing devices." W. P. Thompson. (J. A. G. Trudeau.) Dated March 17th, 1897. Relates to apparatus for producing sound applicable wherever electric bells can be used such as in houses, fire-alarms, and calling or signalling systems. A number of electro-magnets set in a frame are supplied with alternating currents, and act on a magnet plate or diaphragm. A diaphragm may be placed at each end of the magnets, and a bell mouth may be placed in front in case of foghorns. The apparatus is also referred to as a factory, boat, or railway whistle. 3 claims.

7,305. "Improvements in brushes for the commutators of electric dynamos and motors." E. L. Joseph. Dated March 20th, 1897. Brushes are made with copper or other tongues at their upper ends. When a brush is worn so that it is too short for use in the ordinary holder, the tongue is soldered into a corresponding socket on a supplementary bar, and this is used in the holder until the remainder of the brush is worn down. 2 claims.

7,315. "An electric circuit hour-meter or automatic cut-out." C. O. Bastian and F. M. Staunton. Dated March 20th, 1897. On turning a triangular cam after a coin has connected a handle to it, a pivoted fork is dipped into a pair of mercury cups to complete the main circuit, and a disc bearing one terminal of a branch circuit is turned so as to separate this terminal from its fellow on a co-axial crown wheel which is in the same plane as a set of concentric crown wheels driven uniformly. The concentric crown wheels have radii of lengths (relatively), and a sliding cross-shaft, bearing pinions, transmits motion from any one of them according to its position which depends on the number of switches passing current. The switches act on a rack and the displacement of the latter is transmitted through an idle wheel to the slide which carries the cross-shaft. When the terminal on the driven crown wheel has overtaken the terminal on the concentric disc, an electro-magnet in the branch circuit disengages a catch which holds the fork in the mercury cups. 4 claims.

7,412. "An improved switchboard indicator or annunciator." W. H. Holland. Dated March 22nd, 1897. (Date claimed under Patents Act, 1883, Sec. 103, September 5th, 1896, being date of application in the United States.) Indicators or annunciators for telephone switchboards, &c., are arranged with the operating parts on the front of the board, and the magnets secured in an easily removable manner at the back. A plate fixed over an aperture in the board has pivoted to it the armature with the required sign on it. A shutter is in front of the armature and normally kept upright by lugs engaging the armature. The magnet has a T-head which can be inserted in a slot in the plate and secured by a partial turn. A case is passed over the magnet and secured by a groove on it engaging with a segmental-headed screw which is made to release or engage the groove by a half turn. On completing the circuit the armature releases the shutter, pushing it outwards by lugs allowing it to fall and show the sign. A lug on the shutter completes a night-bell circuit in the usual way through a contact when the shutter falls. The armature may have projections at its lower end to enable it to be operated by the finger. 6 claims.

7,421. "Improvements in or connected with the electric lighting of buildings or other areas, particularly applicable to fire brigade stations, asylums, hospitals, hotels, ships, and like institutions." R. F. K. Stubbs. Dated March 22nd, 1897. Relates to the arrangement of circuits in fire brigade stations, hotels, &c., so that all the lights or any desired number of them can be controlled by a single switch placed in any desired position. Instead of having separate "call" lights, a third wire is arranged and connected so as to operate all the lights from one switch, and the switch may be operated by a handle, or may be automatically operated by electro-magnets which are in the bell or alarm circuit. Some of the lights are used for lighting only, others for "call" and for general lighting, while others are for "call" only. 2 claims.

7,482. "Improvements in or connected with the current supply and conduits for electric traction." R. C. Sager. Dated March 23rd, 1897. The conduit is formed by the running rail and a guide bolted to the concrete lower part. The former rail is formed with a deflecting angle to throw water, &c., clear of the conductors. The two rails may be such as only to leave spaces between them at intervals or to leave a continuous slot. The conduit is cleaned by a scraper attached to a chain drawn through by means of sprocket-wheels at the manholes. The collector consists of bars thrust out from an inclined wheel so as to pass into the conduit between the conductors. This wheel is driven from the toothed or flanged running wheel by a universal joint. By means of linkwork and levers these radial bars may be retracted so as to be inoperative. 1 claim.

7,487. "Improvements in regulable transformers, and in regulating alternating current dynamo-electric machines." H. H. Lake. (General Electric Company.) Dated March 23rd, 1897. Relates to a regulable transformer for use in regulating dynamos, motors, &c. Consists of an alternator in which the field-magnet excitation is furnished from the transformer. The transformer has one primary coil in shunt with the mains and is provided with a resistance. The secondary is connected to a rectifying commutator. A third or modifying winding is in series with one of the mains and a resistance is arranged in shunt. The regulation of this resistance enables the effect of the modifying coil to be varied and so regulate the generator. An air gap is left in the magnetic circuit. In dynamos provided with separate exciters the transformer is arranged to regulate the field of the exciter. In the tranformer for the motor the modifying coil has two windings. Resistances are shown. The transformers may be wound for varying the phase-relationships in the different circuits. 11 claims.

7,522. "Improvements in electrically-propelled cars and like vehicles." J. F. McElroy. Dated March 23rd, 1897. Rollers driven by an electromotor are grooved so as to engage the flanges of the wheels and drive them in the same direction. The axle boxes, which can move horizontally, are linked by bars to the arm of the saddle which has springs to support the flanges of the supporting frame on which the car is mounted so as to be capable of rotating. The arm of the saddle is guided by means of springs. The specification describes modifications with respect to the disposition of the friction rollers in all of which the traction is directly proportional to the load carried. 8 claims.

20,919. "Improvements in electric signalling systems, such as fire alarms, telephones, and telegraphs." J. L. Walker and G. B. Walker. Dated September 11th, 1897. Fire or similar alarm systems worked with closed circuits are provided with contact springs at the central station and boxes containing similar springs and signalling instruments at various points. The telephone may be inserted at the central station without breaking the closed circuit, but at the distant station the call is sent by providing the telephone, &c., plug, with an insulating end which breaks the closed circuit before the instruments are connected up. 1 claim.

21,055. "Improvements in and relating to electric cars and surface contact railways." The British Thomson-Houston Company, Limited. (E. M. Hewlett.) Dated September 14th, 1897. Electric railways and tramways on a road-contact system with electro-magnetic switches operated from a battery on the vehicle. To reverse the connections of the shoes which rub over the road contacts supplying current and operating the switches respectively when the vehicle is being reversed on the Y-track, and thereby to change the battery connection to the low-potential side, an extra shoe rubs over a grounded contact and thus allows the coil to be excited and to break the battery circuit by the switch. In a modification, the coil is not cut out when the switch is thrown. A double-pole reversing switch is then used to reverse the connections and the switch is restored by hand. In this switch is a blow-out coil. 4 claims.

22,633. "Improvements in or relating to electrical connecting boards." A. Whalley. Dated October 2nd, 1897. Cross-connecting boards for exchanges of telephone systems, &c., are formed preferably of a sheet of material such as ebonite, upon which are marked the positions of the perforations, the dividing lines, and the subscribers' numbers. The contacts are preferably in the form of tubes, but may be solid with the front end axially drilled. The contacts may be secured by expanding, &c., and the back projecting parts are preferably flattened and connected in horizontal pairs. When the board is formed of materials which cannot be moulded, a sheet of ebonite, &c., having the necessary slots is secured to its face. 4 claims.

26,827. "Improvements in electric arc lamps of the enclosed type." A. L. Davies. Dated November 17th, 1897. In an enclosed arc lamp the upper carbon is held between three radial jaws fulcrumed on a loose ring and connected at their outer ends to an electric controlling device, such as three links attached to the tubular core of a series or differentially wound solenoid. The jaws operate through slots in a tube in which the carbon slides, so that when their outer ends are raised the jaws grip and lift the carbon, but, when the outer ends are lowered, the jaws are tilted by contact with the lower ends of the slots and allow the carbon to slip. The movements of the core are controlled by a dash-pot. The solenoid is carried by a tube. The solenoid may be shunt wound, in which case the core is supported above by a spring. A series resistance is wound on a sheet of asbestos surrounding the casing of the mechanism, and is protected by an outer cover. The arc enclosing globe is held against a cover of heat retaining material, such as fireclay or asbestos; this is stated to render the arc stable, so that the outer globe need not be sealed. 5 claims.

26,880. "Improvements in and relating to electrical furnaces, specially applicable for the production of calcium carbide." G. W. B. Cross, W. L. Durban and J. Gore. Dated November 17th, 1897. The two ends of an incandescent furnace, applicable for making calcium carbide, are formed by the electrodes, or by blocks containing the electrodes, so that these two extend to the bottom of the furnace. The electrodes are held by copper or other frames attached to threaded rods which are movable by nuts rotatable by hand wheels in bearings. The electrodes may thus be moved inward to clamp the conducting rod with which an operation is commenced, or to raise the materials after partial conversion. Springs, weighted levers, or other adjusting devices, may be used instead of the screws. The sides of the furnace may be fireclay slabs secured to the bottom by tie bolts. A discharging slide may be provided in the bottom. 1 claim.

26,918. "Improvements in or relating to the application of electrodes in electrolytic process." Dr. O. C. Strecker and Dr. H. H. Strecker. Dated November 17th, 1897. Consists in employing, in electrolysis for the production of oxides and salts in which the anode is to be dissolved, anodes and cathodes of different metals, whereby the tension is considerably reduced. A number of tables of results are given showing the tensions when the same or different metals are employed as anodes and cathodes in a solution of 15 per cent. sodium chlorate, and in one of 26 per cent. sodium chloride. 1 claim.

26,921. "Improved process for preparing insoluble or hardly soluble salts from metallic anodes by electrolysis of aqueous solutions containing two salts." Dr. O. C. Strecker and Dr. H. H. Strecker. Dated November 17th, 1897. Relates to the preparation of salts which are insoluble or only slightly soluble in water or solutions of salts, such as white lead; and consists in forming the electrolyte by mixing two salts, one to dissolve the anode being added so as to produce the greatest conductivity, and the other to precipitate the salt being added in the proportion of the electro-chemical equivalent of the current density employed. For white lead, carbonic acid gas is injected, whereby also the electrolyte is agitated. For other salts the acids withdrawn from the electrolyte are continuously supplied. 1 claim.

26,923. "Improvements in or relating to the production of protoxides and hydroxides from metallic anodes by electrolysis of alkaline salt solutions." Dr. O. C. Strecker and Dr. H. H. Strecker. Dated November 17th, 1897. Relates to the production of electrolysis of insoluble, or only slightly soluble, metallic oxides and hydrates, particulars being given for the preparation of the following oxides or hydrates: Zinc, tin, iron, copper, nickel, cobalt, bismuth, antimony, cadmium, silver, and lead. Consists in employing a solution of an alkaline salt, such as of sodium chloride, chlorate or sulphate, as an electrolyte, with metallic electrodes corresponding with the oxide or hydrate required, and employing a current strength of 0·5 ampere per square decimeter of anode surface. By this arrangement the alkaline salt is decomposed, its acid ion dissolves the anode, and the salt formed is then decomposed by the alkaline hydrate re-forming the alkaline salt and precipitating the required metallic oxide or hydrate. 1 claim.

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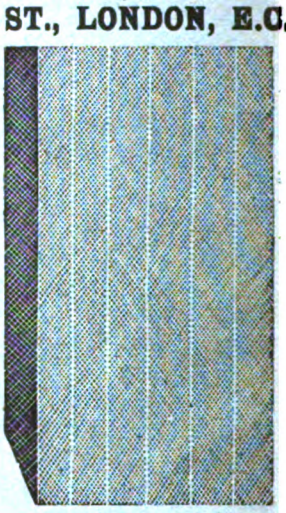

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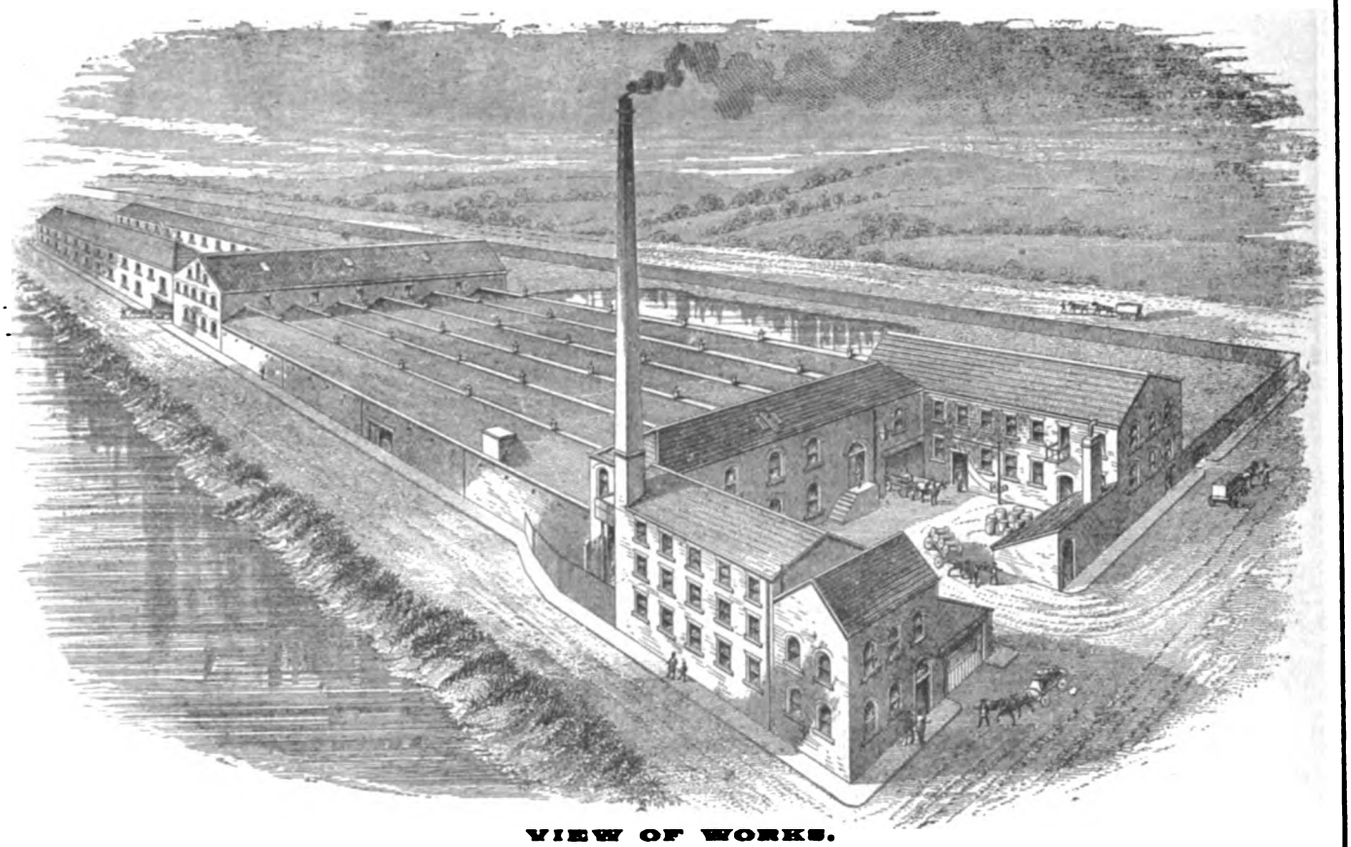

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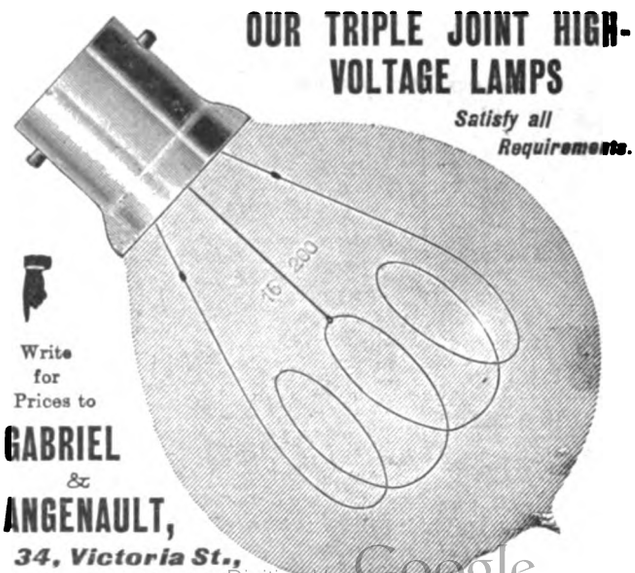

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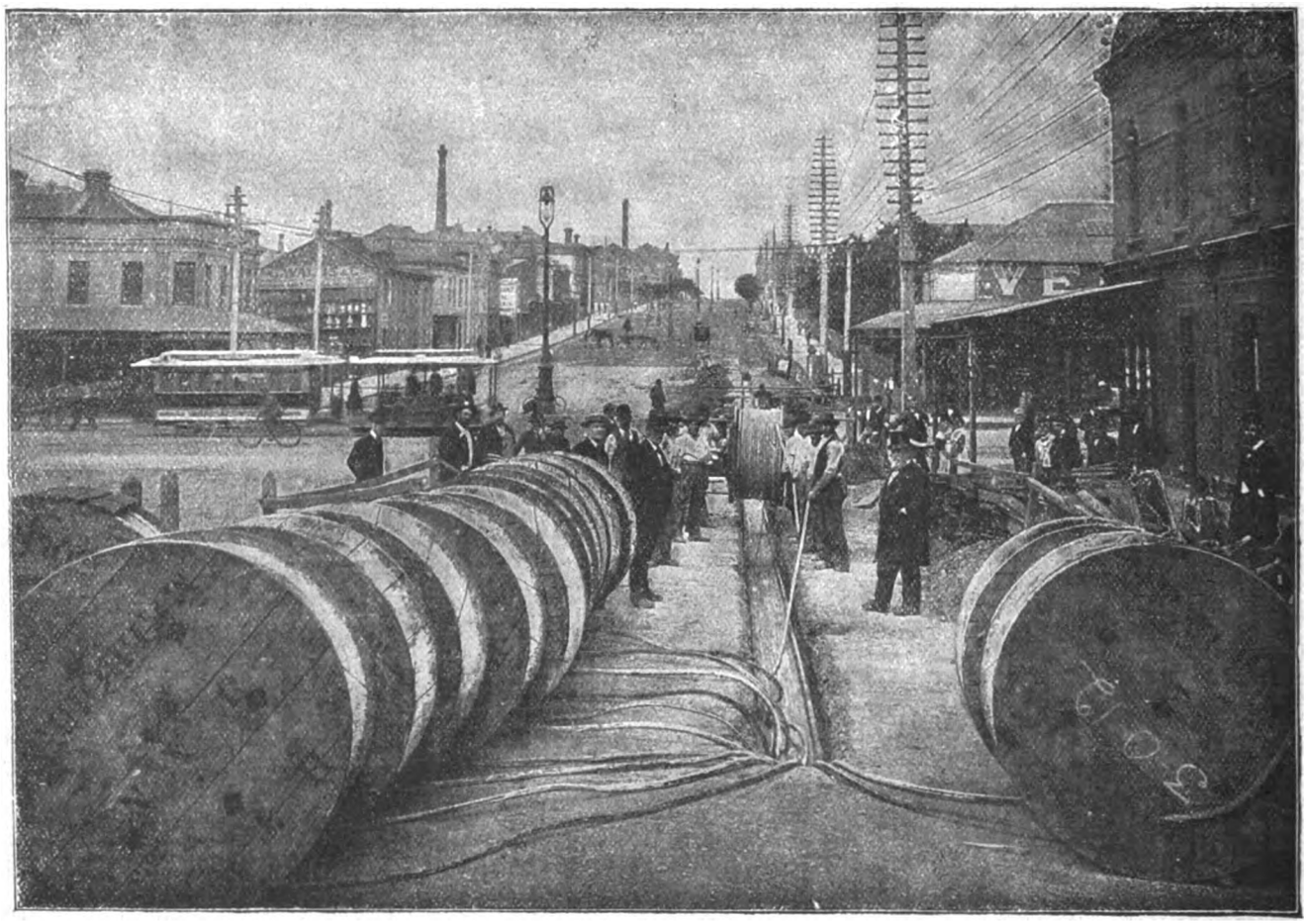

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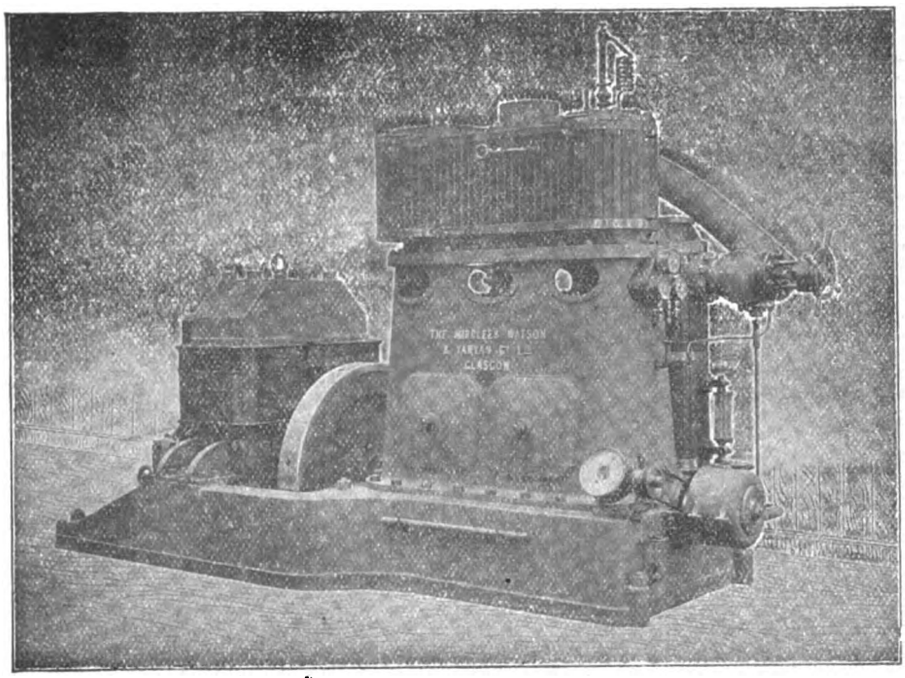

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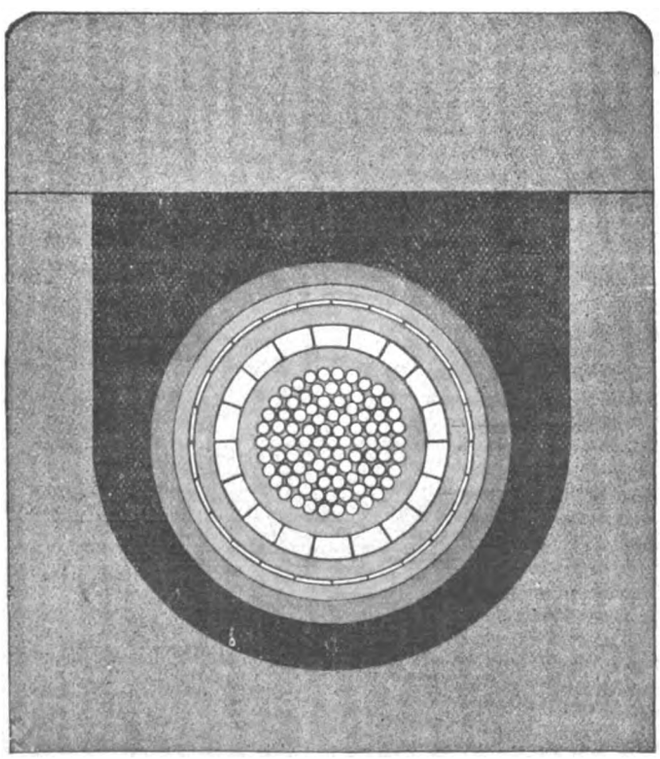

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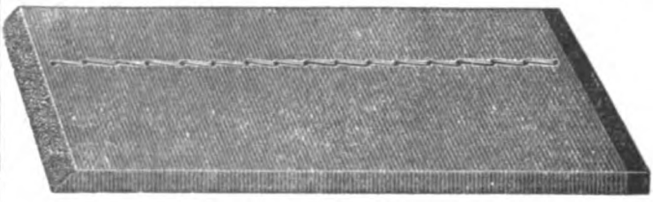

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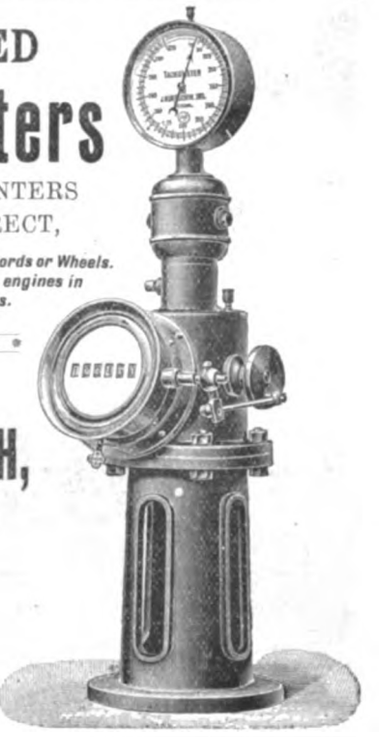

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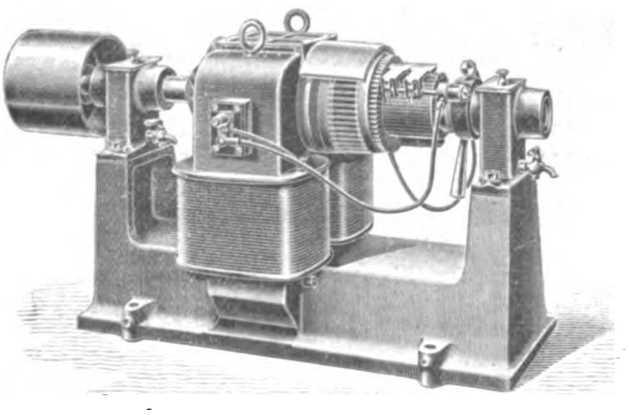

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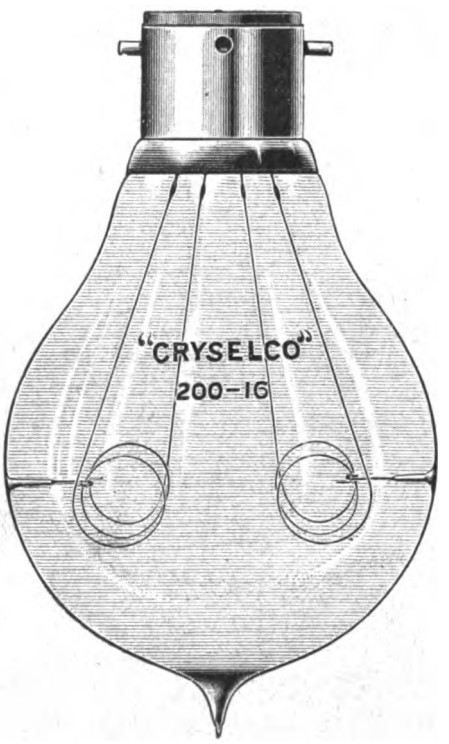

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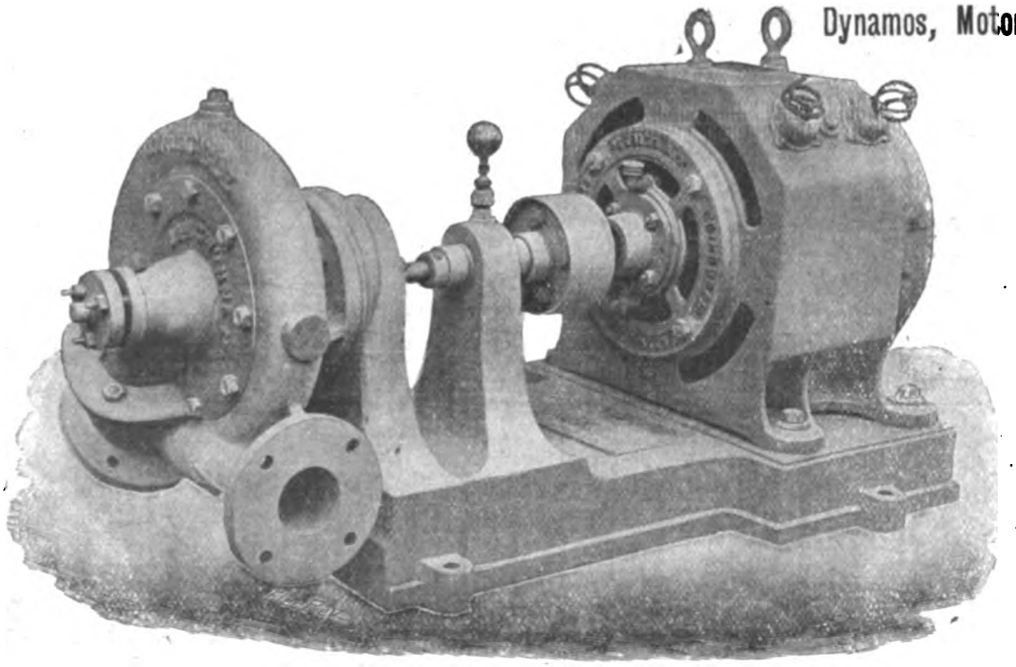

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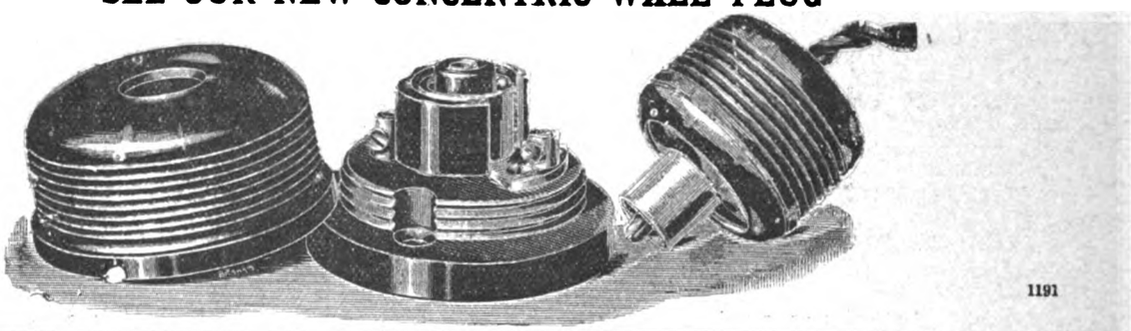

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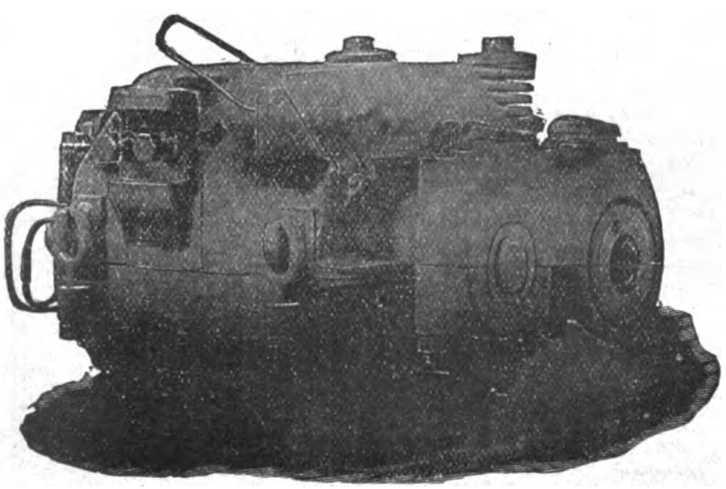

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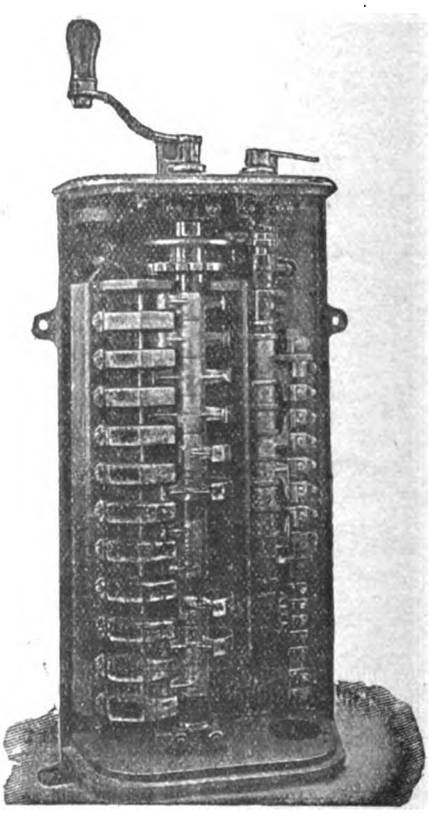

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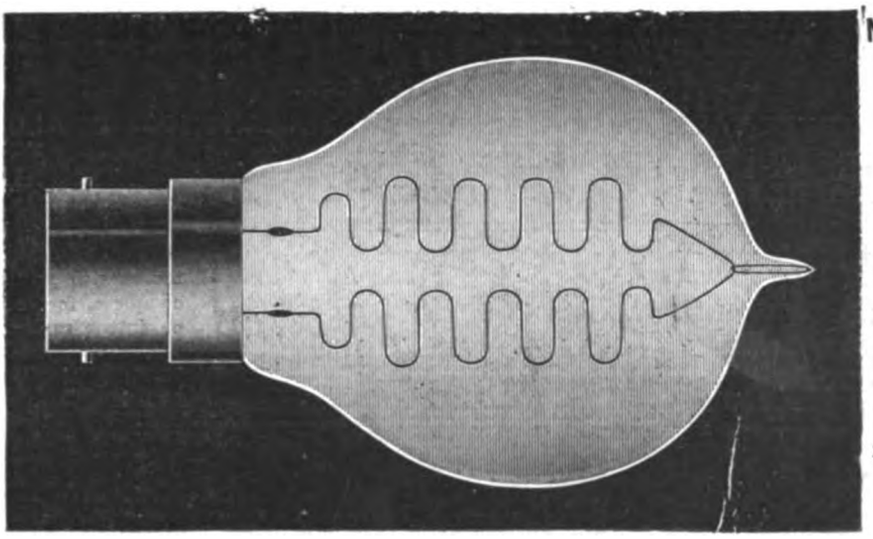

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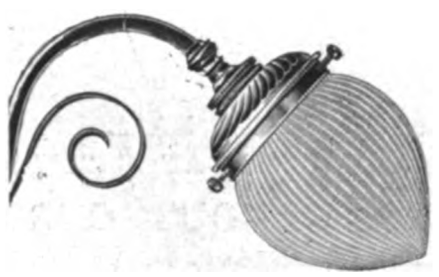

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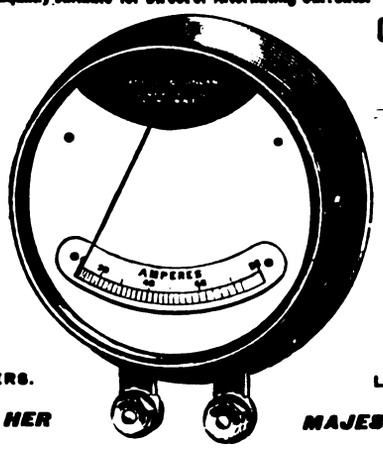

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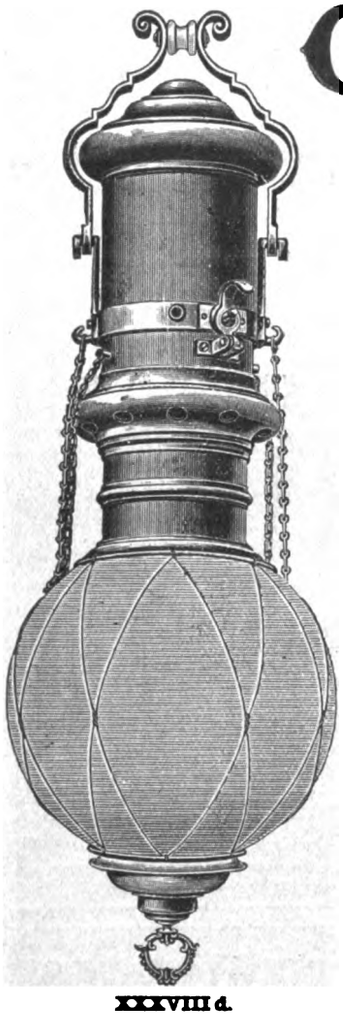

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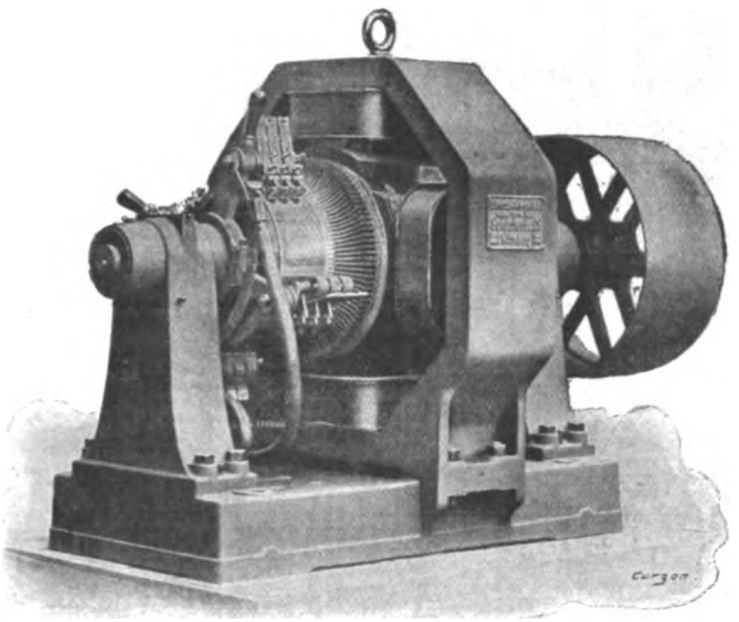

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311·5	6·5	254	35·2	40 3	84 2
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314	4·05	400	35·5	40 2	83·3
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320	3·3	502	36 2	40·5	82·5
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* On removing the load the speed increases by only 4 to 5 %.

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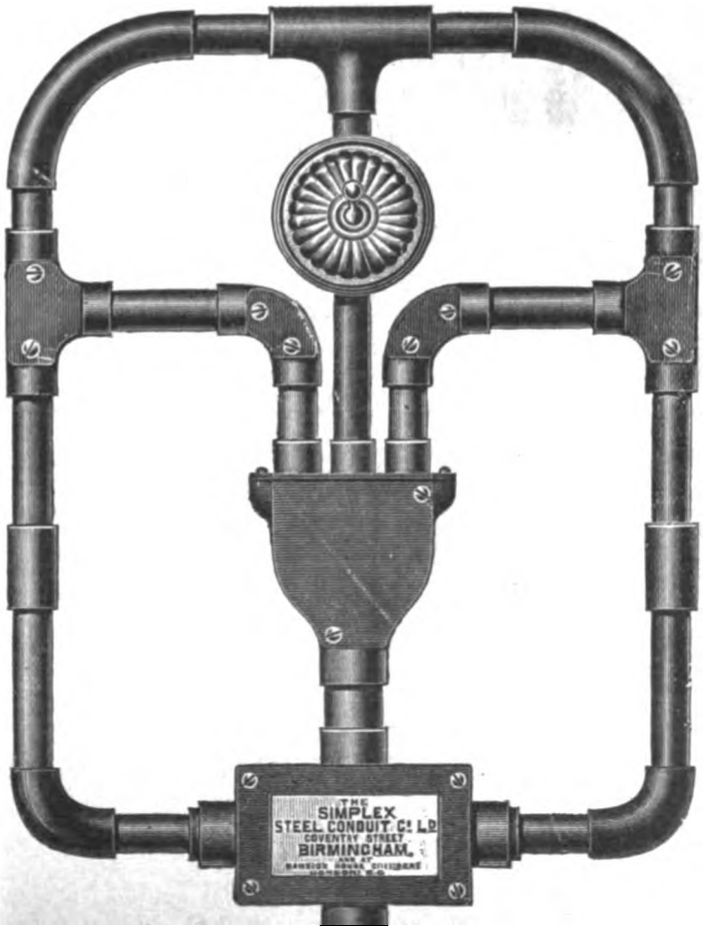

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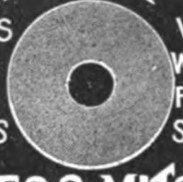

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Established 1855.
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HIGH-SPEED
AIR COMPRESSORS,
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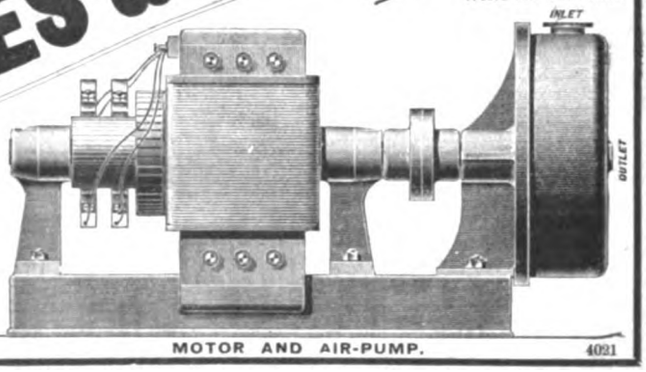

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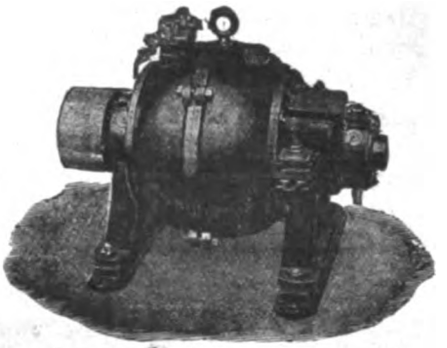
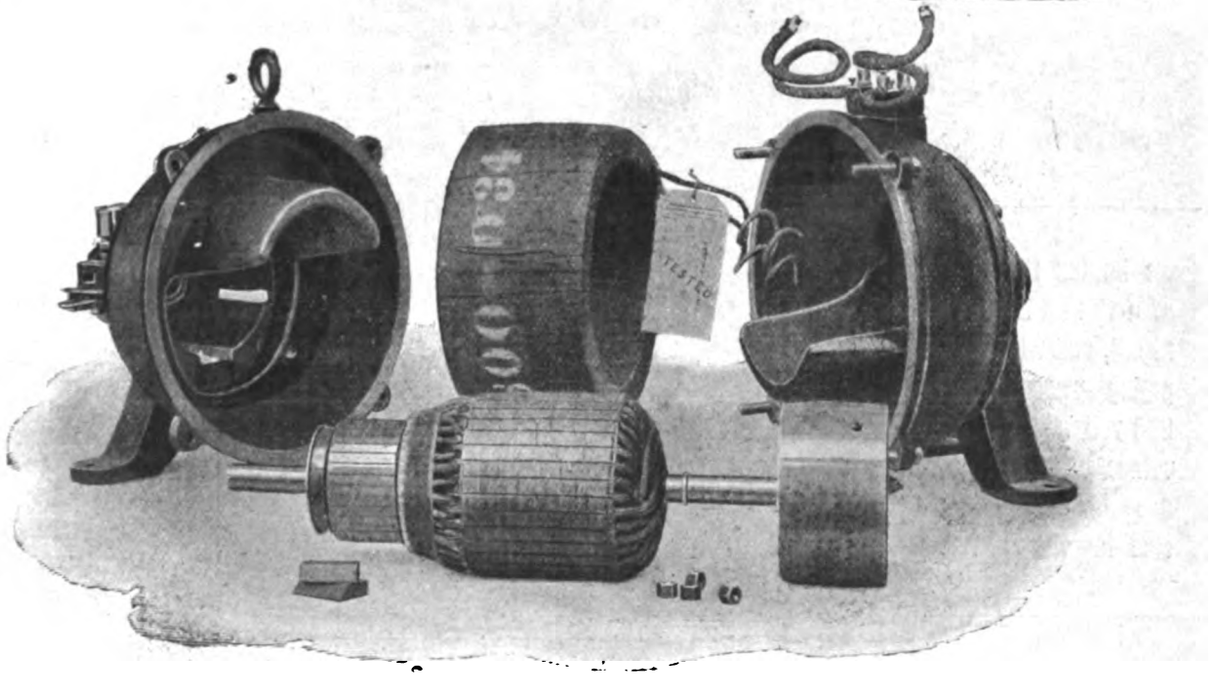
The well-known Lundell Motors are made by us, under license, at our Aston Works. We supply all sizes from $\frac{1}{2}$ to 50 H.P. They are used so extensively to-day that a detailed description of their design is unnecessary. No enclosed type Motors have given greater satisfaction. Standard windings 105 and 220 volts. Lists and full particulars on application.





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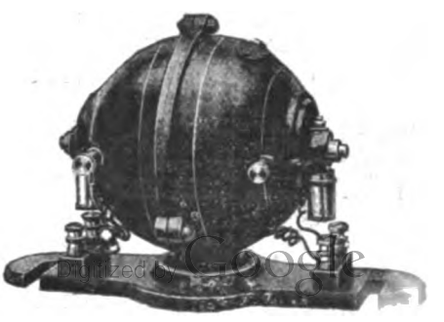

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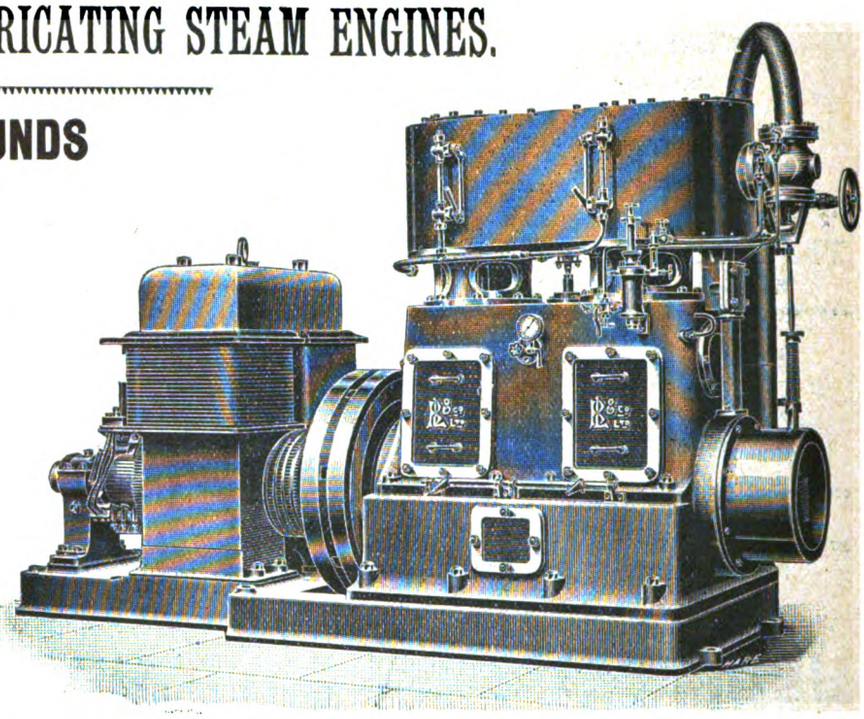

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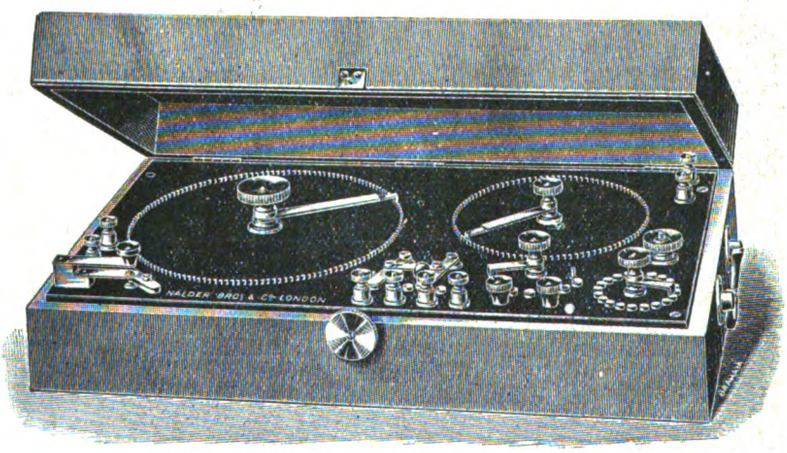

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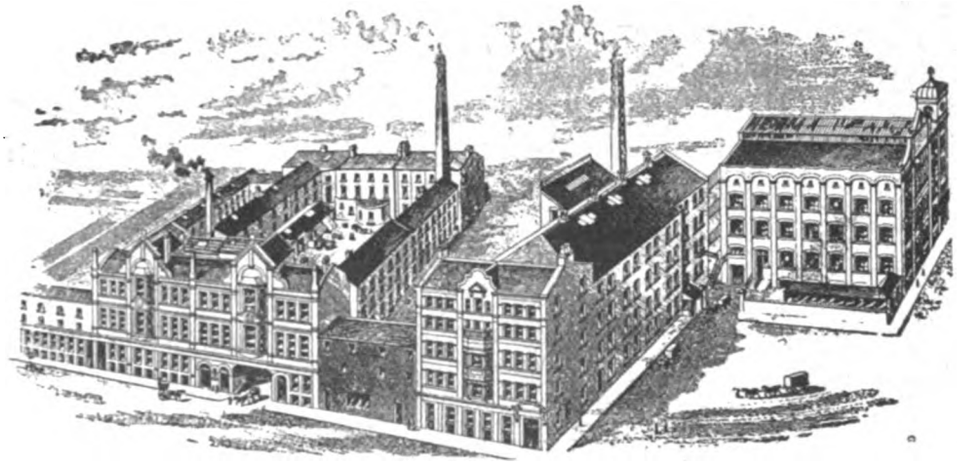

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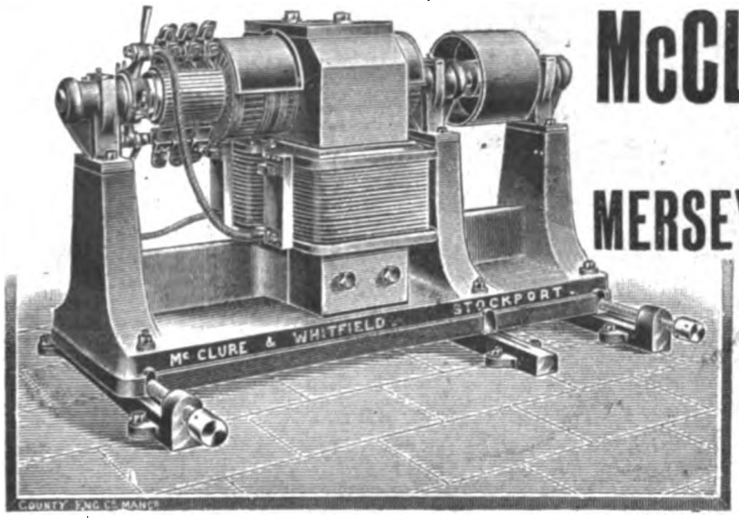

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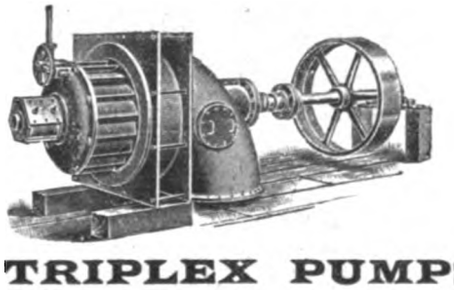

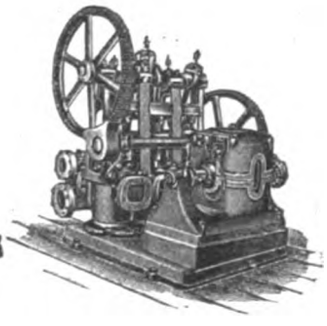

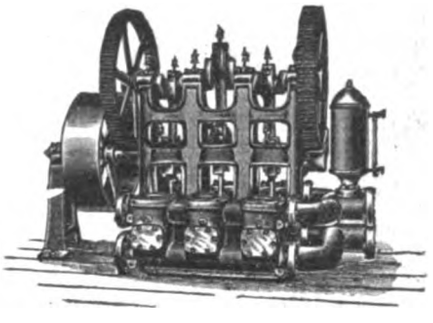

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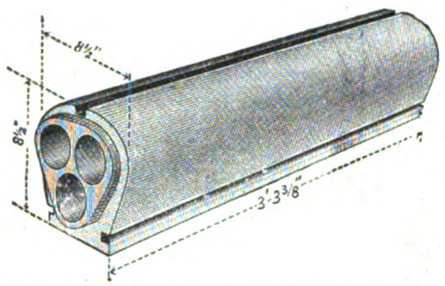

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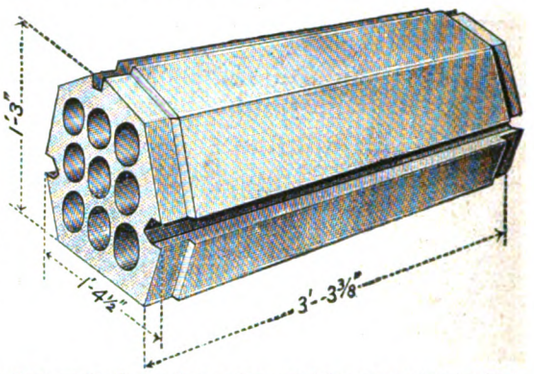

After a long experience it has been proved that the cement has no deleterious effect on lead or other cables, and the concrete of which the conduits are made matures and hardens when buried in the earth, and does not deteriorate.

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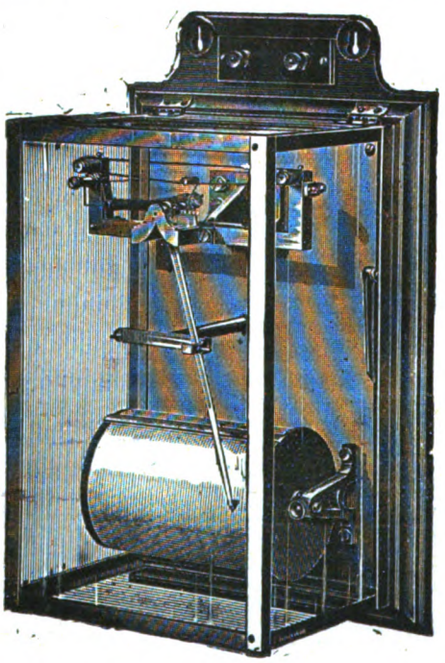

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MELDRUMS' and CLAYTON'S PATENTS.

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TWO FLUES 3 ft. dia.

ECONOMISER NOT USED DURING TESTS.

Duration of each test, 8 hours' continuous running. Heating surface of boiler, 846·5 sq. ft. Total grate area 30 sq. ft.

	Average 2 Tests.	Average 3 Tests.
Kind of coal used (Yorkshire)	Nuts at 7/10	Slack at 6/9
Total water evaporated per hour in lbs.	***8000 lbs.***	***8208 lbs.***
Water evaporated per sq. ft. of heating surface per hour	9·4 ,,	9·69 ,,
,, ,, ,, lb. of coal as fired	9·47 ,,	9·22 ,,
,, ,, ,, lb. (from and at 212° F.) as fired ...	***10·88 lbs.***	***10·61 lbs.***
Temperature of feed water entering boiler	102° F.	99° F.
Steam pressure in boiler (mean)	61 lbs.	62 lbs.
Weight of coal burnt per hour	850 ,,	889·5 ,,
Coal burnt per square foot of grate per hour	28·4 ,,	29·6 ,,
Percentage of heat transferred to water in boiler	69·7 %	72·74 %
Percentage of CO_2 in flue gases	12 %	12·4 %

Absolutely no smoke was made during the whole of the Tests.

MELDRUM Bros., Atlantic Works, Manchester

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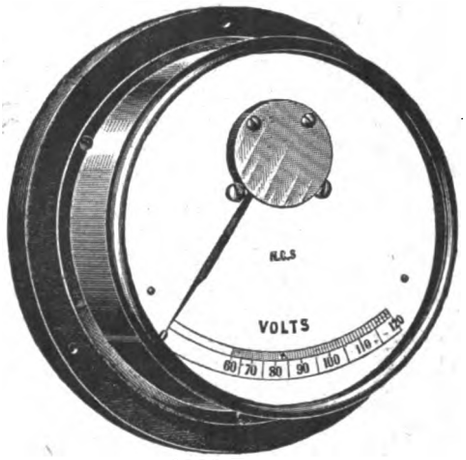
BRASS COVER,

TERMINALS AT BACK.



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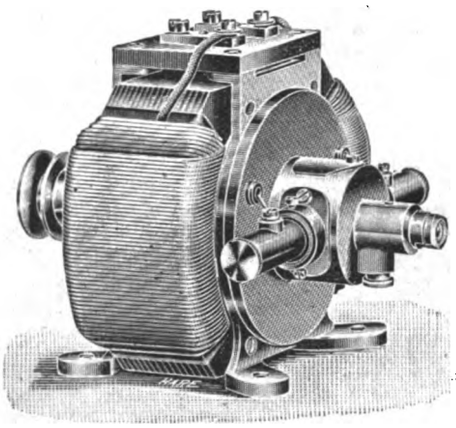

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SMALL ELECTRO MOTORS

both Continuous and Alternating Currents.

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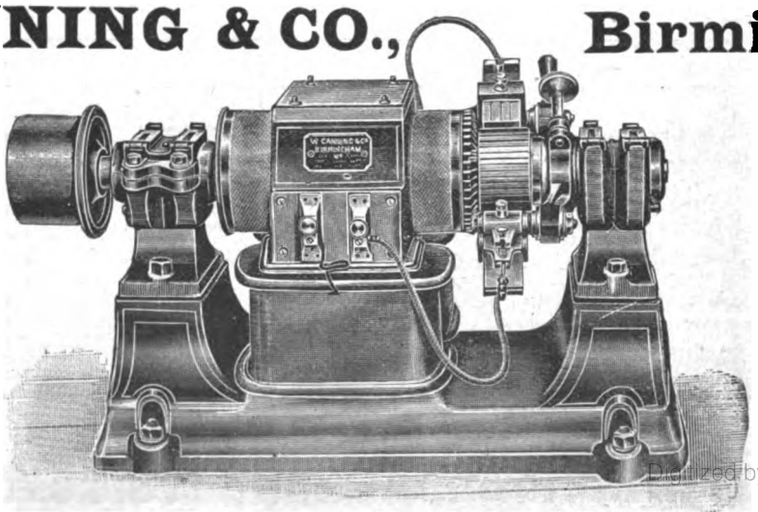

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FIVE SHOWROOMS AT

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Official Notices.

1901—MAY TO NOV.—1901.

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HER MOST GRACIOUS MAJESTY THE QUEEN.

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The Site of the Exhibition is the West End Park of the City, extending to 67 Acres. The population of the City and Surrounding District exceeds 1,500,000, and the Tourist Routes to the Highlands of Scotland radiate from Glasgow. The Exhibition of 1888, on Same Site, was visited by 6,000,000 Persons. Prospectus and Application Forms can be obtained on application, and must be filled up and returned on or before 1st June, 1900.

H. A. HEDLEY, *General Manager.*
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Official Notices.

CITY & COUNTY OF NEWCASTLE-UPON-TYNE

ELECTRIC TRAMWAYS.

To Contractors and Others.

THE CORPORATION OF NEWCASTLE-UPON-TYNE is prepared to receive Tenders for the Laying Down in Newcastle of about 11 Miles of Double-Line Tramway, the rails and fastenings and the poles being supplied by the Corporation. On payment of £3 3s. to the City Treasurer (which will be returned on receipt of a *bonâ fide* tender), Specifications, Bills of Quantities, and Forms of Tender may be obtained, and Plans and Drawings inspected at the office of the City Engineer, Town Hall, Newcastle, on and after Wednesday, January 3rd, 1900; and tenders, addressed to "The New Tramways Committee," must be sent in on before Wednesday, January 24th, at noon. The Committee does not bind itself to accept the lowest or any tender.

By order,
HILL MOTUM,
Town Clerk.

Newcastle-upon-Tyne,
December 19th, 1899. 7288

URBAN DISTRICT OF ILFORD.

ELECTRIC LIGHTING.

THE ILFORD URBAN DISTRICT COUNCIL are prepared to receive Tenders for the supply and erection of the following plant:—

Section A.—Water-tube Boilers with Fittings, Economiser, Feed Pumps, &c.
" B.—Pipework, &c., in Engine and Boiler House.
" C.—Two 200-kilowatt and One 100-kilowatt Steam Dynamos, and Motor Boosters (Vertical Enclosed High-speed Engines).
" D.—Storage Batteries.
" E.—Main Switchboard and Connections.
" F.—Overhead 15-ton Engine-room Travelling Crane.
" G.—Underground Mains, Conduits and Roadwork for Private and Public Lighting.
" H.—Arc Lamps and Posts.
" K.—Station Lighting.

Persons tendering are at liberty to tender for any Section or Sections, or for the whole of the Sections, but not part of one Section.

Tenders will be considered from those firms only with plant of similar size and type working satisfactorily in other electricity supply works.

Copies of the Specification, with Forms of Tender, General Conditions and Plans, may be obtained at the offices of the undersigned, on and after December 12th, on depositing a cheque for Five Guineas, which sum will be returned on receipt of a *bonâ fide* tender. Applicants to state the Section, or Sections, for which they propose tendering.

The works are to be carried out in accordance with the Plans and Specifications prepared by Mr. W. C. C. Hawtayne, of 9, Queen Street Place, London, E.C., Consulting Engineer to the Council, from whom further information can be obtained on and after December 12th, 1899.

Tenders, sealed and marked "Tender for Electric Lighting," to be addressed to "The Chairman of the Urban District Council," at the Council Offices, Ilford, and to be delivered on or before 12 o'clock noon on January 20th, 1900.

The Council do not bind themselves to accept the lowest or any tender.

J. W. BENTON,
Clerk to the Council.

Council Offices, Ilford,
December 6th, 1899. 7289

OFFICIAL NOTICES continued on Sup. VIII.

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Official Notices.—Continued.

URBAN DISTRICT OF BARKING TOWN

ELECTRIC LIGHTING.

CREEKSMOUTH EXTENSION.

THE BARKING TOWN URBAN DISTRICT COUNCIL are prepared to receive Tenders for the supply and erection of the following Plant:—

Section A.—Two Continuous Current Transformers and Switch Gear.
,, B.—Underground Cables and Roadwork.

Persons tendering are at liberty to tender for either or both sections, but not part of one section. Tenders will be considered from those firms only having plant of similar type, doing similar duty elsewhere.

Successful tenderers will be required to enter into a contract to pay the trades union rates of wages, and to recognise trades union hours of labour.

Copies of the Specification, with Forms of Tender, General Conditions, and Plan of Mains, may be obtained at the offices of the undersigned on and after January 8th next, on payment of Five Guineas, which sum will be returned on receipt of a *bonâ fide* tender.

The works are to be carried out in accordance with the Specifications and Plans prepared by Mr. W. C. C. Hawtayne, M.I.E.E., 9, Queen Street Place, London, E.C., Consulting Engineer to the Council, at whose office Plans can be inspected (but not obtained) on and after January 8th, 1900.

Tenders, sealed and marked "Tender for Creeksmouth Extension," to be addressed to the Chairman of the Urban District Council, at the Council Offices, Barking, and to be delivered on or before 12 o'clock noon, on JANUARY 23rd, 1900.

The Council do not bind themselves to accept the lowest or any tender.

(Signed) EDWIN H. LISTER,
Clerk to the Council.

Public Offices, Barking,
December 22nd, 1899.

7329

SALFORD SCHOOL BOARD.

ELECTRIC LIGHTING.

THE BOARD are prepared to receive Tenders for the electric lighting of their new schools in Grecian Street North, Lower Broughton.

Copies of the Specification, and Form of Tender, &c., may be obtained only from the undersigned, upon payment of Two Guineas, to be returned upon receipt by the Board of a *bonâ fide* tender.

Specification and Plans may be seen at, and any further information obtained from, the offices of the consulting engineers, Messrs. Lacey, Clirehugh & Sillar, at 78, King Street, Manchester, and 2, Queen Anne's Gate, Westminster, London.

Sealed Tenders, addressed to the Chairman of the Board, and endorsed "Tender for Electric Lighting," must be delivered to the undersigned not later than noon on MONDAY, JANUARY 8th, 1900. The Board do not bind themselves to accept the lowest, or any, tender.

OGILVIE DUTHIE,
Clerk to the Board.

School Board Offices,
Chapel Street, Salford,
December 16th, 1899.

7287

BOROUGH OF TYNEMOUTH CORPORATION.

TENDERS are invited for Free Wiring of premises in connection with the Corporation Electricity Works.

C. TURNBULL,
The Borough Electrical Engineer, Tynemouth.

7330

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Fellow of the Chartered Institute of Patent Agents.
Norfolk House, Norfolk St., London, W.C.
"PATENTEE'S HANDBOOK" Post Free on Application. 126

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NOTICE TO ADVERTISERS.

The following are the LATEST times up to which Advertisements can be received for publication in current week's issue:—

New Advertisements or Alterations to existing ones, Wednesday 12 noon.

Small Announcements for middle pages, Thursday 2 p.m.

REFERENCE BOOK OF
TABLES & FORMULAS
FOR
ELECTRIC STREET RAILWAY ENGINEERS.
ARRANGED AND COMPILED BY
A. H. MERRILL
Author of Electric Lighting Specifications for the Use of Engineers and Architects.

In the pages of this book are collected the principal tables and formulæ of which the electric street railway engineer makes use in his practical everyday work, arranged in the most convenient manner for practical use.
Only those tables and formulæ in daily use, and which are for the most part complete in themselves, have been inserted. A logical order has been followed in the arrangement, beginning with the steam plant and passing successively through cars and their equipment, overhead work, track work, and miscellaneous tables and formulæ in constant use. A number of the tables and formulæ are original while many others have been modified and extended to adapt them to the conditions imposed in electric street railway work.

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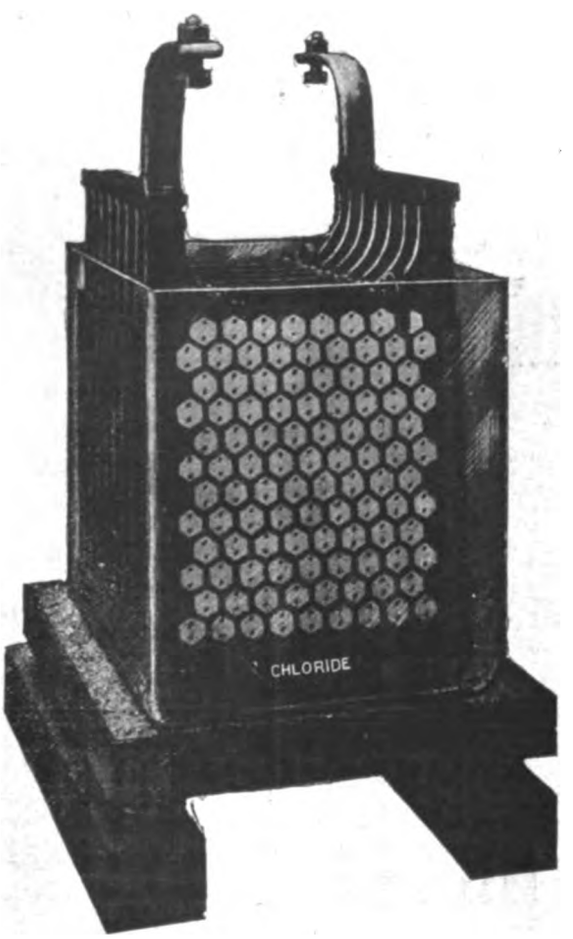

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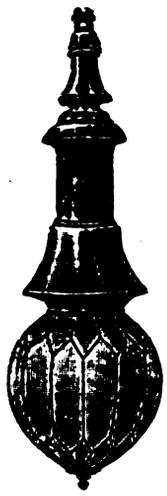

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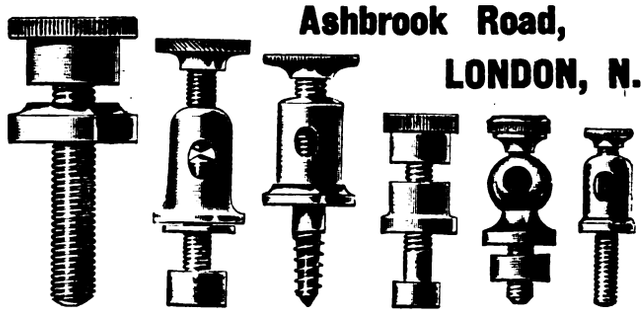

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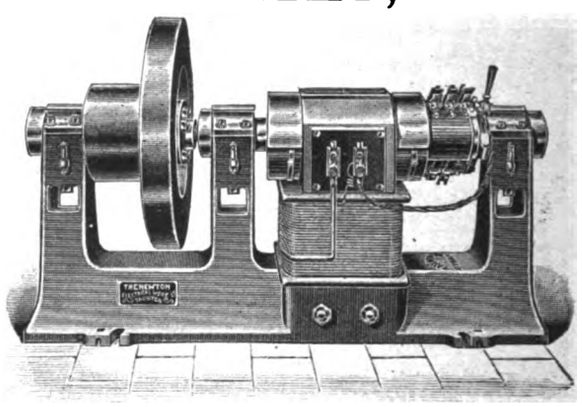

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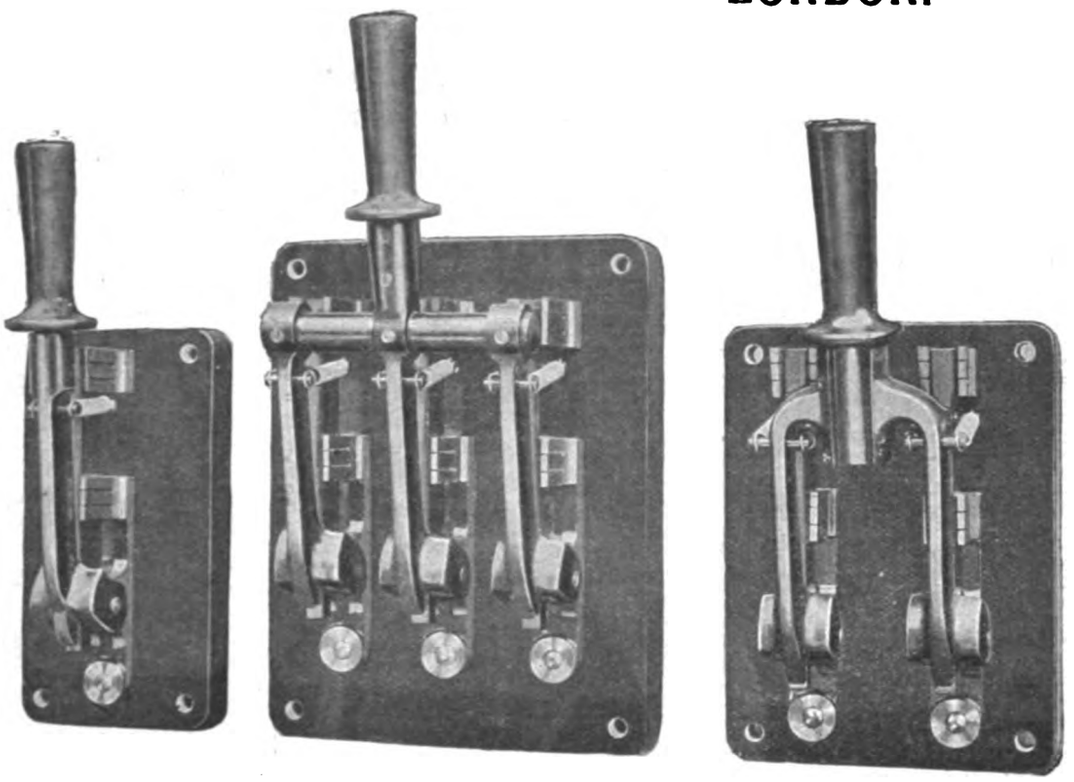

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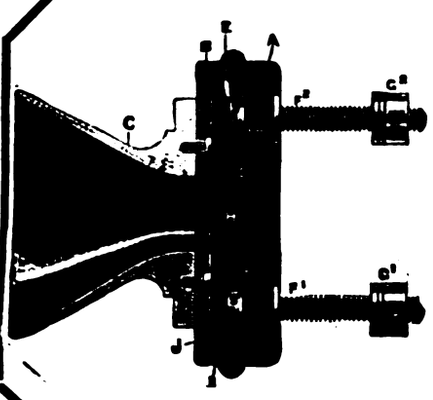

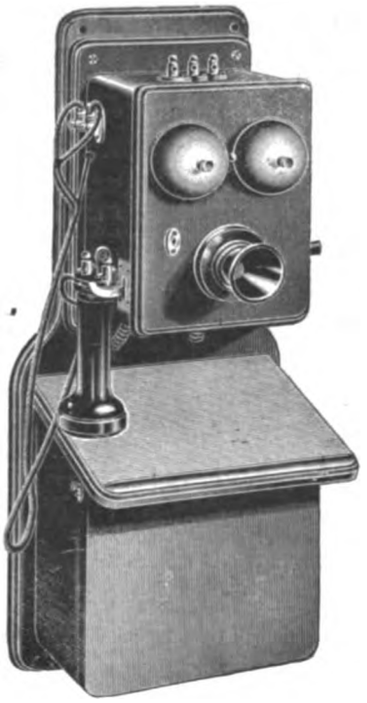

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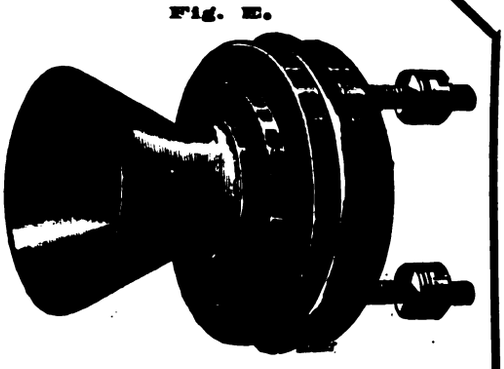

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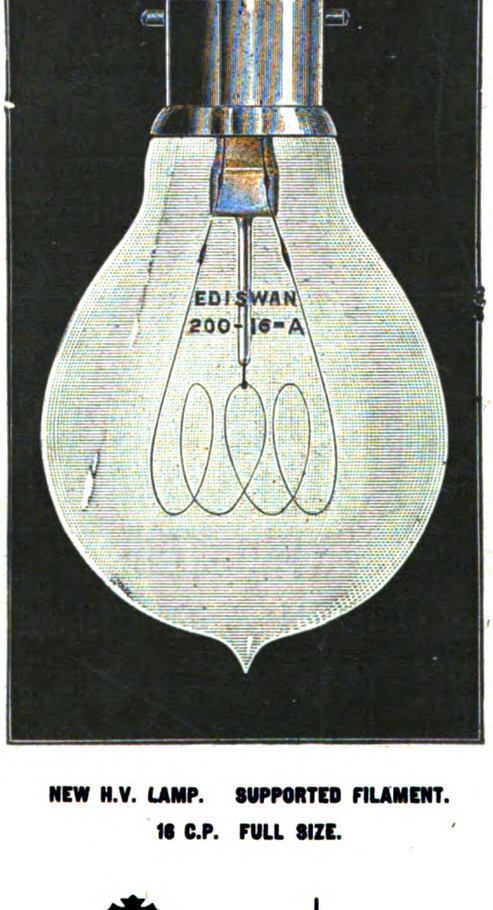

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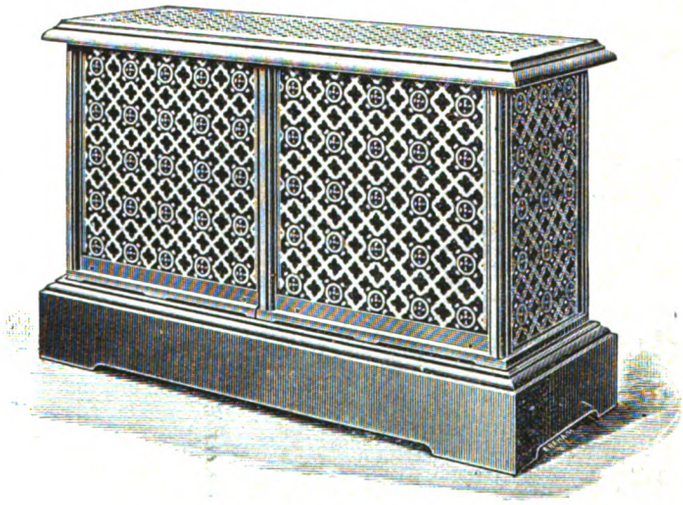

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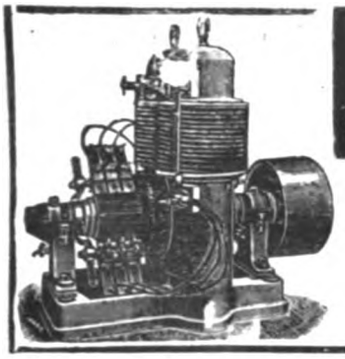

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Superintendent of Testing Department:—ALBERT CAMPBELL, B.A. (Cantab).

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If letters are not to be delivered to certain firms or individuals (if known), instructions to that effect should be sent to the Manager of the ELECTRICAL REVIEW, who will do his best to carry out such instructions. Letters of applicants cannot in such cases be returned to them, nor can the names of advertisers using a number or a *nom de plume* in any way be disclosed.

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ARTHUR ELLIS,
General Manager. 7283

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(Continued on next page.)

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DRY Batteries.—Wanted, Practical Man well up in dry cell manufacture; also with knowledge of primary cells generally. Permanency to good man.—Address, 7331, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7331

ELECTRICAL Engineer.—Gentleman wanted by important Scotch contracting firm, capable of estimating, superintending work and soliciting business, well acquainted with plant and motor work. Applicants should state age, present and past appointments, salary expected.—No. 7327, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7327

ENGINEER wanted for a private estate in Wiltshire. Must be fully competent to take entire charge of, and keep in repair, electric lighting and power installations and telephones, deep well pumps, and wind engines for pumping, with water piping and connections for farm and house supply. Will also be required to carry out all other engineering work on estate, including repairs to agricultural machinery and implements. Applicants not to be over 40 years of age, be fully qualified, energetic, and well recommended. Wages £2 per week; month's trial preferred.—Apply, describing qualifications and previous experience, to OWENS, Estate Office, Cholderton, near Salisbury. 7319

FIRST-CLASS Armature Winders wanted accustomed to heavy slot windings of all sorts. Continuous employment guaranteed to really good men; 9½d. per hour and railway fare paid.—Apply, D. BRUCE PEEBLES & Co., Tay Works, Edinburgh. 8515

LEADING Position open with large manufacturing company for man thoroughly experienced in continuous current dynamo design and manufacture.—Apply, Box 7328, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7328

LONDON Traveller required by English electric lamp manufacturers; good connection indispensable. Remuneration, salary, and commission.—Apply, Box 7326, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7326

REQUIRED at once, Storekeeper in firm of electrical engineers and dealers; a good salary given to reliable and trustworthy man. Must have had previous experience.—Reply by post to 7225, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7225

TRAVELLER (first class) wanted by electrical accessories manufacturers to work Scotland; must reside in Glasgow. Technical experience and good connection indispensable.—State, in confidence, full particulars and terms, 7307, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7307

WANTED, a thoroughly experienced Gutta-percha Jointer.—Apply by letter, stating wages required and previous experience, Box 7292, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7292

WANTED, by a large firm of electrical contractors, a Superintendent for their Glasgow branch; must have had good experience in estimating and supervision of men, also knowledge of working drawings. Some local connection desirable.—Apply, stating age, salary expected, &c., to 7325, c/o ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7325

WANTED, by established firm in the Midlands, good Engineer as Works Manager to control drawing office and works, and to be responsible for quick manufacture of dynamos and motors, one who has, or is, occupying similar position preferred; must be up-to-date and energetic.—Reply, in confidence, with full particulars and salary required, to Box 826, Sell's, 167, Fleet Street, London, E.C. 7308

WANTED by the Wireless Telegraph and Signal Company, Limited, Junior Assistants well up in electrical science. Those with a good knowledge of Hertsian work and acquainted with practical telegraphy preferred.—Apply in the first instance, by letter only, to 28, Mark Lane, E.C., stating age, qualifications, and salary expected. 8742

WANTED, Jointer accustomed to street junction and service boxes for London alternating station, 9½d.—7322, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7322

WANTED on traction work near London, Gentleman Improver with good practical knowledge of electrical work. Must be active and strong. Moderate salary to start.—7343, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7343

WANTED.—Smart young man to manage small works, making continuous current dynamos and motors; must be used to control men, and understand designing. Good opening for energetic man.—Apply, stating wages required, age, experience, &c.; applications treated in strictest confidence.—7308, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7308

WANTED.—Working Foreman for small cable factory; state full particulars as to age, wages and experience.—7268, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7268

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ART Metal Designer.—Artistic electroliers, &c., gates, grilles, &c. Situation required by young man, age 26, previous 10 years' experience with best firms. Exceptional references. Wages, £3 per week.—Write "ART," Gould's Advertising Offices, 54, New Oxford Street. W.C. 7261

CHARGE of institution or private installation; own repairs, good references.—"H. J. E.," 25, Ampton Street, W.C. 7341

ELECTRICAL Engineer desires responsible appointment; two years' theoretical and nine years' practical experience, well up in design and erection of lighting and power plants, first-class references.—"ELECTRICIAN," Oakdale, Hampton-on-Thames. 7338

ELECTRICAL Engineer (German), well up in theory and practice, three years' workshop experience, desires position with good firm. Advertiser has been three years in South Africa with first-class firm, and is thoroughly competent in estimating, testing, and installation work.—Apply, 7240, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7240

ELECTRICAL Engineer (23), eight years' varied experience, desires responsible position in contracting firm; good testimonials.—7256, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7256

ELECTRICAL Engineer (28) seeks engagement; experienced in central station running, installation business, launch work, and the design and manufacture of enclosed motors.—7274, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7274

ELECTRICIAN seeks charge of installation work or plant; 20 years' experience in house and ship lighting, and with steam, oil, and gas engines. Good mechanic.—Address, 7342, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7342

ELECTRICIAN seeks engagement, run own casing, simplex and barrel, bell, telephones, &c.—"J. A.," 88, Raynham Road, Edmonton. 7337

ELECTRICIAN (24) seeks situation as an Assistant; has had experience in light, bells, telephones, accumulators, dynamos, &c., for colliery, theatre, and private work.—For further particulars, apply 7293, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7293

ENGINEER (27) wants charge of plant, experienced gas, oil, and steam engines, dynamos, motors, accumulators, telephones, &c., repairs. References.—PAXTON, 44, Hazelbury Road, Wandsworth Bridge Road, London. 7330

PRACTICAL Dynamo Designer and Electrician disengaged; 14 years' experience in electrical plant.—Apply, 7246, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7246

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WIREMAN, experienced, seeks work.—7, Burlington Road, Bayswater. 7336

WIREMAN, Practical, wood or Simplex, fix well, surface.—5, Tarrant Street, W. 7332

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SECOND-HAND electrical plant and fittings bought and sold to any amount.—Send particulars to Electrical Department, Phillips's Monthly Machinery Register, Newport, Mon. 7259

SECOND-HAND Plant for Sale.—A large number of Meters, Arc Lamps, Transformers, complete Switchboard, a small Bumstead & Chandler Engine, and 100-KW. E.C.C. Alternator, are for sale, owing to change to direct current.—Apply, Electricity Works, Woolwich, S.E. 7305

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ARTICLES WANTED.—*Continued.*

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WANTED.—Shunt-wound dynamo, 70 volts 20 amperes. State speed, maker's name, and lowest price.—7335, ELECTRICAL REVIEW, 4, Ludgate Hill, London. 7335

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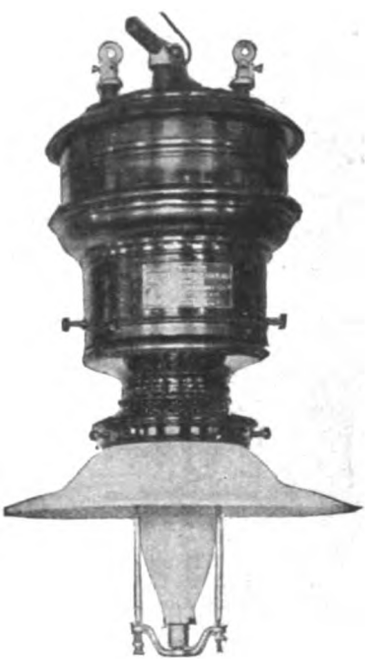

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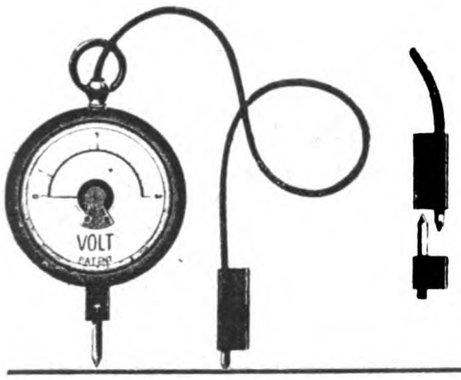

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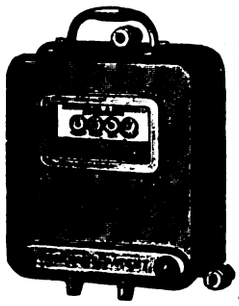

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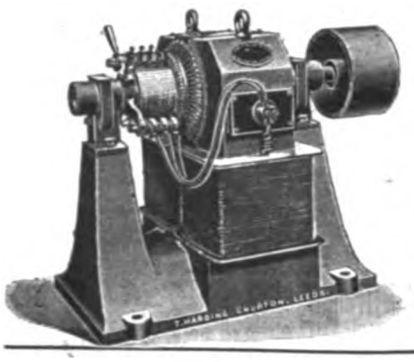

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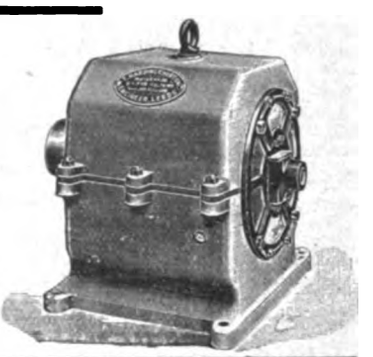

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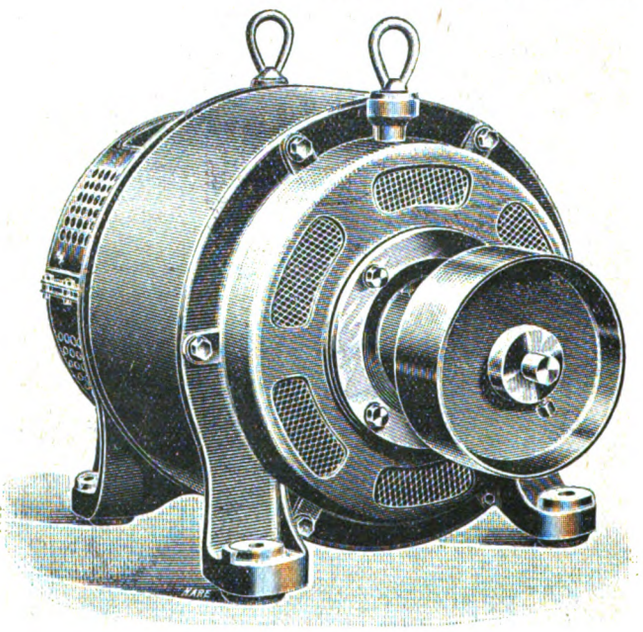

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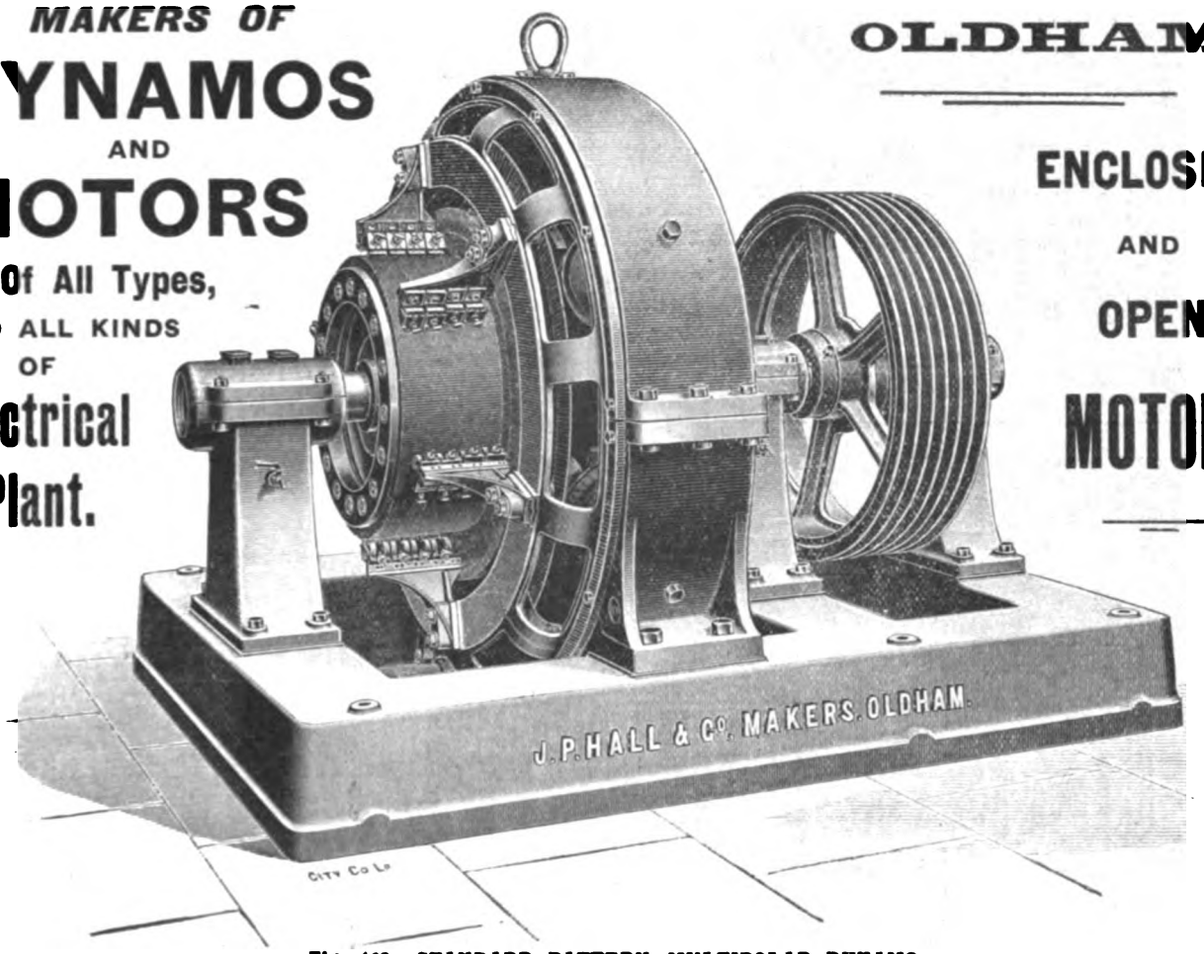

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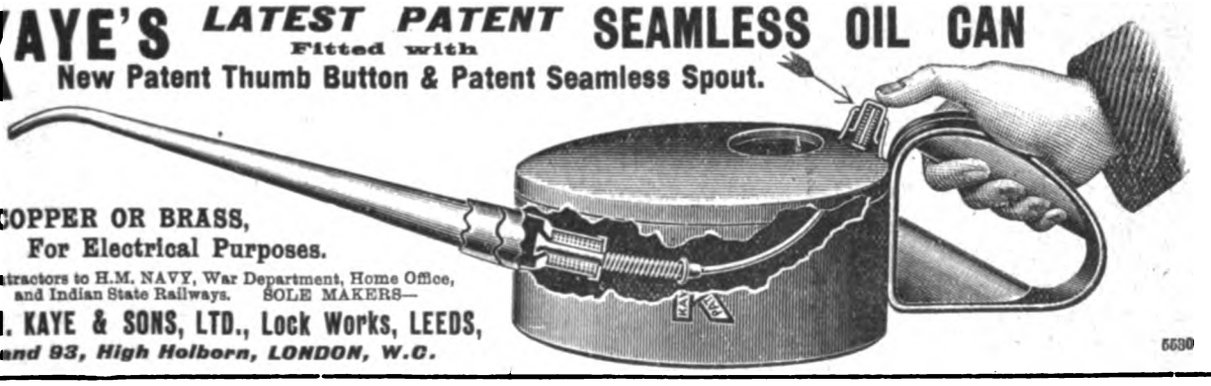

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2. ***"Medium"*** Conduit—Enamelled Steel Tube—seamless, readily "bent cold," "water-tight," "light wall" but "nail-proof," "mechanical screwed joints," with "labour-saving" thread. This tube is as cheap as, and at all points superior to, gas-pipe, and other so-called "enamelled steel" and "open joint" conduits. New prices (see pink list).
3. ***"Lowest Cost"*** Conduit—Plain Insulating Tube—far superior to "wood casing," and similar construction, giving all needful electrical qualities short of "Complete" mechanical protection. The C. & I. Co. have recently improved the mechanical strength of this quality material, and now are arranging to place it on the market at a price *considerably below* that of any so-called "steel" conduit, and, under ordinary conditions, will prove better value (new list in press).

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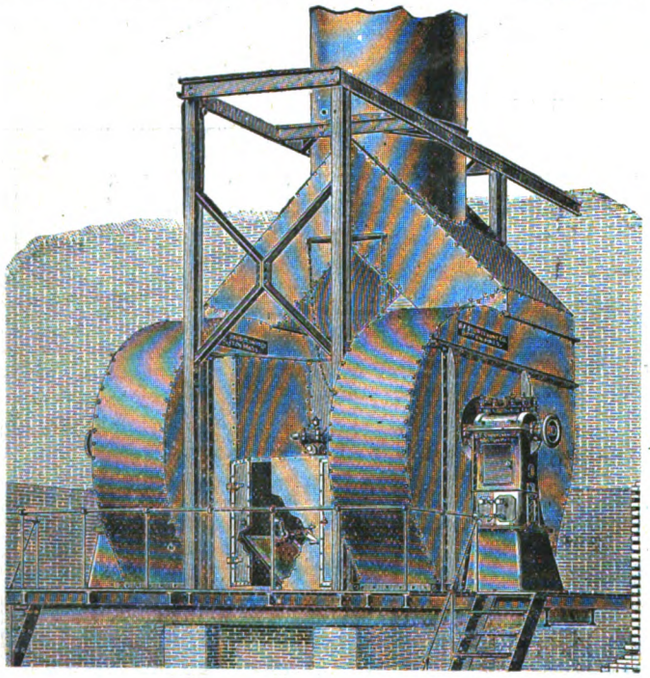

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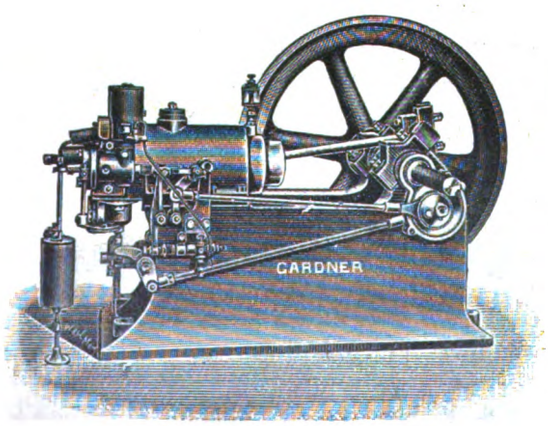

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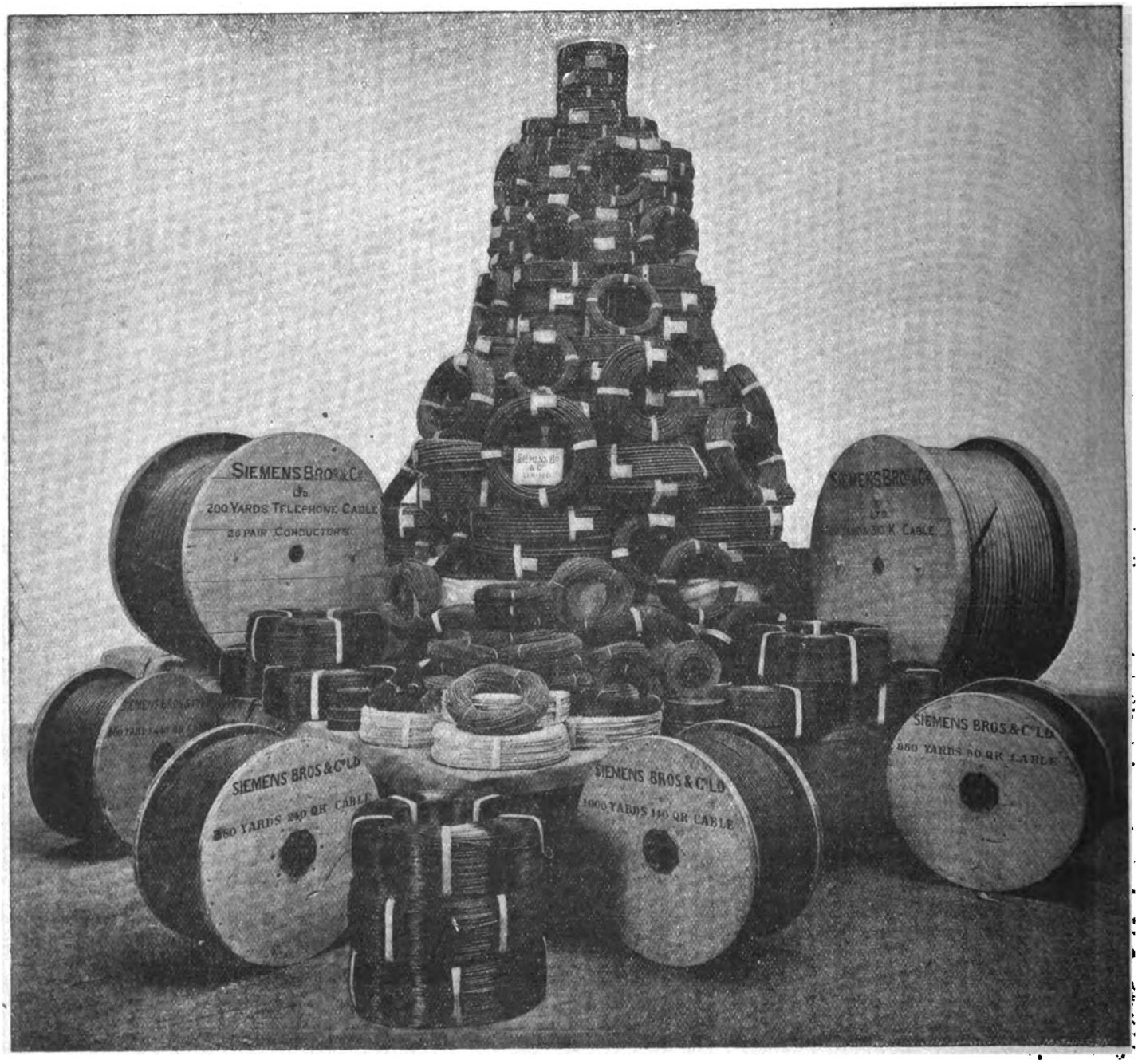
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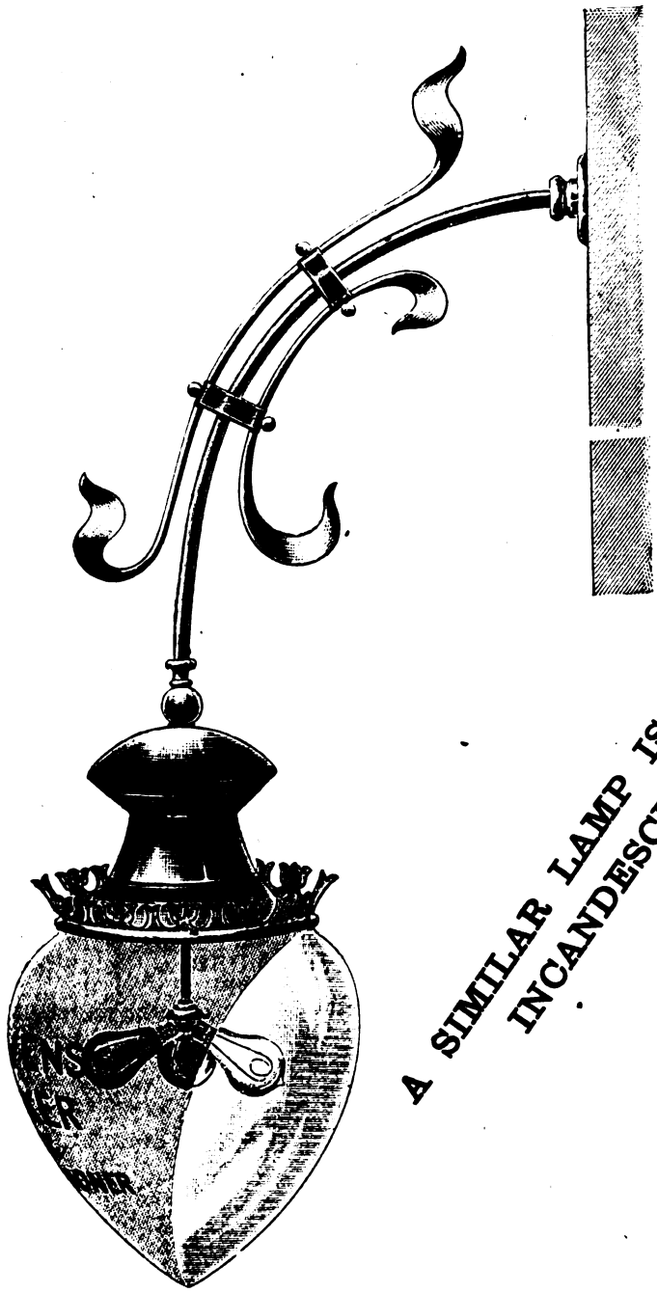

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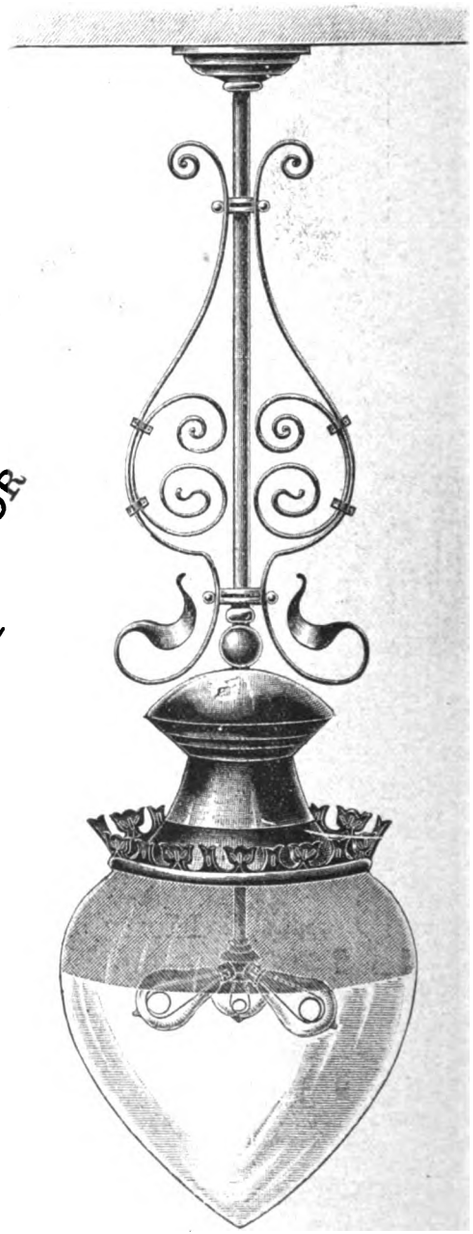

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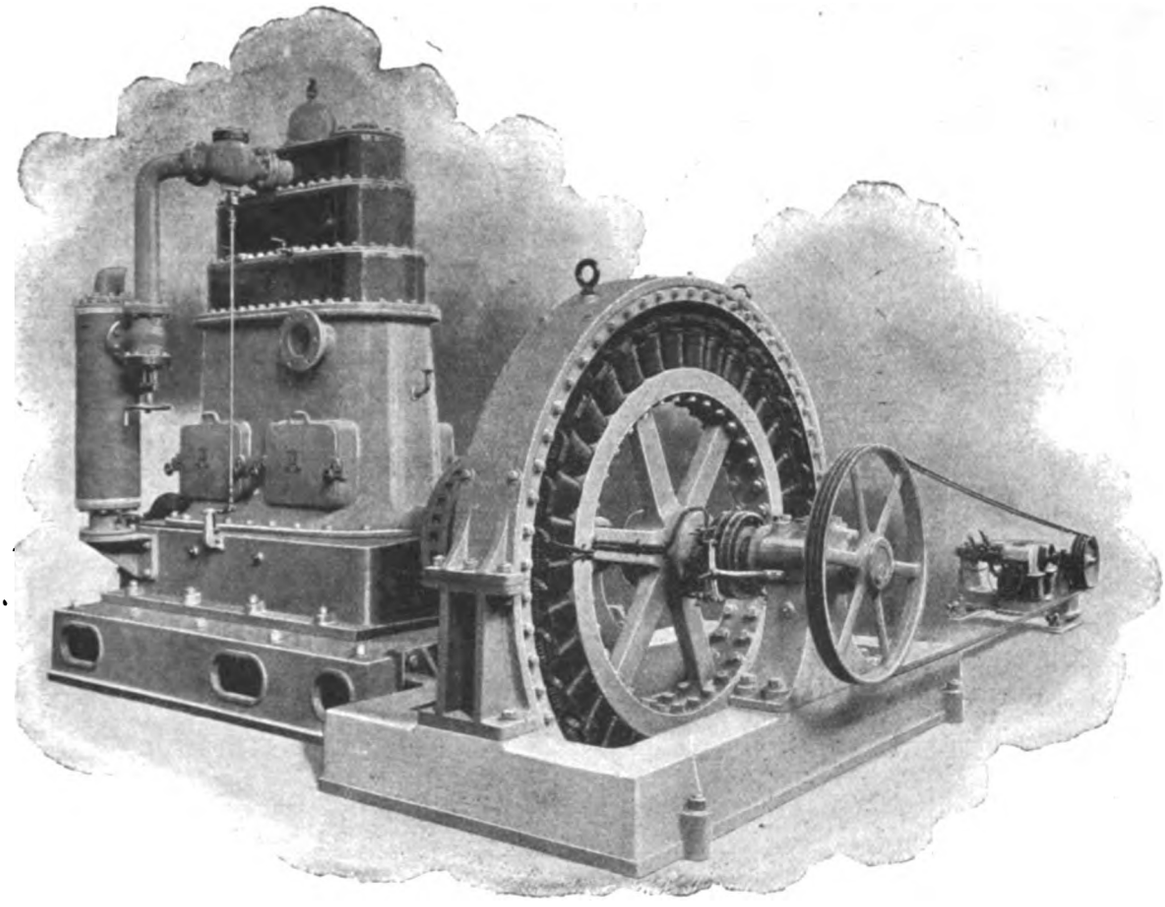

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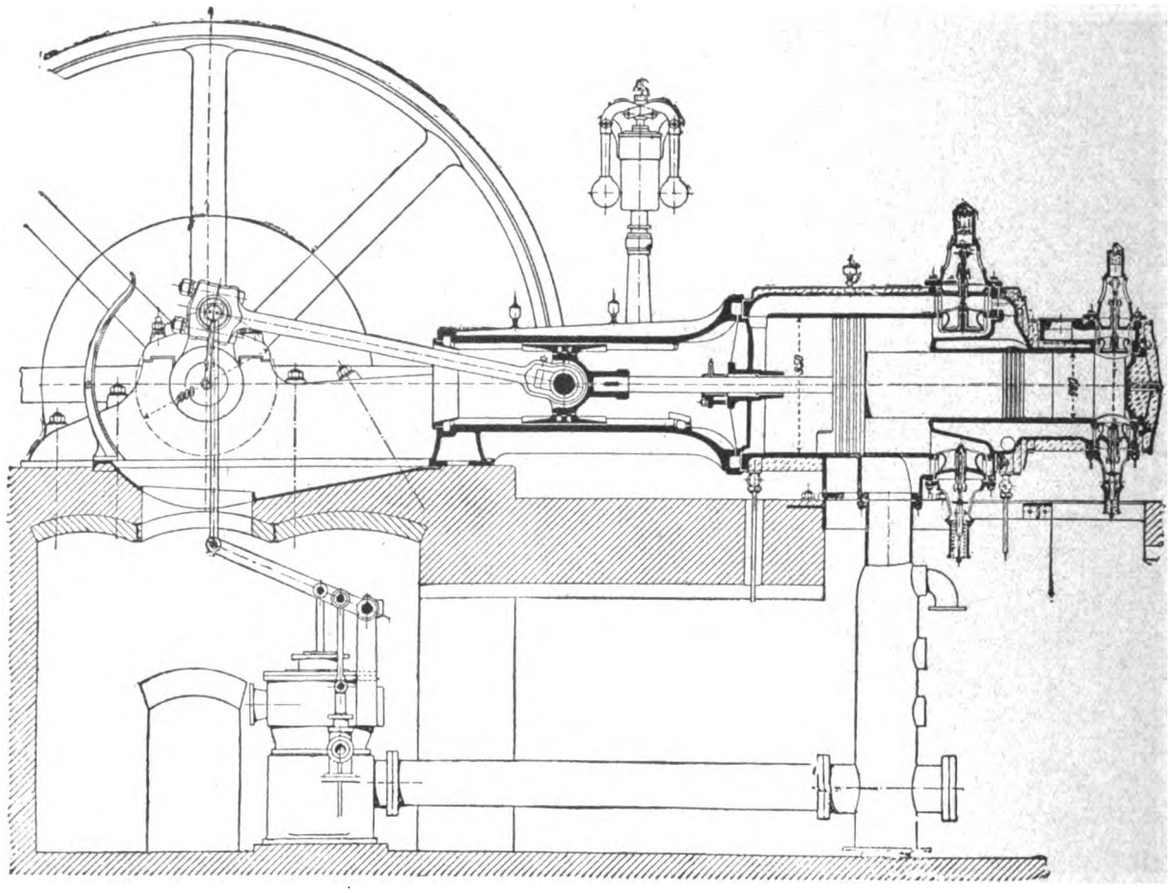

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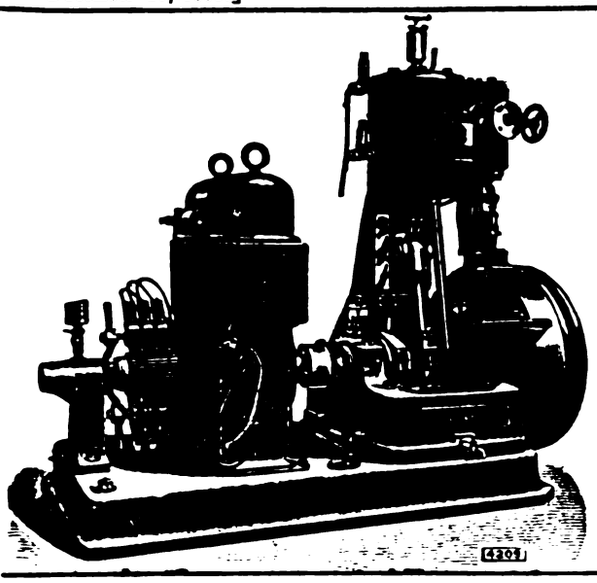

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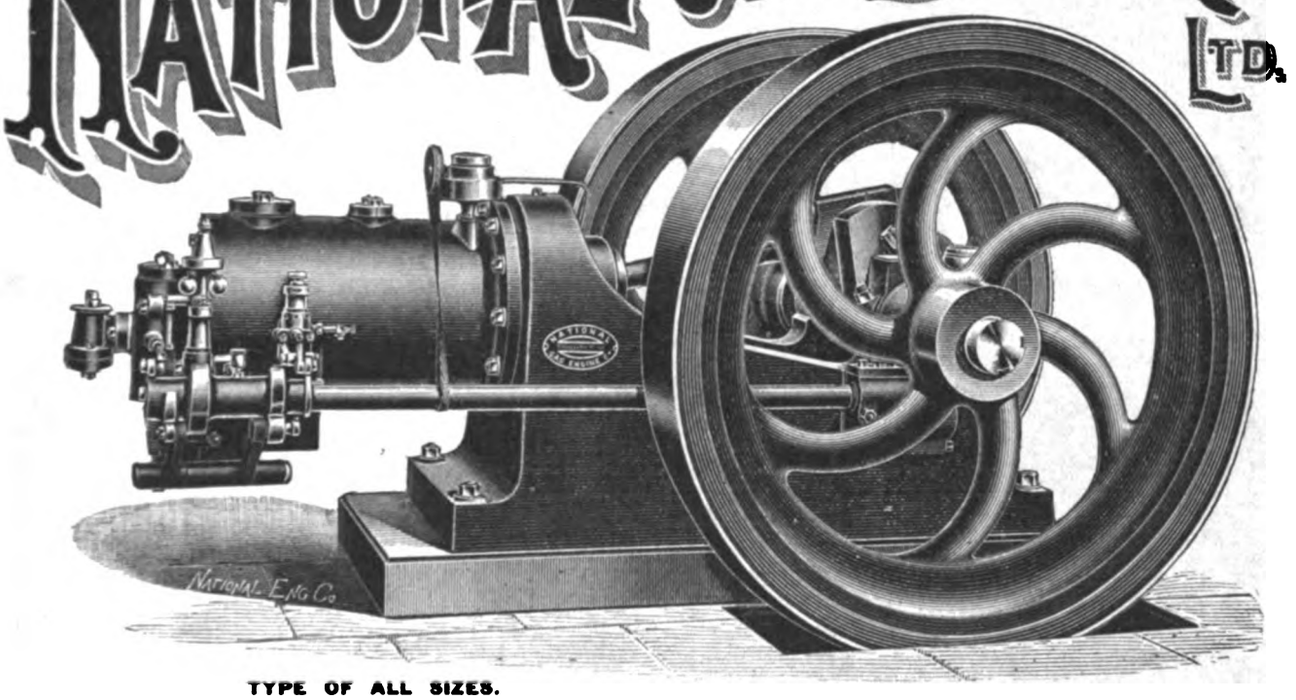

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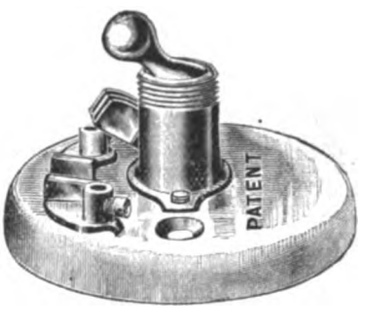

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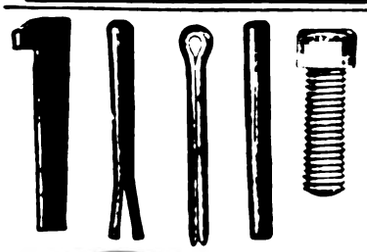

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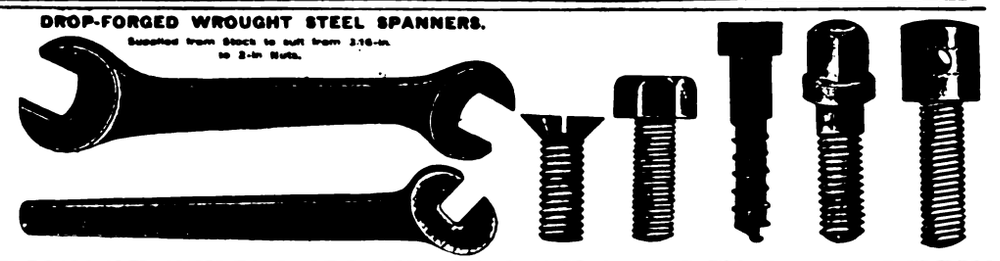

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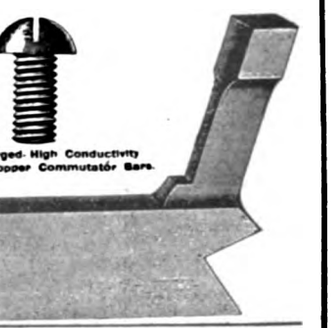

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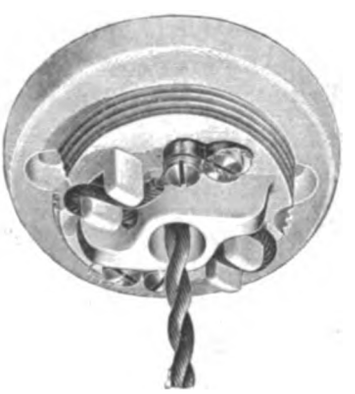

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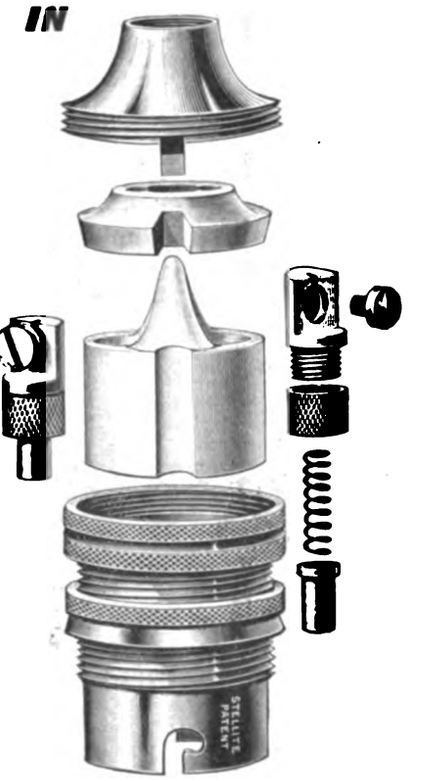

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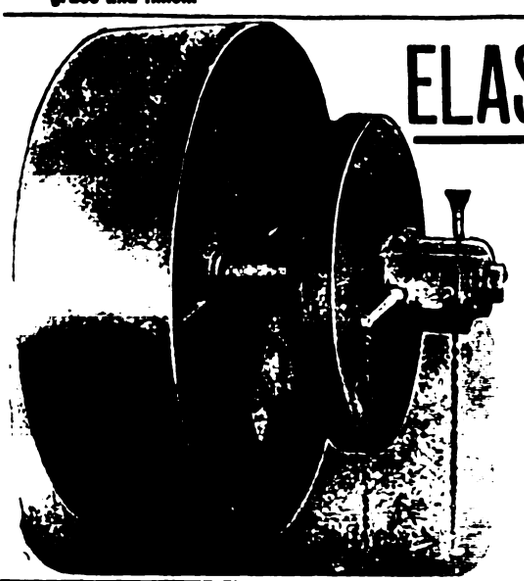

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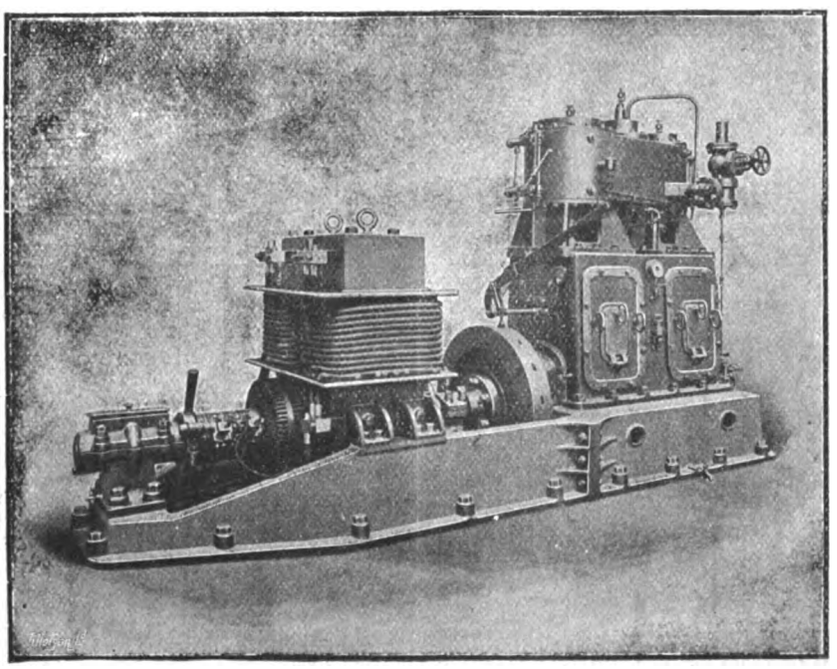

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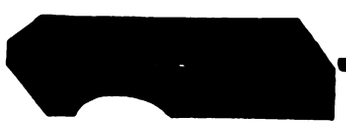

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For ELECTRIC LIGHT MAINS

SUPPLIED RECENTLY FOR
GLASGOW, PRESTON, DUNDEE, NORWICH, WESTMINSTER, ST. PANCRAS, RICHMOND, &c.

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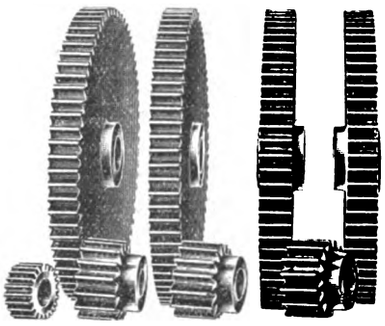

We make these gears in SPUR, BEVEL, WORM, SINGLE or DOUBLE HELICAL, MACHINE-CUT TEETH, For MOTORS, PUMPS, &c.

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Fig. 1.

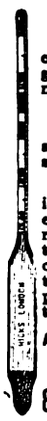

Fig 2.

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IN USE EVERYWHERE.

Fig. 1 has four different beads, indicating different gravities, and the correct gravity is shown on the bead which floats nearest the centre of the tube. *Price 4s. 6d.*

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Fig. 3.

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Enclosed in Enamelled Iron Case.

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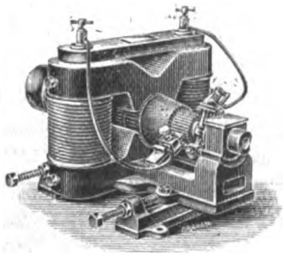

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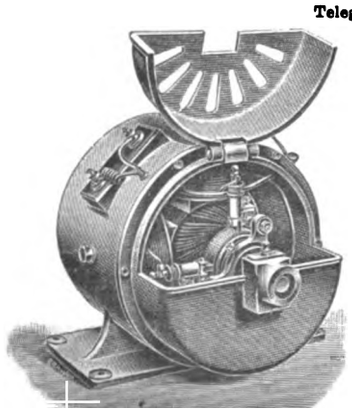

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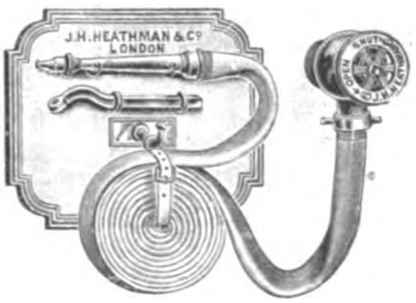

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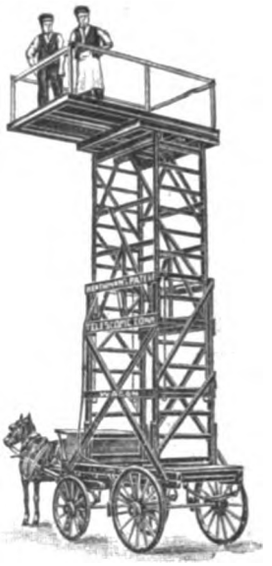

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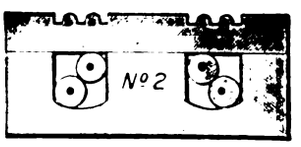

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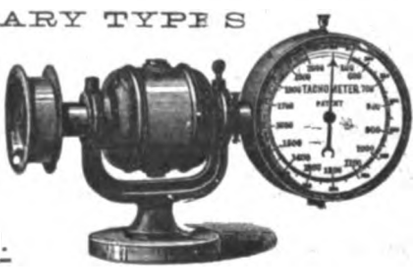

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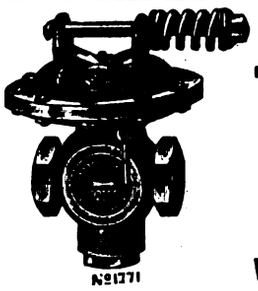

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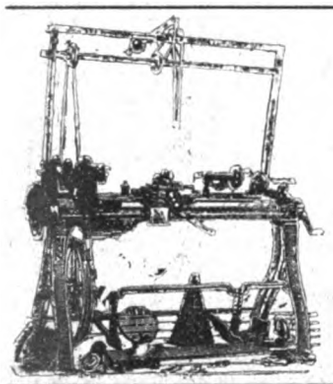

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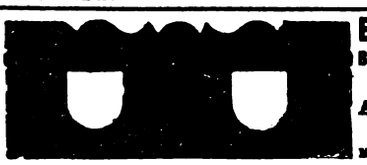

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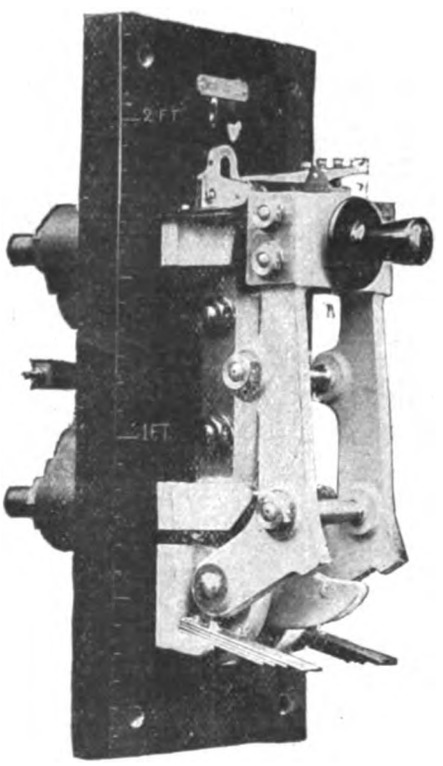

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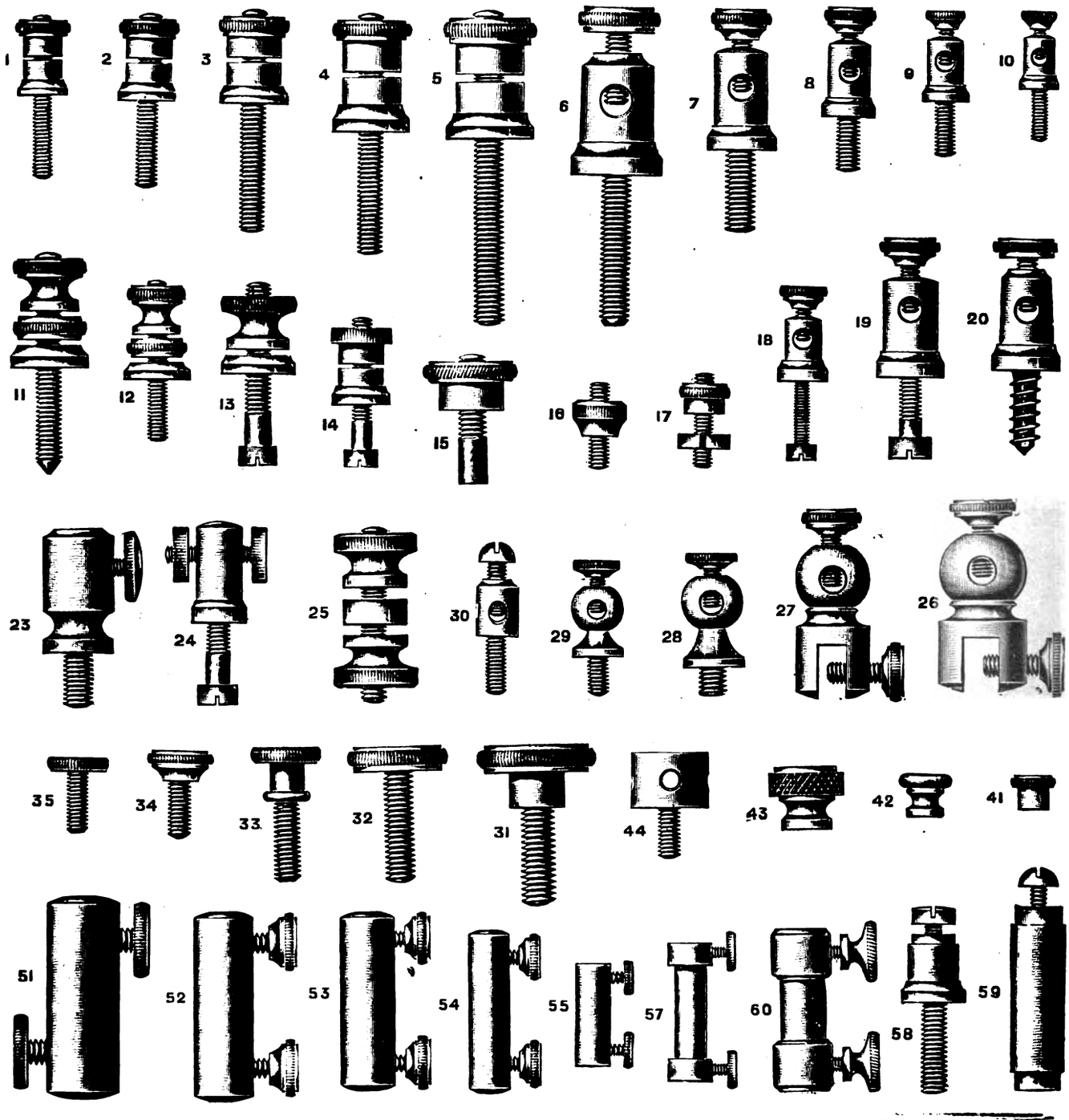

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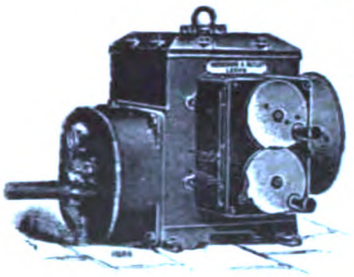

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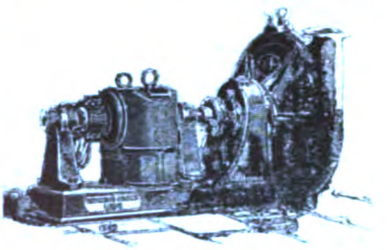

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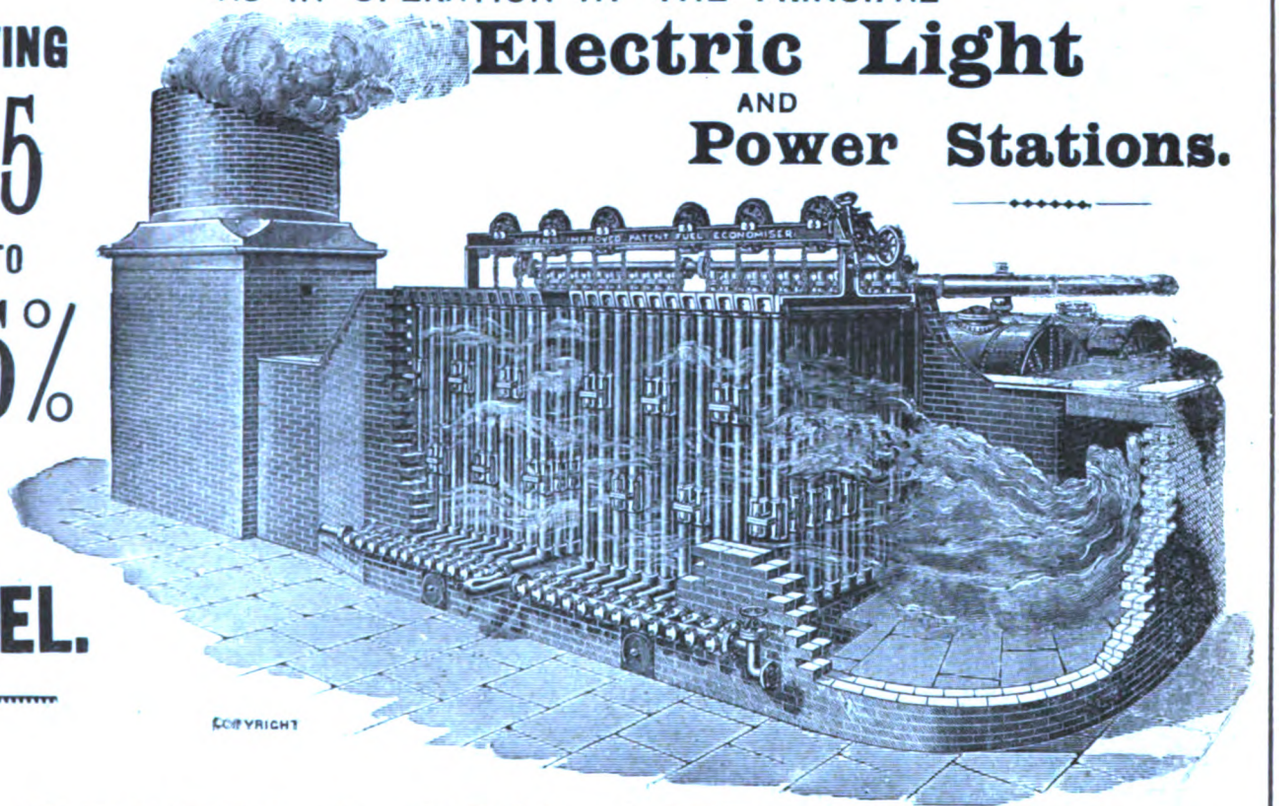

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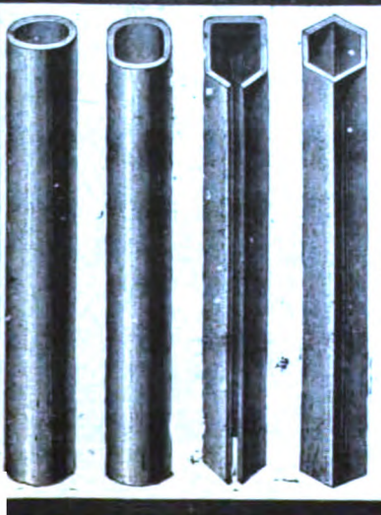

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